EARTH ARCHITECTURE ?
RENAISSANCE OF AN ANCIENT TECHNOLOGY FROM THE POINT OF VIEW OF THE SUSTAINABILITY

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WHY HAVE COME INTO THE LIMELIGHT THE EARTH ARCHITECTURE?

During the history of humanity developed rightly an idea about, that the raw materials and energy sources, which are the basis of economy, are boundless and for this reason they are available for free or for very low prize. Of course we could rightly think this way as long as we only used reproducing energy sources and raw materials, which were mostly used in reproducing amounts.

But in the 1960's and 70' independent organisations (Roman Club) than in the 80' government organisations (Bruntland Committee) and in the 90' inter-governmental organisations (Rio de Janeiro: Agenda 21) realised that using of energy and raw materials, and changing the environment in the present form of the human life is not sustainable in long term. [1]

More and more begin to think that in the future at several parts of life next to questions like "Is it worth?" or "Is it nice?" we have to answer a new fundamental question: "Is it sustainable in long term?"

The question of the more and more often mentioned "Sustainability" raised new point of views and requirements at the relation in building materials as well. Some architects and builders realising the ecological, building-physical advantages of the earth building overvalued the traditional preconceptions about the earth architecture, and next to the rebuilding of ancient earth houses built with traditional technology, started to think of the modernisation and alternative adoption of earth architecture.

(Explaining this not fully developed terminology, the term "earth building" I mean the traditional mud walls, straw clay walls and houses made out of adobe, and varies of some further developed technologies were the local building materials is used after dried on the sun, without being burnt.)

INTERNATIONAL EXPERIENCES

In Germany, in France and in the USA they are dealing with updating of different earth building technologies during the past 20 years.

In the practices of the overseas countries till now were put a big stress on the reconstruction of monumental type of buildings. In Germany were rebuild the old "Fachwerk" mean woodframe adobe houses so they became suitable for the modern heat standards. In the USA ancient Indian pueblos were rebuilt and turned into touristic attractions.

Next to the reconstruction investments, new earth houses were built in West-Europe and in the USA, where during the architectural conception of these buildings, beyond the ecological and building-physical advantages of the earth, was trying to use the artistical formality of the material. In the desert parts of Australia were minimised the expenses of transport, when the rest-houses besides the highways was built from local earth stabilised with cement.

But the most important region of earth architecture researches tends towards to the "countries of the South" trying to solve the problem of lack of houses caused by the demographically exposure. [2]

HUNGARIAN EXPERIENCES

In Hungary beside the rebuilding of monumental type buildings and building reconstruction (Open Air Museum, Szentendre) from the 1970's even private builders modernised old earth houses mostly as weekend houses.

Up to the 1980's new earth houses were built only by the poor, in low quality and insignificant quantity. After the 80's, because of the ecological and building-physical advantages of earth, building of a high standard were built as well out of earth.

First of all, because of the static quality of the earth, walls were built but staves, cupolas, slabs-fillings, furniture, heating installations, isolations also were made out of earth (clay). [3]

Walls were built, beside the traditional mud, straw clay, and adobe technologies, newly developed technologies like pressed-, pressed and stabilised with cement-, lightened and pressed-, and lightadobe-brick walls.

Even using the mentioned technologies we must make it absolutely clear that the optimum use of earth architecture can not be common because of beside other bounds of using the earth suitable as a building material or the place required for the manufacturing of the earth-bricks are not always suitable on the spot, or nearby the spot of the building.

ADVANTAGES AND DISADVANTAGES OF EARTH BUILDINGS

1. Advantages

1.1. high thermal storage capacity

1.2. good capacity for conditioning of humidity

1.3. respiration wall construction

1.4. low primer energy content

1.5. low building environment load

1.6. low transport cost and environment load

1.7. using natural materials

1.8. in according the different technologies, different price, and possibility of the market segmentation

1.9. 100 % recyclable__

2. Disantvantages

2.1. low compressive strength

2.2. unimportant flexural strength

2.3. sensitivity for the biological damage (rodents, insects)

2.4. sensitivity for the humidity
2.5. problems with the plaster strength
2.6 the lingering dry up of the technological humidity
2.7. earthquake sensitivity

Sometime mentioned that the earth walls have bad heat-isolation parameters. Plotted against the new developments it is not an evidence already: the overall heat transfer rate of these walls is can be reduced into 0,7 W/m2K or using more supplementary isolation material (reed batten) into 0,35 W/m2K in a case of 45 cm wall thickness.

WHAT IS THE MENTIONED "LIGHTADOBE TECHNOLOGY"?

This technology was developed in Germany and in Switzerland from the ancient wood-framework "Fachwerk" technology. One element of the technology is the lightadobe-brick, which includes more organic or mineral additive as a traditional adobe brick.

1. chart
Some characteristic technical feature of the adobe
and usual used bricks

	1.	**2.**	**3.**	**4.**
traditional earth wall (mud wall)	1800	0.91	50	1.39
lightadobe wall*	1400	0.59	45+5**	0.41
lightadobe wall (the best from the literature)	900	0.3	45+5**	0.36
Porotherm wall (38 S) (burned brick)	800	~0.2	38	0.49
Ytong wall (G4-0,6) (limy quartz sand cellconcrete)	750	0.2	38	0.49

* This lightadobe brick was produced in Hungary.
** the thickness of the wall is 45 cm, with 5 cm reed isolation batten
[4] [5] [6]

1. density (kg/m3)
2. thermal conduction(W/mK)
3. thickness of the wall (cm)
4. overall heat transfer rate (W/m2K)

KNOW HOW

Because of the low compressive strength of the lightadobe bricks at the usual adoption of the technology it is made only as a fill up wall in between the wood framework.

The foundations of the showed earth house was made from compressed concrete. As DP membrane they laid bituminous felt on the floor slab. The load bearing wood framework was built on the water proofing sheet, with the wood slab construction and the roof frame together, at the same time.

Before filling up type walling would started, they completed the roof covering to protect the water sensitive lightadobe walls from a possible summer rain. The wall was made from the nearby local prefabricated lightadobe bricks and the local produced adobe mortar in according to the rule of the usual brick walling.

Because of the water sensitivity of the earth walls, in the bathrooms and in the kitchen was built a screen wall, from dividing wall brick in 10 cm thickness, in which run the water pipes.

CALCULATIONS TO COMPARE THE COSTS OF AN USUAL HOUSE AND AN EARTH HOUSE

The principles of the calculations

It is possible, using the different technologies, to build walls from the same local earth with significant different quality and prize. As a PhD-student of the Technical University of Budapest, Department of Building Constructions, I was searching at the Naturbau Ltd in August 1996, for the answer of the question: What is the prize of an earth house with the similar technical parameters as an usual house and what from derive the differences?

I compared the costs of the building constructions of an earth house (EARTHH), built by the Naturbau Ltd. in Kercaszomor using the straw additive lightadobe technology and wood slab, and an usual house (USUH), which is the same (fictitious) house using the usual Hungarian building methods, plotted against the prize and wages in August 1996.

The walls of the USUH was imagined from Ytong (limy quartz sand cellconcrete), which has more ecological advantages as the burned brick Porotherm wall with the same prizes. The slab of the USUH was imagined, printed against the usual Hungarian building methods, from reinforced concrete.

The designer of the earth house was Sándor Mezei, who is the leader of the Naturbau Ltd, the original cost calculation was made by Kálmán Bán, the building engineer of the Naturbau Ltd.

Summery of the costs

The constructions differ from each other significant only in their wall-, and slab consrtuctions.

2. chart

The costs of the wall-, and slab constructions

	USUH	EARTHH
Wall	933.501	1.088.894
Slab	1.182.797 (946.603)	603.582
Total	2.116.298 (1.880.104)	1.692.476

The total costs of the EARTHH
in according the quotation of the Naturbau Ltd: 8.480.166 HUF
+ VAT

10.600.207 HUF

The m2-price of the house: 53.563 HUF
In August 1996.

The costs of the USUH are, using monolith reinforce concrete slab with 425 tHUF, using prefabricated reinforce concrete slab with 185 tHUF, more expensive than the EARTHH. Considering the total costs of the building it means that the costs are reduced with 5.0 (2.1)%, which is not a significant difference.

We have to emphasise that the 80% of the material costs of the adobe-walling and the clay mortaring are during the lightadobe brick manufacturing wage costs, which was paid to the worker.

The corrected costs of the lightadobe wall: material 475 814. Ft-
wage 613 080. Ft-,
1 088 894 Ft

But the costs of the Ytong wall: material 623 210. Ft-
wage 310 291. Ft-.
933 501 Ft

Conclusions from the calculations

It is possible to build earth houses in the level of the expectations of the XX. century, as a building for permanent human residence, but the level of the expectations of the XX. century must pay at the prizes of the XX. century.

In any case I found it significant advantage of the EARTHH that producing the same ideal and physical value the material costs reduced with the third part by the USUH, which is the consequence of the energy and raw material efficiently as well, and the wages increased to the douple amount of the USUH's. I think it is important because at first twice more money could stay in the local economy, making possible further investments, and second the energie demand of the industrial producing and transport,

covered in the price of the material costs of the USUH, turned to renewable human energy resource.

I believe in the future architecture we have to keep in view to a greater extent the principal of the technical subsidiary, which makes possible really significant cost savings in according to the walls and the whole building. I mean, first of all by the seasonal (summer) used building it is possible to build using cheaper, low isulated technologies, because in this case the in winter it is not demanded for the walls but the heavy earth constructions with theire great heat-storage capacity and good capacity for conditioning of humidity could make pleasant inside climate without air-condition.

Plotted against the international trends and the above written, I think earth building could have even not much more but higher role in the Hungarian building industry. We should leave our preconceptions and if the building place, the function of the building and the mental ability of the builders make it possible, we consider earth building as a really choice.

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