

*Presented at*



# Auroville **Green Practices**

Seminar and Site Visits  
26-28 August, 2010

## **EARTHEN ARCHITECTURE IN AUROVILLE**

**Auroville Earth Institute  
Satprem Maini  
Architect**

**Auroville attempts to link the ancestral tradition of raw earth building with the modern technologies of stabilised earth.**

**Earth, as a building material, can be used for creating a modern, progressive and eco-friendly habitat.**

**Compressed Stabilised Earth Blocks (CSEB) is today the technology used the most in Auroville.**



**MANAGEMENT OF  
NATURAL  
RESOURCES**

**Respect and  
worship our  
Mother Earth!**



**No management of resources creates ecological disasters  
Never do this !!!**



**Eroded land due to miss management of resources**



**Quarry not planned  
It will become a garbage dump**



**Wastewater treatment**



**Wastewater treatment & percolation**



**Wastewater treatment**



**Underground rainwater**



**Appropriate and sustainable development require first proper management of natural resources.**



**Completed building, on 4 floors**

**Basement floor**



**Half underground reservoir**



**Rainwater percolation system**



**Rainwater percolation system**

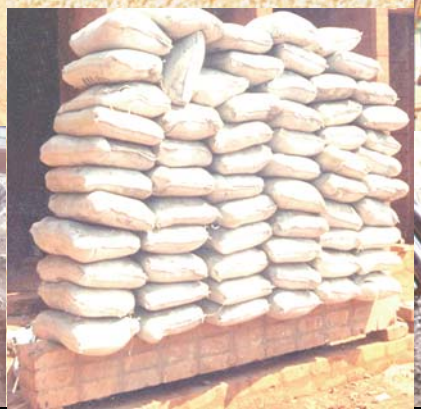


## MANAGEMENT OF HUMAN RESOURCES

Training people and giving them a livelihood insures sustainable development



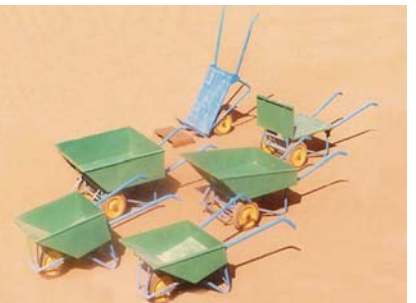
## RESEARCH ON STABILISED EARTH TECHNOLOGIES



# Compressed stabilised earth block technology



**Auram press 3000 - Multi mould manual press with 17 moulds for doing ~ 75 blocks**



**Single mould presses**

**Peripheral equipment**

**Auram equipment for building with earth, sold worldwide**



**Rammed earth forms**

**Limited series production**

**Quality control devices**



**Compressed Stabilised Earth Blocks (CSEB) by the Auram press 3000  
17 moulds for doing about 75 different blocks**

## ENVIRONMENTALLY FRIENDLY

- No firing is required for CSEB, but only curing (4 weeks with cement stabilisation)

### Little embodied energy per m<sup>3</sup> material

- CSEB = 1,112 MJ per m<sup>3</sup>
- Wire cut bricks = 2,247 MJ per m<sup>3</sup>
- Country fired bricks = 4,501 MJ per m<sup>3</sup>

~4 times less than country fired bricks

### Less pollution per m<sup>3</sup> of material

- CSEB = 110 Kg of CO<sub>2</sub> /m<sup>3</sup>
- Wire cut bricks = 202 Kg of CO<sub>2</sub> /m<sup>3</sup>
- Country fired bricks = 441 Kg of CO<sub>2</sub> /m<sup>3</sup>

~4 times less than country fired bricks

## Country fired bricks



**100 tons of wood  
burnt for 250 000 fired bricks !!!**

## COST EFFECTIVE

- CSEB are generally cheaper than fired bricks

### Cost comparison of walls (Blocks produced on site)

CSEB wall (24 cm thick)	Country fired brick wall (22 cm thick)
➤ 3,045 Rs. per m <sup>3</sup>	➤ 3,270 Rs. per m <sup>3</sup>
➤ 731Rs. per m <sup>2</sup>	➤ 719 Rs. per m <sup>2</sup>

(Value Auroville, 1<sup>st</sup> July 2010)

**A finished m<sup>3</sup> of CSEB wall costs in Auroville  
6.9% cheaper than country fired bricks**



## Stabilised rammed earth foundations



Digging the trench and filling the frame



Lifting the frame



Checking penetrometre



Ramming



Adding 200 Litres of sand and 1 bag cement

## Stabilised rammed earth walls

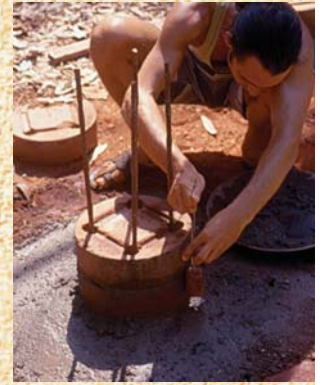




## Composite techniques



Composite plinth beam



Composite columns



Composite staircase



Composite staircase

## Composite techniques



Composite lintel single height



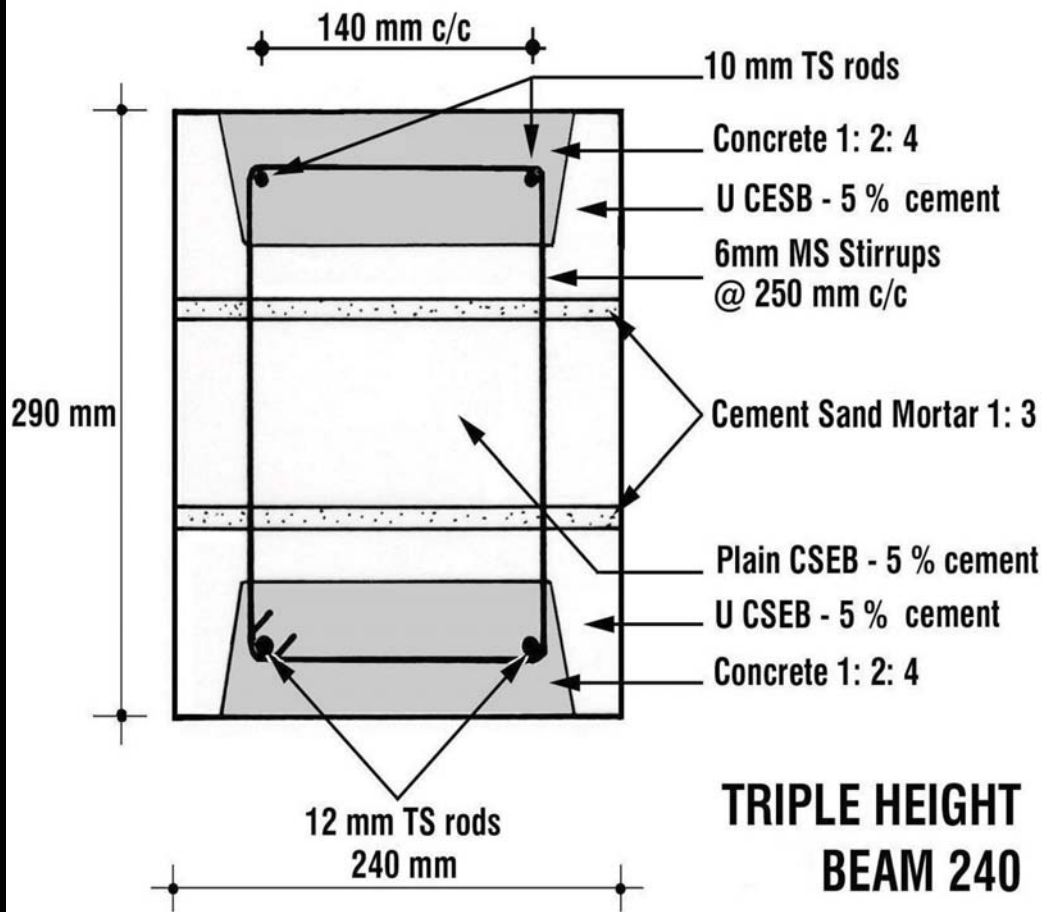
Composite beam double height



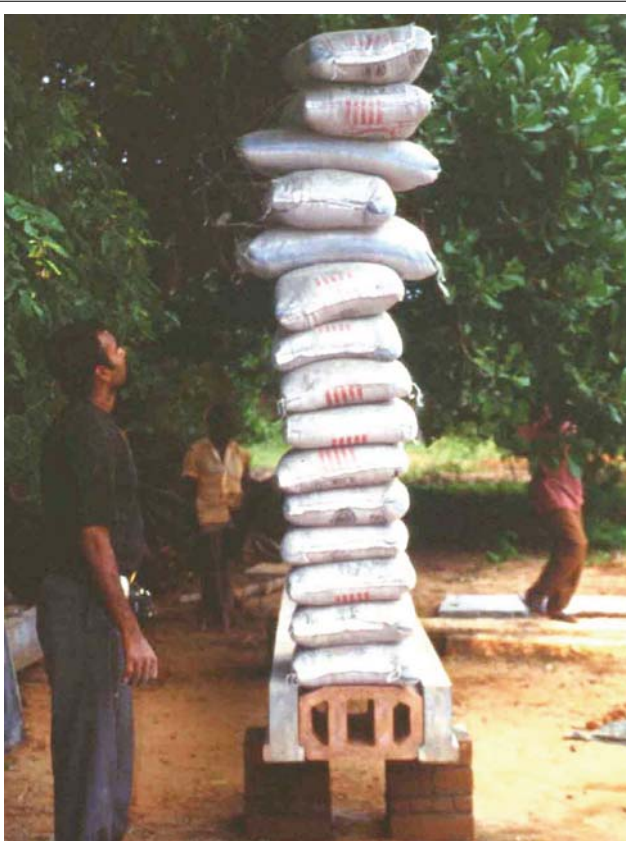
Composite beam triple height cantilevered



Composite beam triple height



Testing a triple height composite beam 240  
2.50 m span, 1280 Kg/m, 4 mm deflection, no cracks



**Testing hourdis blocks:  
750 Kg on 8 hourdis = 3125 Kg /m<sup>2</sup>**



**Hourdis blocks  
and ferrocement channels**



**Hourdis blocks  
and T beams**



**DIVERSITY OF  
EARTHEN BUILDINGS**



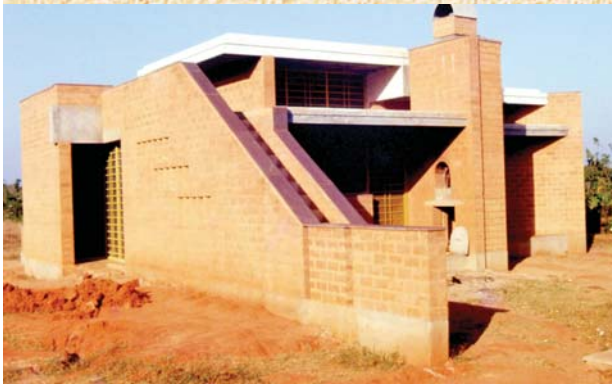
## Projects by various architects



Cost effective houses at Kottakarai village



House at Dana community



House at Auromodele community



House at Dana community

## Projects by various architects



House at New Creation Field community



House in the Green Belt



House at Samasti community



House in the Green Belt

## Projects by various architects



Apartments at Prarthna Community



Row housing at Prayatna Community



Apartments at Aspiration area



Row housing at Prayatna Community

## Projects by various architects



Kailash Youth Centre



Apartments at Djaima Community



Solar community kitchen for 1000 people



Electronic workshop at Auroshilpam community

# Projects by various architects



Office of Aureka, producing the Auram



Multipurpose hall at Vérité community



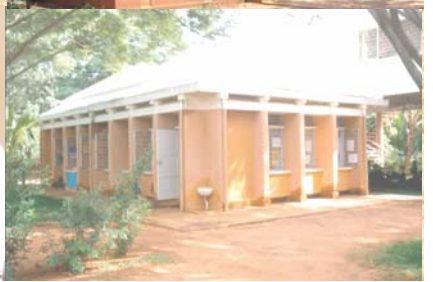
Isaiambalam School



Kindergarten at Centre Field area



**ARCHITECTURAL  
RESEARCH  
AND  
BUILDING  
METHODS**





**Deepanam School near Matrimandir  
- Stabilised rammed earth walls and CSEB domes -**



**Building a cloister dome with the Nubian technique**



**Deepanam School near Matrimandir  
- Stabilised rammed earth walls and CSEB domes -**

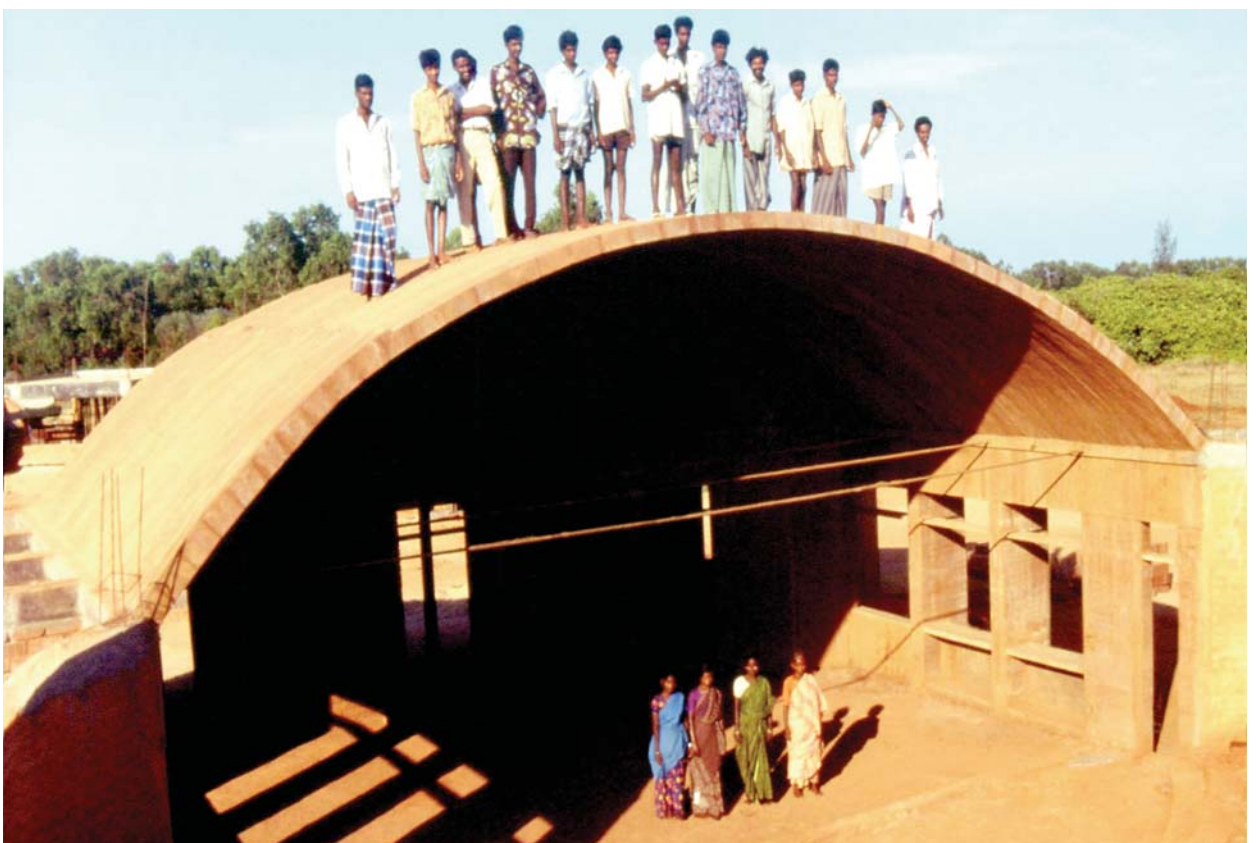


**Deepanam School near Matrimandir  
- Stabilised rammed earth walls and CSEB vault 10.35 m span, 2.25 m rise**





**Deepanam School near Matrimandir  
- Stabilised rammed earth walls and CSEB vault, 10.35 m span -**



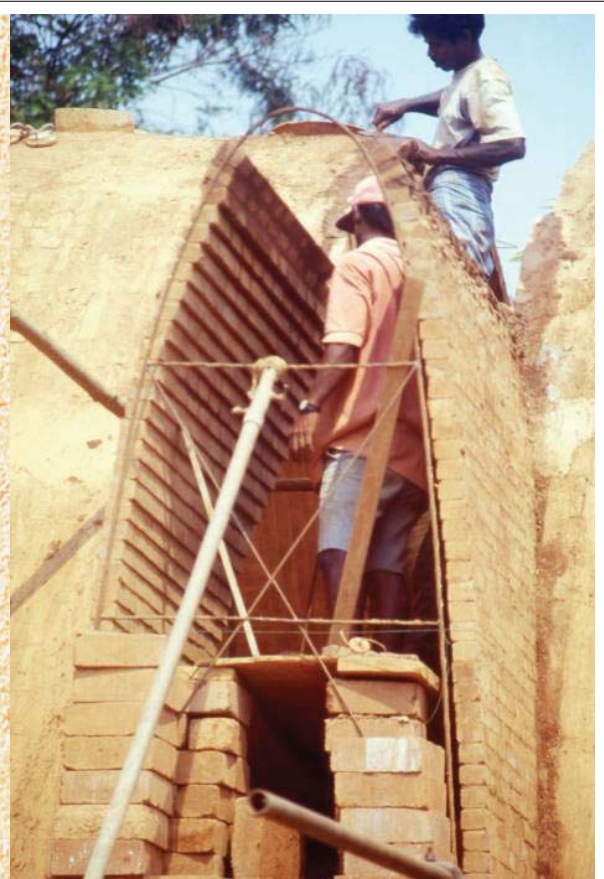
**Segmental vault at Deepanam School, completed in 3 weeks with 4 masons  
- 10.35 m span, 2.25 m rise,  $\pm$  30 tons, built with the Free Spanning technique -**



**Building an Egyptian shaped vault with the Nubian technique, 5 m span, 9 m long  
Completed in 12 days with 4 masons**



**Building a bull eye, 80 cm dia  
Catenary vault, 6 m span, 3 m rise with the Free Spanning technique**



**Building a lunette, 1.2m span with the Free Spanning technique**



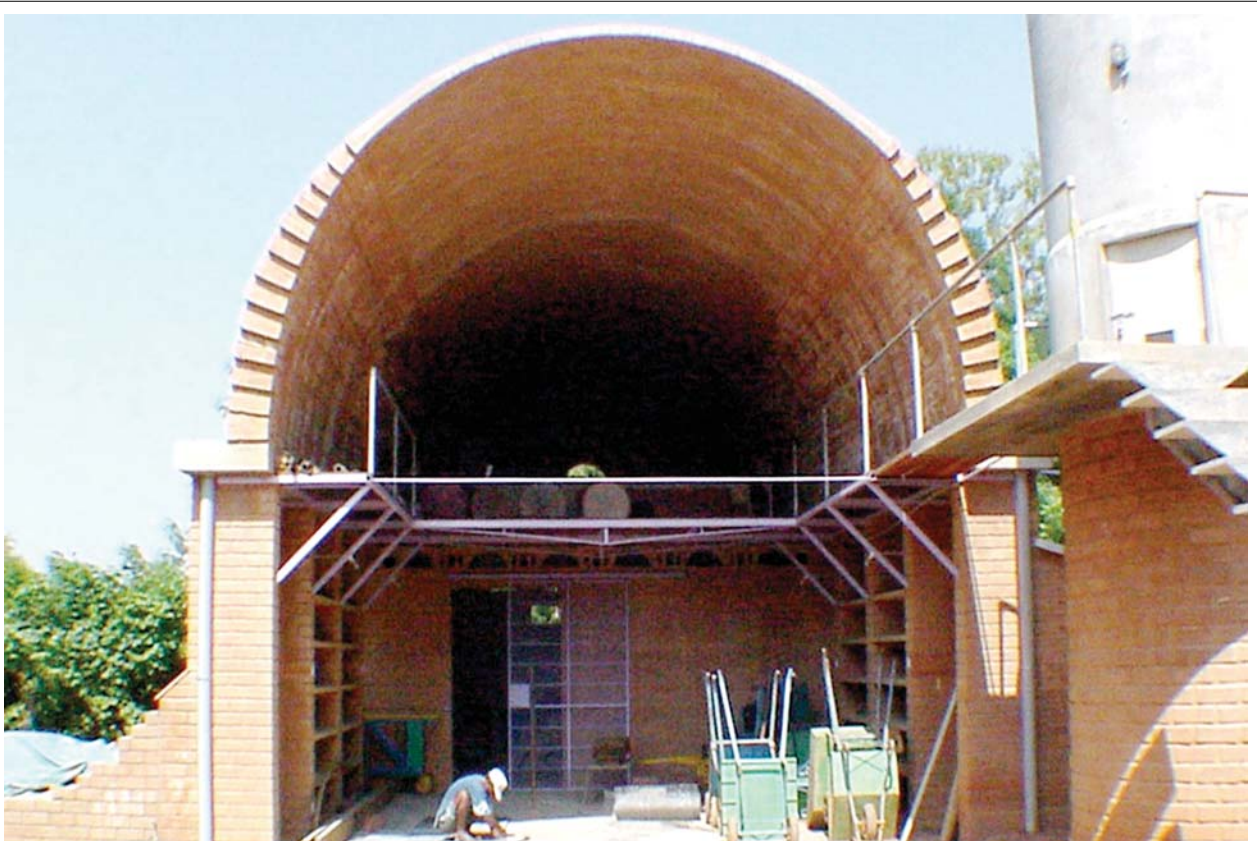
**Building a catenary vault, 6 m span, 3 m rise with the Free Spanning technique**



**Kitchen of the boarding at the Auroville Earth Institute**



**Building a semicircular vault with the Free Spanning technique - 6 m span, 11 m long**



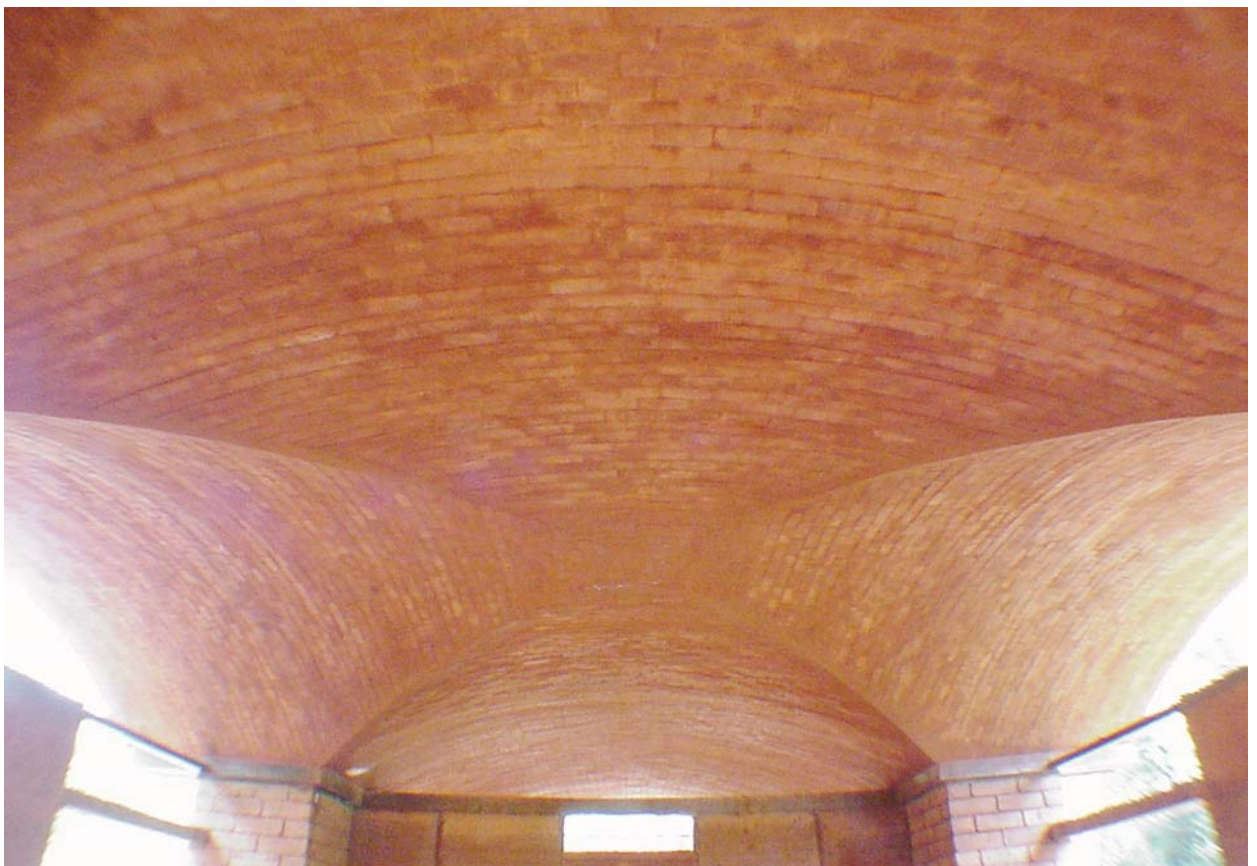
**Semicircular vault built Free Spanning  
- 6 m span, 11 m long, ± 40 tons, built in 37 days with 4 masons -**



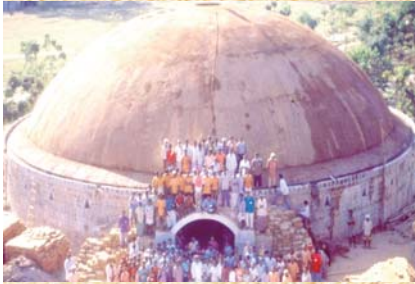
**Building a segmental vault with the Nubian technique**



**Building a groined dome with the Nubian technique**



**Groined dome completed in 6 days with 4 masons**



## PROJECTS' CASE STUDIES OF THE AUROVILLE EARTH INSTITUTE



## Small projects by the Auroville Earth Institute



Cost effective house at Suryanivas community



House at Nalla Farm – Pondicherry



House at Utility community



Cost effective house at Vikas community

## Small projects by the Auroville Earth Institute



Gayatri dome au Suryanivas community



School and community centre at Marakkanam



1<sup>st</sup> prize of a national competition  
Tsunami house at Anumandhai



Community centre at Kilianur

## Small projects by the Auroville Earth Institute



Disaster resistant built after the tsunami

Community centre at Bommarpalayam for UNDP



Disaster resistant built after the tsunami

Community centre at Annavali for UNDP



Community centre at Nadukuppam for UNDP

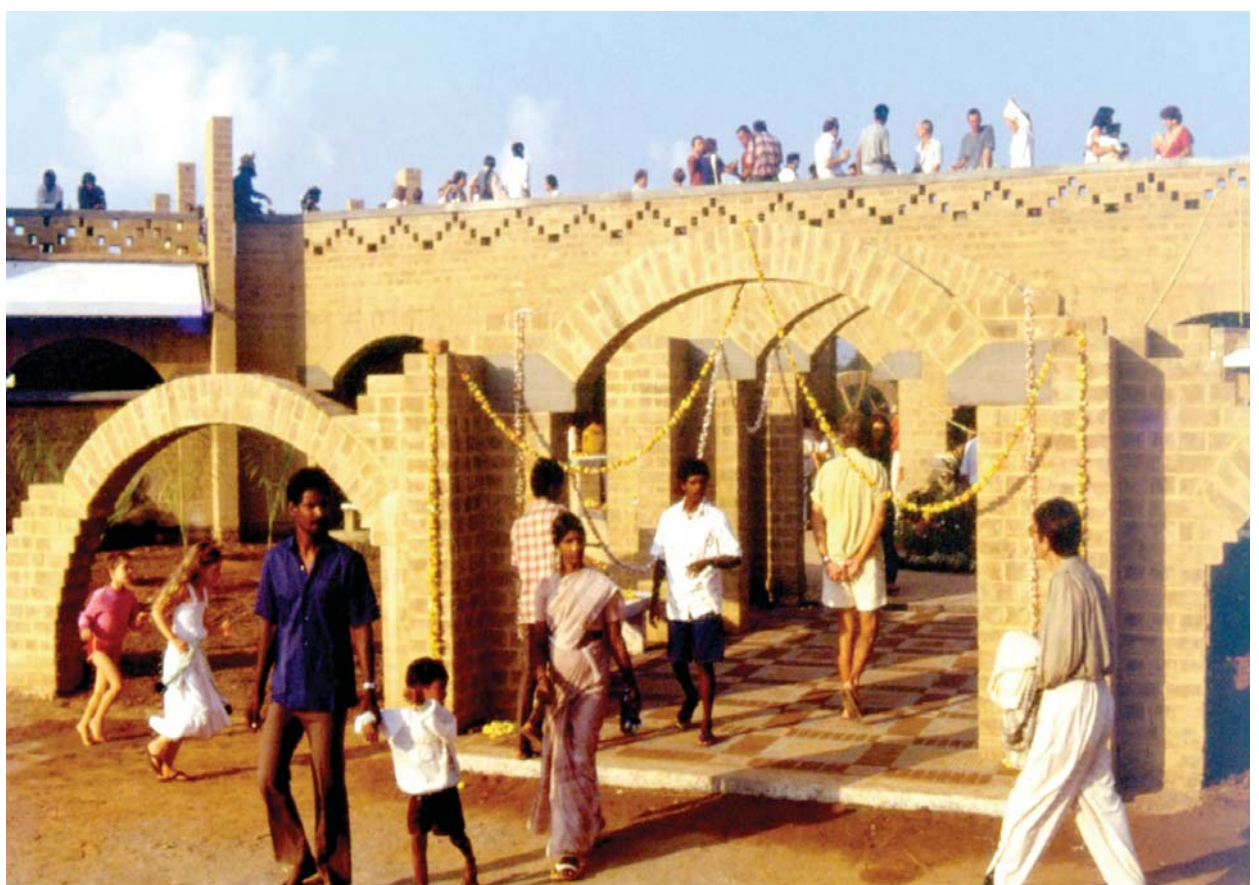


Community centre at Kadapakam for UNDP





**Visitors Centre, 1200 m<sup>2</sup>  
1992 Hassan Fathy International Award for Architecture for the Poor**



**Visitors Centre – 1992 Hassan Fathy International Award for Architecture for the Poor**



**Office of the Auroville Earth Institute**



**Office of the Auroville Earth Institute**



**Training Centre of the Auroville Earth Institute**



**Equilateral vault, the vault of the European cathedrals**



**House at the Auroville Earth Institute, built with the Free Spanning Technique**



**House at the Auroville Earth Institute**



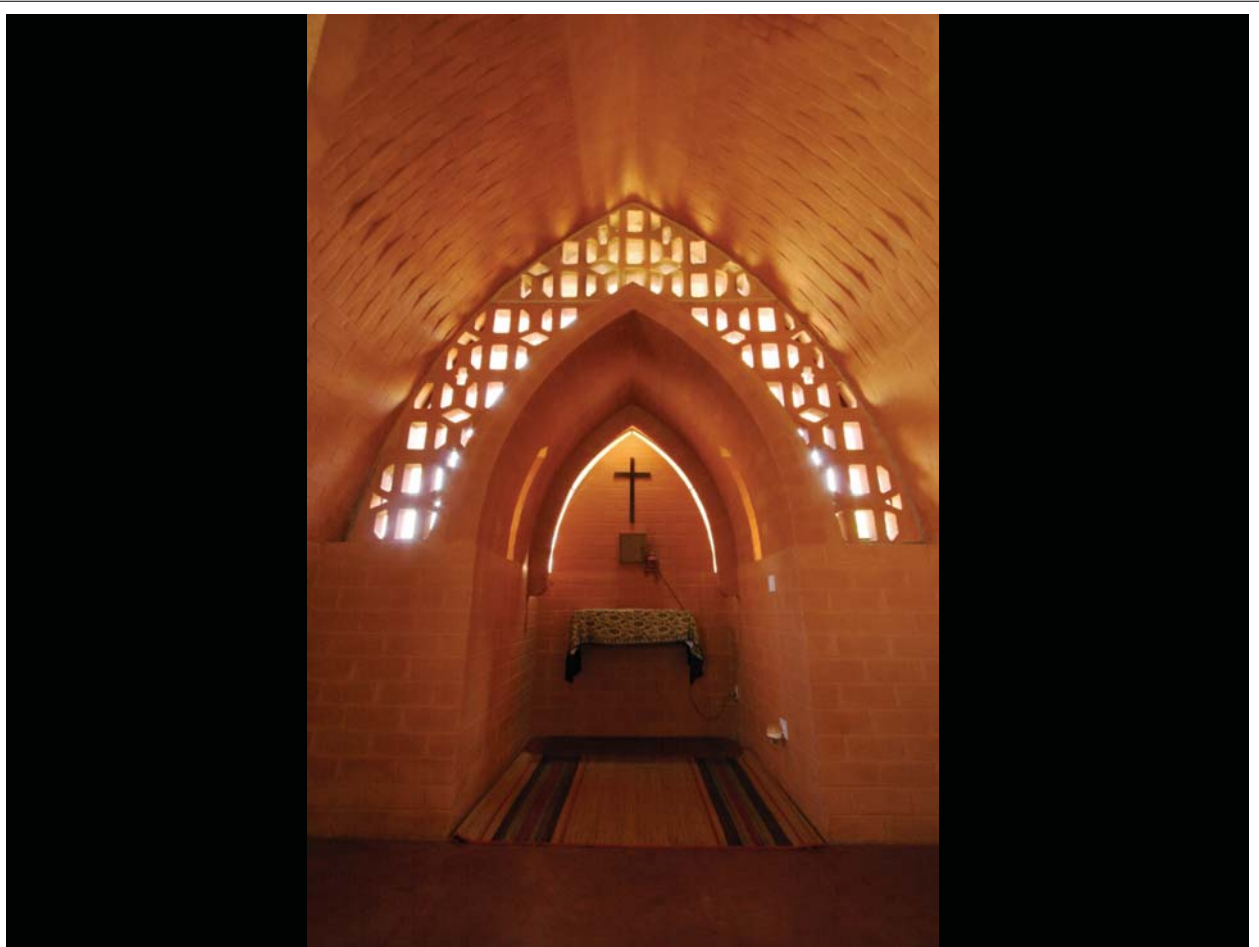
**House at the Auroville Earth Institute**



**House at the Auroville Earth Institute**



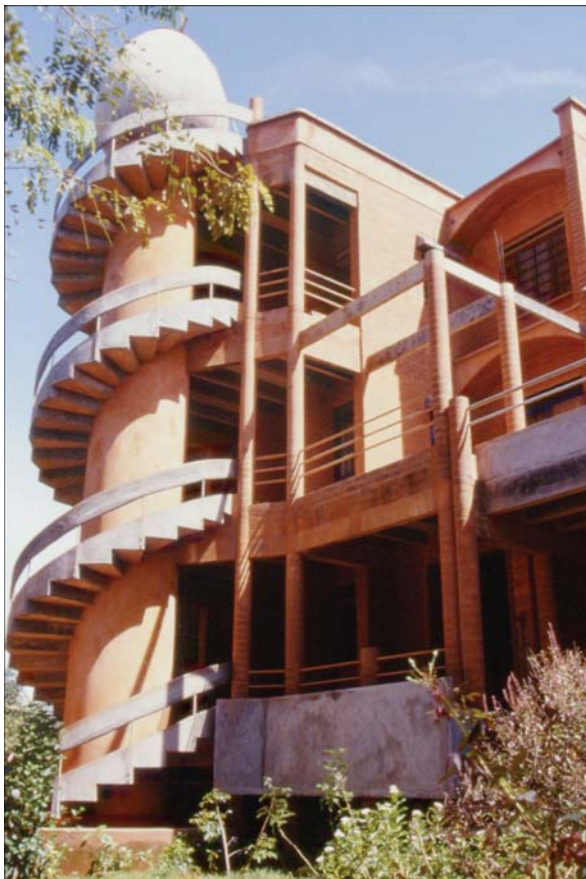
**Chinnakalpet near Auroville – “Hermitage” for a priest**



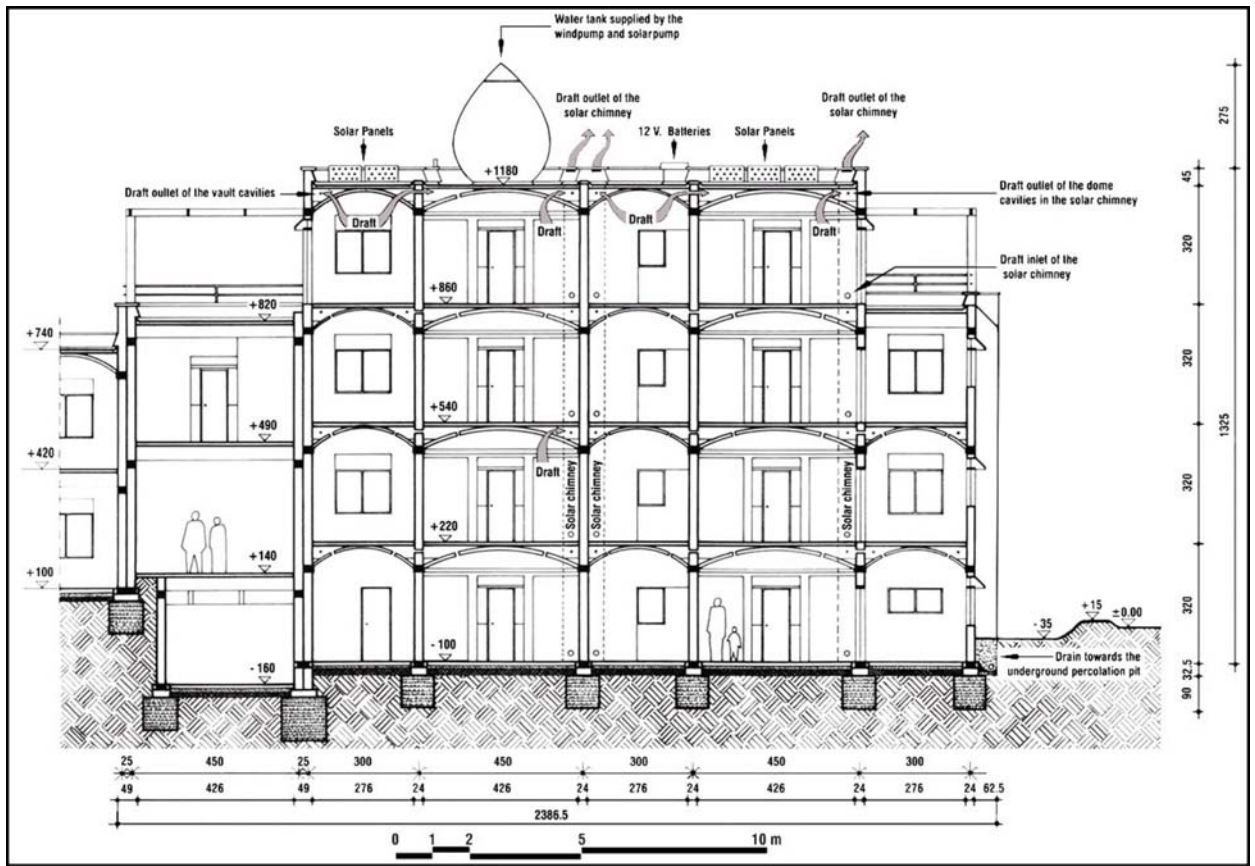
**Apartments at Vikas Community**



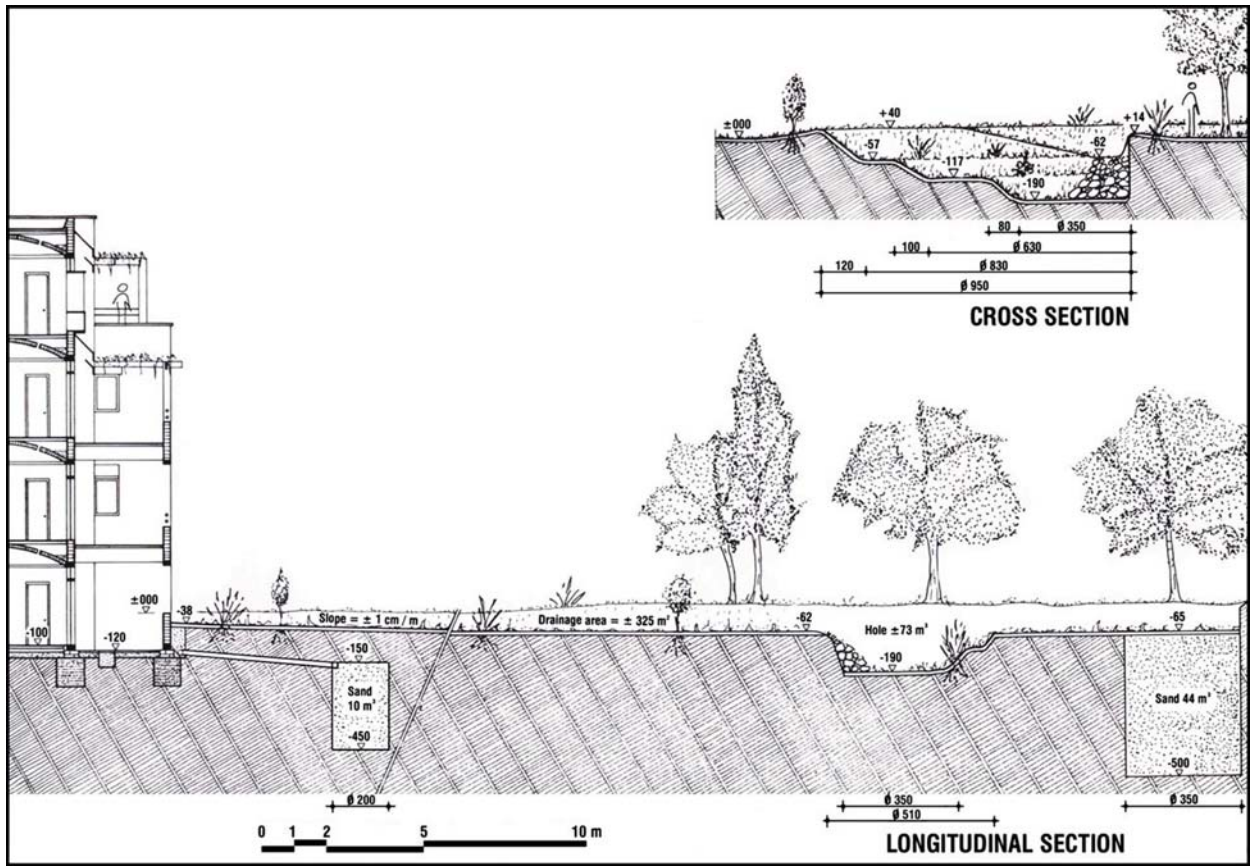
**13 apartments on 4 floors at Vikas Community  
Vikas Community was a finalist for the “2000 World Habitat Award”**



**Apartments at Vikas Community**



**Section of the third building**



**Section of rainwater harvesting system of the third building**





## Realization Housing project with 17 apartments

- CSEB and stabilised earth from foundations to roof
- Wind energy
- Rainwater harvesting
- Wastewater biological system
- Earth tunnel for natural air conditioning
- ← Low emission for construction and use than conventional buildings and systems
- ← 4 times less initial embodied energy
- ← 3 times less operating energy



Realization - 5 Apartments completed



**Shakti Vihara School at Pondicherry, for 700 children**



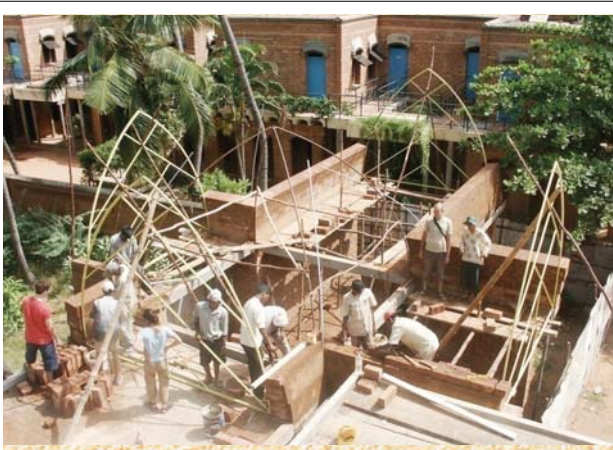
**Shakti Vihara School, for 700 children, at Pondicherry**



**Shakti Vihara School at Pondicherry**



**Showroom in Shakti Vihara School at Pondicherry**



**Showroom in Shakti Vihara School at Pondicherry**



**Showroom in Shakti Vihara School at Pondicherry**



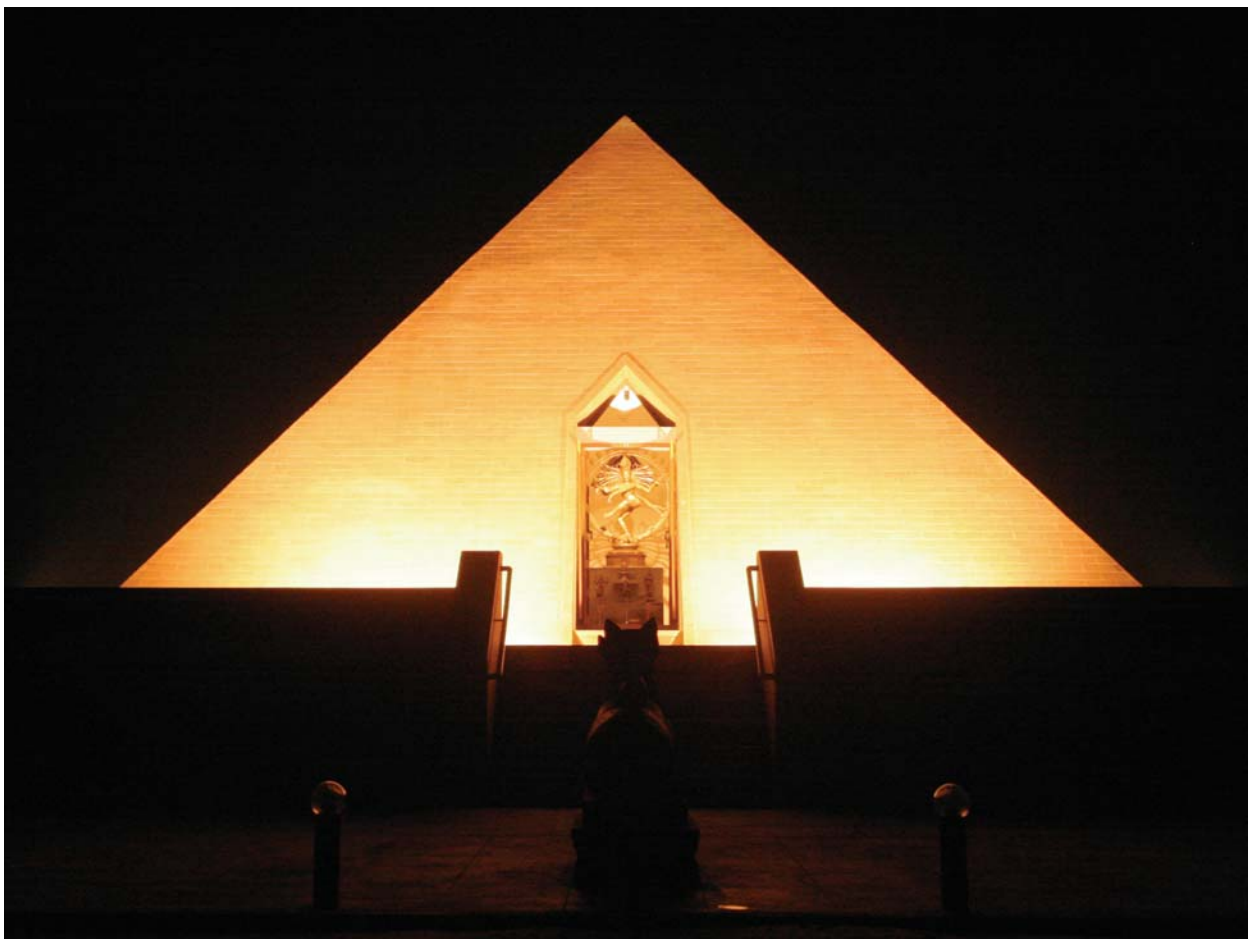
**Auroville, Realization community – Moveable house, earthquake resistant, built in 64 h.**

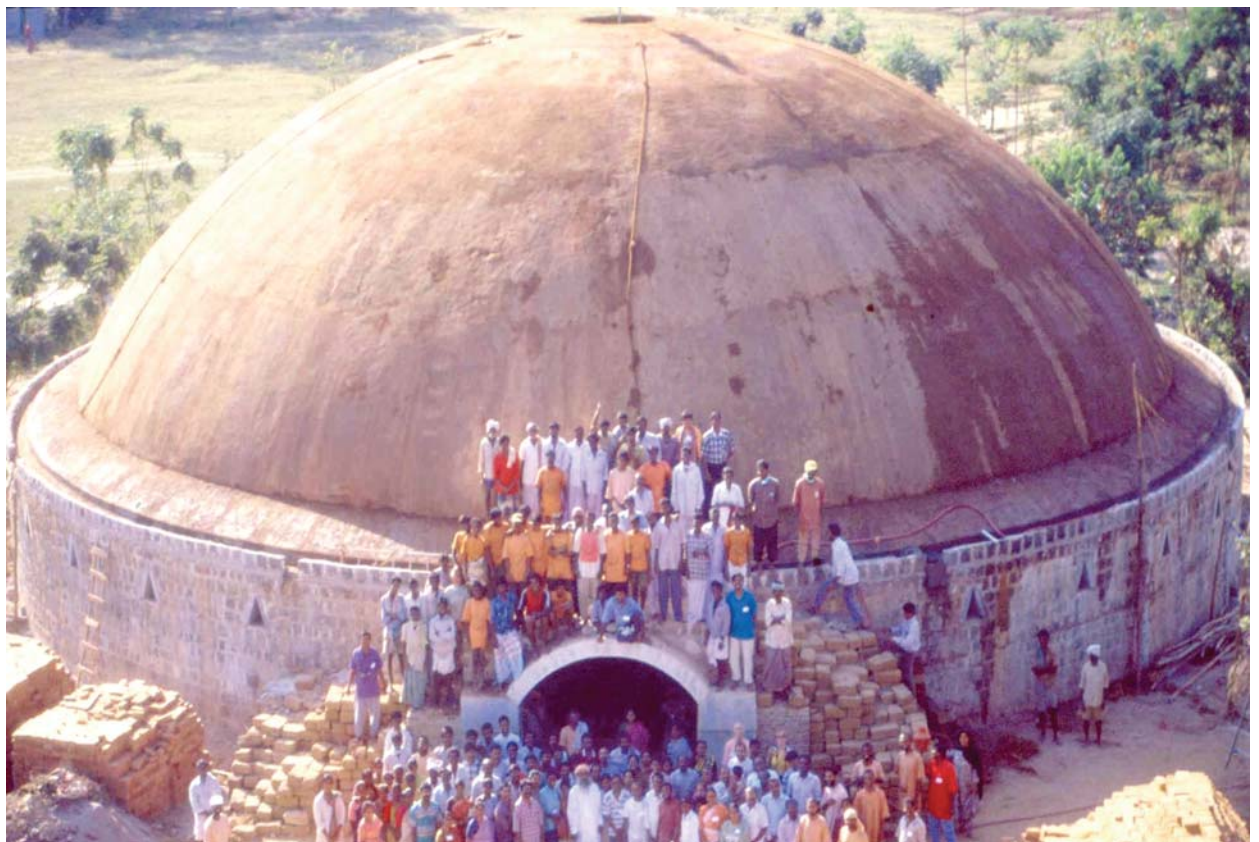
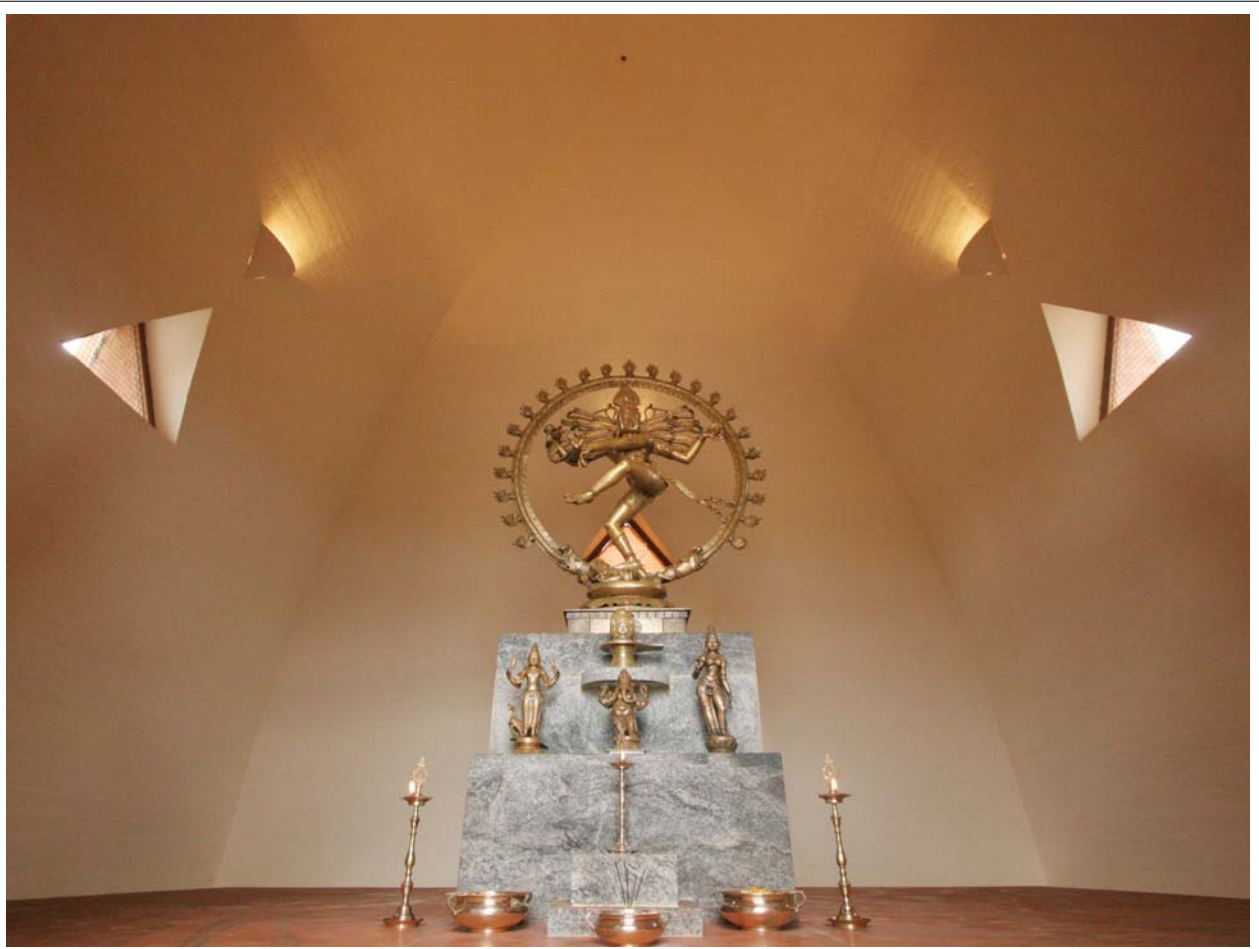


**Nepal – Jantanagar school, built in 20 days  
Earthquake resistant, climate responsive – Built with community participation**



**Sri Karneshwar Nataraja Temple near Auroville**  
**Pointed cloister dome 6 m span and pyramid, built in 6 months**

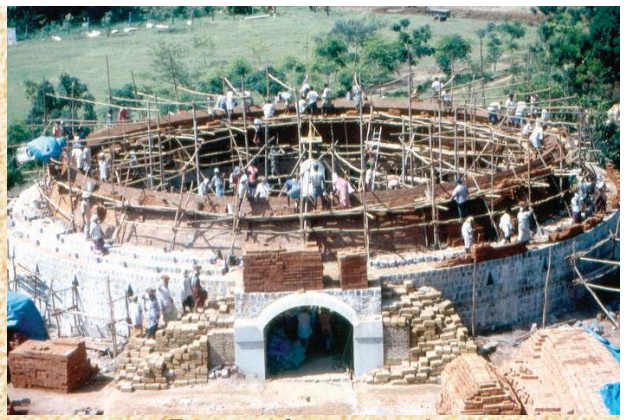




**Dome of the Dhyanalinga Temple near Coimbatore**  
**Segmental elliptical dome - 22.16 m diameter, 7.90 m rise, ~ 570 tons, built in 9 weeks**



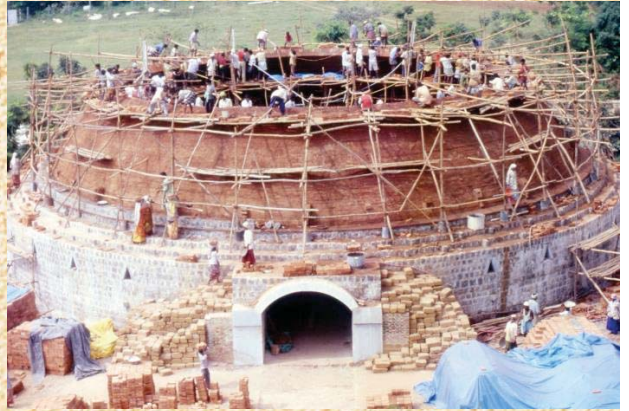
**Dome and vault after 5 days**



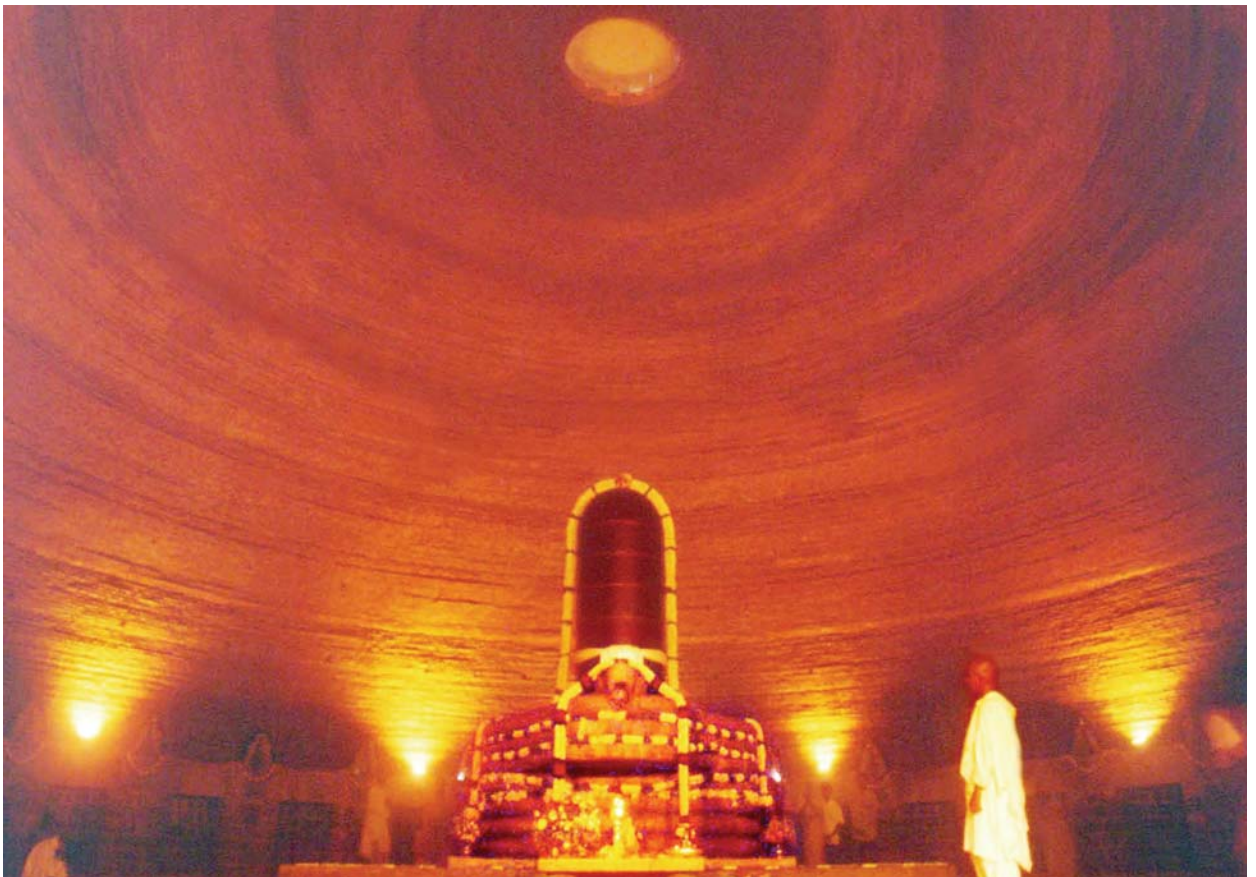
**Dome after 3 weeks**



**Dome after 8 weeks**



**Dome after 5 weeks**





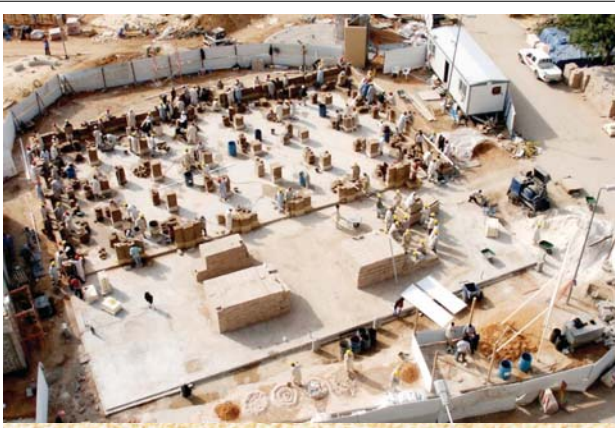


After 9 weeks

22.16 m diameter Dome



**Al Medy Mosque built in the heart of Riyadh , 420 m<sup>2</sup>, 18.05 m high minaret  
Built in 7 weeks with ~ 75 unskilled masons and ~ 150 workers**



**After 9 days work**



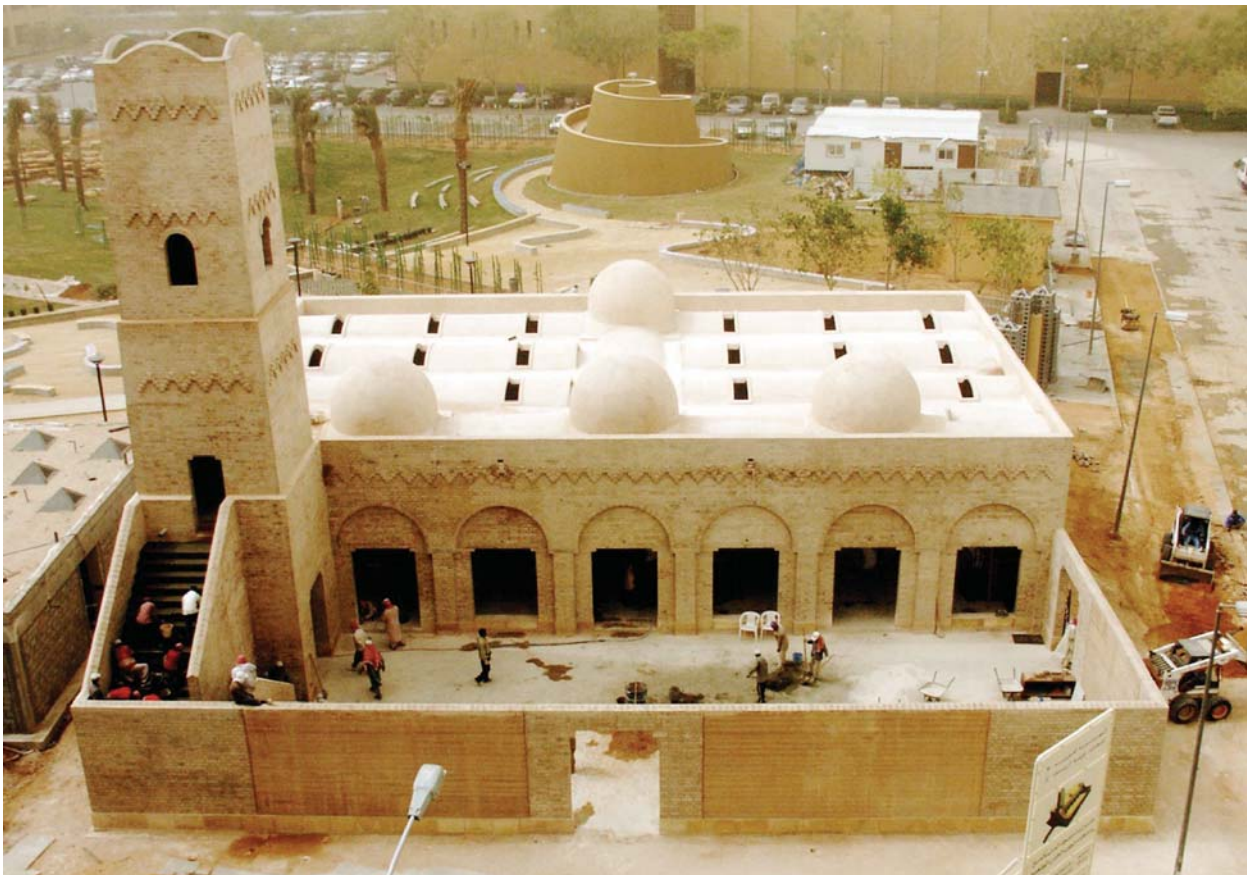
**After 3 weeks**



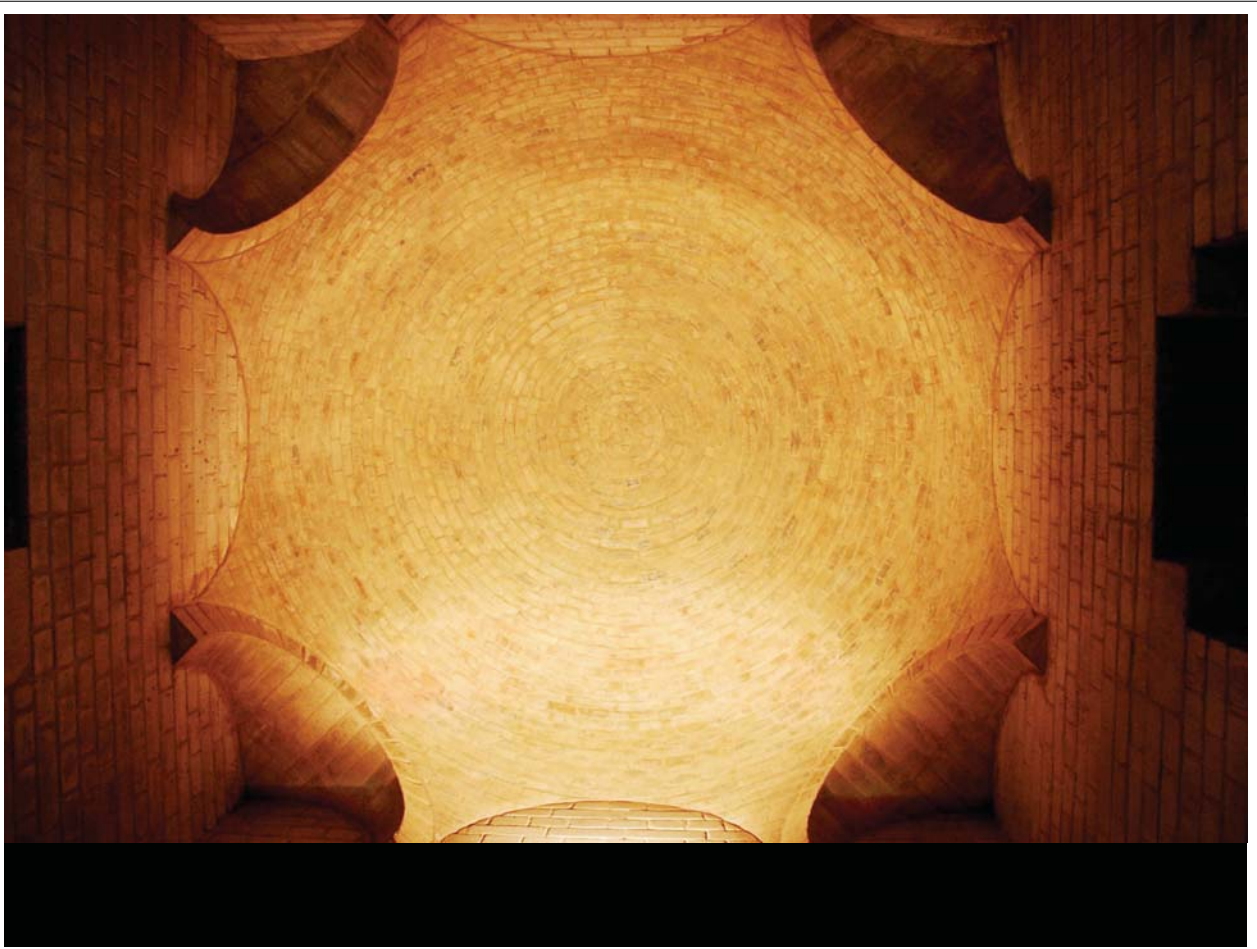
**After 6 weeks**



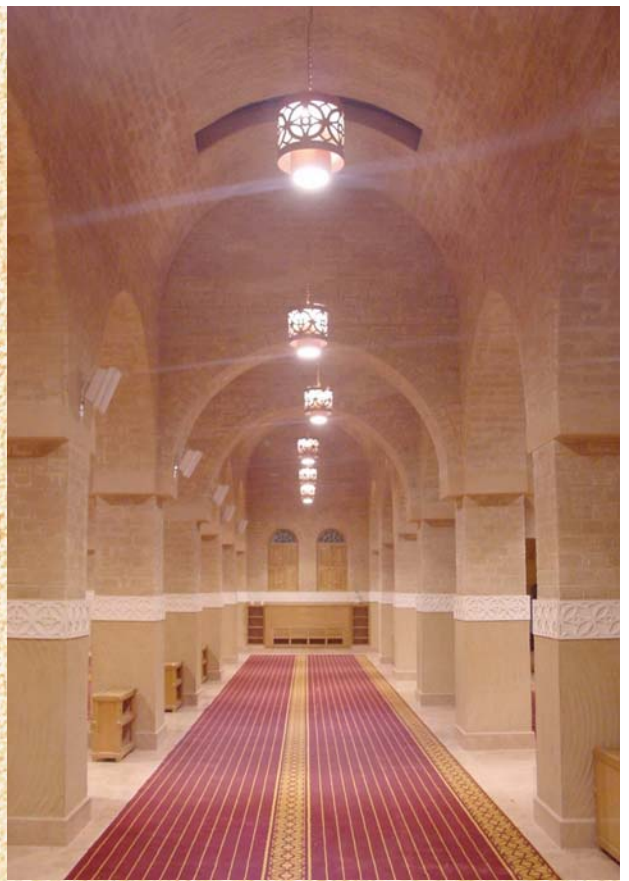
**After 5 weeks**



**After 7 weeks**



After 7 weeks



**7 months later...**

**"Treat the Earth well.  
It was not given to you by your parents.  
It was loaned to you by your children."  
Kenyan Proverb**

\*\*\*\*\*

**The Earth is Sacred,  
and any soil for building is a precious material. Don't waste it!  
Building with earth has a great past,  
but also a promising future everywhere in the world. Don't miss it!**

**I don't see the Earth as a formless material without consciousness,  
But as Spirit consciously disguised as matter.  
Satprem Maïni**

**Satprem Maini**  
**Architect**

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