



Eco-friendly house

with compressed stabilized earth blocks

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CAMaRSEC project (2019-2023)

Climate-Adapted Material Research for the Socio-Economic Context of Vietnam (CAMaRSEC)

**Nghiên cứu vật liệu thích ứng biến đổi khí hậu
trong điều kiện kinh tế - xã hội Việt Nam**

*Enabling Research and Development for Sustainable
Buildings in the socio-economic context of Vietnam*

**Thúc đẩy nghiên cứu và phát triển các công trình xây dựng bền vững
trong điều kiện kinh tế - xã hội Việt Nam**

research consortium- **hiệp hội nghiên cứu:**

funded by- **tài trợ bởi:**



National University of
Civil Engineering (NUCE)
Hanoi, Vietnam

Tuesday 25. April 2017



ReBuMat project (2020-2024)

**Start 1.7.2020
End 30.6.2023**



BMBF CONNECT-Program:

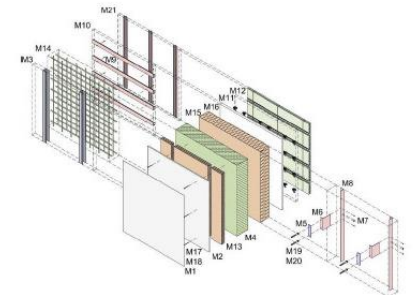
ReBuMat - German-Vietnamese cooperative project on
resource-efficient building using sustainable building materials



**Bio-based
Building materials**

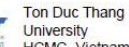


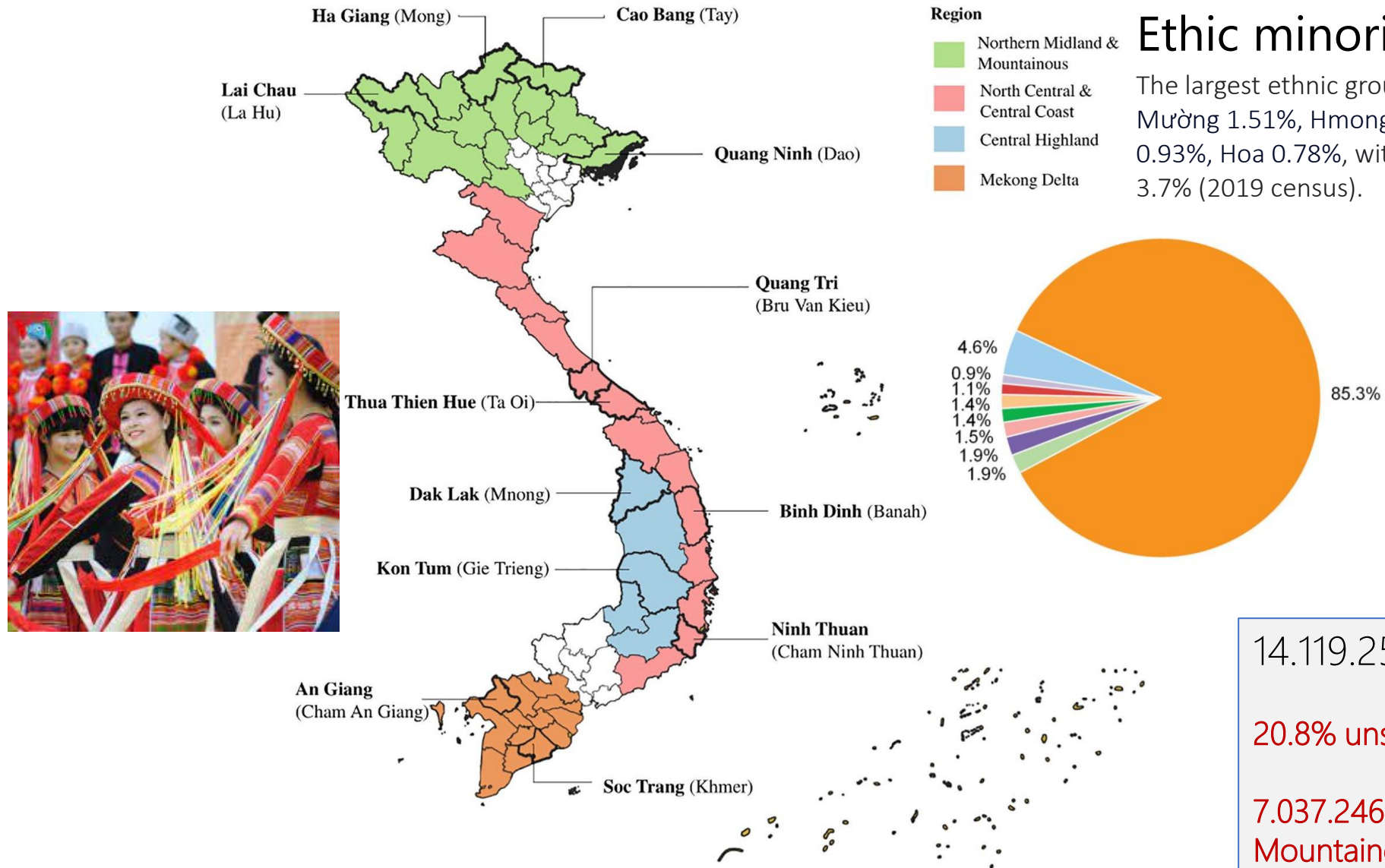
**Recycled
Building materials**



**Resource-efficient and
recycling-friendly
construction systems**

The aim of this cooperation project is to promote the research and development of building materials and construction methods for an energy-efficient, resource-efficient and generally sustainable construction practice. ReBuMat will bring together the existing work of the established german-Vietnamese CAMaRSEC project consortium in this field, thereby strengthening it scientifically and application-oriented.





14.119.256 people (2019)

20.8% unstable or simple house

7.037.246 (Northern Midland & Mountainous)

Inspiration

In many difficult areas of the Northern mountainous region, people's houses are dilapidated and temporary



Tân Minh, Đà Bắc (2022)



Tân Minh, Đà Bắc (2022)



Hòa An, Cao Bằng (2022)



Đồng Văn, Hà Giang (2021)



Mường Tè, Lai Châu (2021)



Mường Tè, Lai Châu (2021)

Inspiration

Difficulties in transporting materials is one of the reasons limiting people's housing construction



In addition to solutions to support housing construction costs, using on-site materials (non-fired clay bricks) in house construction overcomes difficulties in transporting materials, taking advantage of available materials is the basis for building houses for the poor



Hill land (no farming features) is very abundant



Palm leaves are used for roofing...



Bamboo supports the palm roof

Some exist in housing support programs for the poor



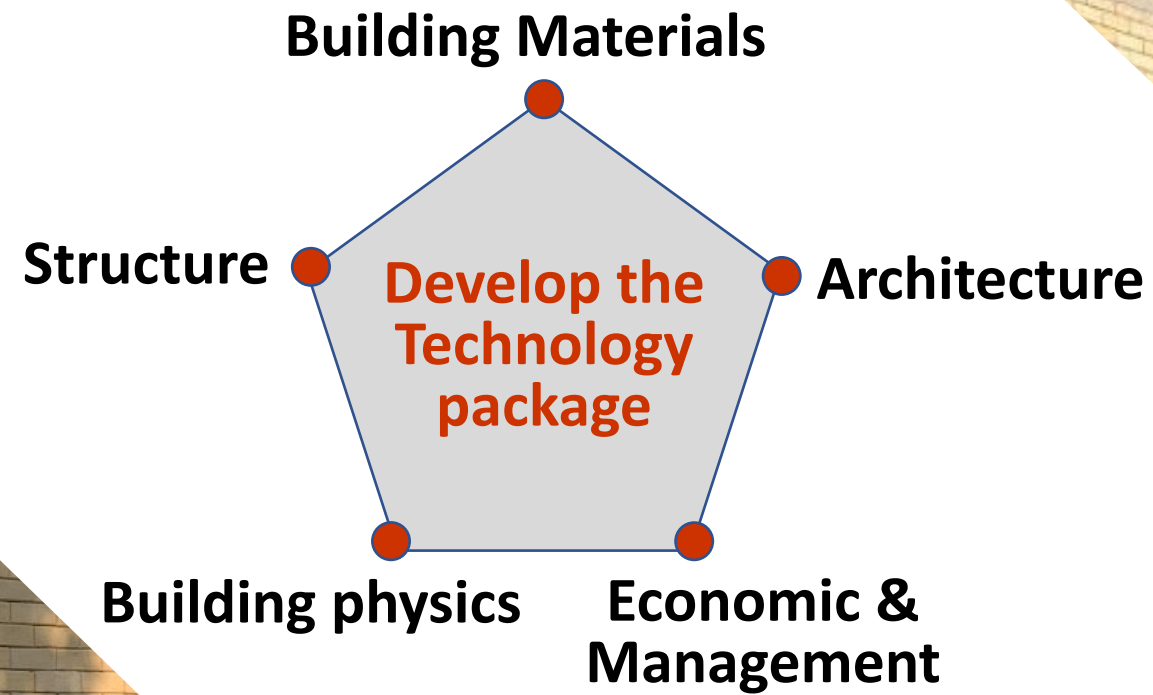
The state budget supports localities with a maximum of 40 million VND/household for new house construction (Clause 1, Article 9, Decision No. 02/2022/QĐ-TTg); Circular 01/2022-BXD



House built by the Ministry of Public Security in Muong Te, Lai Chau



Develop the Technology Package to build the house for the poor



Ideas

Survey



H'Mông



Thái, Tày

Production of compressed stabilized earth blocks (CSEB)

Property	Compressed stabilised earth blocks	Fired clay bricks	Calcium silicate bricks	Dense concrete blocks	Aerated concrete blocks	Lightweight concrete blocks
Wet compressive strength (MN/m ²)	1 - 40	5 - 60	10 - 55	7 - 50	2 - 6	2 - 20
Moisture movement (%)	0.02 - 0.2	0.00 - 0.02	0.01 - 0.035	0.02 - 0.05	0.05 - 0.10	0.04 - 0.08
Density (kg/m ³)	1700 - 2200	1400 - 2400	1600 - 2100	1700 - 2200	400 - 950	600 - 1600
Thermal conductivity W/m°C	0.81 - 1.04	0.70 - 1.30	1.10 - 1.60	1.00 - 1.70	0.10 - 0.20	0.15 - 0.70
Durability against rain	good to very poor	excellent to very poor	good to moderate	good to poor	good to moderate	good to poor

Develop the Technology package to build the house for the poor

Develop the Technology package to build the house for the poor

(1)
Design the house



(2)
**Production of
non-fired earth
bricks**



(3)
**Guide the poor to
produce bricks**



(4)
Build the house

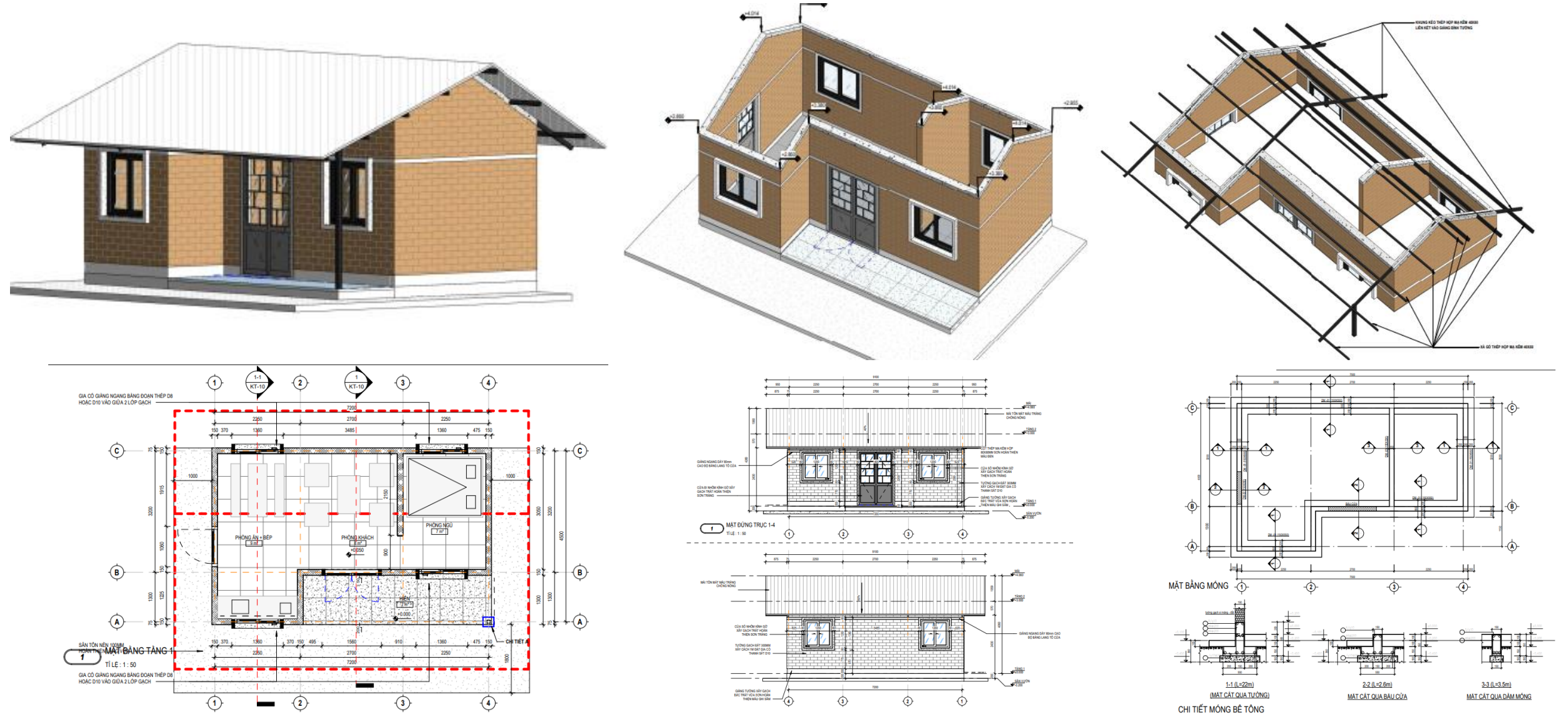


(5)
Finishing



(1) Design the house

Typical house with a square of 40 m²



(2) Production of non-fired earth bricks

Making the samples in the laboratory



Collecting the earth



Drying



Crushing



Seiving



Weighting the
earth+cement+water



Mixing



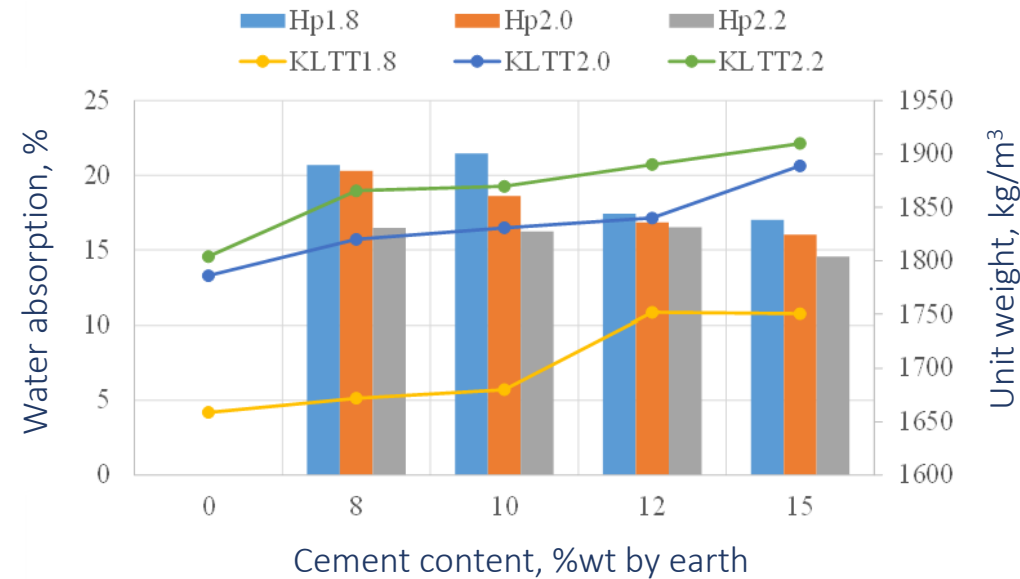
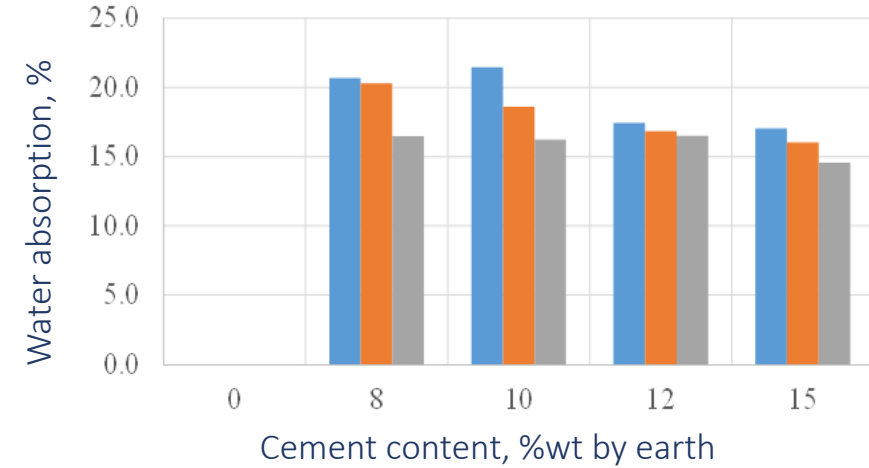
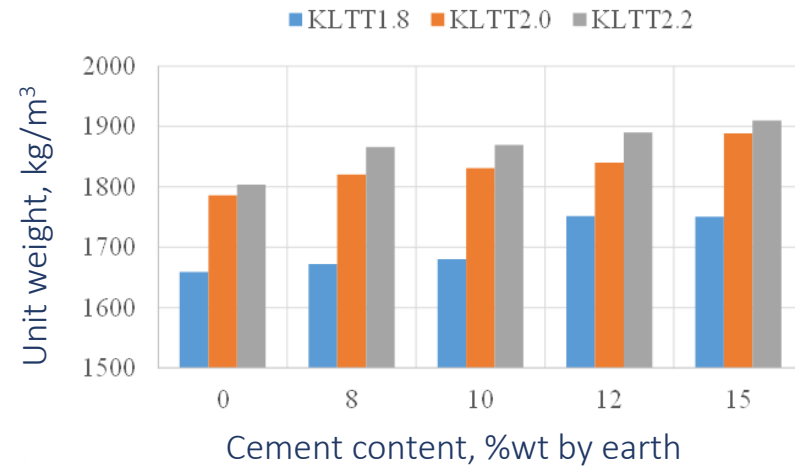
Pressing to make the
sample



The samples

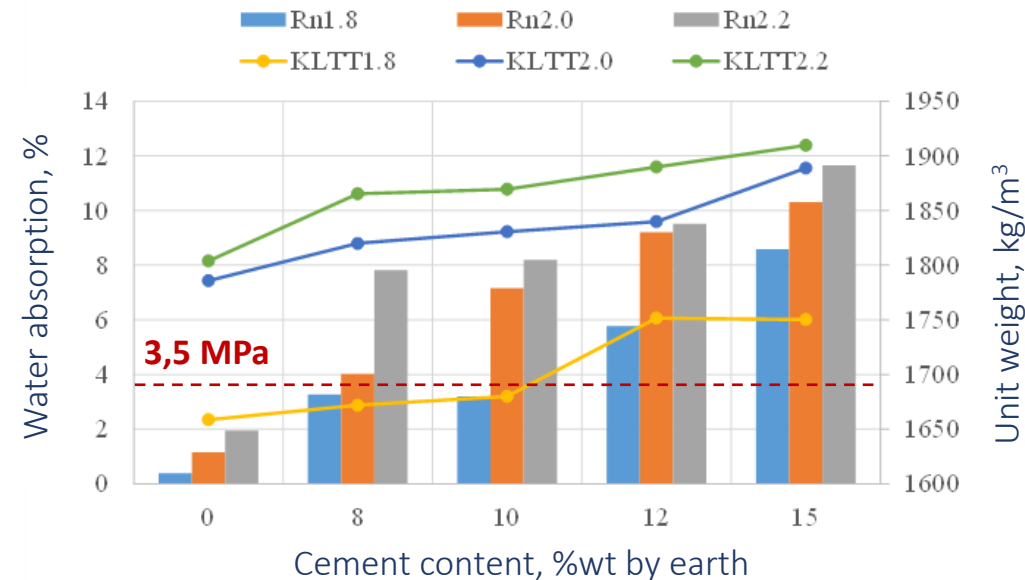
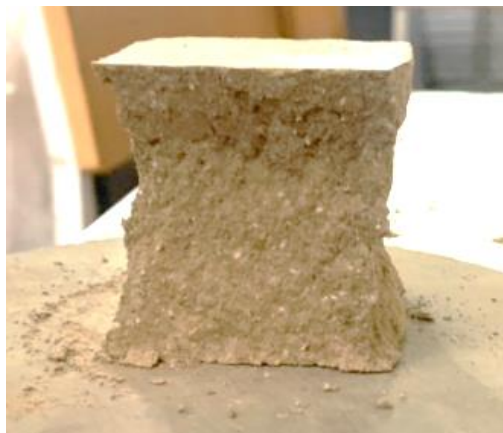
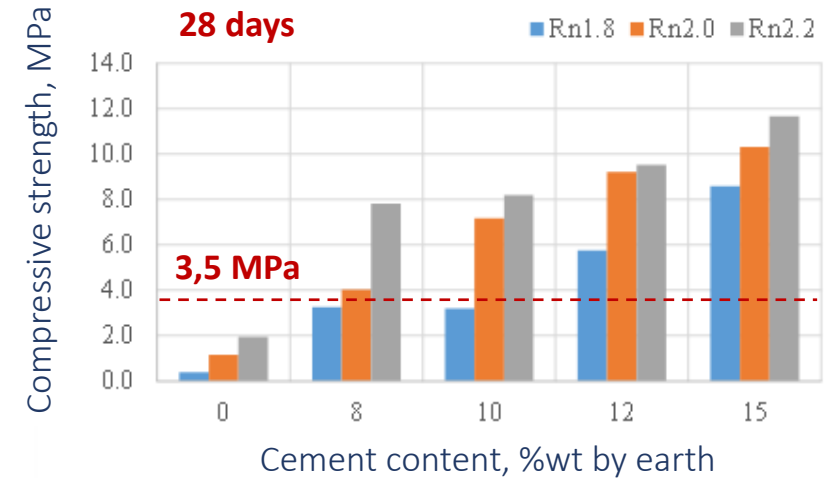
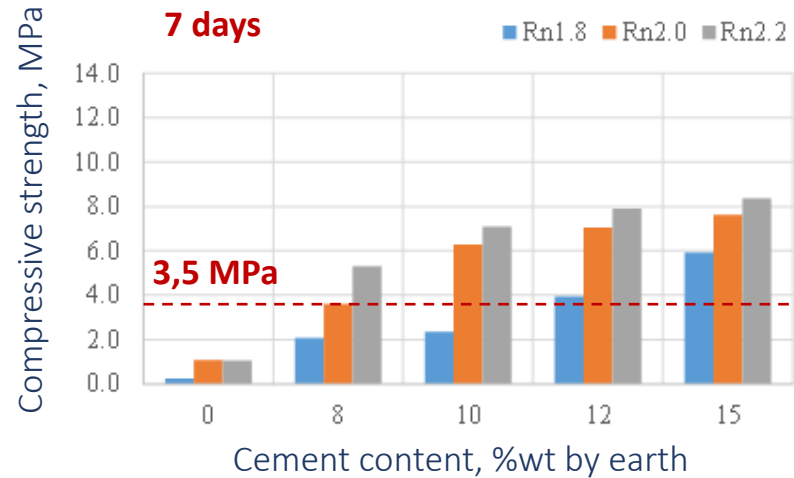
(2) Production of non-fired earth bricks

Experimental results in the laboratory



(2) Production of non-fired earth bricks

Experimental results in the laboratory



CSEB: 0,353 W/m.K
Fired clay bricks: ~ 0,814 W/m.K

(2) Production of non-fired earth bricks

Production of compressed stabilized earth blocks (CSEB)

For one-storey buildings, blocks with a compressive strength in the order of **2.0 MPa** will probably be strong enough, but where rainfall is high an external treatment is necessary. Since the wet strength of a compressed stabilized earth block wall may be less than two-thirds of its dry strength

A good durable construction with a wall density of about $2,000 \text{ kg/m}^3$ can be achieved without the need for costly external protective rendering to resist weathering problems. Each individual block will have a dry weight of about 7kg which is easy for the mason to handle. **A wall thickness of 140 mm** with a density of **2000 kg/m^3** should provide adequate thermal insulation even when external wall temperatures fluctuate, thus helping to reduce temperature variations inside a building.

Compressed Stabilised Earth Block Manufacture in Sudan

Doctor E.A. Adam
in collaboration with
Professor A.R.A. Agib



United Nations Educational, Scientific and Cultural Organization



(2) Production of non-fired earth bricks

Production of compressed stabilized earth blocks (CSEB)

Type: interlocking

- Compressive strength > **3.5 MPa**
- Block size : 300 x 150 x 100 mm
- Shape of block: No. 7

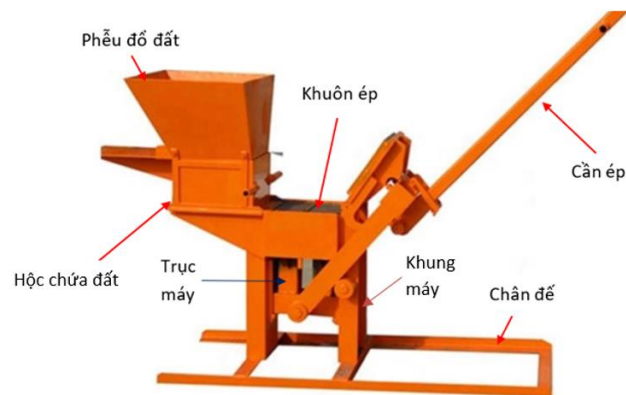


1 300*150*100mm	2 300*150*100mm	3 150*150*100mm	4 300*150*100mm	5 300*150*100mm
6 150*150*100mm	7 300*150*100mm	8 300*150*100mm	9 150*150*100mm	10 300*150*100mm
11 300*150*100mm	12 300*150*100mm	13 250*175*100mm	14 250*175*100mm	15 300*150*100mm
16 300*150*100mm	17 230*180*115mm	18 230*220*115mm	19 230*220*115mm	20 230*220*115mm
21 230*140*115mm	22 245*107*60mm	23 250*60mm Diagonal	24 200*100*60mm	25 200*100*60mm
26 200*100*60mm	27 260*160*100mm	28 300*150*100mm	29 300*150*100mm	30 250*125*60mm

(2) Production of non-fired earth bricks

Experimental results in the laboratory

Manual pressing machine



CSEB with a size of
 $300 \times 150 \times 100$ mm



Hydraulic pressure machine



Make the machine



Modify the Chinese
machine

(2) Production of non-fired earth bricks

Experimental results in the laboratory



(3) Guide the poor to produce bricks

Technology transfer



(3) Guide the poor to produce bricks

6.000 bricks to be produced in total (250-300 bricks/day)



(3) Guide the poor to produce bricks

Technology transfer



(4) Build the house

Foundation



(4) Build the house

Foundation and wall



(4) Build the house

Wall



(4) Build the house

Wall



(4) Build the house

Brace the wall



(4) Build the house

Roof



(4) Build the house

Roof with palm leaves



(5) Finishing

The house has a corrugated iron roof



(5) Finishing

The house has a palm leave roof



(5) Finishing

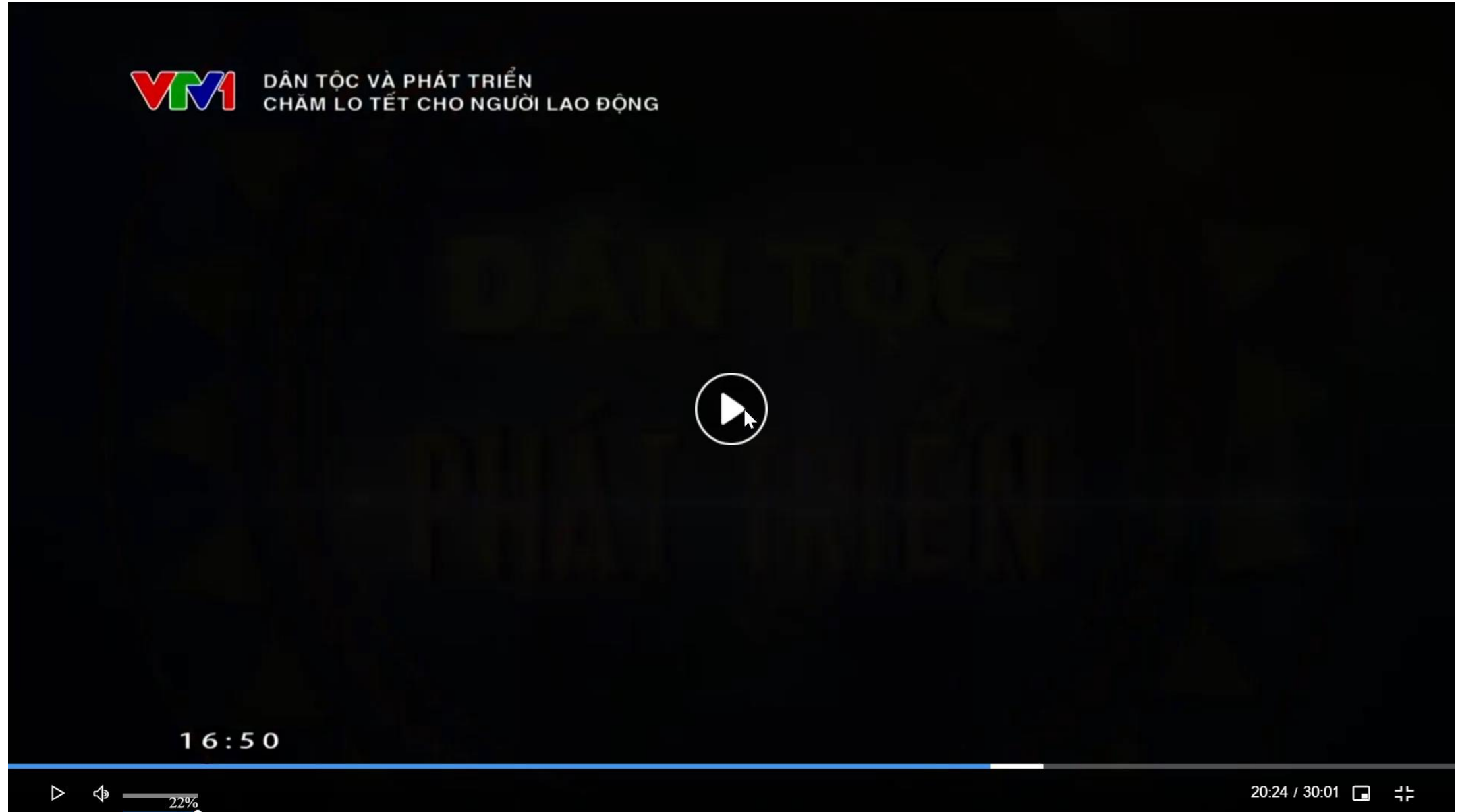
House sign







(5) Finishing





Thank you for your attention!