



الهيئة العليا  
لتطوير مدينة الرياض



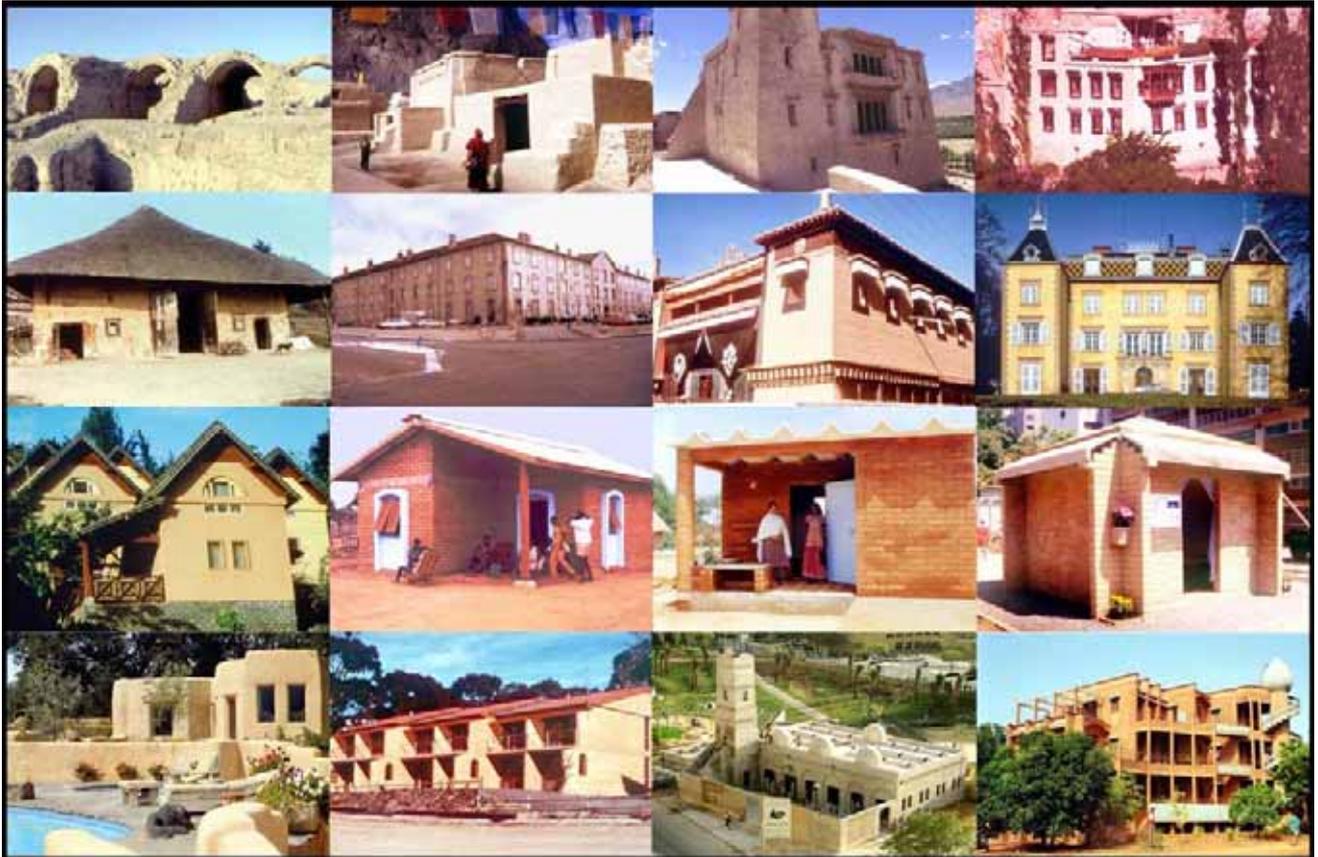
UNESCO CHAIR  
Earthen Architecture

AUROVILLE EARTH INSTITUTE



برنامج المحافظة على التراث

## EARTHEN ARCHITECTURE FOR SUSTAINABLE HABITAT AND COMPRESSED STABILISED EARTH BLOCK TECHNOLOGY



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## 1. EARTH ARCHITECTURE IN THE WORLD, A MILLENNIA OLD TRADITION

Since ages raw earth has been used all over the world as a building material to achieve amazingly long lasting buildings. There is hardly any continent or country which does not have numerous examples of earth construction. From the roof of the world in Tibet, or the Andes Mountains in Peru, to the Nile's shore in Egypt, the deserts of Middle East or the fertile valleys of China, many are the examples of earth as a building material.

Statistics from UNCHS show that:

- 40 % of the world population lives in earthen dwellings
- 25 % of the world population does not have access to decent housing

Statistics from the heritage lists of UNESCO show that:

- 15 % of the "world cultural heritage" is built with earth
- 25 % of the "world heritage in danger" is built with earth
- 14 % of the "100 most endangered world heritage" is built with earth

The oldest earthen building can still be seen in Egypt, near Luxor, which was built around 1300 BC: the vaults of the Ramasseum, in the "rest" of Thebes. In Saudi Arabia, people were used to build with earth since very ancient times. The capital of the first state of Saudi Arabia, Al Dir'iyah has been built with earth very long ago. The first recorded settlements in Dir'iyah date since 1446 AD. From 1745 to 1818 AD, Al Dir'iyah became a large city and an amazing example of earthen architecture.



*Ramasseum – Adobe  
Egypt, ±1300 BC*



*Al dir'iyah, Sa'd Palace – Adobe  
Saudi Arabia*



*Najran palace – Cob  
Saudi Arabia*



*Mari – Adobe  
Syria, Founded ± 2800 BC*



*Shibam – Adobe and cob  
Yemen, World site heritage*



*Ksar villages – Rammed earth  
Dades valley, Morocco*



*Tabo monastery – Adobe  
India, 996 AD*



*Rebkung monastery – Rammed earth  
Amdo, Tibet*



*Chateau of Reyrieux – Rammed earth  
France, XVIII<sup>th</sup> century*

Earth architecture and the skill of earth builders have disappeared since nearly a century: from the end of the XIX<sup>th</sup> century till the latter half of the XX<sup>th</sup> century. We owe a lot to the Egyptian architect Hassan Fathy, for the renaissance of earthen architecture in the middle of the XX<sup>th</sup> century.

## 2. COMPRESSED STABILISED EARTH BLOCK TECHNOLOGY

The new development of earth construction really started in the nineteen fifties, with the technology of the Compressed Stabilised Earth Blocks (CSEB): a research programme for affordable houses in Colombia proposed the first manual press – the Cinvaram. Since then, considerable scientific researches have been carried out by laboratories. The knowledge of soil laboratories concerning road building was adapted to earth construction.

Since 1960 – 1970, Africa has seen the widest world development for CSEB. Social programmes and prestige demonstration projects are not computable anymore. Africa takes, these days, a further step with semi industrialization and standards. India developed CSEB technology only in the nineteen eighty's, but sees today a wider dissemination and development of CSEB.

The soil, raw or stabilized, for a compressed earth block is slightly moistened, poured into a steel press (with or without stabilizer) and then compressed either with a manual or motorized press.



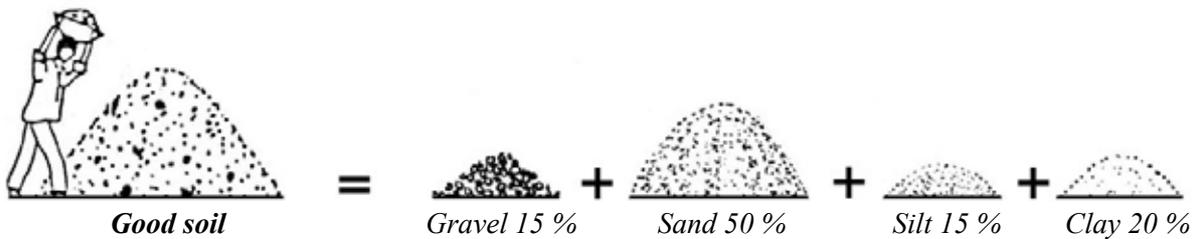
*Auram hollow interlocking block*  
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The input of soil stabilization has made it possible to build higher with thinner walls, which have a much better compressive strength and water resistance. With cement stabilization, the blocks must be cured for four weeks after manufacturing. After this period of time, they can dry freely and be used like common bricks with a soil cement stabilized mortar.

### Soil suitability and stabilization for CSEB

A soil contains four components: gravel, sand, silt and clay. In concrete, the binder of gravel and sand is cement. In a soil, the binder is silt & clay. But silt and clay are not stable in water. Thus, the aim of stabilization is to stabilize silt and clay against water, so as to give lasting properties with the minimum of maintenance.

Topsoil and organic soils must not be used. Identifying the properties of a soil is essential to create, at the end, good quality products. Not every soil is suitable for earth construction and CSEB in particular. But with some knowledge and experience many soils can be used for producing CSEB.



A good soil for CSEB is more sandy than clayey.

### Soil identification and stabilisation

Only a very few laboratories can identify soils for building purposes. But soil identification can be performed by anybody with sensitive analyses and people can learn it during a short training. The main points to examine are:

- Grain size distribution, to know the quantity of each grain size.
- Plasticity characteristics, to know the quality and properties of the binders (clays and silts).
- Compressibility, to know the optimum moisture content, which will require the minimum compaction energy for the maximum density.
- Cohesion, to know how the binders bind the inert grains.

Many stabilizers can be used. Cement and lime are the most common ones. Others, like chemicals, resins or natural products can be used as well. The selection of a stabilizer will depend upon the soil quality and the project requirements:

- Cement will be preferable for sandy soils and to achieve quickly a higher strength.
- Lime will be rather used for very clayey soil, but will take a longer time to harden and to give strong blocks.

The average stabilizer proportion is rather low:

- Cement stabilisation = 5% average.  
The minimum is 3% and the maximum is 8% (only for cost reasons).
- Lime stabilisation = 6% average.  
The minimum is 2% and the maximum is 10% (for technical reason).

#### Basic data on CSEB

Dry compressive strength at 28 days (+5% after 1 year + 10% after 2 years)	4 to 6 Mpa = 40 to 60 Kg/cm <sup>2</sup>
Wet compressive strength at 28 days (after 3 days immersion)	2 to 3 Mpa = 20 to 30 Kg /cm <sup>2</sup>
Dry bending strength (at 28 days)	0.5 to 1 Mpa = 5 to 10 Kg /cm <sup>2</sup>
Dry shear strength (at 28 days)	0.4 to 0.6 Mpa = 4 to 6 Kg /cm <sup>2</sup>
Water absorption at 28 days (after 3 days immersion)	8 to 12% (by weight)
Apparent bulk density	1700 to 2000 Kg/m <sup>3</sup>
Energy consumption (Ref. Development Alternatives 1998)	110 MJ

#### Management of resources

All over the world and through centuries, one is amazed by the balance and harmony of these buildings with the landscape and the surrounding physical environment. With new developments (i.e. CSEB on a semi-industrial scale) one should not overlook the risk of ecological disasters due to mismanagement of resources. On the other side, a proper management of the earth resources can create a new harmonious balance between nature and the buildings, where one enriches and completes the other.

First of all, one should scrape away topsoil, which can be re-used later for agriculture or gardens. Two types of quarries may be developed: deep - which can be used later on for water harvesting, wastewater treatment, basement floors, pools, etc., or shallow - which can be used for landscape design, play areas, gardens, etc.

A proper plan should be drawn up beforehand to avoid later disasters. A decentralized approach can be the most harmonious and efficient, if well coordinated. The use of water harvesting, medium scale wastewater treatment, etc., can be integrated harmoniously into the urban environment. At this point, coordination between the city/village authorities and the block manufacturers will profit everybody: urban development always needs holes somewhere and they can be made in an intelligent way by producing building materials for the local developments.



*Biological wastewater treatment*



*Basement floor*



*Percolation pit and landscaping*

#### Energy effectiveness

Cost is too often limited only to the monetary value. It is understandable and one can remember that in Auroville a cubic metre of CSEB is around 23.6 % cheaper than a cubic metre of country fired bricks. But the energy approach should be integrated: some studies have shown that, in the Indian context, building a m<sup>2</sup> of masonry with CSEB consumes 5 times less energy than a m<sup>2</sup> of wire cut bricks masonry and 15 times less than country fired bricks!

#### Ecological comparison of building materials

Compressed stabilised earth blocks are more eco-friendly than fired bricks. Their manufacture consumes less energy and pollute less than fired bricks.

##### Energy consumption

4.9 times less than wire cut bricks  
15.1 times less than country fired bricks

##### Pollution emission

2.4 times less than wire cut bricks  
7.9 times less than country fired bricks

Product and thickness	No of units (Per m <sup>2</sup> )	Energy consumption (MJ per m <sup>2</sup> )	CO <sub>2</sub> emission (Kg per m <sup>2</sup> )	Dry compressive crushing strength (Kg/cm <sup>2</sup> )
CSEB – 24 cm	40	110	16	40 – 60
Wire Cut Bricks – 22 cm	87	539	39	75 – 100
Country Fired bricks – 22 cm	112	1657	126	30 – 50
Concrete blocks – 20 cm	20	235	26	75 – 100

**Notes:** - Wire cut bricks are fired in good kilns and their quality is quite good.

- Country Fired bricks are produced in villages. They are burnt in poor quality kilns and their quality is poor.

- Source: 1998 – Development Alternatives for the Indian context

### Cost effectiveness

CSEB are generally cheaper than fired bricks. This will vary from place to place and specially according to the cement cost. The cost break down of a 5 % stabilised block will depend on the local context. In India with manual equipment (AURAM press 3000), it is usually within these figures:

➤ Labour: 20 - 25 %    ➤ Soil & sand: 20 - 25%    ➤ Cement: 40 - 60 %    ➤ Equipment: 3 - 5 %

In Auroville, a finished m<sup>3</sup> of CSEB wall is generally: 48.4 % cheaper than wire cut bricks and 23.6 % cheaper than country fired bricks

The strength of a block is related to the press quality and the compression force, and to the quantity of stabiliser. This implies that to reduce the cost of a block one should try to reduce the quantity of cement but not the cost of the labour with unskilled people. One should also not cut down the cost of the press with cheap quality machines, which would not last long and would not give strong blocks.

### Selection of the equipment and products

The development of CSEB means nowadays a wide range of equipment and products of different size and shape. To select the best adapted equipment and product to one's need, one should pay special attention to these factors:

<b>Module of the block</b>	It is the block size plus the mortar thickness. Choose preferably an easy module, in the decimal system, to avoid wasting time on the design calculations. Select also the module with the thinnest mortar joint possible.
<b>Possibilities of different wall thickness</b>	According to the module of a block, which thickness of wall can be achieved with easy bonds? According to the thickness, one can know if a block can be load bearing or not.
<b>Area of the block</b>	The bigger it is, the weaker the block will be. A large area will require great compaction energy: a manual press with 15 Tons capacity will not be able to compress properly a block with an area of more than 600 cm <sup>2</sup> .
<b>Plain, hollow or Interlocking blocks...?</b>	Each of them has different possibilities: plain ones will be laid with a thick mortar (1 to 1.5 cm); hollow ones will be laid with a thin mortar (0.5 to 1 cm); the interlocking blocks will require a thin mortar (0.5 cm) and very special details.
<b>Mould possibilities</b>	Whether a mould can do full size, 3/4 or half block. To do proper bonds, one needs to use these 3 sizes in order to achieve a good quality bonds, without breakage.
<b>Equipment selection</b>	<ul style="list-style-type: none"> <li>- Manual equipment requires quite a lot of manpower and presents the advantage of being cheap, but the disadvantage of a low output.</li> <li>- A motorized press will present the advantage of a high productivity, with a better and more regular quality. But it will require energy and a more complicated maintenance. Its cost will have no comparison with a manual press.</li> <li>- Heavy manual presses are most of the time the best choice in terms of optimisation for the ratio investment/output/quality.</li> <li>- Industrialization is not adapted to the production of CSEB.</li> <li>- Semi industrialization is acceptable, as it offers the advantage of being more flexible and easily adapted to a local context. It increases the quality without increasing tremendously the cost of a block.</li> </ul>

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## Advantages of CSEB

### A local material

Ideally, production is made on the site itself or in the nearby area. Thus, it will save transportation, fuel, time and money.

### A bio-degradable material

Well-designed CSEB houses can withstand, with a minimum of maintenance, heavy rains, snowfall or frost without being damaged. Their strength and durability have been proven since half a century.

But let's imagine a building fallen down and that a jungle has grown on it: the bio-chemicals contained in the humus of the topsoil will destroy the soil cement mix in 10 or 20 years... And CSEB will come back to our Mother Earth... No other building material can do that.

### Limiting deforestation

Firewood is not needed to produce CSEB. This will save forests, which are being depleted quickly in the world, due to short view developments and mismanagement of resources.

### Management of resources

Each quarry should be planned for various utilisations: water harvesting pond, wastewater treatment, reservoirs, landscaping, etc. It is crucial to be aware of this point: very profitable if well managed... Disastrous if unplanned!

### Energy efficiency and eco friendliness

Requiring only a little stabilizer the embodied energy in a m<sup>3</sup> can be from 5 to 15 times less than a m<sup>3</sup> of fired bricks. The pollution emission will also be 2.4 to 7.8 times less than fired bricks.

### Cost efficiency

Produced locally, with a natural resource and semi skilled labour, almost without transport, it will be definitely cost effective, more or less according to each context and to ones knowledge.

### An adapted material

Being produced locally it is easily adapted to various needs: technical, social, cultural habits.

### A transferable technology

It is a simple technology requiring semi skills, easy to get. Simple villagers will be able to learn how to do it in a few weeks. An efficient training centre can transfer the technology in a week's time.

### A job creation opportunity

CSEB allow unskilled and unemployed people to learn a skill, get a job and rise in the social scale.

### Market opportunity

According to the local context (materials, labour, equipment, etc.) the final price will vary, but in most cases it will be cheaper than fired bricks.

### Reducing imports

Produced locally by semi skilled people, no need to import from far away expensive materials or transport over long distances heavy and costly building materials.

### Flexible production scale

Equipment for CSEB is available from manual to motorized tools ranging from village to semi industry scale. The selection of the equipment is crucial, but once done properly, it will be easy to use the best adapted equipment for each case.

### Social acceptance

Demonstrated, since long, CSEB can adapt itself to various needs, from poor income groups to well off people or government needs. Its quality, regularity and style allow a wide range of final house products.

To facilitate this acceptance, banish from your language "*stabilized mud blocks*", when speaking of CSEB. Often people associate in their minds the name mud with poor building material.

## Disadvantages of CSEB

- Proper soil identification is required or lack of soil.
- Unawareness of the need to manage resources.
- Ignorance of the basics for production & use.
- Wide spans, high & long buildings are difficult to do.
- Low technical performance compared to concrete.
- Untrained teams producing bad quality products.
- Over-stabilization through fear or ignorance, implying outrageous costs.
- Under-stabilization resulting in low quality products.
- Bad quality or un-adapted production equipment.
- Low social acceptance due to counter examples (by unskilled people, or bad soil & equipment).

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### 3. A WORLDWIDE NETWORK

All over the world, governmental and non governmental organisations, institutions, schools, research centres, etc. are researching, developing and promoting earth architecture. All continents witness these kinds of development:

- Europe (France, Germany, Italy UK, Spain, Portugal, etc.)
- Americas (USA, Brazil, Colombia, Mexico, Peru, Uruguay, etc.)
- South Asia (Australia, India, Korea, New Zealand, Philippines, Thailand, etc.)
- Africa (Burkina Faso, Egypt, Kenya, Morocco, Niger, Nigeria, South Africa, Uganda, etc.)

#### ➤ CRATerre – EAG

CRATerre-EAG, the International Centre for Earth Construction, is a scientific organization within the School of Architecture of Grenoble, France. Since its creation in 1979, CRATerre-EAG is actively contributing to the development of scientific and technical knowledge on earthen architecture. CRATerre-EAG is today the world leader in earth architecture and construction. Besides its specialized training programmes, CRATerre-EAG offers an 18-month post-graduate course, the DESA Earth Architecture, which grants a diploma recognized by the French Ministry of Culture.

CRATerre-EAG is focussing its activities on various fields:

- Theoretical and fundamental research in collaboration with various research centres and universities: research is focussed these days on understanding the nature of soils through various analysis and test, such as X rays, molecular modelisation, numeric and microscopic analysis, spectrometry, scanning, etc.
- Environmental issues and heritage conservation: this research and implementation is done with the collaboration of UNESCO, ICCROM (International Centre for the Study of the Preservation and the Restoration of Cultural Property) and the GCI (Getty Conservation Institute). They aim to develop the conservation of earthen architectural heritage as a science, a field of study, a professional practice, and a social endeavour.
- Economy and production of materials
- Human settlements

#### ➤ UNESCO Chair *earthen architecture*

UNESCO, on the initiative of CRATerre-EAG, created in 1998 a Chair on earth architecture. This UNESCO Chair "*Earthen Architecture, Constructive Cultures and Sustainable Development*" aims to accelerate the dissemination of scientific and technical know-how on earthen architecture amongst the higher education institutions, in the following three domains: environment and heritage, human settlements, and economy and production.

CRATerre-EAG is the centre of excellence of the UNESCO Chair Earthen Architecture and the Auroville Earth Institute is representative and Resource Centre of the Chair for South Asia. Other representations of this Earthen Architecture Chair are also found in South America (Brazil, Colombia, Mexico and Peru), Europe (France and Italy), Africa (Burkina Faso, Nigeria, South Africa and Uganda) and South Asia (India and Philippines).

#### ➤ The Auroville Earth Institute

The Auroville Earth Institute was previously named the Auroville Building Centre / Earth Unit, which had been founded by HUDCO, Government of India, in 1989. The development of the former building centre evolved in such a way that the Auroville Earth Institute came into existence in 2004 and will be able to offer in a while various diplomas in earth architecture.

The Auroville Earth Institute is researching, developing, promoting and transferring earth-based technologies, which are cost and energy effective. These technologies are disseminated through training courses, seminars, workshops, manuals and documents. The Institute is also offering various services, and provides consultancy within and outside India. One of the aims of the Auroville Earth Institute is to give people the possibility to create and built themselves their habitat, while using earth techniques.

The Auroville Earth Institute offers various training programmes such as one-day awareness, two-week intensive and one-year long term training. Since its inception, 3240 people were trained in India and 132 people abroad.

#### 4. WORLDWIDE DEVELOPMENT

All over the world many researches and modern development are happening. Africa has seen many development projects being implemented, mostly done for social housing but also governmental projects. Worldwide programmes are mostly focussed on CSEB and stabilised earth techniques.



*Saudi Arabia – Al Medy Mosque*



*Saudi Arabia – Exhibition Centre*



*India – Development Centre*



*Zaire – School by UNIDO*



*Somalia – School by UNESCO*



*Mali – National Research Centre*



*Ivory coast – Restaurant*



*Mayotte – Prefecture*



*Mali – French Cultural Centre*



*Egypt – House*



*France – House of 24 hours*



*Ivory Coast – Low cost house*



*Mayotte – Social housing*



*Morocco – Social housing*



*Madagascar – Social housing*



*India – Cost effective house*



*Salvador – Earthquake resistant house*



*India – Earthquake resistant house*

## 5. RESEARCH AND ACTIVITIES OF THE AUROVILLE EARTH INSTITUTE

The Auroville Earth Institute is a research and training centre in earth architecture. Training courses have been conducted for the very onset and many technologies have been researched, developed and promoted.

### Auram equipment for earth construction

A wide range of equipment for building with earth has been researched and developed from the very outset. It ranges from presses for compressed earth blocks, quality control devices for block making, handling equipment, hand tools, scaffolding, and rammed earth equipment.

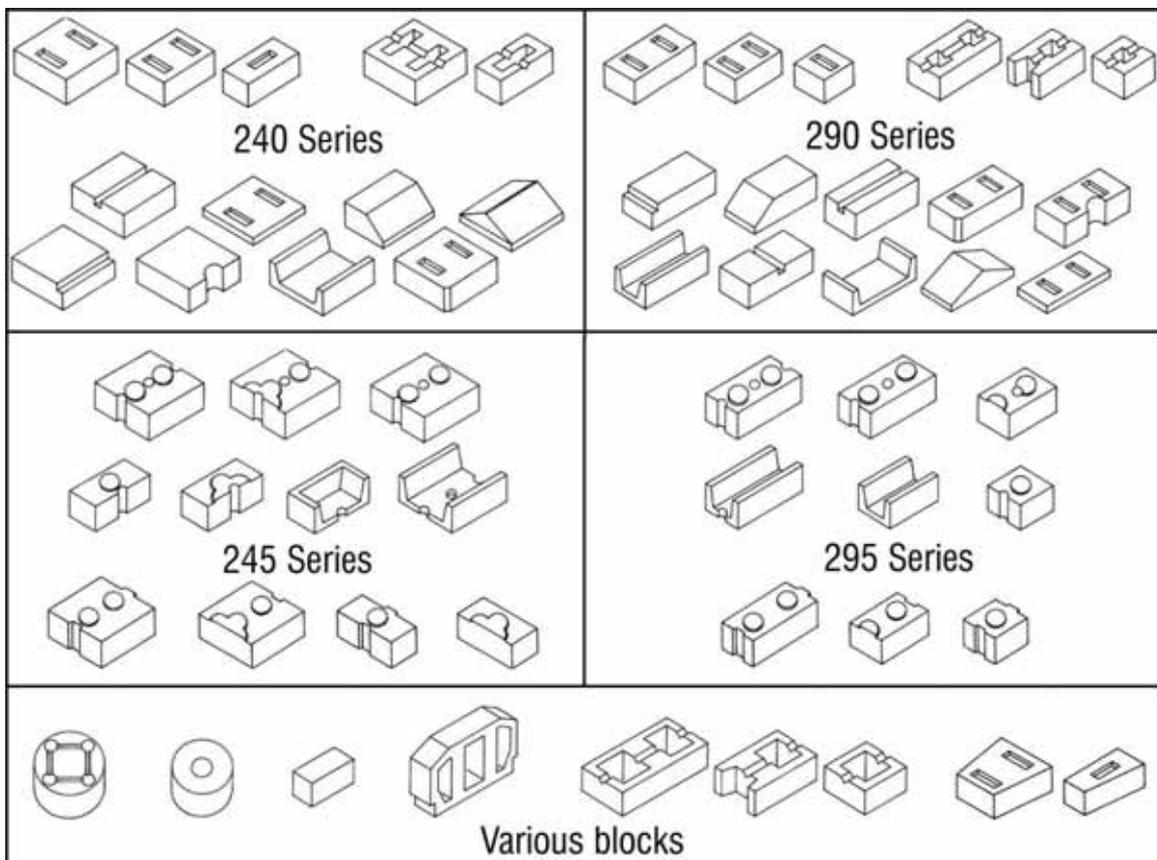
To date, this equipment has been sold mostly in South Asia and Africa. Meanwhile, the AURAM Press 3000 has become renowned as one of the best presses available worldwide, and machines are being sold worldwide: in USA, Europe and Middle East.



*Press 240*

*Press 3000*

*Rammed earth forms*



*Blocks produced by the Auram Press 3000*

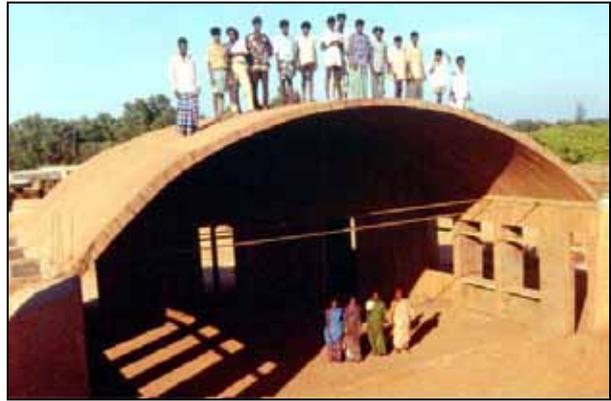
## Vaulted structures

The research with this kind of roofing aims to revive and integrate in the 21<sup>st</sup> century the techniques used in past centuries and millennia, such as those developed in ancient Egypt or during the period of gothic architecture in Europe.

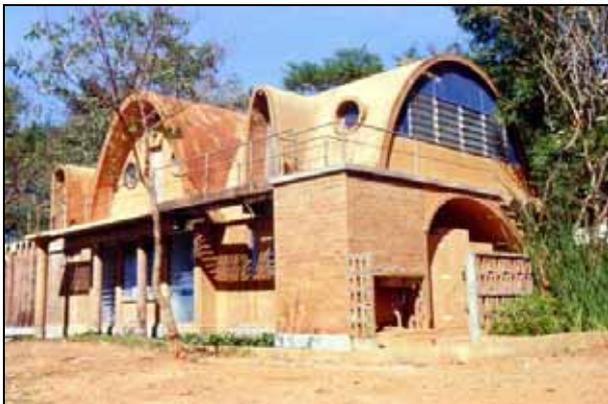
This R&D seeks to optimize the structures by increasing the span of the roof, decreasing its thickness, and creating new shapes. Note that all vaults and domes are built with compressed stabilised earth blocks, which are laid in “free spanning” mode (without formwork), which has been developed by the Auroville Earth Institute. This technique is a development of the Nubian technique.



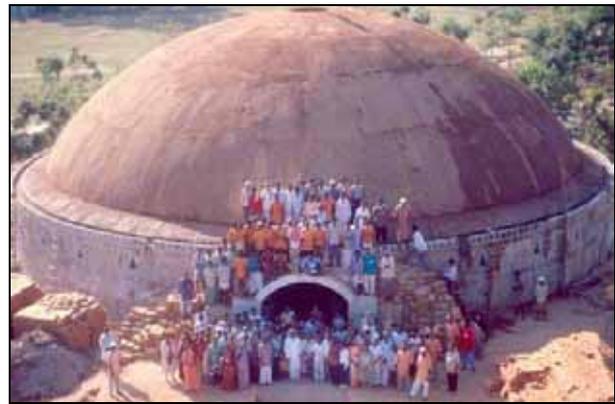
*Domes of the Visitor's Centre at Auroville  
1992 Hassan Fathy Award for Architecture for the poor*



*Vault of Mirramukhi School at Auroville  
10.35m span, 2.25m rise, 30 tons – Built in 3 weeks*



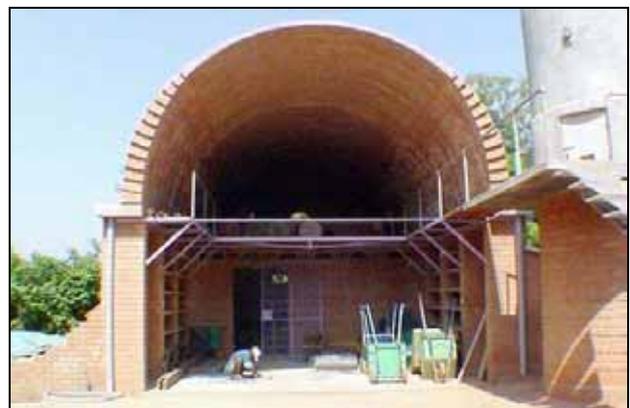
*Training Centre at the Auroville Earth Institute  
Various vaults with stabilized earth waterproofing*



*Dome of the Dhyanalingam temple near Coimbatore  
22.16m dia, 7.90m rise, 570 tons – Built in 9 weeks*



*House at the Auroville Earth Institute  
3.60m span – Built in 36 days*



*Workshop at the Auroville Earth Institute  
6m span, 11m long, 40 tons – Built in 37 days*

### Appropriate building technologies based on soil

This research aims to make extensive use of raw earth as the main building material. The idea is to use a local resource which can help developing technologies that are saving energy and, are eco-friendly and sustainable. The main research and development tries to minimise the use of steel and cement. These technologies have been researched and developed:

- Stabilised rammed earth foundations (with 5 % cement)
- Stabilised rammed earth walls (with 5 % cement and a “homeopathic” milk of lime and alum)
- Composite columns (round and hollow CSEB with reinforced concrete)
- Composite beams (U shape CSEB with reinforced concrete)
- Stabilized earth mortars and plasters
- Wide variety of compressed stabilised earth blocks (Today 16 moulds for producing  $\pm$  75 types of blocks)
- Various vaults with compressed stabilised earth blocks
- Alternative stabilizers to cement (“homeopathic” milk of lime and alum)
- Alternative waterproofing with stabilized earth (mixes of soil, sand, cement, lime, alum and juice of a local seed)



*Stabilised rammed earth foundations*



*Stabilised rammed earth walls*



*Composite plinth beam*



*Composite column 240*



*Composite column 290*



*Composite lintels and beams*



*Testing a composite beam*



*Stabilised earth waterproofing*



*Stabilised earth waterproofing*

### Disaster resistant constructions

Since 1995, research has been oriented towards the development of a system which is based on reinforced masonry with compressed earth blocks that are hollow interlocking. Two types of blocks have been developed: the square hollow interlocking block 245, which allows building up to 2-3 floors high, and the rectangular hollow interlocking block 295, which is used only for ground floors. The masonry with these blocks is reinforced at the critical points with reinforced cement concrete.

The Auroville Earth Institute is transferring this technology through training courses and project assistance, as happened especially in Gujarat to the Catholic Relief Services and Kutch Nav Nirman Abhiyan for the rehabilitation after the 2001 earthquake, where a few thousand houses have been built.

The technology has been approved by:

- The Government of Gujarat (GSDMA) as a suitable construction method for the rehabilitation of the zones affected by the 2001 earthquake in Kutch district.
- The Government of Iran (Housing Research Centre) as a suitable construction method for the rehabilitation of the zones affected by the 2003 earthquake of Bam.



*MINE House – Istanbul, Turkey  
9 m<sup>2</sup>, built in 8 days by a 6-man team*



*AUM House – Khavda, Gujarat  
23 m<sup>2</sup>, built in 62 hours by an 18-man team*



*Houses built by the CRS – Gujarat, India  
2698 houses built in a year time, in 39 villages*



*House built by the International Blue Crescent  
Bam – Iran*

### Publication of manuals

Six series of books and manuals have been published for the dissemination of earth-based technologies. They can be ordered from the Auroville Earth Institute and a few thousands of them have been disseminated.

30 publications are presently available in six series:

- Introductory booklets
- Lecture summaries
- Training manuals
- Case studies
- User manuals
- CDs

## 6. BUILDING WITH EARTH IN AUROVILLE

The International Township of Auroville is under construction in Tamil Nadu, south India. One of its aims is to harmonize material and spiritual researches to give a living embodiment to an actual human unity. Auroville was founded in 1968.

This Visitors' Centre of 1200 m<sup>2</sup> was the starting point of the development with earth architecture in Auroville. It was granted the "Hassan Fathy Award for Architecture for the Poor" in 1992. Today, Auroville can show a wide variety of earthen projects: public buildings, schools, apartments and individual houses.

### Houses



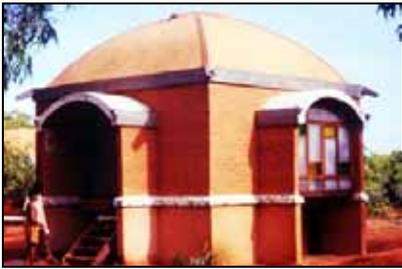
*Cost effective houses in a colony*



*Experimental house*



*Cost effective house at Vikas*



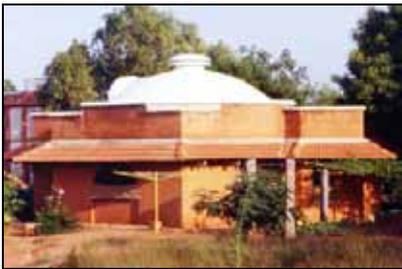
*Cost effective house at Vikas*



*Cost effective house at Vikas*



*Moveable house at Vikas*



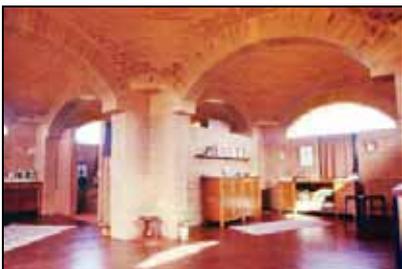
*Samasti community*



*Auromodele community*



*Dana community*



*Aurobrindavan community*



*New Creation Field*



*Utility community*

## Apartments



*Staff quarter of the Health Centre*



*Prarthna community*



*Vikas community*



*Vikas community, on 4 floors*



*Vikas community*



*Djaima community*

## Public Buildings



*Complex of reservoirs*



*Electronic workshop on 3 floors*



*Kindergarten*



*School at Udavi*



*School at Pondicherry*



*School at Kottakarai*



*Deepanam School*



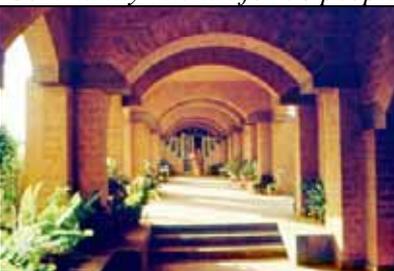
*Community kitchen for 50 people*



*Solar kitchen for 1000 people*



*Visitors Centre*



*Visitors Centre*



*Visitors Centre*

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## 7. TOWARDS THE FUTURE

Building with earth is definitely an appropriate, and cost and energy effective technology. Obviously one has to know the material and master its disadvantages, which normally are variations in the soil quality and hence the block quality, shrinkage cracks, lower strength than high quality fired bricks or concrete, production of the blocks on site, etc.

Since half a century, research and development has proved the potential of earthen techniques. Earth can be used as a quality and modern building material almost everywhere in the world. One of the main key points for a general revival and dissemination of earthen techniques is respect for Nature and management of resources.

Another important parameter is the training aspect. Quite a few training centres are blossoming all over the world, but it appears that government organisations have an essential role to play. They should bring awareness, from the schools to the masses, and give a political direction for the implementation of the research and development done by the best research and training centres.

**The Earth is Sacred, and any soil for building is a precious material: don't waste it.**

*“Treat the Earth well. It was not given to you by your parents. It was loaned to you by your children.”*

*Kenyan Proverb*

To avoid wasting earth, separate the piles of topsoil from the building soil. Don't mix waste building materials with it. Use rubble from building sites for filling basements rather than good soil. Don't spoil quarry holes by dumping in garbage.

**Building with earth has a great past, but also a promising future everywhere in the world.  
Don't miss it!**