

Earth construction: A changing tradition

Abstract

In the recent past, this age-old construction technique has been transformed through thorough research, the application of scientific methods and innovative experimentation. Today this traditional system has a much more sophisticated application, has a longer life span, looks modern and may accommodate all the modern amenities that Africa's people strive for. We may benefit from this method of construction in South Africa since it may contribute towards the empowerment and development of local people through the development of skills, the provision of job opportunities and the limitation of building costs, since local materials are used. The opportunity is thus created to live in harmony with the environment, whilst evoking memory and identity.

Keywords: Earth construction, South Africa.

GRONDKONSTRUKSIE: 'N TRADISIE IN VERANDERING

Opsomming

'n Eeue oue tradisionele grondbou-metode, eie aan Afrika, is weer besig om te herleef, nadat dit byna deur die moderne boumetodes verdring is. In onlangse jare het die tegniek egter na navorsing en die toepassing van wetenskaplike metodes met inbegrip van innoverende eksperimente, weer begin herleef. Deesdae is die tradisionele sisteem baie meer vaartbelyn, het 'n langer lewensduur en 'n moderne voorkoms wat pas by die hedendaagse inwoners van Afrika. Suid-Afrika kan baie baat vind by hierdie grondbou-metode, aangesien dit die plaaslike gemeenskappe kan bemagtig met basiese vaardighede, dit werk kan skep en die boukoste laag kan hou wanneer plaaslike grondstowwe gebruik word. Bowenal bied dit die geleentheid om met die omgewing te identifiseer en terselfdertyd lei dit tot die ontginning van die geheue en identiteit.

Sleutelwoorde: Grondkonstruksie, Suid-Afrika.

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Introduction

One of the rich traditions of Africa is the use of earth as a building material and construction technique. This method is familiar to most of the people of this country. In our modern society however, this tradition is disappearing rapidly although it still has much to offer to contemporary African societies and cities.

The Egyptian Hassan Fathy can surely be called the father of modern earth construction. He spent three years of his life building the village of New Gournah that was meant to be a model village for the whole of Egypt. He used mud bricks as the main building material for all the buildings, public and private, and for walls and roofs (domes and vaults). But he invented neither the mud brick building system nor its resultant forms. His major achievement was to identify traditional building not as a source of visual reference, but as a living system that has many advantages over the alternative building systems that are available (Gibbs:17). This means that the integration of all systems, cultural, social, and technical, must be achieved in order to provide a habitable settlement (Gibbs:17). The ideas of Hassan Fathy on the tradition of earth construction are used as the theoretical framework. This is a traditional African model which is referred to and within the framework with contemporary examples in Africa, e.g. Egypt, Mayotte and Nigeria.

Tradition

"It may be that that what we call modern is nothing but what is not worth of remaining to become old" (Alighieri, Dante) (Fathy, 1969: 24).

'Tradition' is not necessarily old-fashioned or synonymous with stagnation. Some problems are easy to solve, and take a day while others take years or a lifetime. Other solutions can take generations before they are complete and this is where tradition can play a creative role. It is only through tradition, by respecting and building on the work of previous generations, that progress can be made in solving a problem (Fathy, 1969:24).

When a specific tradition has been established and accepted, it is the responsibility of the individual artist to keep this tradition alive and strong, by being inventive and using his insight to give it that additional momentum that will keep it from coming to an end. Tradition relieves the individual artist from making decisions, but he will need to make other demanding decisions, to be innovative, to stop the tradition from dying on his hands (Ibid:25).

This idea of working with the old and transforming it into something new and vigorous is also echoed in the words of the Aga Khan in his opening speech at the ceremony for the Aga Khan Award for Architecture. "We strive for appropriate solutions to the problems of today's Muslim societies. Firmly anchored in the present, the best architectural efforts are those that dare to innovate, to start from what we have, and actively invent the future in practical, empowering terms, thereby creating a heritage to the future" (Steele, 1992:25). No architect can avoid using the work of his predecessors, no matter how much he would like to be original. The largest part of his work will be in one tradition or another (Fathy, 1969:25). He should therefore work in the tradition of the area instead of using foreign traditions in an artificial and uncomfortable synthesis (Ibid:26).

When an architect works within a tradition, he should not think that it will restrict his creativity. On the contrary, it will make a relevant contribution to the tradition and to the enrichment of the culture of the community. James Steele (1992:51) describes Fathy's contribution to tradition as follows: "Throughout his life, he struggled to ensure that this new identity which continues to evolve, would reflect the best elements of both the past and the present, in order to truly express the cultural richness and complexity that is the essence of Egypt rather than the foreign materialistic values that are completely alien to it."

In the words of the Aga Khan:

"What ... I suggest, is more of those innovative architects who can navigate between the twin dangers of slavishly copying the architecture of the past and of foolishly ignoring its rich legacy. It needs those who can thoroughly internalise the collective wisdom of bygone generations, ... and then reinforce them in the language of tomorrow" (Steele, 1992:25).

This observation captures the essence of this discourse since we contemplate:

- ◆ How one can look at tradition as a source of knowledge, inspiration, guidelines, wisdom, etc.
- ◆ How one should innovate on tradition and thus make it prosper
- ◆ How tradition and the innovations can be synthesised and lead to a new architectural language.

These three main ideas will act as guidelines for the three parts of the article and form the main points for discussion on which the author will expand.

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Part 1: The contribution of Hassan Fathy to all of the three above-mentioned ideas:

- ◊ How he tried to understand the Egyptian peasants' tradition on all the possible levels
- ◊ How he innovated on those traditions with a thorough understanding of it as a system
- ◊ How he developed that system into a specific language of earth architecture.

Part 2: Modern innovations on the tradition of earth architecture and earth construction, highlighting the second main idea.

Part 3: The possibility of creating a new architectural language in the current South African context by using both *Part 1*, the ideas of Fathy (as the traditional model) and *Part 2*, the recent modernizations of his model (as the innovative part).

Part 1: The contribution of Hassan Fathy

"Fathy thus opened up a new era of architectural research – the identification of the nature of existing traditional building systems. The way in which they work and their potential for future application" (Gibbs:17).

We will look at the contribution of Fathy (in terms of the three guiding ideas) by using the above quotation.

"... the identification of the nature of existing traditional building systems."

What is the nature of the system that Fathy promoted? By addressing this question an attempt is made to identify principles that may be used in modern societies.

- ◆ It is cheap (local materials, no expensive machinery)
Fathy knew how poor an Egyptian peasant was and he said: "There does not exist a factory on earth that can produce a house that a peasant can afford" (Fathy, 1969:32). "To talk of prefabrication to people living in such poverty is worse than stupid, it is a cruel mockery of their condition" (Ibid:32). So Fathy uses the material that Egypt has a lot of; earth and sand with straw and water; very cheap and easily available. No sophisticated machinery is necessary, only moulds that can be handled by one person. A team of four can make 3 000 bricks per day (Ibid:89).
- ◆ Gives character, meaning and evokes memory
This method of building with earth has its own character that is implicit in the material and method.

- ◆ Takes into account local customs, traditions, culture
- It was very important to Fathy to understand the local customs and traditions. He did not see tradition as necessarily old-fashioned or synonymous with stagnation (Ibid:24). If one accepts that tradition is not restrictive, creativity backed by a living tradition can inspire work that is much greater than the work of an artist who has no tradition to work in (Ibid:25). Fathy does this by reviving local, but almost extinct crafts – carpentry, making doors from small pieces of wood (Ibid:35). He understood the culture very well e.g. if he put running water in the houses, the girls would not get a chance to leave the house to fetch water and would therefore not be seen by the young boys of the village. “A girl who stayed in the kitchen, drawing water from the tap, would never get married” (Ibid:99). This made Fathy decide not to put running water in the houses. It would upset the social system. He looked at the vernacular architecture of old Gourná and interpreted that, e.g. the beds where the children slept looked like big mushrooms. The reason was to keep scorpions away from the children (Ibid:41). His search for local forms and their incorporation into the new village was not a sentimental attempt to keep a souvenir of the old town. He wanted to restore something of the heritage of their own building tradition (Ibid:43). He also worked within the Arab tradition by building houses around a courtyard. This puts something of the traditional meaning back into the houses (Ibid:55-57). The above explains how important local customs and culture were to him, how he tried to understand it, tried to make life easier by making some traditions and customs easier to keep, but without disrupting the system (Photo 1). This is something that will need to be looked at carefully in the SA context.

Photo 1: The mosque at New Gourná, Egypt (Jooste-Smit, P)



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- ◆ Works in the climate; environment

Fathy understood the climate of upper Egypt very well. It is a hot, arid zone with big differences between day and night temperatures. He used this to his advantage to create buildings that were cool during the day on the ground floor and hot during the night on the upper floor (Fathy, 1969:46). Ventilation is very important. He used a wind-catch to get air movement through the house (Ibid:49) (Figure 1). These methods and devices all make a contribution to the aesthetics of the buildings. Their forms, character, etc. were very strongly influenced by the climate. These are different in other parts of Egypt.

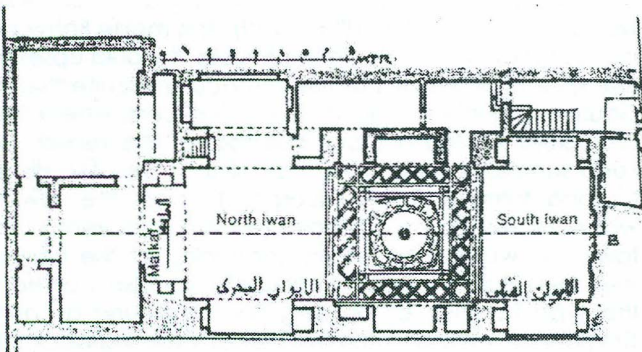


Figure 1: Plan of *malkaf* (wind-catch) in Kathoda, fourteenth century (Fathy, H., Illustration no. 49)

- ◆ The individual is important

The individual is very important in the work of Fathy. He rejected mass housing by governments. They use statistics to design a house that will suit the average person (Fathy, 1969:30). If an architect designs one house and then puts six zeros to it, he is multiplying something that cannot be multiplied (Ibid:31). He then acts like an engineer who designs one section of a road and unreels it for any number of miles (Ibid:33). Nobody expects a doctor to do mass-production operations: "If you chop off appendixes by thousands with a machine, your patients will die, and if you push families into rows of identical houses, then something in those families will die ... The people will grow dull and dispirited like their houses, and their imagination will shrivel up" (Ibid:31).

Each person has his own needs and own initiative. One does not have to built a house for him, just as one does not have to built a house for the birds. If one gives people a chance, they will make their own contributions to the solution of the housing problem (Ibid:32).

- ◆ Traditional crafts, skills are important
The architect is in the position to revive the traditional crafts of people in two ways:
 - by giving it prestige, and
 - by giving commissions.

This will help the traditional craftsman to regain his self-respect and self-confidence (Fathy, 1969:35). The architect is in a position to revive the peasants' belief in his own culture. If he shows interest in local forms and also uses them, the peasants will begin to look at their own tradition with renewed pride. Something that has been ignored in the past, becomes something to boast about (Ibid:43). The importance of regional craftsmanship is also stressed at the Aga Kahn Award as one of the elements that improves the quality of the environment (Steele, 1992:26). It is one of the elements that is able to evoke memory and revive identity.

- ◆ Socio-economic situation
Part of the system that Fathy talks about, is the socio-economic situation. By reviving some of the traditional crafts, the people of Gournā could sell their products and skills to tourists and surrounding villages (Fathy, 1969:61). But Fathy looked much wider than Gournā. One must be careful not to have too many industries in one place, since this could prevent other towns in the vicinity from getting an opportunity to grow. Gournā must fit into the bigger pattern regarding all the different levels of social and economic growth. It must make a contribution to the environment and not upset it (Ibid:62).

"The way in which they work ..."

- ◆ A co-operative method
Knowing the material and how to use it, and keeping in mind its low cost and availability, what can we learn from how the peasants work within a traditional system (Fathy, 1969:119)? They work within a co-operative system, helping each other to build their houses. You help your neighbour, friend etc. and when you need a house, they will help you build yours. If it is done for free – it becomes a community activity like harvesting, or helping to extinguish a fire. Like

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bees or ants they co-operate without very much organization or leadership. The disadvantage of this system, is that it only works within a traditional set-up where not too many houses will be build in a year so that one can still do one's normal work (This is still the case in rural areas in South Africa). The co-operative system is a good one – it is cheap and works like a living organism. The problem is to make it work in non-traditional circumstances. The motivation behind such a system of free service is that you will receive the same service when you need it. Each person that helps to build a house receives the right to be helped; he "... opens an account in a kind of labour bank. If this principle is recognized and if the exact amount of work to a man's credit can be calculated and recorded, the cooperative system will begin to appeal to even the most commercially minded peasant" (Ibid:120). This means that one has to find a way to establish how many useful hours a person had worked and how many hours went into a specific component of a building. Fathy did this in Gournia by analyzing the cost of each part of the work and establishing a standard part that could be converted in terms of money or hours for each part of each building (Ibid:121). This specific method might not be practicable in present communities, but the principle of looking at localized ways of working is important. This principle was applied in a school in Burkina Faso in Songha where the village was entrusted with the 'contract' (Bertagnin, 1992:99).

◆ Aided self-help

Fathy argues that the government will always have to play a part in the building revival, especially when it comes to housing the poor. It will have to create the conditions for a revival where the individual plays a part in building his own house (Fathy, 1969:33). This usually involves aided self-help systems where the government provides people in remote places with equipment and materials to build their own houses. The labour is provided by the people (Ibid:116). The disadvantage is that the 'self-help' only lasts as long as the 'aid' lasts. People learn to use a cement mixer, but as soon as the free materials are used up, they are in the same position as they were before, except for the finished houses. They cannot apply the skills they learned because they cannot afford the materials. The craftsman learns a sophisticated trade that he will later be unable to apply (Ibid:117). Rich countries will give a certain amount of cement or

money for a million prefabricated houses. Donors should however help the peasant to recognize his own creativity and to realize it (Ibid:117-118). Fathy gives a few conditions for a system of aided self-help:

- The materials must be cheap so that the peasant can afford it or for the Government to give it away.
- Use local materials that one can easily obtain, should the schemes come to an end.
- Do not make use of skilled labour, other than what will normally be available in the village, e.g. carpenter, mason.

"In brief, 'aided self-help' must aid peasants to build in local, virtually costless materials, using skills which they themselves already have or can easily require" (Ibid:118). Fathy also describes a system of aided self-help that was used in SA, the nucleus system where a core of some sort is put up and the owner builds the rest. However, the owner may not be able to finish his house in the same material as the core, and in the case of South Africa, this core was usually a toilet and water-point like a sink or wash-basin that became generally known as toilet towns. Like other nucleus systems, this does not stimulate local crafts or teach the owner any skills that he can use later on (Ibid:119).

◆ Use of local materials

The use of local materials is one of the conditions that Fathy sets. This is closely linked with local crafts. The Aga Khan also stresses this aspect (Steele, 1992:26).

"... and their potential for future application."

◆ Do not copy

The specific place and its character is very important. A building must be something that is true to that place. "Being faithful to a style, in the way I mean it, does not mean the reverent reproduction of other people's creation. It is not enough to copy even the very best buildings of another generation or another locality" (Fathy, 1969:44-45). You should strip your mind of pictures and let the buildings grow from the daily lives of the people who will live in them. It must be an architecture that is an expression of the character of the community (Ibid:45).

The Aga Kahn also emphasizes that one should copy neither the past nor solutions developed for other problems and other cultures (Steele, 1992:25).

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- ◆ Use scientific methods

Although Fathy argues strongly for much more attention to be given to the traditional systems of each culture, he does not exclude the possibility of intervention and modification of the tradition through scientific experimentation (Fathy, 1969:23). Fathy looked at the problems people experienced and tried to make a contribution by using simple scientific methods to improve their lives. For instance he used aerodynamic principles to work out airflow through and around buildings (Ibid:46). He developed a glaze that melted at a low temperature for which an ordinary kiln was adequate (Ibid:64). He later developed a type of compressed earth brick when he worked in Mit-el-Nasara. This was because the village had to be built very quickly after a fire destroyed part of it and left 200 families homeless. A drier mix was used, which was wetted by steam and then pressed in a mechanical press (Ibid:134). He promoted the services of soil mechanics engineers to test the different soil conditions for different types of bricks, earthbricks, stabilised earth bricks etc. (Ibid:140). This is a very important aspect if the whole idea of earth construction is to be accepted by people. Scientific experimentation can make a contribution to the change of perceptions regarding earth buildings.

- ◆ Adapt to the specific situation

One should look at the specific situation as a whole and adapt the system to suit that situation. The system used at Gournah was different from the one used in Mit-el-Nasara. In Gournah sun-dried bricks could be used, because they had three years and the villagers had homes to stay in. This was not the case in Mit-el-Nasara where they did not have time and therefore used a brick that did not need time to dry (Fathy, 1969:134). In a place like Egypt the cost of the contract system is too high for peasants and Fathy therefore promoted a system of co-operation (Ibid:113). He also worked out a new way of pricing buildings, because the government will still be responsible for the public buildings that will be built by paid workers. The other part of the system is the co-operative system, for which Fathy worked out a method of pricing work and hours (Ibid:140). Again, the situation must be understood on different levels and adapted accordingly.

- ◆ Give prestige to and commissions for traditional crafts

The local craftsmen's work should have prestige not only because it is good for trade, but also because it is a way of

evoking memory and establishing identity. It is thus a way of promoting progress without the loss of identity, because meaning is carried forward into the future.

- ◆ Adapt organization to suit the situation
One has to adapt the organisation of work so that it suits the peasant. The contract system is expensive, because of a lot of middlemen, especially with large schemes (Fathy, 1969:113).
- ◆ Training
 - Training of people and professionals is necessary.
 - In service training for the peasants (Fathy, 1969:123)
 - Postgraduate training for architects (Ibid:141).

Fathy did not believe in technical schools for training. One should give someone just enough to put up a house for himself and perhaps help his neighbour. By starting with the public buildings one can train a lot of people simultaneously, and one can use skilled people to do the training, among them architects, master builders, etc. (Ibid:122). Fathy worked out a pay system and curriculum for the training of peasants (Ibid:124-126).

There is also a need for architects trained to work in the rural areas. Fathy proposed a two-year postgraduate course. Students will study the existing examples and with that as a background, design buildings in the rural areas (Ibid:141-142). Training and education are important, because they imply a long-term investment; knowledge that can be used afterwards and transferred to others.

Why did Gournā fail?

Although Fathy worked out an ingenious system for poor peasants in Egypt, the project in Gournā was a failure (Fathy 1969:149). The town has never been finished and up till today it is not a flourishing village. There are many reasons for the failure, but I shall list only a few of the most important ones:

- ◆ There was little understanding from the side of the government. It did not deliver straw on time (Ibid:155,161) and the Government interfered with the way Fathy appointed workmen (Ibid:157).
- ◆ The people of Gournā were not interested in leaving the old town. The Gournīs were tomb raiders. They lived on top of old tombs and sold the treasures to tourists at very low prices in relation to what they are worth. The government in collaboration with the department of antiquities decided to move the whole town to a new place. They were thus ex-

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hausting some of the richest treasures. This was a great loss in some cases to Egyptology, because nobody knew the provenance of their finds (Ibid:15).

It is thus not strange that the Gournis were reluctant to move to the new town or help to build it. They did not want to take part in the designing of their houses (Ibid:39). They tried to stop the building process by deliberately damaging one of the dikes which flooded the village or parts thereof (Ibid:176).

- ◆ The government was used to working with big contractors.
- ◆ The government did not support the revival and promotion of local crafts and traditions and promoted modern, expensive materials.
- ◆ Regulations made organization difficult.

Part 2: Development and innovation in earth construction technology

Although Fathy's project in Gourni seems to have failed, much has been written about his work since the publication of "Architecture for the poor" (Gernicke, May/June, 1992:37). After some interest in earth construction in different parts of the world, the French took the lead in innovative earth construction in the seventies (Ibid:37). In 1973, CRATerre, the Centre for Research and Application of Earth Construction was founded by a group of engineers and architects, for research and development in earth building technology (Ibid:38). This group has since acquired international renown through its publications, interventions in real building schemes, research programmes and professional and university teachings (*Project Monograph*, January 1987:2). Many foreign people have attended short courses at CRATerre and a network of experts is being built up over the world (Gernicke, May/June 1992:38). Their work can serve as an example of how the principles of Fathy can be introduced in our times.

- ◆ Research and experimentation
CRATerre and the *Ecole Nationale des Travaux publics de l'Etat* has specialized in the study of earth construction. Much new work has been done on the composition and properties of soils and building methods; this includes: cob, adobe (sun dried bricks), pisse de terre, compressed earth blocks and also surface protection of earth buildings (Ibid:38). One of the important experimental projects was the building of a village at Villefontaine near Lyon. This is in a region of France where a lot of historical earth buildings still

exist. The 'Domaine de la Terre' was completed in 1985 and in this social housing project, earth has proven its technological pertinence and its architectural potential in the modern world. One of the many consequences of the project was that it has encouraged the development of scientific and technical research into the material itself, architectural design and the means of production and construction (*Project Monograph*, 1987:1).

"The intention behind the project was to prove that within the current social, cultural, technical, economic and legal situation, the vernacular tradition of earth construction could be brought up-to-date with the help of modern knowledge and technology" (Ibid:2-3). From this quotation one can hear echoes of some of Fathy's ideas. Three techniques were used: rammed earth, vibro-compacted stabilised earth blocks and a straw-earth mix. They also experimented with improved frames, the means of compacting the earth (Ibid:5). Apart from using earth, the project also experimented with economy of energy by using different devices to make use of natural ventilation, heating, etc. (Ibid:6). Here the ideas of Fathy of working with the climate can again be seen. This experimental village has achieved its principal goal, "... to provide a 'missing link' between intuitive traditional practices, ill adapted to the modern world, and a more rational, resolutely modern form of earth architecture that takes account of the production constraints of today. This project represents a stage within a global strategy, relevant to both industrialised and developing countries, aiming to make the best possible use of earth architecture for economic housing" (Ibid:8).

- ◆ Scientific methods with an understanding of the African context

CRATerre has gone further, with *Domaine de la Terre*, acting as a precedent and its members are now acting as consultants to governments and other organisations all over Africa (Rigassi & Joffroy, July, 1994:31-37). They use the scientific methods they have developed, but adapt them to the African situation. Their methods can be used in remote places, rural and urban areas. This can be illustrated by using one method, Compressed Earth Blocks (CEB) as an example. There are many more, but CEB's have proven to be one of the most acceptable methods of earth construction as it looks like a fired brick and many of the problems concerning water has been dealt with. It is also chosen because the

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soils of South Africa, especially that of the Free State, are very suitable for CEB's, as we will explain later on.

Very simple methods of testing the raw material and the finished product have been developed, (cigar test, etc.) and also simple ways of mixing the materials with very basic equipment like shovels, buckets, etc. and the use of very simple machinery. Some of this equipment like brick presses are manufactured by small building enterprises in for example Kenya (Agevi, July 1994:5) Projects CRATERre has been involved in which can serve as examples, are schools in Burkina Faso (Bertagnin, 1992:90-99) for the Ministry for Basic Education and Mass Literacy, and a programme for the global improvement of housing on the island of Mayotte (Guillaud, et al. 1/92:11-16).

◆ Improvement of the product

Compressing earth blocks are surely an advanced earth building product. It can be manufactured very easily with semi-skilled labour. It is also quite cheap to manufacture and is a product with all the properties that appeal to the modern world, since it looks modern, is sophisticated, has a longer life span and can accommodate all the modern amenities modern people strive for. Making compressed earth blocks is a simple process that works as follows:

- Identification of the raw material: it consists of four components: gravel, sand, silt and clay (15%). The raw material can be tested by way of laboratory tests or

Photo 2: A CEB production yard showing sieving, pressing and curing, Mangaung, Bloemfontein (Jooste-Smit, P)



field tests where little more than one's two hands are necessary (Lectures notes, 1994:77).

- ◆ Now one can go over to the production process (Photo 2):
 - Sieve the material
 - Mix it with a stabilizer e.g. 5-8% cement; this is a dry mix that can easily be measured off with a bucket, cans or wheelbarrow
 - Compress in brick press
 - The compressed blocks are packed on an even surface and wrapped with plastic. They are left in this condition for one week. Under the plastic a humid condition develops which activates the chemical process of the cement. After three weeks one has a cured, hard brick without the consumption of any energy (Lectures notes: 1994:8). Then it should be left uncovered for three weeks.
- ◆ After the bricks have been cured, one can run simple quality tests for:
 - Capillary action by leaving bricks in water
 - Abrasion by using a steel brush
 - Do a rupture test to find the bending strength of the block.

These are only a few of the tests that can be conducted to do test control of the quality of the end product and they show how easily this can be done without the use of expensive equipment. If one wishes to obtain more accurate and scientific results, tests can also be run by a laboratory (Lectures notes: 1994:79).

Although this is a very easy method of making bricks it is a scientific method with an end product that looks like a face brick and is used like a face brick. It can also be plastered if one prefers a plastered wall, but some rules must be obeyed.

- ◆ Can implement on different scales
An important advantage of the CEB technique is that the production of blocks can be implemented on different scales, and the technique can therefore be used by governments as well as small entrepreneurs. "In practice, however, the production of earth building materials remains competitive thanks to the wide range of levels of investment possible. Thus industrial large-scale production units can be set up, but equally so can craft workshops ..." (Houben, H. & D'Ornano, S., *Basin-News*, July, 1991:26). The industry is therefore quite flexible. Governments can establish big, fully mechanized plants, while a small entrepreneur

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can move his brickyard around on a small lorry. This also provides for a difference in investment, from as low as R2 200,00 for a manual brick press to R75 000,00 in South Africa. It also allows for mechanization at different stages of production e.g. manual earth removing with mechanical pulverizers, manual mixing and manual pressing. One can intervene at each of the production levels and this gives to a small entrepreneur a chance to start with a small manual production process and develop that gradually into something bigger and more mechanical (Ibid:27).

- ◆ Must understand the technique

One of the major factors determining the success of building with earth is an understanding of its strong and weak points. What can be done with earth and what not. "Good architectural design and good building work depend on the knowledge and skills of designers and builders. It is by renewing links with a long tradition of earth "design skills" and by making good use of recent technological inputs, that high quality earth architecture can be produced. There are a number of regional sayings which reflect this popular common sense and wisdom, such as this saying from Devon in England: 'All cob wants is a good hat and a good pair of shoes', in other words a good roof and good footings" (Lectures notes: 1994:33). The main problems (or aspects) that one has to understand very well fall in two categories, namely:

- 1) Structural problems that force one to respect the principles of earth's good compressive strength as well as its poor tensile and shearing strength. The designer must choose appropriate structural design and construction details.
- 2) Problems with water and humidity that result in erosion, streaming water, splash back, infiltration and absorption. Again these make the designer aware of fundamental principles: protecting the top and base of walls, allowing the building to breathe and using suitable detail (Ibid:33).

The above are very general comments on principles involved in understanding the technique and using the best possible application. One has to understand the material, its physical characteristics and properties. Knowing the specific technique that is going to be used, one has to know the special equipment and ways in which they are applied (Ibid:35). It is important with any material that one has to understand the basic principles involved when using that material. In the same way it is necessary

to understand the essential principles involved in earth construction.

Part 3: The current South African context

South Africa is in a situation similar to the one that Fathy describes. We have a huge shortage of affordable housing and a huge number of people who cannot pay for housing that the government supplies. Like Egypt we also have a long tradition of earth construction in South Africa. It can be divided into two main categories, namely the European tradition and the indigenous tradition. Both contributed to the earth construction tradition in its own way. Today very little use is made of these traditions. In rural areas new earth buildings are still being constructed, but in the same way as it had always been done. None of the recent developments in earth construction techniques are used. This is not due to unwillingness or resistance, but to total ignorance. Gernicke (*Architecture SA*, Jul/Aug, 1992:44) writes, "Such lack of interest by the building industry and architectural profession does not invalidate the crucial role building in earth still plays in Southern Africa. The informal sector cannot be quantified, but many thousands of South Africans are still housing themselves as they have done for ages by building their own shelter in wattle and daub, sod or adobe all over the country."

The most important difference between our situation and the one Fathy describes, is the fact that we do not work with traditional settlements and that very many of the problem areas are urban. Possible guidelines for implementing earth building on a larger and wider scale in South Africa will be discussed in the following section. This will be done by looking at earth building as a system and then at a possible strategy for implementation.

Earth building as a system in South Africa

If we want to revive our earth tradition and transform it to something that people will be proud of, we should see it as a system and not just as a means of supplying houses. A system that can possibly create a language that evokes memory and provides identity.

Like Fathy, one should think of the culture of the people, their aspirations, and skills that can be used that are already existing in the community, e.g. in rural areas earth building is well known, but techniques must be upgraded. Climatic conditions should play a role, as we have vastly different climatic zones in South Africa. Providing for climatic conditions will necessitate inventions that may have a profound effect on design. If we look at

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earth building as a system of which tradition, culture, economy, local crafts, local materials, local skills etc. form part, we may take part in a very exciting future.

- ◆ A system that creates jobs through training of small builders
"On the other hand, this low investment requirement is counter-balanced by a fairly high consumption of labour" (*Basin-News*, July 1991:25). The manufacture of earth building components like CEB's is a labour intensive process. In a country like South Africa, we have many unemployed people, unlike most industrialised countries of the world. We can create jobs for thousands of people by training those who would like to begin small and medium-sized private enterprises. For instance if you begin a manual production line, you can provide work for 9-10 labourers, make on average 600 - 1 000 bricks per day; an investment of R15 000. Or one can have an automated production line, give 9 people work and produce 5 000 - 6 000 blocks per day, an investment of R100 000. To produce 6 000 blocks per day, type 1 will need 9 manual production lines, 86 men, while type 2 need 1 automated line, 9 men per day. This shows on average that with manual production many more people are employed, which is something we should consider very seriously in South Africa, rather than an automated situation. Even if labour costs equal that of the automated process, we shall still have more people who are employed (Lectures notes: Production, 1994:9-10). Many of these small to medium-sized enterprises can be established all over the country and can supply work to hundreds of people.
- ◆ A system that uses local materials
One of the problems that Fathy identified was the use of expensive, foreign materials (1969:32). Local materials, and in this case earth, can be obtained very cheaply. The government can also play an important role in identifying quarries. This will help to prevent the removal of earth from sensitive areas and to prevent erosion caused by the removal of topsoil. By using local materials (with local skills and adaptation to the climate) one can create something that is unique to a specific place. Consequently a place will have its own forms and character.

In Burkina Faso, the "Research, Experimentation and Popularisation of Materials Project" (LOCOMAT – a creation of the Ministry of Public Works) promoted local materials in the first years of its existence. This led to a situation where both

the technical and economical feasibility of buildings in local materials could be proved (Rigassi and Joffroy, July, 1994: 34).

- ◆ A system that develops local skills
The development of local skills can be divided into two aspects:
 - 1) Building with CEB's is almost the same as building with fired bricks. It is a normal brick-building process, and skills already exist in brick masonry in South Africa. One can now develop these skills further by introducing earth bricks.
 - 2) Skills to work with earth are also available, especially in the rural areas, but one can upgrade the traditional techniques by using the appropriate equipment and complying with the rules of CEB masonry (*Basin-News*, July 1991:27).

It is important to remember that one should first look at the type of skills and type of soil available. It might be the case that one should rather use adobe bricks. CEB's are used as an example of an advanced earth product that might be accepted more easily.

Implementation strategy: some points

- ◆ Put up experimental structures
If we want to promote earth as a building material and use it on a large scale in South Africa, we shall have to put up experimental structures (Fathy) to convince the people, the government and financial institutions. This was also done in Cameroon (Rigassi and Joffroy, July, 1994:32), and Mayotte (Guillard, *Gate*, 1/1992:11-12). In South Africa this could mean that the structures will have to be high-profile buildings in the urban context and not necessarily low-cost (like the *Domain de la Terre* in France). The acceptability of the material and method might be greater if used for prestige buildings. The method will then not be stigmatized as alternative, low-cost or inferior. It should start from the top down (contrary to the common belief in the country at the moment), in the sense that one should start with important buildings. It is also important that the government should play a part in this by promoting these methods through commissions (Fathy, 1969:35, and Cameroon; Rigassi and Joffroy, July, 1994:33).
- ◆ Training and education
Much development has taken place on the equipment front and a whole range of different products is available.

What is also necessary now is investment in technical skills. The university at Grenoble has begun to integrate building with earth as a specialized discipline in its own right. Post-graduate courses are also running. This includes research on building materials, production and application methods (Houben & D'Ornano, *Basin-News*, July, 1991:28). In South Africa we shall need to educate and train people in earth construction on different levels, and provide training to people who want to establish small brickyards. This should be different from courses for professionals and decision-makers. It is also important to run courses in our schools of architecture and other institutions. Fathy propagated a 2-year post-graduate course (Fathy, 1969:141). We are in the position today to change our university courses to include earth as one of the many materials and methods of construction, but it must be given the same priority as steel, concrete, etc.

Another area of research and training will be the way the prices of buildings are calculated. Because earth is not a common material in our present building industry, no standardized method of calculating the costs exists in our country. Such systems have been worked out, but they will have to be adapted to the South African situation.

- ◆ Change the way the organization and payment of work are done

Fathy promotes a double system of organizing the building industry. On the one hand are the public buildings that could still be built by contracting firms. In the case of public buildings the normal way of payment will still be used. The private buildings on the other hand can be done in a different way. It may be difficult to use a co-operative system as Fathy suggested, but it may be possible to work with many of small entrepreneurs, as in Cameroon, Burkina Faso and Nigeria (Rigassi and Joffroy, *Basin-News*, July, 1994:31-36). Such a system can provide employment for many people. The people themselves will make a contribution to the housing problem and local customs and skills can easily be introduced and developed. By using smaller entrepreneurs, the danger of mass repetition of houses is lessened. Such a builder will build fewer houses, because of the smaller size of his operation. These builders can also employ local people to help with the process and thus give buildings a local and perhaps also an individual character.

- ◆ Standard building regulations must change
Part of the research that one should undertake is the establishment of a system of standardization. The establishment of standards is not to penalise producers, but to promote high-quality products and thus open up markets for earth building products. There are standards established for earth products by organizations like UNIDO, UNCHS and others (Houben & D'Ornano, *Basin-News*, July 1991:28). We do not have any standards in South Africa. Nothing about earth building exists in the National Building Regulations or Municipal regulations. This means that anybody who wants to build an earth structure will be unable to get their plans approved and will be unable to get a loan from a building society. This applies when one wants to put up an earth building within a municipal area. Outside municipal areas, in squatter camps, on farms etc., this will not pose a problem.
- ◆ Role of the government
The Government must be realistic in what is possible. "In Nigeria I saw a public relations display two panels, one showing the worst African hovels photographed from unflattering angles, the other showing clean European type buildings in concrete and aluminium, and the question 'This or That?' The officials there confessed that these were not real alternatives at all; the country could afford only mud and straw" (Fathy, 1969:36). The Government has an important role to play in the building industry, but should not promote unrealistic expectations of what is economically feasible. The shortage of housing in South Africa is a very sensitive and controversial issue. A situation similar to that which Fathy experienced in Nigeria is developing in South Africa. Millions of houses have been promised to people, but the economic situation does not allow for the building of these houses. Nigeria has realized this and has started a joint effort by the National Commission of Museums and Monuments of Nigeria (NCMM), and the Co-operation Service of the French Embassy to Nigeria, launching a programme aimed at the exploration of the potential of building with earth for low-cost housing. The objective is to contribute to the National Housing Policy by finding solutions to reduce the significant dearth of housing at national level (Rigassi and Joffroy, July, 1994:35). What Fathy found in Nigeria came true; they are now building with earth.
The Government has a further role to play, and that is to create the climate and conditions for a building revival

starting from the individual family. Fathy writes: "It would have to remove the various obstacles to private building, it would have to give a great deal of guidance to the completely inexperienced people ... the training of people in the craft of building, and the giving of material help at the right points ..." (1969:33).

The Government can also promote aided self-help schemes within the conditions that Fathy set. People must be encouraged to play an active part in housing themselves. If people see that they can build good houses themselves for next to nothing, they will get enthusiastic. "If you want a flower, you don't try to make it with bits of paper and glue, but you devote your labour and intelligence instead to preparing the ground, then you put a seed in and let it grow. In the same way, to make use of the natural desire of the villager to build, we must apply ourselves to preparing the ground by creating an atmosphere or social climate in which building will flourish, and we must not waste our energy on the construction of buildings which, however smart or striking they may be, will be as sterile and unproductive as artificial flowers" (Ibid:119).

- ◆ Architects must use and develop the method
Architects and all the other disciplines involved in the building industry should promote earth construction as one of the systems that we have at our disposal. If architects do not design earth buildings, nobody will build earth buildings. Architects are in the position to introduce new materials and techniques in their designs. This can contribute to the acceptance of earth as a building system. It does not mean that every part of the building need to be of earth; on the contrary. A mixture of materials can provide an interesting aesthetic effect. An architect in Toulouse, Colzani, tries to use CEB's in every project he is involved in, in a limited way. The function, design and size of the building etc. all play an important role in the decision of where to use earth. He does this to make earth acceptable to people. His work is interesting because he combines earth building techniques and traditional earth forms like domes and vaults with modern technology and materials like steel. This stresses the exciting design possibilities of working with earth techniques. By working within the limits and characteristics of earth and combining that with other appropriate materials, a new world of design possibilities is opened up to the innovative architect.

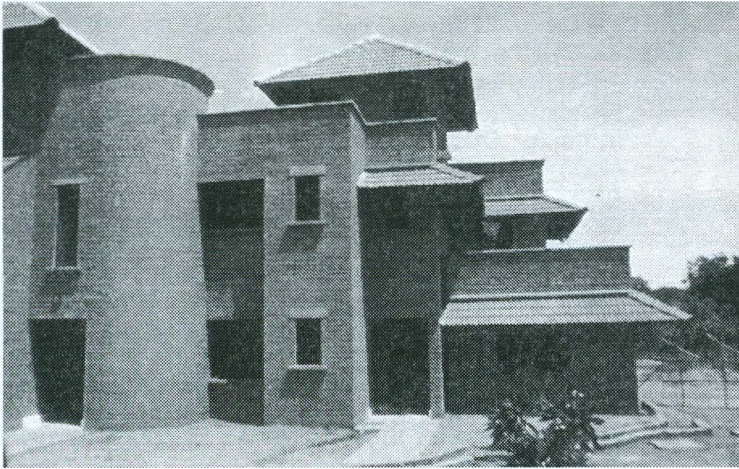


Photo 3: Contemporary flats in earth, Auroville, India (CRATerre-EAG library)

- ◆ What is happening in other parts of the world
Gernicke (Jul/Aug, 1992:40), shows a map of areas in France and the world where earth building is still a flourishing practice (Photo 3). All of Southern Africa and a narrow strip northwards are shown as lacking the tradition. In parts of the world like the USA, more than 176 000 earth houses were to be found in 1980, mainly in the south-western states. Earth building is increasing at a rate of 30% per year in California. In New Mexico, in 1981, there were 48 adobe factories that produced 4 million blocks per year. In France wattle and daub is gaining popularity, because of mechanization and a scientific approach to the material, which has improved the quality (Houben & D'Ornano, July, 1991:26). Small and medium-sized enterprises are playing an important role in the manufacturing of CEB's in Africa (Rigassi & Joffroy, July, 1994:31-36). Seeing that earth building is used in developed and developing countries, we should be able to use similar systems in South Africa. We experience many of the same problems as the rest of the African continent in respect of unemployment, housing and over-population. If the rest of Africa can take earth building seriously, we can learn a lot from them.
- ◆ What is happening in South Africa today?
In 1996 the Unit for Earth Construction was established as

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part of the Department of Architecture at the University of the Orange Free State (UOFS). Many of the above strategies have been employed since then.

— Experimental structures

Experimental structures were put up to promote the material. One is a prototype house at Glen near Bloemfontein, where stabilized compressed earth bricks were used. The structure of 45 m² was erected for R17 147,73 excluding labour. Another demonstration project is the Albert Luthuli Day Care Centre. Here both adobe and CEB's were used for the construction. The cost of the structure was R301,00 m² excluding labour. This building is very popular with the community. Many people were sceptical about the technology at the outset of the process, but are now convinced of its quality. Adobe and CEB's are the two methods of construction used for these buildings, because of the following reasons:

- ▣ The red soil of the Free State is suitable for both these techniques.
- ▣ Masonry skills needed for both these techniques are available.
- ▣ Adobe is the traditional way of building in the Free State. CEB is an upgrading of the existing skills and methods.

— Training and education

Training is provided by the UEC on different levels and for different groups of people. Students receive training as part of their building construction and design courses. Short courses are also presented to professional people in the building industry. These courses focus on specific fields of interest. Training is also provided to communities and small builders as part of community projects, like the one mentioned above. This training focuses on knowledge that can immediately be used in the project. This includes training on the raw material, production of blocks and the construction of the building itself. The information given is less theoretical and more practical exercises as many of these trainees are illiterate. This provides an opportunity for creative ways of teaching.

— Standard building regulations

Standard building regulations should change since this is one of the biggest problems in the SA construction industry. The situation is being addressed on different

levels and by different groups, e.g. the NBRI in the country. Tests by the South African Bureau of Standards (SABS) have successfully been performed on earth walls in Buffalo Flats in East London (SABS Test Report, 4471/89608). Some machine manufacturers have performed SABS tests on their own products like Masakane Bricks. Another machine manufacturer, Hydraform, received certificates from the Agreement Board (Agreement Certificate, 96/237). An acknowledgement system of standards does not exist in South Africa, but many groups are working towards it. Individual municipalities are approving plans of buildings in earth, some under certain conditions. In East London the municipality is erecting a pilot housing project in earth. In Bloemfontein the use of earth will be approved if the UEC is in charge of the project. This is not an ideal situation yet, but from all parts of the country interested parties are working to change the situation so that earth will later be included in the National Building regulations.

— The role of the Government

The UCE have made numerous presentations to local government in the Free State. Everybody seems to be interested, but nothing is mobilized. One can only speculate as to what the reasons may be. The author is of the opinion that the Government is not realistic in their expectations in terms of housing in this country. Not only regarding the number of houses, but also regarding the type of materials one can obtain for the subsidy amount. This amount has not changed in the past years, despite the drop in the value of the rand. The cost of building materials are far more expensive than when the Government announced their subsidy scheme. The experience of the UEC is that private organizations and clients are far more advanced in their approach to earth construction.

— The role of architects

Many architects in South Africa are using earth as a building material and technology and design buildings in earth, but the majority of architects do not have enough knowledge about this concept, since it was perhaps not included in their curricula at university. The UCE endeavors to teach this technology as part of the students' course, as to put them in the position to know how use the material where appropriate when they start practicing.

Conclusion

Progress has been made in South Africa in the field of earth architecture and specifically its acceptability. Many contemporary buildings in earth are being built today. One such an example is the Alliance Française building in Mitchell's Plain that was built with CEB's. This technology in its modern form is exiting, but a lot has still to be done. As Gernicke says:

"The timeless custom of building in earth, part of the collective consciousness of mankind from time immemorial, will yet have to be taken seriously here (South Africa), and could be exploited to great advantage in a country with a low economic growth rate and a high proportion homeless citizens" (Gernicke, July/Aug., 1992:44).

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