

Unfired earth: a low-cost technologies for self-help constructions The case of Pedras Brancas in São José do Vale do Rio Preto

by Claudio Pavesi

«A terra é o material por excelência daqueles que não têm recursos financeiros para arcar com as despesas de materiais industrializados. Por isso, os europeus a recomendam para construções no terceiro mundo, esquecendo, ao que parece, que seu uso foi muito divulgado em seu território na fase pré-industrial. Durante quatro quintos da história de nosso país, a terra se constituiu no material de construção mais importante. Seu emprego requer pouca energia em sua elaboração. Sua pequena resistêntia à pressão e à tração pode ser facilmente compensada com a combinação com outros materiais. Terra é um material brando, que não requer altos investimentos para ser trabalhado. As próprias mãos são suficientes. É muito barato. Talvez por isso seja considerada como de pouca qualidade». GÜNTER WEIMAR, *Arquitetura popular brasileira*, Martins Fontes, São Paulo, 2005, p. 250.

Unfired earth is a building material which is part of building tradition of many countries. According to different culture, it has been utilised with different technologies and results. In particular we can distinguish between three prevalent building typologies: the older technique consists in filling up a grid of branches with wet earth sometimes mixed with vegetal stuff (the ancient Romans called this method *opus craticium*)¹; the second technique is based on beating wet earth pressed in formwork; a third way to use unfired earth is to create dry blocks and then assembling walls using mortar for fixing them. Still today in many part of Italy – i.e. Piemonte, Sardegna and Marche – there exist rural buildings, with one or two floors, made of unfired earth. Their persistence represent an important heritage which is important to conserve.² Traditionally, the use of this poor material was motivated not by technological reason (lack of clay or difficulty to produce fired bricks) but, quite obviously, by economical motives (the cost of coal and kilns). But between XVIII and XIX centuries there are also scholar essays which describe the advantages to built with earth.³

¹ See EGI VOLTERRANI, *Terra: una tipologia costruttiva presente anche nel torinese*, in Anna Gilbert, Roberto Mattone (edit by), *Terra: incipit vita nova*, Politecnico di Torino, 1998, p. 5. In *De Architectura* Vitruvio describes the type of clay which is better for producing unfired bricks and gives suggestion for building with earth: too much sand and gravel make more fragile the walls; spring and autumn are the better season for making bricks because temperatures are more constant.

² See EUGENIO GALDIERI, *Le meraviglie dell'architettura in terra cruda*, Laterza, Bari, 1982.

³ I.e. *Dell'Economica Costruzione delle Case di Terra*, by the Academy of Georgofili, Florence 1793, and Giovanni Rondelet, *Trattato Teorico Pratico dell'Arte di Edificare*, first Italian edition: Mantova 1832.

Nowadays, in many countries, the utilisation of unfired earth is still associated to poverty and backwardness, but modern technologies can improve its quality and transform it in an important resource for self-help construction.

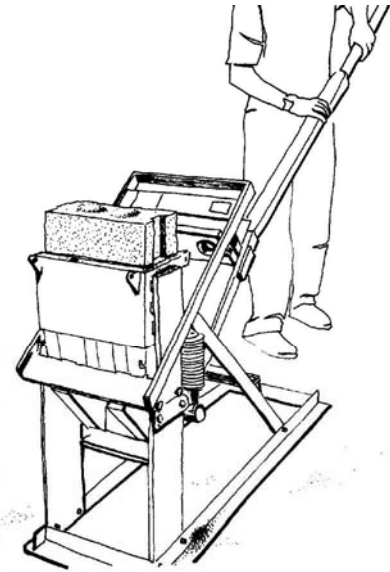
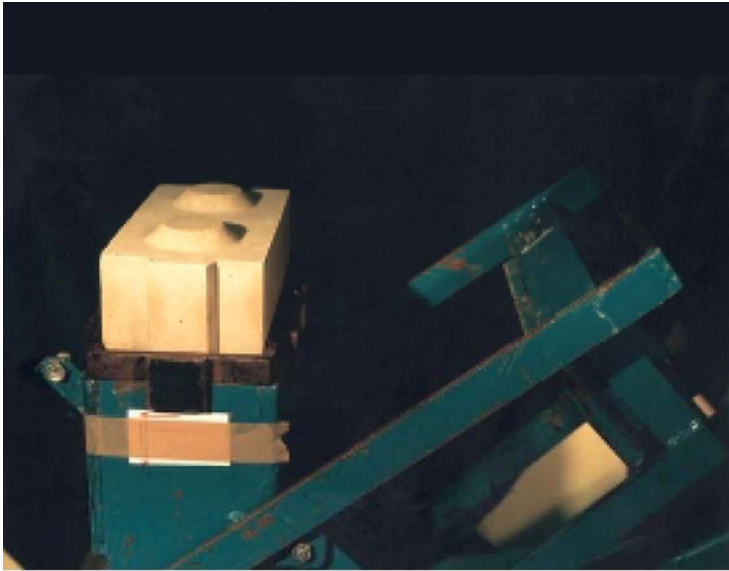


Ghinda (Eritrea): auto help houses made of branches and wet earth

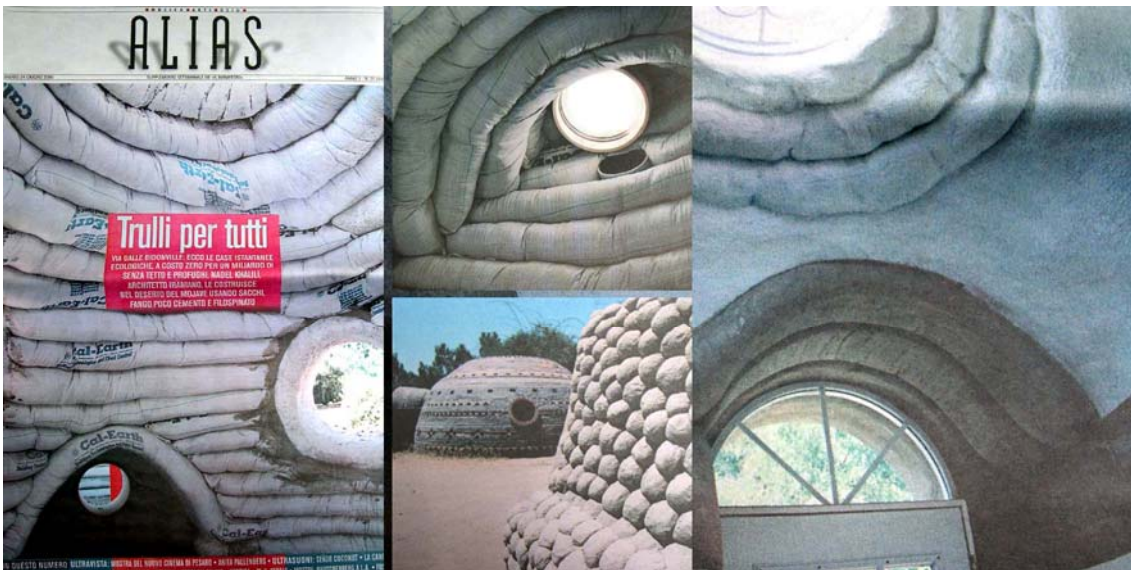
Actually many European universities are trying to demonstrate its economic and ecological potentialities⁴, attempting to reinvent the concept of earth block, which appears as the most practical and reliable way to utilise unfired earth. In order to produce a earth block the material must be fragmented and then pressed in moulds using manual labour or machines. The compacted block offers a regular and standard form which simplifies building constructions. According to its composition and to different percentage of clay, sand and silt, it is suitable to employ earth blocks or rammed earth blocks. In the second case, the earth is stabilised with an addition of a small percentage of cement (5% ÷ 10%). Rammed earth blocks give excellent responses to compression and water erosion tests. As an alternative to cement, it is also possible to utilise lime or bitumen for stabilising the blocks. In Italy, the Material and Component Testing Laboratory of the Department of Sciences and Techniques of the Politecnico of Turin has developed interesting studies on the form of the block. The experiments concern with different shapes of the blocks in order to make easier the assemblage and simplify the building process. The blocks, made with a manual press,⁵ have dimension of 28x14x9,5 cm and arrive to support a compression of 10 MPa.

⁴ «Earth architecture does not only belong to history: it is also reality, innovation, and progress. At a time when concepts like sustainability, ecology, respect for the environment, all belong to the common language of living, the use of unfired earth, introduced at an the application level and in terms of performance, has again aroused particular interest on the building materials scene. In the last few years, experts of the sector, but also several public administration bodies, on both a regional and local level, have been committed to promoting site identification operations and to the recovery of existing buildings, paying attention also to the innovative aspects». R. MATTONE, *La terra cruda, tra tradizione e innovazione*, in “Industria dei Laterizi”, n. 71, September-October 2001, p. 315.

⁵ A GEO-50 press produced in Italy by Altech spa.



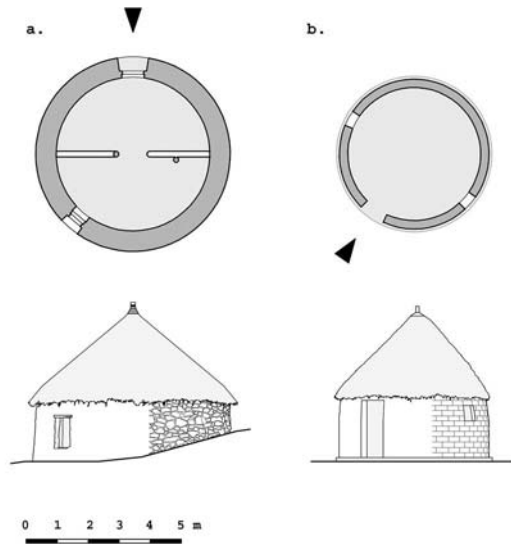
Experimental unfired earth block made by Politecnico of Torino, Italy (photo and drawing from *Tecnologie per tutti. Soluzioni semplici e a basso costo per l'habitat*, edit by Massimo Foti, Scuola di specializzazione in "Tecnologia architettura e città nei Paesi in via di sviluppo", Torino, marzo 2003)



Cal Earth (California), the work of Nadel Khalili (from "Alias", supplemento settimanale de "il manifesto", sabato 24 giugno 2006, p. 1-3)

Other interesting tasks to modernise earth technologies are conducted all over the world. One of this is the work developed by the Iranian architect Nadel Khalili in the desert of Mojave, near Los Angeles. Here Khalili builds ecological dome houses using bags, barbed wire, earth and 10% of cement. Long tubes of industrial nylon – which are base elements for producing bags – are filled up with a mixture of water, earth and cement. The tubes are put one on the other in concentred circles. The barbed wire between the layers fixes and armed the structure. The result is a extremely cheap and very solid building designed for poorest people but also for a more sustainable world.

In African countries like Eritrea, where self help building is a relevant fact, unfired bricks are today a common material. In such situation it's important to observe that rammed earth blocks substitute stones or branches and adobe in the construction of *tukuls* – the most common houses in the highlands of Eritrea – but don't change the typology of the buildings. The round rooms with thatched roof are constantly preferred to more squared constructions.



Asmara (Eritrea): tukuls made of stones (a) and made of rammed earth blocks (b)



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The tukul made of unfired earth and a advertising of a press machine for producing earth blocks

A diffusion of the know-how about modern unfired earth technologies could be a valid help in the renewal of Pedras Brancas which is the neighbourhood of São José do Vale do Rio Preto (SJVRP) where major social and economic diseases are concentrated. In fact, agricultural day labourers and unemployed people live in

Pedras Brancas suffering not only for the shortage of services and public structures, but, first of all, for the bad conditions of their own houses.

Today in Pedras Brancas there are 50 social housing built in 2002 by the State of Rio de Janeiro on a municipal property. The dimension of these houses are too small: only 21 sqm per dwelling (the average occupancy is about 5 persons). The original project made prevision for a possible addition of two bedrooms per dwelling, but only few inhabitants – who don't own directly the houses – have realized it.

In Pedras Brancas there are also many abusive houses. Most of them are self-help buildings and sometimes they have evident structural diseases. Usually, people who built their own houses⁶ use grids of branches stuffed with wet earth or, when it is possible, concrete structures with walls made of hollow brick, usually without plaster.⁷ Not necessarily they have concrete flooring. Frequently houses have no finishes. All of them have only one floor. Sometimes they have evident structural problems. The paths linking these abusive houses run along a strong slope. Since they have no paving, when it rains, they become small torrents of mud. Obviously, a project for Pedras Brancas has to make prevision for new pedestrian paths with stairs.

Houses in Pedras Brancas are usually only one storey high. They have a lengthened plan. If the main entrance is situated on the short side, it has a little veranda and serves the living room. If it is on the long side, then the living room is in the middle of the house and separates kitchen from bedrooms. Sometimes there is also a little veranda on the back, where occasionally householders cook. In the poorest houses and in the Government's ones, windows have no glasses and saddle roofs have no insulation. Houses have tile roofs or asbestos cement roofing. People use to cultivate small vegetable gardens near their houses.

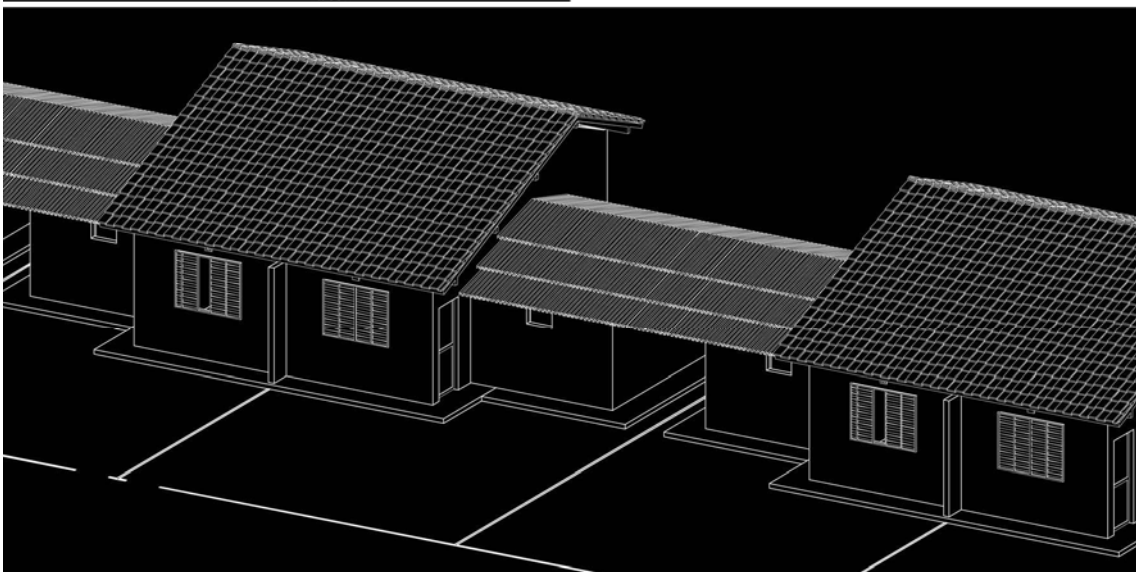
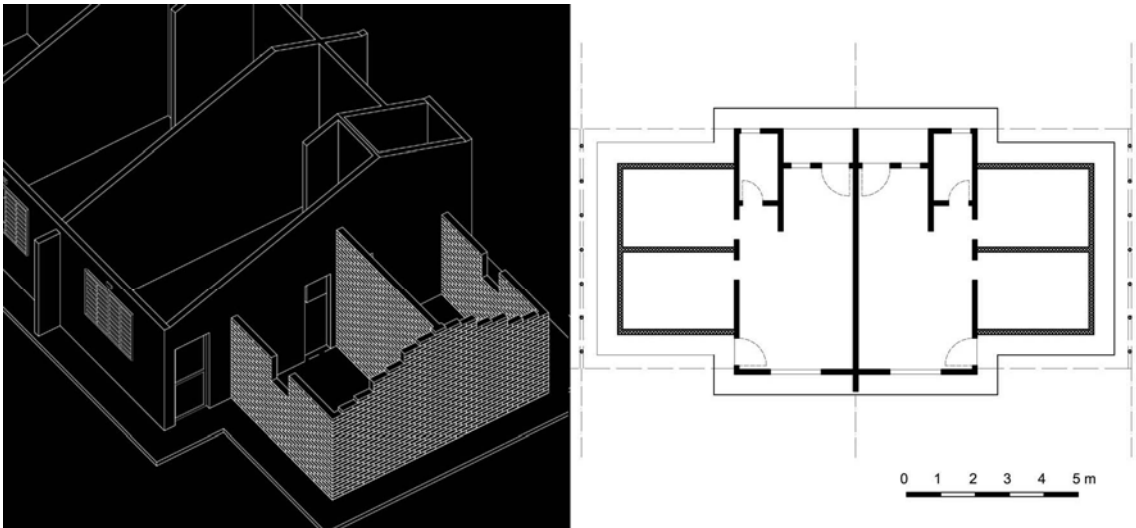
Final drawings show the example of a possible extensions of social housing in Pedras Brancas using unfired earth. Floors are made of concrete and ventilated roofs are of corrugated iron with structures of bamboos. The extension consists of two rooms of 320x245 cm and the number of blocks (24x14x9 cm) utilised is about 1,800.

⁶ Abusive houses are related to necessity of low-cost labour: «É também muito difícil compreender a cidade do presente, sobretudo no que se refere à formação do autoempreendimento da casa própria nas periferias, que predominam no espaço urbano, sem aprofundar o estudo das ações no setor da moradia desenvolvidas no período Vargas. Esta intervenção foi extremamente útil ao projeto desenvolvimentista, de substituição das importações, que requeria capitais e mão de obra barata. [...] A habitação, principalmente dos setores de renda mais baixa, deixou de ser produzida em moldes tipicamente capitalistas, passando a ser considerada uma questão social, esfera da ação do Estado, ou produção doméstica, a cargo do morador. Este processo foi fundamental para a formação das periferias, vale dizer da maior parte das cidades brasileiras contemporâneas, com todos seus dramáticos problemas. [...] Malgrado a precariedade dos expedientes que viabilizaram a casa própria, eles permitiram a transformação do trabalhador num proprietário. E, enquanto proprietário, ele acabou por ganhar direito à cidade, entendido como acesso à terra e à infra-estrutura, mesmo que os benefícios urbanos levassem anos para serem implantados». NABIL BONDUKI, *Origens da habitação social no Brasil. Arquitetura Moderna, Lei do Inquilinato e Difusão da Casa Própria* (1998), Estação Liberdade, São Paulo, 2004, p. 316-317.

⁷ A exhaustive description of Pedras Brancas is expressed in MENNO TRAUTWEIN, ARNOLD BLANKENSTIJN, MARTIJN BLOM, *Urban analyses for Pedras Brancas and selection of a project location*, in *Social Housing on Slopes, São José do Vale do Rio Preto*, April 2004.



São José do Vale do Rio Preto (Rio de Janeiro): social housing in Pedras Brancas. Present situation



Possible extensions for social housing in Pedras Brancas using unfired earth blocks and corrugated iron