MUTIRÃO IN COB HOUSES BUILDING PROCESS: ADVANTAGES AND LIMITATIONS

O MUTIRÃO NO PROCESSO CONSTRUTIVO DE CASAS DE BARRO: VANTAGENS E LIMITAÇÕES

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Key Words

Arquitetura; Construção Natural; Sustentabilidade Social; Mutirão; Autoconstrução

Palavras Chave

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ABSTRACT

Earth still is one of the most common building materials in the world, and is said that because of its low-tech approach it is a good option for self-construction and mutirão — Portuguese word for collective mobilization for mutual assistance in a free character. The problem addressed is the feasibility and social gains of the mutirão practice in cob buildings. The case study is an earthen house that the author designed and self-built in the rural area of Pelotas-RS, southern Brazil, where more than 80 volunteers helped to build. The general objective is to study the possible gains of the mutirão practice, and the specific objectives are: a) to define the concept of natural construction and explain the building technique applied in the house studied (cob); b) to analyse the relationship between mutirão and the complexity of the building technique; and c) evaluation of the observed social sustainability gains. The results showed that the mutirão sessions attracted many helpers due to the curiosity about learning an unconventional technique. They have also contributed to a more playful work environment, despite hard work. It is concluded that natural building and mutirão complete each other, and can collaborate for practical gains of social sustainability.

RESUMO

A terra ainda é um dos materiais construtivos mais utilizados mundialmente. Por sua baixa complexidade tecnológica, ela costuma estar relacionada a práticas de autoconstrução e mutirão (mobilização coletiva sem fins lucrativos). Aborda-se o problema da viabilidade do mutirão e seus ganhos sociais em construções naturais que tenham o barro como principal material. Estuda-se como caso a casa de barro que o autor projetou e autoconstruiu na área rural de Pelotas, extremo sul do Brasil, na qual mais de 80 voluntários ajudaram na construção. O objetivo geral é estudar os possíveis ganhos advindos da prática do mutirão. Como objetivos específicos, definiu-se: a) conceituar construção natural e explicar a técnica construtiva empregada na obra estudada (cob); b) verificar a relação entre mutirão e complexidade da técnica construtiva; e c) avaliar os ganhos de sustentabilidade social observados. Como resultados, percebeu-se que os mutirões atraíram muitos colaboradores, especialmente por se tratar de uma técnica construtiva não convencional. Também eles contribuíram para um ambiente de trabalho mais lúdico, apesar do desgaste físico. além do considerável volume de trabalho produzido, levando em consideração a inexperiência dos voluntários. Conclui-se que a construção natural e mutirão são complementares e colaboram para ganhos práticos de sustentabilidade social.

1. INTRODUCTION

Earth still is the most available building material in the world. It is estimated that a third of the world population live in houses made out of mud. In developing countries the number can reach to fifty percent (MINKE 2002). The Industrial Revolution, since the late seventeenth century, drastically affected how, where and with which materials would be built the houses of the ordinary people. The vernacular building practices lost their importance before mass production housing, beginning with the United Kingdom and the industrialization. Today one can see a detachment of society from the vernacular techniques, as the whole social structure suffered several changes as well, making the once popular self-construction almost fully disappear among those living in the industrialized world. Consulted works (WEISMANN and BRYCE 2006; EVANS 2002) aim this social reshape as responsible for the association of earth buildings to poverty, as people tend to take it as an inferior material.

Such situation motivated people to pursuit alternatives. In the "back-to-the-land" movements of the 1960s and the 1970s there was a new interest on studying and put into practice natural building techniques. At the energy crisis of the 1970s, many public attention was directed due to a proper use of natural resources, building energy efficiency, passive house and alternative means of energy (EVANS 2002).

2. SELF-CONSTRUCTION AND MUTIRÃO

Historically, in most cultures, it used to be a common practice for the people to build houses for themselves. If the work was too heavy or became too slow, the family and neighbors would gather to help. The idea of trading this duty to people outside the friends or family circle is recent in human history. This resulted in people working decades to pay for a house they are not directly connected with (EVANS 2002).

This disconnection is also noticed by Alexander et al. (1977), in the book A pattern language. The authors defend that modern types of property such as renting, when the dweller is not the legally owner, are opposite to natural processes of formation of stable communities and do not allow people to feel truly comfortable since the house does not actually belong to them. Emphasizing the definition of ownership control — instead of ownership as financial investment —, the authors believe that people would only feel comfortable in their houses if they could adapt them according to their needs, and such investments could only happen if they were the legally owners of the building (ALEXANDER et al. 1977).

In Brazil, as shows Bonduki (2011), the idea of the small private land was largely spread between the 1930s and the 1940s. However, that specially contributed to a wide peripheral occupation in the cities by the poorer population that moved to low cost lands, away from urban facilities, to self-build their substandard housing, once they could not have access to the limited housing programs offered by the government.

One can therefore see that self-building and mutirão — popular word in Brazilian Portuguese for a collective mobilization for mutual assistance in a free character — to Brazilian population in general is associated with lack of resources, poverty and precariousness. But the retake of these practices since the "back-to-the-land" movements from the 1960s introduces a new approach to the problem: "The natural building movement has helped humans reconnect with our tradition of self-reliant shelter, surely one of our natural rights" (EVANS 2002, p. 5). This way, people interested in living more connected to the natural environment and to each other have begun to appropriate traditional building techniques and natural materials to build themselves their houses.

What one intends to demonstrate in this paper is the good reception of mutirões — plural for mutirão — in natural buildings that use earthen techniques for walls, such as cob, to be explained later. To Minke (2002), cob building techniques does not need people experienced in building nor demand complex tools and heavy machinery. At the same time, they are more laborious to work with and it is recommended at least one experienced person in the construction site to control the process and teach the team.

3. NATURAL BUILDING AND COB

3.1 Defining natural building

It is common to think about natural building (or "bioconstruction", neologism often used in Brazilian context) as a building built with natural materials, that is, non-industrialized (Figure 1). However, any row-material to build a house, despite its roughness would demand a certain level of processing. One understands, in this kind of work, natural materials as "materials that, even when processed, retain its natural essence" (EVANS 2002, p.14). It means that a tree, even when chopped into timber sheets, keeps its natural aspects and proprieties. Industrialized timber, such as OBS or MDF, drastically modifies the proprieties of the original material, turning it into a new one, which can be no longer considered natural.

Still, as the consulted bibliography shows, the concept of natural building is wider — to Evans (2002), natural building goes beyond materials — implies in completely different attitudes addressed to site plan, ecology, work force, and use of the building. It is to pay more attention to the natural structures that coordinate the world and transport them to the work.

Figure 01 - Stone, mud and wood are examples of natural materials. Detail of a rounded cob wall corner of the studied house

Source: Author

To Weismann and Bryce (2006), more than building with what, is to ask yourself how, where and why to build. They highlight as natural building basic concepts: a) an emphasis on the minimization of the environmental impact of materials, techniques and the building itself; b) simple low-tech approach; c) use of local, renewable and available resources; d) a respect with the building site and its local environment as an unique place; e) encouragement to self-construction; f) priority to materials that have not been industrially processed, such as stone, mud, straw and wood. Also here the materials are not only important, but also a single component in a whole wider context.

In this paper, thus, one defines natural building as a practice that aims to employ only the minimum necessary of industrialized processes and materials and is characterized, formal and technically, by the presence of natural materials and low technology building techniques.

3.2 Cob walls made out of mud

Minke (2002) points out three disadvantages that mud has in comparison to the most common industrialized materials: a) it is not a standardized material, it can vary its characteristics from place to place; b) it contracts when drying, and may present cracks; c) it is not impermeable, and should always be protected from the direct action of rain. Nevertheless, this natural material has several advantages when compared to industrialized materials: it regulates the humidity of the environment, stores heat, takes low energy expenditure in its production, is reusable, economical, suitable for self-construction and preserves organic materials when in direct contact (like when it is covering wood), among other benefits.

Even the mentioned disadvantages do not discredit the use of the material. The variation of soil characteristics from different places can be compensated with the addition of more sandy or clayey soil, followed by simple tests that guarantee the reliability of the adopted trait; cracks that may appear, feared to be able to house insects like the "barber", causing the Chagas' disease, are easily eliminated by towing the wall; and the same plaster, added to generous eaves, will guarantee protection against the direct incidence of the rain (MINKE 2002).

Thus, one of the most recurring materials in natural construction is earth, or more specifically, mud. It is possible to make walls, niches, benches and other architectural elements out of mud, according to the chosen technique, that can be adobe, rammed earth pau-a-pique, cob, among others (VAN LENGEN 2009; MINKE 2002). In the house studied in this work the main technique used for the walls was cob.

Cob is an English term for a building technique building with mud that does not need shapes, bricks or wooden structure. The vernacular tradition of the English cob house dates from the thirteenth century to the industrial era. Nevertheless, the same technique or similar variations can be found in practically all the continents (EVANS 2002).

The constitution of the cob is based on four materials: clay soil, aggregate (sand), fresh straw and water. Sand and clay should be mixed in the ratio of 3:1. Therefore, sand is the most abundant ingredient, and the final trait should result in a homogeneous mass balanced, that does not shed (excess sand) and is not sticky (excess clay) (LENGEN 2008).

In cob, mud is seated with bare hands, without need of forms, complementary structures or mortar (Figure 2). The walls of the house are raised in layers (rows) of approximately 30 cm at a time. When completing the first row, you can start a new one, saving at least one day for the lower row to dry. Thus, the walls of the house are raised and dried as a single whole, working as a monolithic structure (EVANS 2002; WEISMANN and BRYCE 2006).

Figure 02 - Cob walls are thick mud walls sculpted with bare hands, without any need of surplus structure.

Source: Author

The cob wall is like a common brick masonry in small scale: the particles of sand are like bricks; clay, in contact with water, has its binder properties activated and becomes the mortar of settlement; finally, straw is added as a fibrous material to help the sand in the function of stabilizing the clay, preventing eventual cracks when drying (MINKE 2002).

Compared with conventional bricks, cob has much less embodied energy in its production, since it uses raw clay, and is not burned in wood-fired ovens. Compared to other natural construction techniques, it has the advantage of no need of shapes (such as in adobe or rammed-earth) and no need of structure for the mud to grasp to (as the bamboos in Brazilian pau-a-pique). On the other hand, cob walls require a great thickness to stabilize (around 35 cm minimum), which can be considered a problem due to the volume of material used, but could also be advantageous considering that the wall will have a larger thermal mass (it will store the heat for longer time, differentiating outside and inside temperatures).

The two main precautions when working with cob are the direct action of rain and the use of Portland cement in the plaster. Earth is not waterproof and can lose a lot of resistance when wet again. It is advisable to raise the walls of the ground with a stone foundation and to design roofs with generous eaves (between 45 cm and 60 cm). In addition, to ensure greater safety, it is recommended to protect the external walls with lime-based plaster. Lime is a porous material and allows the wall to breathe and balance its moisture with ambient air, besides its good water resistance properties (WEISMANN and BRYCE 2006). Cement should not be used when towing mud walls because, although it is more impermeable than lime, it does not have the porosity that clay requires for the wall to "breathe". Cement and clay do not work well together, and with the appearance of the first cracks, water can enter and not escape from the wall by evaporation, what makes the moisture accumulate at the base of the wall, where are the largest loads, and may collapse the structure (EVANS 2002).

4. CASE STUDY — OUR COB COTTAGE

4.1 Project

As object of study, the author presents the cob house he himself made to live, as soon as he graduated in Architecture and Urban Design. The design was made in the first half of 2014 and the work started in August of that year, going up to August 2015. The site is a small rural property in the countryside of Pelotas, Rio Grande do Sul, southernmost Brazil. An extremely narrow site (ranging from 12 m to 50 m wide by approximately 320 m long), with a hectare of area, not cultivated for more than two decades, taken by a young bush, with a total slope of 18 m towards the bottom, where a stream runs.

The three main conditioning that defined the location of the house in the site were ground unevenness, solar trajectory and visual interest. It was chosen an implantation to the center of the site, which would guarantee both privacy and proximity to the stream and beautiful visuals of the rural landscape, as well. The gaps up to 1.5 m between the ends of the building were minimized by level differences between rooms.

The house has built area of 82,56sqm — 52,80sqm of internal area, 6,50sqm of porch and 22,26sqm of wall area, which represents 27% of the built area. That happens because the cob walls were raised 42cm thick (37cm of mud + 2,5cm of lime plaster on each side), consuming a mud volume estimated at 27m^3 (almost equivalent to four loaded concrete mixer trucks).

The house has a foundation of irregular granite stones, built both to support the walls and raise them from the ground. At the ends and intersections of the foundations there are round eucalyptus pillars attached, put to structure the roof and allow it to be started before the walls were finished. In the second floor — the mezzanine — the walls are made out of wood, to make the cons walls, to facilitate the execution (raising the mud would require extra work). Both floors received green roofs, consisting of eucalyptus board base waterproofed with vinyl truck canvas.

4.2 Team work and the mutirão sessions

According to Minke (2002), a natural construction is much more laborious, given to its artisanal character. Thus, it was planned the strategy of mutirão sessions on Saturdays, to involve as many people as possible and make better use of time and tasks. However, at the beginning of the foundations, one realized that not all steps would be suitable for inexperienced volunteers, either for being physically heavy tasks, either for requiring some specific technical knowledge.

The execution of the house was taken by a three-to-five men team working five days a week full time — the regular staff — with eventual additional construction professionals' assistance — carpenters, plumbers, electricians and masons. The author, owner and architect of the house — within no practice in natural construction yet, only theoretical studies — worked as a builder and coordinated a team of young people with little or no experience in conventional building, much less in natural building. In Table 1, it is possible to see the different steps of the work and the corresponding type of workmanship, professional or voluntary.

Table 01: Steps of the work

	Fase	Mão de obra profissional	Mutirão
1	Fundações	Não	Não
2	Estrutura de madeira	Sim (carpinteiros)	Não
3	**Paredes (cob)**	**Não**	**Sim**
4	**Cobertura**	**Não**	**Sim**
5	Revestimentos	Sim (pedreiros)	Não
6	Instalações elétricas e hidrossanitárias	Sim (eletricista e encanador)	Não
7	Pisos e acabamentos	Sim (pedreiro)	Não

Source: Author

The foundations did not require professionals because they were technically uncomplicated, though very physically draining to perform. In the next step, woodwork, it was contracted a team of professional carpenters. Only in the beginning of the cob walls, at the end of the fourth month, the mutirão strategy could happen (Figure 3).

Figure 03 - Volunteers raising a cob wall at the second mutirão.

Source: Author

The mutirão sessions took a workshop shape. There were invitations published in social media, with the dates, times and schedule: leave the city at 5 am; work from 6 am to 1 pm, with two breaks for snacks; (offered by the organization, but prepared by one volunteer) and bath in the stream in the afternoon. There were also rides for those unable to travel to the site of the work by themselves, as the house is 37km from downtown Pelotas.

Figure 04 - Cob walls almost finished, at the thirteenth mutirão.

Source: Author

The mutirões followed simple dynamic: the author, who worked as builder with the regular staff during the week, would assume the task of facilitating, helping people to build. In addition to questions about the work, many conversations arose about the reasons for choosing this type of construction, advantages and disadvantages, the option to live in the countryside, etc. Eventually there were also multidisciplinary exchanges among the volunteers, many of them related to building and construction area, research and academia.

As for the tasks performed in the mutirões, there were five roles determined (Table 2): first, the coordination, by the architect and owner, and the technical support, made by regular staff workers. Volunteers took on some of the other tasks: most were builders; those able to perform more demanding tasks such as carrying weight were the helpers; and generally elderly or physically limited people were the cooks.

At the wall step, the work done at the mutirões often amounted three to four regular days of work. However, many things were already prepared beforehand aiming for greater productivity in the mutirão. Also more precise tasks, such as fixing window frames on the walls or anything that required more reflection and care, were performed by the regular staff during the week.

Table 02: Types of functions for the volunteers

Cargos	Tarefas	Encarregados
Coordenação e facilitação	Determinar as tarefas, esclarecer dúvidas, motivar	Arquiteto-proprietário
Construtores	Levantar as paredes de cob	Pessoas mais cuidadosas e atentas
Suporte técnico	Conferir medidas, nível, prumo; orientar a construção	Arquiteto-proprietário, integrantes da equipe fixa
Auxiliares	Alcançar barro e ferramentas aos construtores; armar andaimes	Pessoas com melhor preparo físico para atividades pesadas
Cozinheiros	Preparar as refeições, servir água	Pessoas prestativas, mas sem condições físicas de ajudar a construir

Source: Author

Figure 05 - The last mutirão, for the green roof.

Source: Author

Part of the green roof was also built by mutirão (Figure 5). It consisted in several layers: wooden boards base over the timber structure, cardboard, vinyl canvas (for waterproofing), cardboard again and sand (2cm). Gravel placed along the edges work as drains, as well holes in the baseboard at the ends, to allow the water to flow. The volunteers helped to get pieces of topsoil with native grass cover (7cm to 10cm thick) from the neighboring field and raise them to the roof.

In all, from November 2014, when the walls began, to April 2015, when the green roof was completed, fourteen mutirões were held, gathering 85 different volunteers. Many of them were friends, co-workers or family members, but about 25 percent of the volunteers were unknown people who found the invitation online and decided to help and share experiences.

Figure 06 - The cob-timber house in 2017.

Source: Author

5. RESULTS

Some conclusions emerge from the experience with mutirão in natural building. Firstly, it is questioned the "democratization" of the cob, defended by some authors

referred in this paper. The main demand for labor in such buildings is to make the walls. However, other steps essential to complete the house (see Table 1) are not suitable for the help of inexperienced volunteers.

It is remarkable how easily volunteers at the building site can begin to help raise a cob wall. Yet, it is important to emphasize that the scope of construction is much larger than just the walls. Those who think of building their house with similar techniques should anticipate the cost with specialized workmanship for the other steps.

Besides the ease of learning, which allowed the expressive number of attendees (85 people in 14 mutirões), it is believed that the natural building itself and the curiosity it arouses were decisive in attracting unknown volunteers, and would hardly happen in a conventional building — in the Brazilian context, industrialized bricks and structure in reinforced concrete, for example.

In addition to being in touch with a new technique, many volunteers have shown interest in participating to exchange ideas and information on issues beyond natural building — there were many conversations about food, education, lifestyle, and other topics related to integral sustainability, traditional lifestyle and contact with nature.

It is evident that the mutirão sessions required a lot of work: planning, disclosure, motivation, logistics (rides, meals), etc. Also during the process, there was significant effort to instruct the team, to distribute the tasks and to keep everybody motivated and comfortable. However, such an effort was offset by the considerable productivity and the resultant work environment as well, more playful and lighter, without the pressure often seen in building sites.

Finally, it is concluded that the making of cob walls in natural buildings is an appropriate task for voluntary help through mutirões, although it is a more laborious activity than some industrialized techniques. However, it is indicated the hiring forecast of skilled labor to other of the building that require technical experience. The mutirão in natural building is a recommended strategy due to its potential to attract people interested in the different, for offering savings, optimize the work and for collaborate with exchanges of experiences among the participants, resulting in practical gains of social sustainability.

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