



Auroville
Earth Institute

UNESCO CHAIR EARTHEN ARCHITECTURE



United Nations
Educational, Scientific and
Cultural Organization



UNESCO Chair
Earthen
Architecture



National High School
of Architecture
of Grenoble

BUILDING THE FUTURE WITH EARTH USING COMPRESSED STABILIZED EARTH BLOCKS (CSEB)

A “Greener material”

AUROVILLE EARTH INSTITUTE

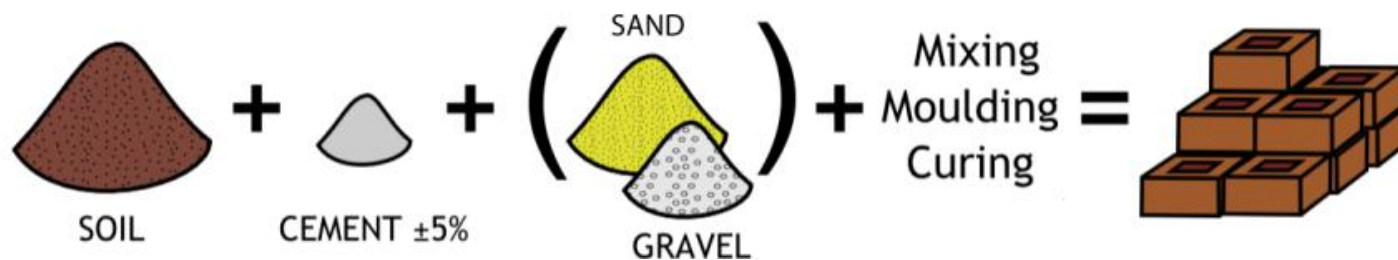
2

- The Auroville Earth Institute (AVEI), based near Pondicherry is researching, developing, promoting and transferring earth-based technologies by:
 - Disseminating knowledge through seminars and websites
 - Providing regular training and workshops to people all over the world:
 - More than 7,850 trainees of which more than 3,700 from 73 foreign countries
 - Publishing manuals and documents
 - Providing consultancy within and outside India
- AVEI is member of a world network and Representative and Resource Centre for Asia of the UNESCO Chair “*Earthen Architecture, Constructive Cultures and Sustainable Development*”
- AVEI was granted thirteen awards: two international awards and eleven Indian awards
- CSEB is the Auroville Earth Institute’s technique of excellence.

WHAT ARE CSEB?

3

- CSEB are a mix of soil, sand, a stabilizer (often 5% of cement), and water.
- They are compressed in a press (manual or motorised) and cured during 28 days.
- **They are not fired !!!**



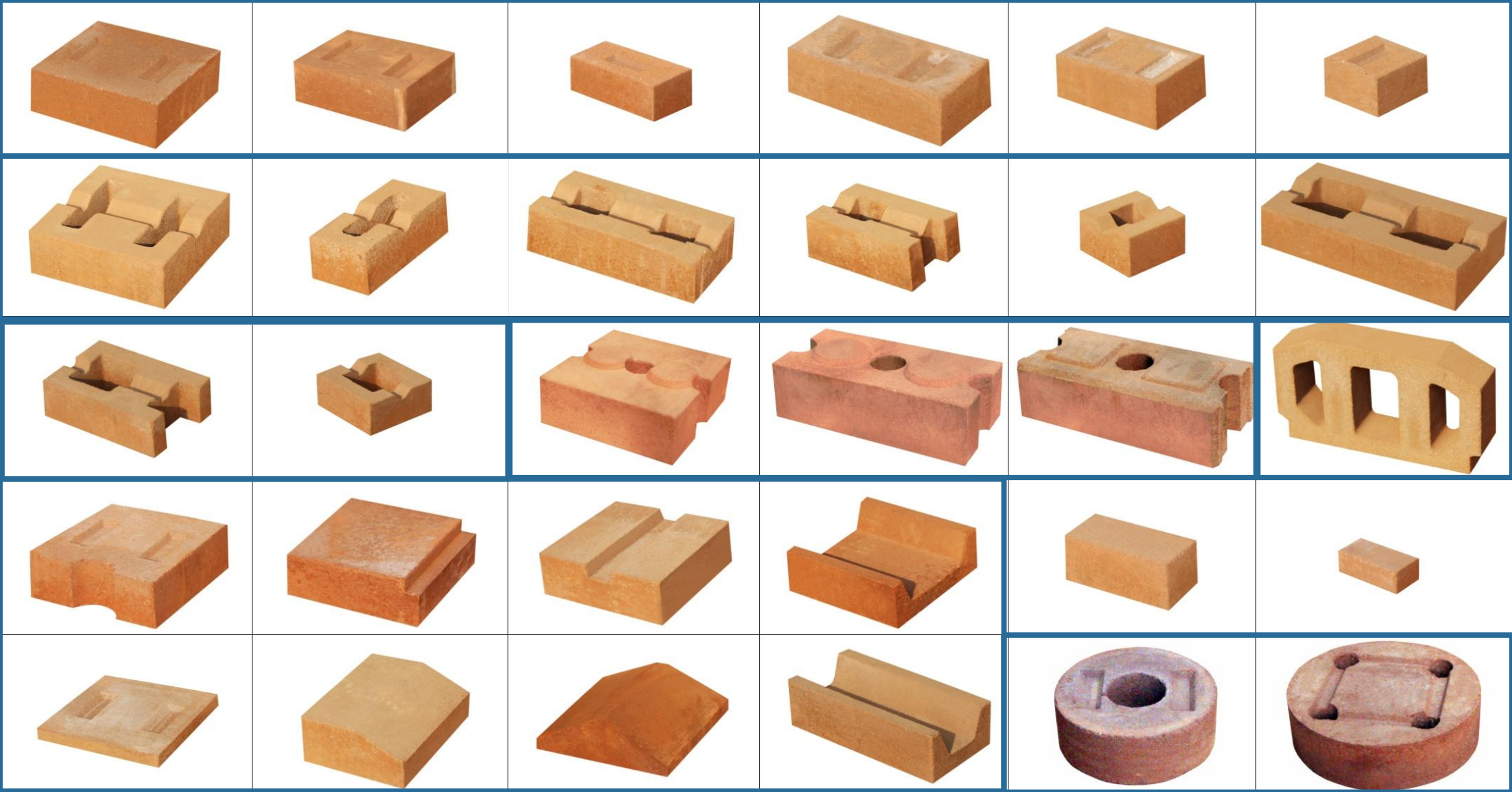
- They can reach a dry compressive strength of 9 MPa (in Auroville).
- CSEB are also called **E'Blocks, as Eco-friendly, Economical, Earth block**
- Top soil is removed and only the deeper soil is extracted.
- CSEB are used on all continents.
- CSEB are a major tool for the renaissance of earth architecture worldwide.
- It is today the earth technology which is used the most worldwide.
- **The Auram Press 3000 can produce about 80 types of blocks with 18 moulds.**

MACHINERY FOR CSEB

4

- The Auram press 3000 can produce about 80 blocks with 18 moulds.





Several series of blocks have been developed for various uses:

- Solid blocks for load bearing masonry
- Hollow blocks for load bearing masonry
- Hollow interlocking blocks for disaster resistance
- Hourdi for floors & roofs
- Round blocks for columns
- Tiles and special blocks

Variety of blocks produced by the Auram Press 3000

MANUAL PROCESS

6



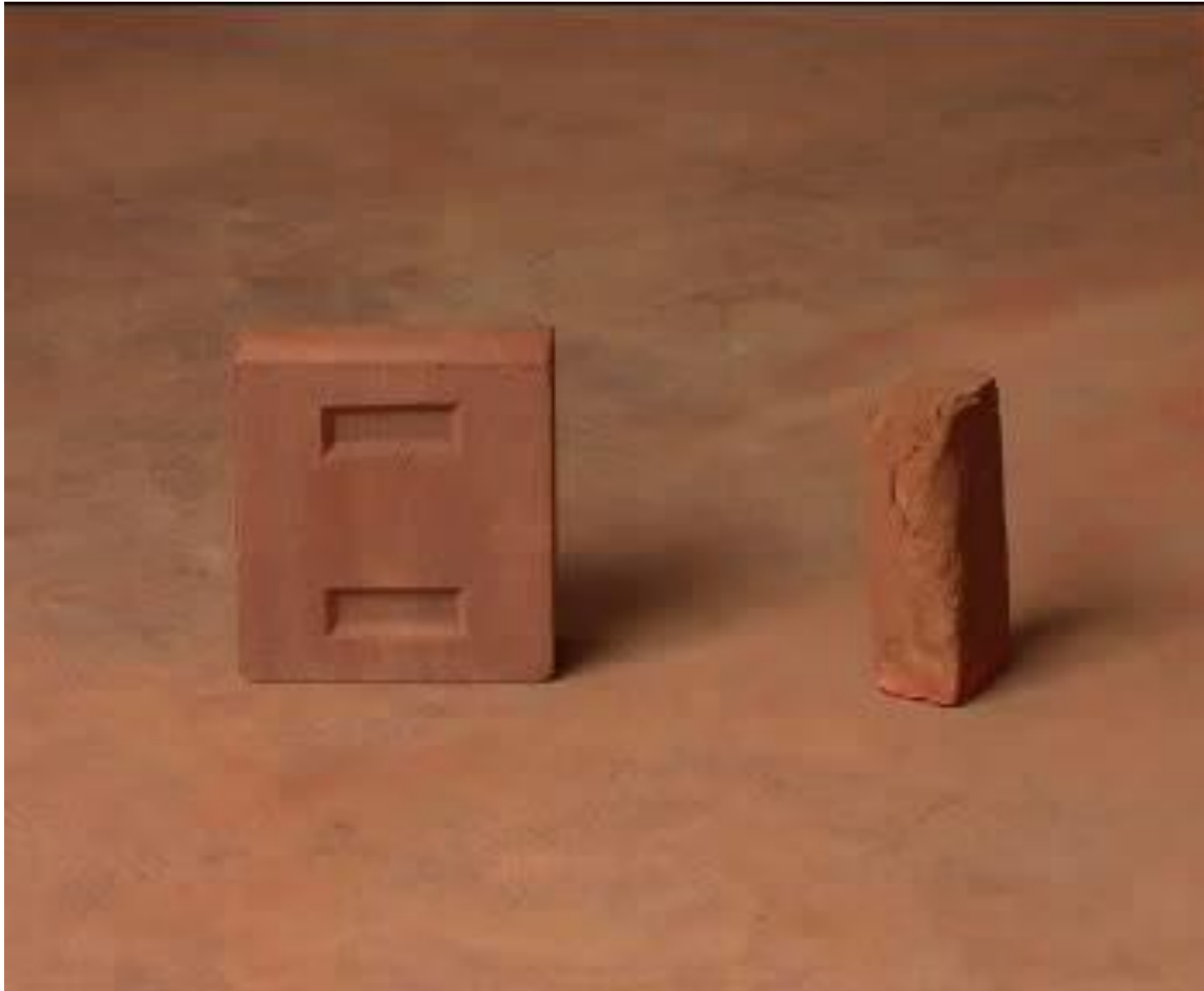
WATER RESISTANCE

7



STRENGTH OF CSEB VERSUS COUNTRY FIRED BRICKS

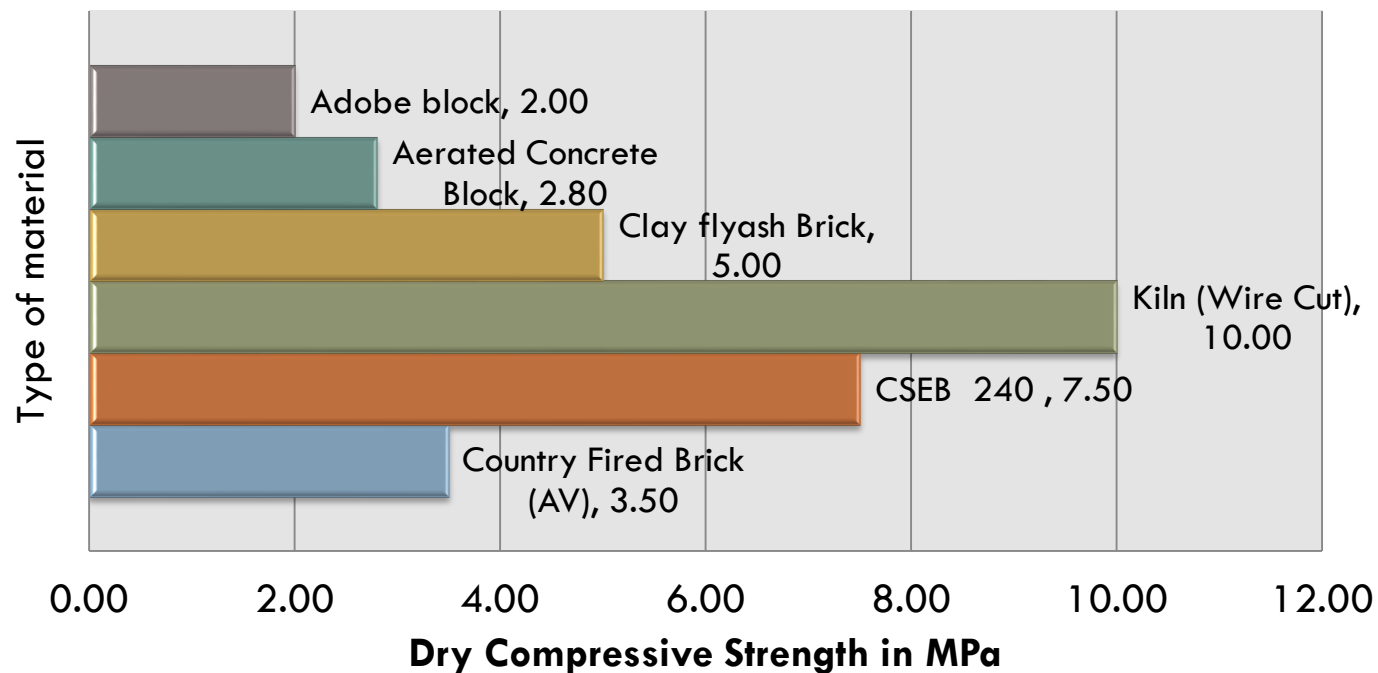
8



A STRONG MATERIAL

- Well made blocks are strong:
 - Average dry crushing strength of 7.5 MPa (up to 9 MPA in Auroville)
 - Wet crushing strength of 3 to 4 MPa (after 24 hours immersion)

Dry Compressive Strength for different materials (MPa)



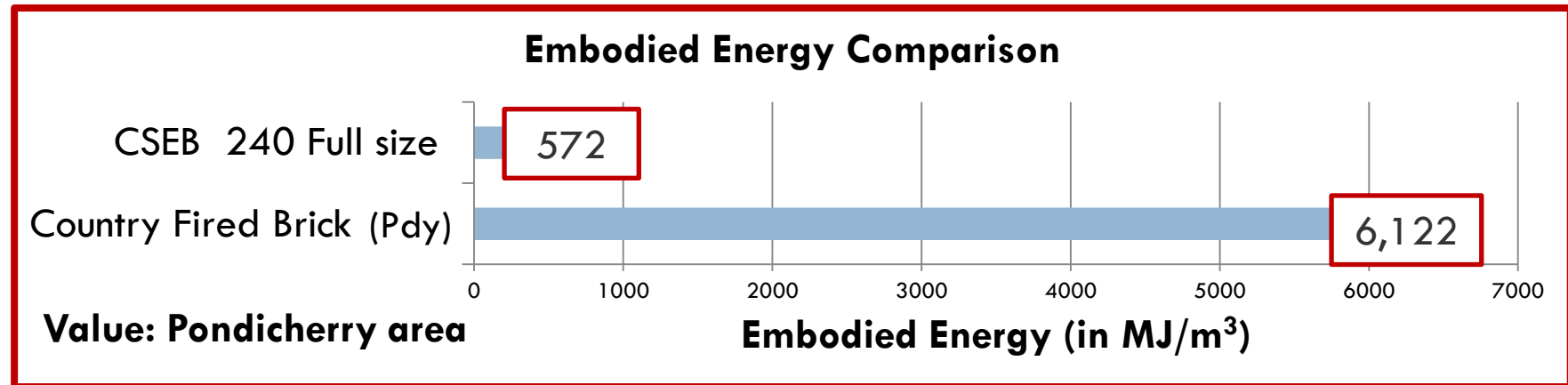
LOW INITIAL EMBODIED ENERGY

10

- It is a good indicator of the overall environmental impact of building materials or systems.
- The initial embodied energy of CSEB is in general less than other building materials.

CSEB are environmentally friendly as:

- No firing is required, but only curing (4 weeks with cement stabilization)
- Less transportation is required and production is manual

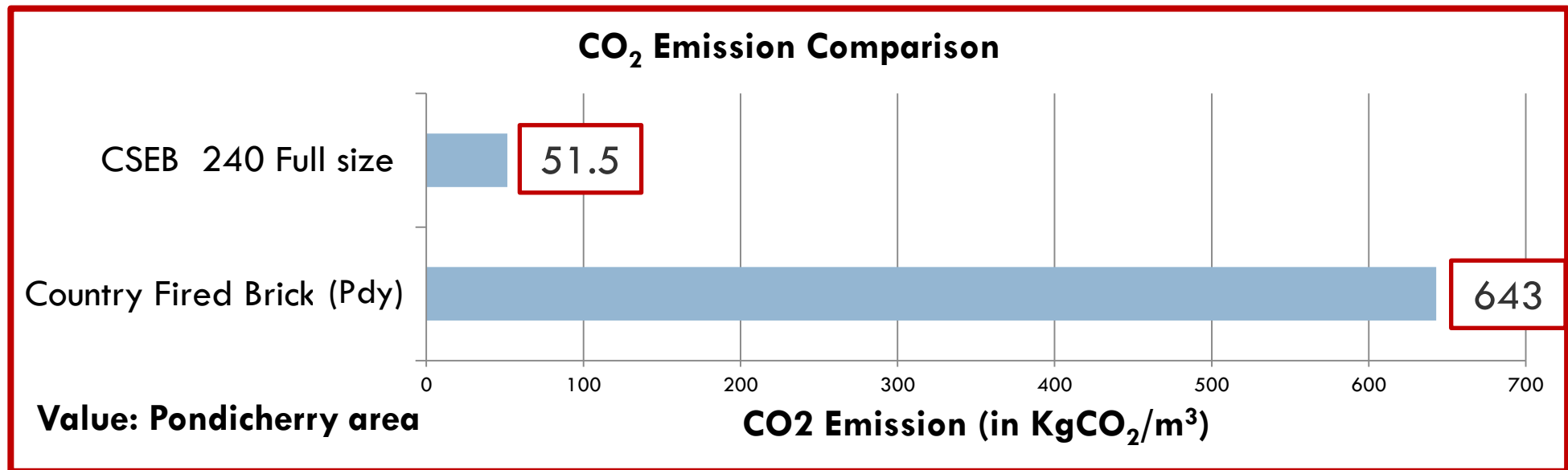


CSEB consume 10.7 times less energy than country fired bricks (Pondicherry)
CSEB consume 7.9 times less energy than country fired bricks (Indian average)
CSEB consume 3.9 times less energy than kiln fired bricks (Indian average)

LOW CARBON DIOXIDE EMISSIONS

11

- ❑ Carbon dioxide emissions are in general less than other building materials.
- ❑ They are mostly coming from cement stabilisation.



- ☛ **CSEB emit 12.5 times less carbon dioxide than fired country bricks (Pondy) !!!**
- ☛ **50 tons of wood burnt for 100,000 country fired bricks in Pondicherry area !!!**
- ☛ **Opportunity for Carbon Credits Revenue**

COST EFFECTIVE

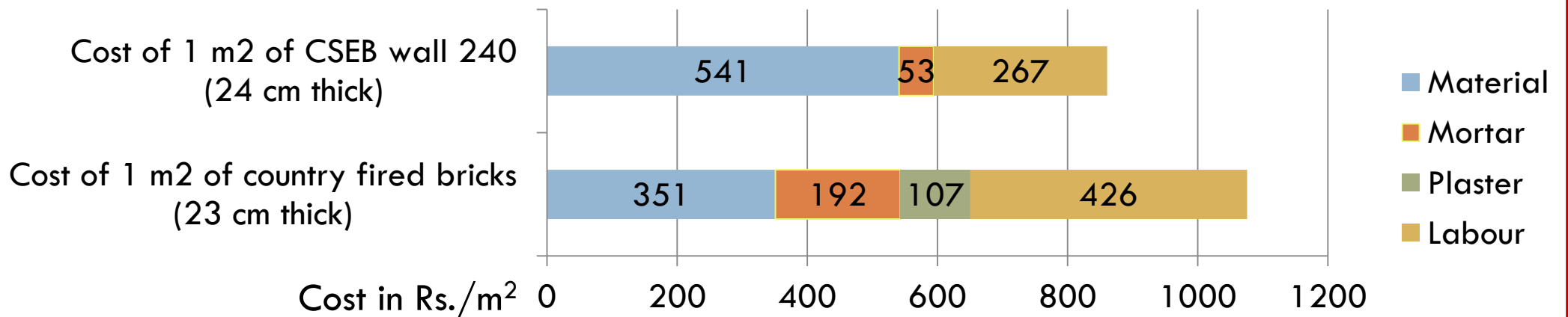
12

- **CSEB are generally cheaper than fired bricks.**
 - No plaster is needed in most of cases
 - Less mortar is required and it is cheaper
 - 5% of waste against 10% for country fired bricks

**A finished m² of CSEB wall 240
is in Auroville
20 - 25% cheaper than country fired bricks**

Cost comparison per m² of CSEB and fired brick wall (Auroville, July 2011)

CSEB wall 24 cm thick = **861 Rs./m²** - Country fired brick wall 23 cm thick = **1076 Rs./m²**

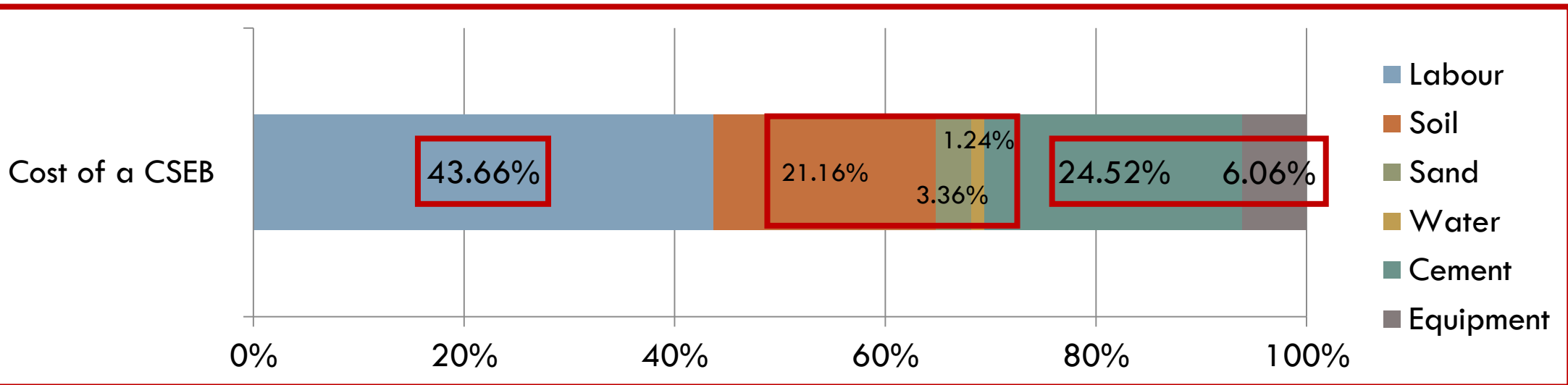


COST EFFECTIVE

13

- CSEB is a very labour intensive technology
- 13 people per press for manual pressing
- This gives job opportunities
- This gives livelihood to people
- This insures sustainability

**Labour represents more than 40%
(Block production)**
Cement and equipment are about 30%
Raw materials are less than 30%



PROMOTE ENDOGENOUS DEVELOPMENT

14

- **NATURAL RESOURCE MANAGEMENT**
- **Local authorities and people can manage their own natural resources**
- Quarries resulting from sourcing soil on site can be rehabilitated into:
 - Underground rainwater harvesting tanks, reservoirs
 - Surface rainwater harvesting by percolation and Landscaping features.
 - Wastewater treatment systems
 - Basement floors
- They are beneficial to the development to the place if well planned.
- But they can be disastrous if unplanned.
- **Indispensable to foresee first a rehabilitation plan for the quarry.**



PROMOTE ENDOGENOUS DEVELOPMENT

15

- **HUMAN RESOURCE MANAGEMENT**
- **Production of CSEB is a job creation opportunity**
- This technology allows unskilled and/or unemployed people to learn a skill.
- Therefore to get a job and rise in the social values.
- CSEB production is a labour intensive technology.
- **Labour cost is ~ 40 to 45 % of the block production (manual process).**
- **Labour cost is ~ 60% of the building cost (buildings using vaults and domes).**
- ⇒ **Proper human resource management is the first key to sustainable development.**



COMFORTABLE AND AESTHETICALLY PLEASING

16

□ **Thermal comfort**

- Exposed CSEB walls regulate indoor humidity, helping you achieve thermal comfort through the year.
- With proper planning and design, lesser energy is needed to achieve a comfortable indoor environment.

□ **Creative design**

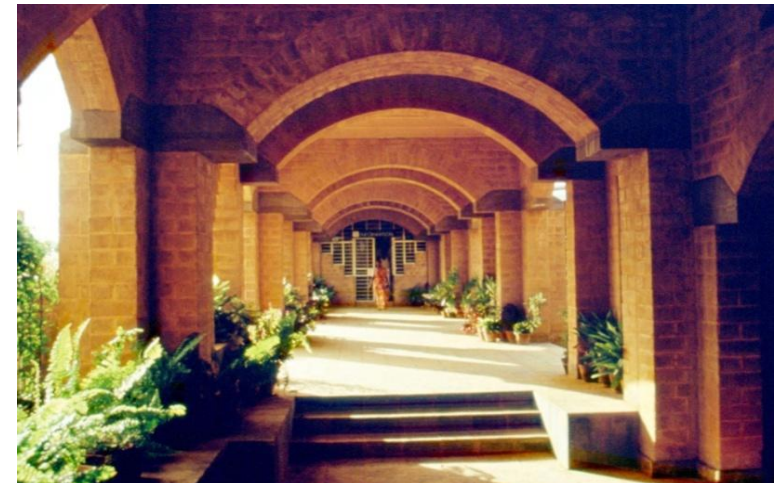
- Readily available in different sizes and types with consistent dimensions, you can build Arches, Vaults and Domes.
- You can use CSEB in flooring, composite beams and columns.

□ **Aesthetically pleasing**

- Achieve natural, exposed, high quality finishes.
- E'Blocks create a convivial living space with the natural colors and freshness of earth.



House at the Auroville Earth Institute



Auroville Visitor's centre

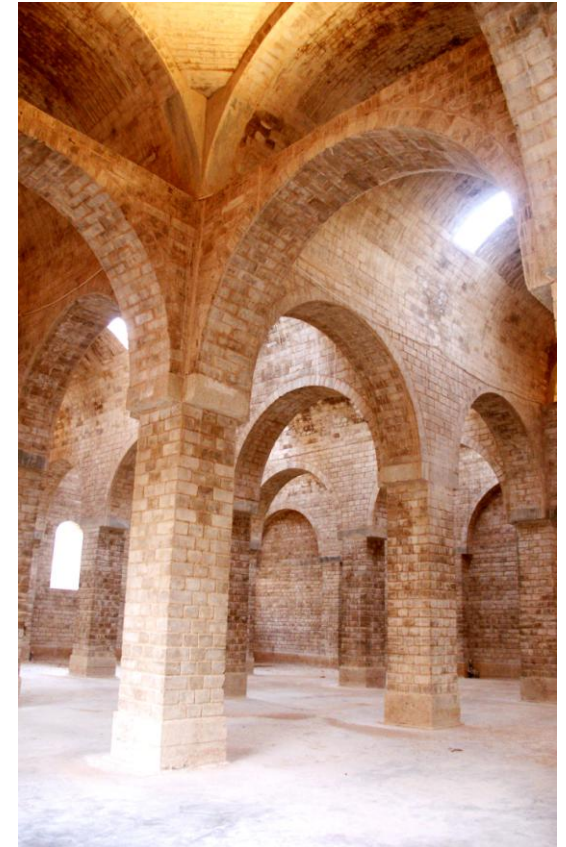
COMFORTABLE AND AESTHETICALLY PLEASING

17

- ❑ **You don't need reinforced concrete frames, columns and slabs.**
- ❑ **You can build arches, vaults and domes**
- ❑ **You can create convivial living spaces with natural colours**



Realization apartments, Auroville



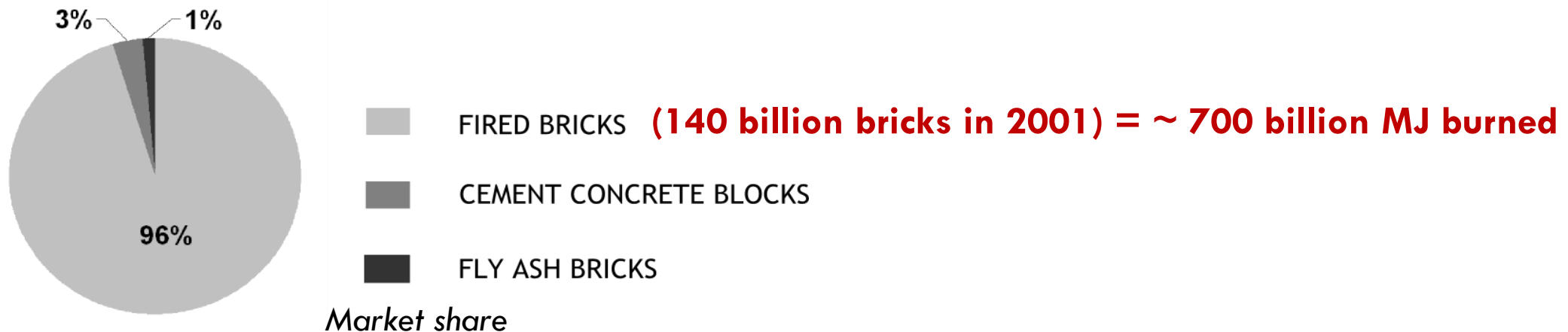
Al Medy Mosque, Riyadh

**You can improve your design !!!
And be more creative !!!**

INDIAN CONSTRUCTION SECTOR

18

- **The construction sector is nowadays growing and springing up.**
- Fired bricks and concrete frame are still the most used materials.
 - ⇒ **What about a more eco-friendly material?**
 - ⇒ **Why not to use CSEB / E'Blocks?**
 - ⇒ **Still... CSEB has to face a lot of resistances and mind sets...**



How much energy would be saved if CSEB would replace fired bricks by 50% ???
And how much would be saved more if people used less reinforced concrete ???

BUILDING EXAMPLES WITH CSEB





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

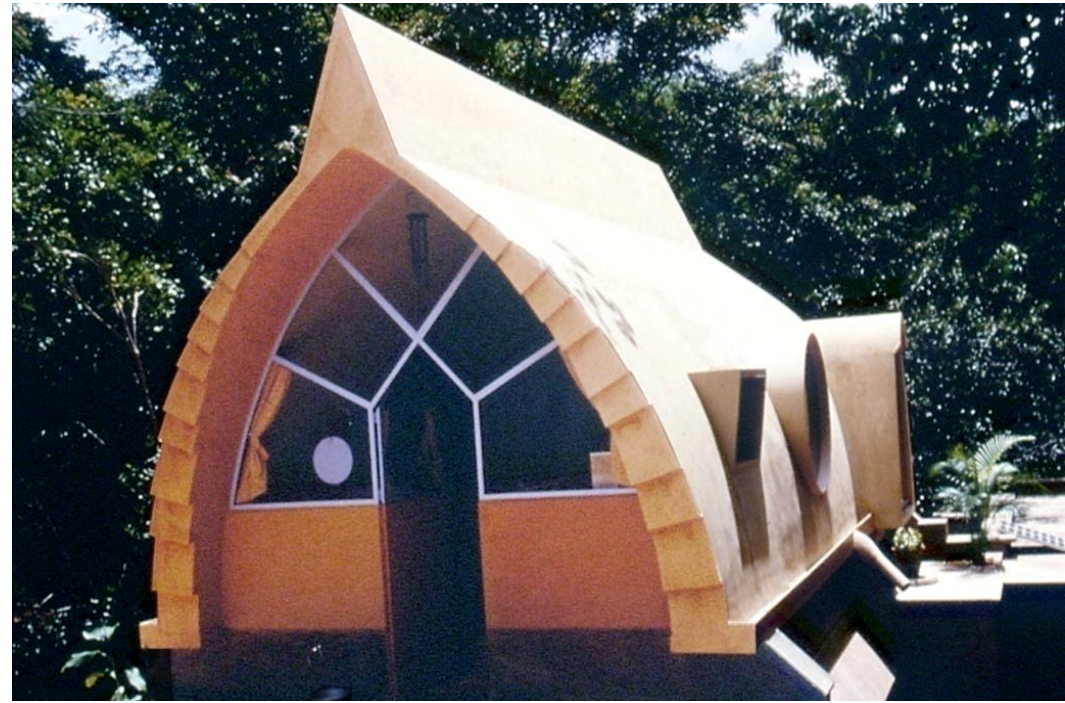


Apartments at Vikas Community, Auroville



Segmental vault at Deepanam School, Auroville

10.35 m span, 2.25 m rise, 30 tons, built with the Free Spanning technique



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



Chinnakalpet near Auroville – “Hermitage” for a priest



Realization Housing project with 17 apartments

- CSEB and stabilised earth from foundations to roof
 - 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 housing, Auroville - 5 Apartments completed in 2010



Realization housing, Auroville - 8 Apartments completed in 2011



1st prize of a national competition

Tsunami house at Anumandhai – Disaster resistant



Primary School at Jantanagar, Nepal

Disaster resistant, built in 20 days with the community (Precasting was done in 3 months)



Sri Karneshwar Nataraja Temple near Auroville



Sri Karneshwar Nataraja Temple



First prize
“2010 Award For Urban Heritage”
Al-Turath Foundation, Saudi Arabia

Saudi Arabia, Riyadh – Al Medy Mosque – 420 m², 18.05 m high minaret
Built in 7 weeks with ~ 75 unskilled masons and ~ 150 workers

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

Satprem Maini

THANK YOU !

**Satprem Maini
Architect**

**AUROVILLE EARTH INSTITUTE
UNESCO Chair "Earthen Architecture"
BASIN South Asia**

Auroshilpam, 605 101 Auroville, TN India

Tel.: +91 (0) 413 - 262 3064 / 262 3330

Fax: +91 (0) 413 - 262 2886

Email: earthinstitute@auroville.org.in

Website: www.earth-auroville.com