Final Report
On
Low Cost Housing Using Stabilised Mud Blocks

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C O N T E N T S

Project at a glance

Project tittle	:	**Low Cost Housing Using Stabilised Mud Blocks**
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Co-Investigator	:	**Shri Ch. Sarat Singh** Scientific Officer (Engg) Manipur Science & Technology Council, Central Jail Road Imphal-795001
Other project Personnel	:	(i) Shri N.Megha Singh Skilled Mason (ii) Shri L. Sanajaoba Singh Skilled Mason (iii) Shri Ch. Ingobi Singh Unskilled Worker (iv) Shri Th Kalachand Singh Unskilled Worker (v) T.Shingshit Unskilled Worker.
Implementing Institution	:	Manipur Science & Technology Council Central Jail Road, Imphal – 795001
Date of Commencement	:	May 15, 2004 (DD receipt)
Planned date of commencement	:	May 14, 2006
Actual date of completion	:	May 31, 2007

Objectives stated in the project proposal

(i) To upgrade the rural traditional Kutcha houses.

(ii) To introduce cost-effective and durability houses – an alternative of burnt bricks.

(iii) To demonstrate and popularise the technology of stabilised mud blocks using locally available soils/muds.

(iv) To uplift the poor people with standard houses of the technology

(v) To impart the technology to rural artisans for socio-economy upliftment.

Objectives Met:

(i) Introduction of the stabilised mud block technology.

(ii) Demonstration of the technology.

(iii) Construction of mud houses for demonstration and popularisation of the technology.

(iv) Imparting the technology to local artisans and youths.

Methodology

Phase I : (a) Survey of locally available building materials.

(b) Awareness training for Artisans and technology transfer.

Phase II : Preparation of stabilised mud blocks and construction of houses.

Phase III : Monitoring and evaluation.

Introduction

Earth is the oldest material used by man. People have used their native ingenuity to develop forms for the utilisation of earth ranging from the extremely simple to highly complex. They have used the material in response to varying resources, social needs and site conditions.

With the individual revolution, people had access to machines, easily available fossil fuels and a range of newly developed materials. New technologies became popular and earth construction skills were lost or regulated to the vernacular builder. Impetus was given to earth architecture in the post world war II era due to economic and energy saving concerns. However, as western nations worked their way to prosperity, the use of earth was eclipsed by a desire for **modernity.**

Earth has always been the most widely used material for building in India and is a part of its culture. Traditionally, mud construction varies enormously with topography, climatic condition and needs of different regions. The common methods used for earth construction are cob, wattle and daub, rammed earth, and adobe.

Approximately 55% of all India homes still use raw earth for walls. Earth is now though of as a poor man's material because of disadvantages such as high maintenance and low durability. Its major limitations are:

- water penetration
- erosion of walls at level by splashing of water from ground surfaces
- attack by termites and pests
- high maintenance requirements

The compressed earth block overcomes these limitations by an increase in block density through compaction using a mechanic press. The water content in soil is low for compaction as compared to the puddle clay required for mud bricks and ensures much greater dimensional stability. A block :

- has high density which varies between 1.8 and 2.1 gm/c.c., this gives more load bearing capacity and improved water resistance.
- is low cost
- is easy to manufacture locally by small group of people

- is low in energy consumption because no fuel is burnt for block making or transportation
- can use soil available at site
- has smooth surfaces

With these advantages a compressed earth block can be used for construction of houses. Greater design care and stabilisation enable the construction of more ambitious structures that need less maintenance and are longer lasting.

Stabilised Compressed Earth Block Technology

The Stabilised Compressed Earth Block (SCEB) Technology offers a cost effective, environmentally sound masonry system. The stabilised compressed earth block has a wide application in construction for walling, roofing, arched openings, corbels etc. Stabilised earth blocks are manufactured by compacting raw material earth mixed with a stabilised such as cement or lime under a pressure of 20 – 40 kg/cm using manual soil press such as Balram. A number of manual and hydraulic machines are available in India. The basic principle of all the machines is the compaction of raw earth to attain dense, even sized masonry. Some of the hydraulic machine can even manufacture interlocking blocks. These interlocking blocks are highly suitable for speedy and mortar less construction.

SCEB technology helps in offsetting the use of fuel wood that is getting expensive every day. On the other hand, compressed earth blocks are sundried and use cement as stabilisation for gaining the required strength.

The most important factor that affects the quality of a compressed earth block is the composition of the soil mix used to manufacture the blocks. The physical properties of soil have greater relevance in the manufacture of compressed earth block. They include colour, particle size break-up, structural stability, adhesion, bulk density capillary, porosity, specific heat, moisture content, permeability, linear contraction and dry strength. Soil classified, as clayey sands are excellent for making blocks. Such soils require little stabilisation to achieve block strength 20 kg/sq. cm. with the BALRAM machine. The optimum soil composition for compressed soil/mud block is 7% gravel, 53% sand, 20% silt and 20% clay.

Advantages

- Low energy and emissions
- Uniform size
- High strength
- Thermal insulation
- Versatile
- Cost effective

Applications

The compressed Earth building system can be used in a variety of ways to construct buildings that are aesthetic, efficient and easy to build.

The basic design principles of a good SCEB building are:-

- Strong foundation with sufficient plinth height.
- Sufficient roof overhang and a strong wall finish.
- Careful detailing of joints and use of concrete elements where tensile stresses are active.

In India more than 5 million stabilised earth blocks have been used to build residential and community buildings in both urban and rural areas.

The benefits of this technology have been appreciated by both the public and private sectors and it is being promoted by HUDCO's Network Building Centre to build housing and institutional projects.

Technical Details

The performance specification of SCEB are based on BIS code IS 1725, 1982 and tested in accordance with IS 3495 – 1992

Dimensional Variations	:	+/- 2 mm
Wet compressive strength	:	20 – 30 kg/cm^2
Water absorption	:	<15% by weight
Erosion	:	<5% by weight
Expansion on saturation	:	<0.15% in block thickness
Surface characteristics	:	No pitting on the surface
Manpower required	:	1 skilled, 6 – 8 unskilled

Product

The stabilised compressed earth block is a masonry unit of cuboidal shape. This may be solid or hallow or interlocking. The shape and size of a block is defined by the equipment used in its manufacture.

TARA Balram Machine

TARA-Balram Machine

TARA Balram is a unique machine that harnesses compressed earth block(CEB) technology to offer an economical and environment friendly sound masonry system. Development Alternatives, New Delhi has designed the machine and Technology and Action for Rural Advancement (TARA), New Delhi has manufactured it. It has been designed to enhance the strength and durability of earth construction. Houses made from earth blocks are strong and have a longer life. This machine manufactures SCEBs by compacting raw earth mixed with a stabiliser such as cement or lime under a pressure of 20-40 Kg/cm^2 using a manual press. This machine is a perfect profit making machine for small entrepreneurs.

Specification:

Size of the machine	:	1500 x 600 x 1200 mm
Weight of machine	:	180 kg
Size of block	:	230 x 109 x 76 mm
No. of blocks per cycle	:	2 Nos.
Type	:	Portable
Manpower required	:	5-8
Energy source	:	Manual
Compaction by	:	Pressure.
Compressive strength	:	20 – 30 Kg/cm2
Stabilisation	:	5 – 10 % Cement.

Process

The production of SCEB is based on the principle of densification of raw earth mixed with stabiliser (cement or lime) in small quantities ranging from 5 -10% by weight of the mix. The production process incorporates 3 main stages.

Sieving : Filling the mould. humid and wet curing

Batching : Moulding final stage

Mixing : Block ejection, transportation and stacking.

Raw Material

The primary raw material for the production of SCEB is raw earth or soil. OPC cement in small quantities and water are other constituents, coarse sand or stone dust may be added depending on soil quality. Soil is made up of grains of various sizes. The grain size distribution of a soil determines its suitability for the manufacture of SCEB.

Summary of Progress:

The socio-economy condition of Manipur state is very low and hence, it is essential for the people of Manipur to explore an alternative technology for low cost housing in a consequence of styles of modernisation. It is obvious that everybody awares for extensive use of mud/soil as a material for wall construction in traditional houses in India and abroad. Most of the technologies are simple and the skills needed would be easily required. Soil/mud is used in various forms for wall construction like puddle soil, unburnt bricks, burnt bricks, bamboo reinforced mud etc. Direct use of soil (without burning) for wall construction in various forms in inexpensive though it has certain disadvantages. Hence, there is a need for some advanced technologies for wall construction using soil/mud at a village **Leimaram**, Bishnupur district, Manipur.

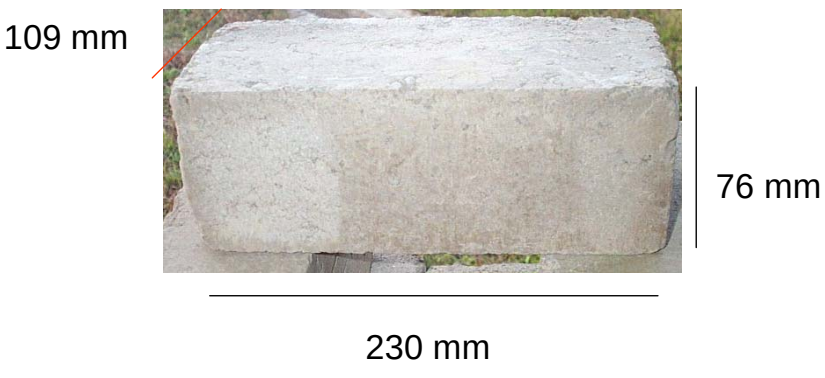
Leimaram, the project village is situated in Bishnupur district of Manipur and 25km from the state capital, Imphal. The village is dominated by scheduled caste population with a total population of 1778 and 357 families (Census 2001). The houses in the project area are mostly Kutcha and mixed types. Building materials like boulders, pebbles, sand, woods etc are locally available in the village. The soil found in the area is silt clay loam and it is suited for making of mud/soil blocks. Topographically, the area is at an undulated higher slope and it is free from flood/water logging.

The Compressed earth block (CEB) technology offers a cost effective, environmentally sound masonry system. A stabilised earth/mud block has wide application in construction for walling, roofing, arched openings, corbels etc. The blocks are manufactured by compacting raw earth mixed with stabilised such as cement or lime under a pressure of 20-40 kg/cm^2 using a manual or mechanised soil press. TARA-Balram Compressed earth blocks machine manufactured by Technology and Action for Rural Advancement (TARA) New Delhi has been utilised for making stabilised soil blocks of the project. The project workers and local youths have been trained about the operation of the machine and mud blocks making techniques.

Operational of the machine

In India the technology for stabilised earth block is being promoted by HUDCO's network of Building Centres to build public sector housing and institutional projects.

Stabilised Mud Blocks



Dimension of block

Boulder Foundation

Construction Stage of Mud Block House

Stabilised Mud Block House for KYDC Club

Stabilised Mud Block House for HYS Club

Demo Mud Block House at MASTEC Office Complex

Stabilised Mud Block House for DEWALI, Club

Stabilised Mud Block House at Manipur Science Centre, Imphal

Conclusion:

The project was sanctioned during April 2004 for a period of 2 (two) years by DST, GoI. From June- September 2004 there was a continuous unstable law and order situation in Manipur. The soil block machine TARA-Balram could be delivered at Imphal only during November 2004.The engagement of the project staff was done during March 2005 nearly after one year of the project commencement as much time was taken in the appointment procedure of the authority. The construction season available during the project tenure was less and therefore target for construction units could not be achieved. 5 (five) low cost houses have been constructed out of which 3 (three) are at Leimaram village, 1(one) demonstration model unit at MASTEC office complex, Takyelpat Imphal and 1 (one) unit also at Manipur Science Centre, Imphal.

About 20-30 youths from 3(three) local clubs of the project village and 10 – 15 rural artisans have been trained for operation of TARA- Balram machine and preparation of stabilised mud blocks. The machine can be transported at the site of the construction of blocks and houses. Many of the local masons and youths have been awared of the technology. The technology is ecofriendly and it can be created a sustainable business for rural markets.

Manpower Trained

The following persons of the project village have been trained on stabilised mud block technology:

(1) M. Sarat Singh
(2) O. Chinglensana Singh
(3) Y. Tombi Singh
(4) Y. Manao Singh
(5) M. Sanatomba Singh
(6) S. Chandrakumar Singh
(7) Y. Hemanta Singh
(8) N. Roben Singh
(9) A. Biren Singh
(10) Y. Debeshwor Singh
(11) N. Ibomcha Singh
(12) TH. Tomba Singh
(13) M. Jiten Singh
(14) Y. Sharatkumar Singh
(15) S. Iboucouba Singh
(16) Y. Punshiba Singh
(17) M. Roniboy Singh
(18) Y. Premjit Singh
(19) P. Ibocha Singh
(20) Y. Manibabu Singh
(21) N. Gandhi Singh
(22) S. Ratan Singh

Replication Potential

The stabilised mud block prepared by compressed earth machine is promoted by HUDCO India and this technology has now been recommended by CSIR for rural development technology. The project was conceptualised with a view to demonstrate and popularise the technology in Manipur. The stabilised mud blocks for wall construction of houses will improve the traditional housing technologies at low cost. This technology once popularised can easily be replicated in many parts of the state.

Linkages developed

Manipur Building Centre, Imphal has been linked for giving training. Linkages with local clubs and village panchayats have also been made for popularising the technology and also conducting artisans training programme.

Future Plan

i) To constitute a group of trained entrepreneurs/artisans.

ii) To take up research on utilisation of locally available building materials, soils/muds for low cost housing.

iii) Dissemination of technology.