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GENTRIFICATION OF VERNACULAR MATERIALS AS A KEY TOWARDS SUSTAINABLE BUILT ENVIRONMENT

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ABSTRACT

Earth and Stone are prime materials that were at the origins of construction. Since the dawn of humanity, these vernacular materials have been at the base of architecture and the act of building in general. It is through them, that architecture has begun to take shape. Moreover, these materials have always been favored by the builders in hot countries because they are simply the most adaptable to their climate. Nevertheless, since the advent of cement, followed by concrete that allowed for more daring achievements up to architects' expectations, these vernacular materials have been rarely used or have become marginalized in architecture. They even became symbols of heritage, anti-modernist era and sometimes of social categorization. We believe that gentrifying these materials, by using them in a more modern efficient and effective way, will allow them to regain their place in the architectural arena. Furthermore, they will be accepted by upper social classes as they will offer modern architectural solutions by using clean recyclable materials with a minimum of energy expenditure. This paper aims to demonstrate the particularity of these vernacular materials and how their gentrification can be a key towards achieving a sustainable built environment.

KEYWORDS: Gentrification, Earth, Stone, Vernacular Materials, Sustainable Built Environment

1. INTRODUCTION

Earth has been known as the most locally-available, abundant and cheap construction material since the dawn of Humanity. It is an environmental-friendly material to build with and widely spread as one third of the world's inhabitants live in houses constructed from earth. Moreover, this material is economically-sustainable, as

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it is usually excavated from the site itself; plus, clay and laterite (iron contained clay) represent 70% of earth's landmass [1].

As an indication of joining the modern world, western materials and construction techniques have been adopted inappropriately in the hot-climate countries. However, in these countries vernacular architecture and indigenous constructions techniques, that are more adequate to the environment, witness that adaptability [2]. We believe that the social connotation and the image associated with buildings of earth have played a big role in the rejection of this material. It is a fact that earth dwellings and mud constructions were linked, a very long time ago, to rural and semi-rural populations. Nevertheless, in recent years, earth construction science has developed enormously in order to revive old techniques and to surpass its limitations. This evolution in building with earth made it possible to compare its performance to other modern and contemporary materials, and thus for earth constructions to become a technology [3]. Yet, most of the people still have in their memories the same old image when they hear about building with earth. We believe that these old ideas hold back the spread of this material especially among upper classes.

Building constructions based on earth are also economically interesting in our regions, if architects effectively manage designs, logistics, quality management and technology in manufacturing and construction. One of the advantages of earth houses is the climate adaptability and energy savings qualities. Houses built with earth are low-energy, low-cost and passive models. They might be cheaper as a building option, yet, they can be of very high quality, durable in dry, as well as wet climate.

It is proven that the construction industry is actually considered as a main source of waste production, pollution and carbon emissions. On the one hand, sustainability characteristics of earth-based materials led us to believe that this vernacular material could revolutionize the achievement of sustainability in the built environment. This benign material minimizes pollution and waste, lowers carbon emissions, and guarantees efficient use and recycling of finite resources, local sourcing and biodegradability [4]. On the other hand, we are well aware that free availability

and widespread, associated this material with poverty rather than a durable substance of a very good recyclable quality. Moreover, the need for the existence of a certain social hierarchy made it clear that the built environment is produced with a certain symbolic connotation. This built environment may involve "humble" or "modest" architectural solutions or materials as an evidence of social categorization reality [5].

Therefore, we believe that the key for this material to gain back its place among the contemporary construction materials is its acceptance by the upper classes. More explicitly, the gentrification of these materials, by using them in a more modern efficient and effective way, will allow them to regain their position in the architectural arena. Furthermore, they will be reaccepted by other social classes as they will offer modern architectural solutions by using clean recyclable materials with a minimum of energy expenditure.

2. RESEARCH INTERESTS AND OBJECTIVES

Earth architectural and building techniques, as a vernacular construction material, are of great interest to the sustainability of built environment. This paper explores the use of earth, as a contemporary construction material, its advantages and its techniques. It will also shed light on the aesthetics and aspects of earth as a construction material and how this substance could be used to fulfill, aesthetically and functionally, the needs of the modern urban world. Therefore, examples of modern contemporary projects from countries that started to adopt earth construction as a new trend of environmental sustainability will be studied. Showing that gentrifying these vernacular materials, by using them in contemporary housing designs for upper class clients, may contribute to spreading the usage of this material as a main actor towards achieving environmental sustainability and thus a sustainable built environment.

3. GENTRIFICATION OF A VERNACULAR MATERIAL

Earth, as a construction material, was considered for a very long time as a symbol of architecture for poor societies [6]. As it is an affordable material that can be found on the construction site, plus it doesn't need a complicated manufacturing

process. Therefore, the collective memory of different populations usually related this material to non-aesthetic and unsanitary housing, as it was usually used as a building material in the villages for peasants' housing. Nowadays on the contrary, it's considered in many European and American countries as a symbol of eco-urbanity. It is used by richer communities as evidence of environmental awareness, energy-saving trends and urban ecology practices. According to "Vocabulary.com Dictionary" gentrification happens "When people with money start fixing up poor neighborhoods". In other words, it can be considered as "making something suitable for a higher class of people" [7]. So gentrifying a certain material will be making it suitable and socially appealing for higher classes' architectural practices.

Vernacular materials are primitive materials that promote for sustainability in its simplest form [8]. They are energy-savers, comfortable and climate-responsive; they exist on the construction site and therefore are sustainable. Vernacular materials are basically used by humans as a way of survival by the accessible natural resource, as well as living in connection with their surrounding environment. This is why vernacular materials come in a wide variety of color schemes, depending on the region of origin. Gentrifying vernacular materials will be making primitive, recyclable sustainable materials- that are highly adaptable to the surrounding environment- fashionable, socially-attractive and suitable for upper classes' social and urban practices. This process will certainly promote for sustainable built environment and thus a better ecological urban community. As "every usage is converted to a sign itself" [9], the symbolic acceptance of upper classes and cultured population of earth to dwell-in will be a sign for other social classes that earth is not only used for or by the poor.

4. HISTORICAL BACKGROUND ON EARTH AS CONSTRUCTION MATERIAL

Earth as a building material can adapt itself in almost every climate and is not limited to a certain one. As long as buildings have boots (good foundations) to protect them against humidity and hats (overhanging roofs) to keep them from the driving

rain, they can last forever. Raw earth was one the first construction materials worldwide. Effectively, the techniques of cob, wallow and bricks have emerged towards the 10th millennium BC and are still in use today.

In every continent, unbaked earth has been a major building material. Archeological excavations are the biggest witness on this fact. There are entire cities that were built from earth, and not just mud huts but monuments and temples, such as Jericho and Babylon and its famous tower of seven stories high [1]. The Great Wall of China is also constructed of earth some 5000 years ago plus other earth buildings found from the 7th century BC. In Luxor, Egypt also the remains of Theban Necropolis of Ramesseum show great ancient achievements in the adobe barrel vault construction [10]. Rammed earth technique was introduced in many countries as a consequence of colonization. For example: in the Rhone Valley in France, the Romans introduced this technique in order to build their Gaul Capital Lugdunum at the South East near the Alps where they can easily find the suitable earth material for constructions. Furthermore, when the Arabs entered Spain, they introduced the *adobe* (a kind of mud brick) that was more convenient and adapted to heavier clay soil [1]. That same technique was imported later by the Spaniards to South America where today, in New Mexico, we still find the traces. The earth construction technique even attained Australia in the 1850's.

Nowadays, the environmental degradation of the planet Earth motivates research and experimentation centers, as well as public and private enterprises, to come up with better alternatives of construction materials other than concrete and steel. These attempts hope to reduce the negative impact of the construction process on the environment, to reduce our ecological footprint and to maintain our natural resources intact.

This is why there is a growing interest to go back to more natural building materials like earth and straw. Nevertheless, the real challenge, in a world where concrete culture prevails, is how to change the *cliché* of living in mud huts? This spread notion in the media or even common life that conveys unhealthiness and poverty!

5. EARTH BUILDING TECHNIQUES

The association of earth, as a building material, with poverty distorted its image; this is why its quality and durability are overlooked [3]. Earth, as a building material, can offer very high quality architectural solutions in all weather conditions: wet, hot, humid or even cold climates. However, its construction technology is variable, not only technically, but also physically and socially according to the region, the soils availability, the way they can be used and the function for which they are used, etc.

Earth is a beautiful material that can provide acoustic and thermal insulation. It has this ability of regulating internal air temperature and humidity. Moreover, it can form walls (non-load and load bearing), roofs and floors, etc. Here are some of the very famous techniques to build with earth.

5.1 Wattle and Daub

It is one of the cheapest techniques and the most ancient ones. This technique is used worldwide to make dwelling walls where the sticky earthen material of daub is bonded with a woven wattle of wooden stripes [11] as shown in Fig. 1. The inconvenience in this technique that it is more used in a rural context and not an urban one.

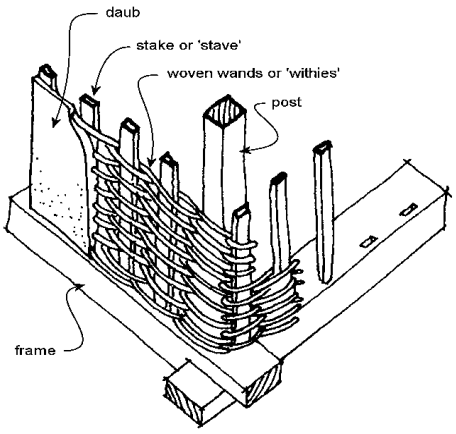

Fig. 1. Wattle and Daub technique [11].

5.2 Adobe

The Adobe technique is about creating sun-dried blocks made of earth as shown in Fig. 2. Nowadays, this technique is adapted to be more durable by mixing soil with

some cement or clay to strengthen it. Bricks produced from this technique are often very solid, beautiful and convenient for urban modern uses. In Egypt this technique costs around 200 LE/m^3.

Fig. 2. Adobe Production [12].

5.3 Stabilized Earth Blocks, Compresses Earth Block or BTC (Blocs de Terre Coprimee)

These blocks are harder and more durable. The addition of small proportions of cement or lime (5-10%) to the earth mixture (soil 60%: clay 30-35% and sand 35%) and sometimes some bitumen as a water repellent makes the material harder, durable and water-resistant [1]. This technique is one of the most adapted in urban areas as the blocks' size is usually standardized and produced by high pressure machines. Moreover, the performance of these blocks is as good as any other brick blocks in terms of capacity, durability and maintenance. In Colombia 1 m^3 of BTC sieved through 1.5 cm usually costs 12.5 Euros, as the minimum salary in Colombia is 200 Euros/month. As in Switzerland it was very hard to calculate the cubic meter but the square meter costs 104 Euros if industrially produced and 78 Euros if crafted manually.

5.4 Rammed Earth or (Pise de Terre)

The product that comes out of this technique is usually very beautiful and appealing to different social classes. In this technique a dense monolithic wall is created by compressing earth between temporary formwork or shuttering. Like the previous technique, small amounts of lime or cement are added to the mix in order to

strengthen it. After drying, rammed earth wall will become as durable as sandstone, as long as its bottom and top are waterproofed [1]. The compacted earth layers, with their different colors, form a very artistic walls at the end as shown in Figs. 3, 4.

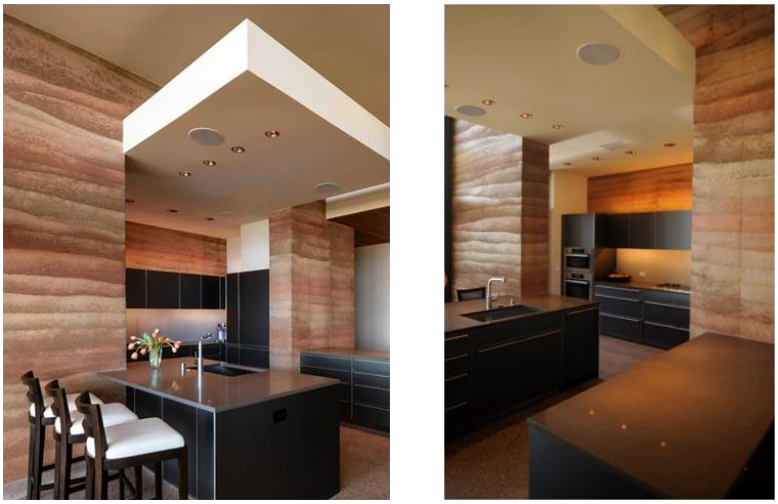

Fig. 3. Rammed earth House in New Mexico [13].

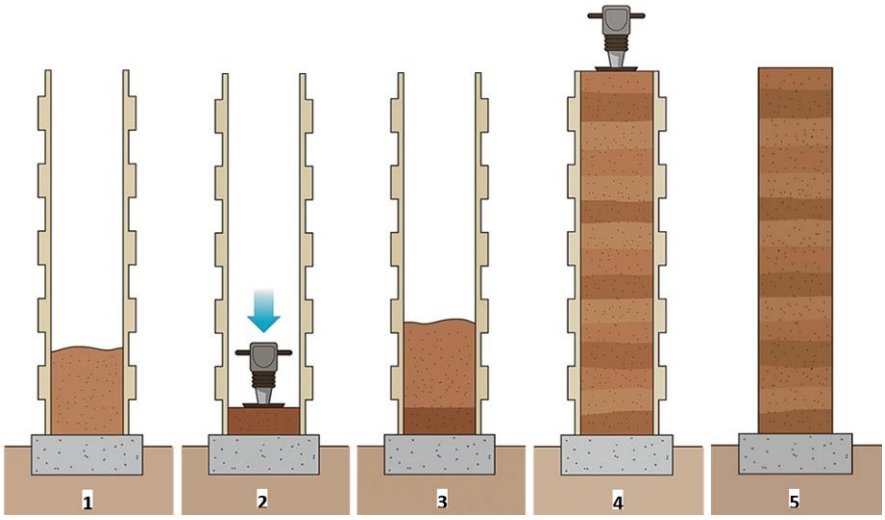

Fig. 4. Contemporary rammed earth technique [13]. 1- Wooden temporary forms are placed on poured concrete foundations; 2- A damp moist blend of sand, gravel, silt, clay and cement is poured in layers (15-25 cm thick) into the wooden forms; 3- A pneumatic backfill tamper compacts firmly each layer until it becomes very solid and hard; 4- Compiled layers are firmly compacted one on top of another to reach the top of wooden forms or the wall. To increase energy efficiency, heat insulation can be integrated. Moreover, in the areas of high seismicity, reinforced steel is also incorporated; 5- The wooden forms can be finally removed once the top layer is strongly compacted.

6. THE RIGHT TO THE CITY IN EARTH BUILDING

Every citizen has the right to live as an urban dweller if he wishes to [14]. He/she has the right to enjoy the modern life to dwell in contemporary houses and to access all the services of an urban area. Since earth construction was usually associated to life in rural areas, it was rejected by people in favor of reinforced concrete and steel construction as a symbol of mounting the social ladder. This is why around 82% of earth builder recognize that negative perception of earth as a construction material is non-negligible [15].

We acknowledge that today the perception of building materials is affected by notions of progress, the desire of economic growth, specialization and industrialization. However, the right to city should be in its favor not against it. As Harvey said " *It is for this reason that the right to the city has to be construed not as a right to that which already exists, but as a right to rebuild and re-construe the city as a socialist body politic in a completely different image—one that eradicates poverty and social inequality, and one that heals the wounds of disastrous environmental degradation*" [16]. The urban produced space should enhance more the city life adding to its qualities not a catalyst for its deterioration. We believe that by gentrifying eco-local materials like earth and stone, the produced urban/social space can largely contribute to the sustainability of the built environment and community resilience. This is why this paper aims at helping to rediscover these natural materials -whose transportation and transformation necessitate little energy- via shedding light on contemporary projects and examples of earth constructions worldwide.

6.1 The Garden City of Cota Cundinamarce, Colombia (La Arborada de Cota in Colombia)

This residential project of 196 villas and common facilities (sauna, gym, swimming pool and tennis courts) extended over 50000 m^2, is located in a humid area near Bogota River. It also includes a vegetable garden that insure a self-sufficiency for the inhabitants of the residence. This luxurious project by TierraTEC is built completely with BTC (Compressed Earth Block) with 6% cement. It demonstrates that

construction with local materials can also rhyme with modernity. The BTC blocks were produced in the construction site with a manual machine. This process saved a lot of money and preserved the natural environment as shown in Figs. 5, 6.

Fig. 5. The Garden City of *Cota Cundinamara*, Colombia [12].

Fig. 6. Interior of the houses in the Garden City of *Cota Cundinamara*, Colombia [12].

6.2 Archaeological Heritage Interpretation Center in Dehlingen, France

In this project by Nunc Architects in Dehlingen Alsace-France, this museum of archeology values two techniques of earth construction. It's an ancient villa that needed to be renovated and extended to create the museum. The two construction techniques are based on raw earth: the first is about traditional mud walls in the old building of the 17th century that were renovated; the second technique is rammed earth walls that were used in the extension. In the interior they produced baring walls

of rammed earth (2% lime, 2% cement), in the exterior non-baring stabilized rammed walls of 6% cement. The soil was collected at a depth of 5km at the construction site, so the compacted earth layers evoke the strata of the archeological excavations. The project was achieved in 2014 and covers 428 m^2 renovated and 74 m^2 in the extension. As the rammed earth has low thermal resistant and high inertia, the interior groomed wall is separated by a cork insulation of prefabricated modules placed outside. Also the south gable that is lined with a glazed wall forms a passive solar heating system. This symbiosis between art, technology, architectural performance and eco-friendly construction materials is a symbol of gentrification of an old construction material. This example can easily shift old thoughts towards another perspective as shown in Fig. 7.

Fig. 7. Interior and exterior of the Archaeological Heritage Interpretation Center of Dehlingen, France [17].

6.3 Palo Alto Meditation Center California, United States of America

The Windhover Meditation Centre was designed by the Aidlin Darling Design and inspired by the Californian artist Nathan Oliveira's artwork. The project was finished in 2014 to cover 372m^2. The construction technique used is stabilized bearing rammed walls. This project offers to the community of Stanford University temperate spaces through its passive strategies. The atmosphere is refreshed via the plant transpiration and the evaporation of the basins' water plus the thermal inertia and the natural ventilation. The earth used is taken from the site excavations to form walls 46 to 61 cm. This project is another symbol of vernacular eco-friendly material's

gentrification to offer an impression of permanence and attractiveness to the inner journey as shown in Fig. 8.

Fig. 8. Interior and exterior of the Palo Alto Meditation Center [18].

6.4 The Royal Automobile Club of Victoria Hotel Complex, Australia

Achieved in 2013 and covering 2600 m^3, this project is located near a very well-known Australian surf spot. It is a luxurious complex and resort that contains breakfast room conference, restaurant, swimming pool, bar, spa, gym, and golf club. The projects encloses many challenging techniques as the wall height of 12 m necessitated on-site prefabrication of stabilized rammed earth modules, mounted using a crane. The rammed earth modules incorporate a steel support structure and a rigid insulation. Cracks is avoided by taking into consideration the dilation between materials. The construction material is mixture of earth, chert (siliceous rock was taken from the seabed) and cement as shown in Figs. 9, 10.

Fig. 9. Interior and exterior of the complex of The Royal Automobile Club of Victoria Hotel Complex, Australia [18].

Fig. 10. The complex of The Royal Automobile Club of Victoria Hotel Complex, Australia [18].

7. CONCLUSION

Architectural expression has been since long ago representative of a whole spectrum of distinctive urban/rural life-styles. Since the industrial revolution with the growing urban community and the aspiration of economic growth, there is a tendency to focus more attention on building and architects rather than the urban/social produced environment. Therefore, the option for construction materials was driven away from vernacular alternatives labeled as unprogressive and associated with poverty an unsanitary. The field of building materials was polarized in a way to be directed towards unyielding concrete, steel frames and glass; these materials are

standardized and recognized as more prestigious, durable and long-lasting. They became the symbol of modernity, however they are the environment biggest enemy, usually expensive and climatically inappropriate. Modern construction materials are constantly rising in cost and polluting the environment, for this reason vernacular eco-friendly construction materials should regain its status in the architectural arena.

Earth today as construction material is conquering the field of architecture thanks to many buildings of remarkable technical and aesthetic qualities. However, as "Old ways of life" become folklore [14], we believe that this is the major barrier for this construction method to thrive as a modern sustainable building solution. The social connotation related to the image of earth architecture, that it is architecture of/for the poor, exacerbates the gap between people of high societies and their natural environments. Adding to this that in the competitive world we live in, as a hope for reaching upper social classes, people tend to imitate others' social practices even if it's not environmentally or financially suitable for them. This is why in some Egyptian villages or oasis, the transition to concrete construction is always a symbol of richness, regardless of the level of comfort, sustainability or affordability that earth architecture offers.

We suggest in this paper that the gentrification of these vernacular construction materials via offering attractive contemporary architectural solutions, as well as using neat contemporary finishing supplies is the key to this dilemma. Giving a new social image to vernacular material will help architects, planners and users to sustainably restore the built environment.

Our built environment, like any other industry, is subject to manipulation by a select group of people. Nevertheless, this built environment is also a social production that implicates several factors [19]. The key to its sustainability is to return to eco-friendly solutions. Earth and stones are vernacular materials that can be reused to achieve this goal. Once accepted by the targeted social class, the others will follow the same trajectory. Consequently, the gentrification of these materials will be a symbol of eco-urban social practices that can attract all social classes. It will be an elevated vector in the field of achieving environmental sustainability.

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رفع المستوى الاجتماعى لمستخدمى مواد البناء الدارجة كمفتاح نحو بيئة عمرانية مستدامة

يهدف البحث الى توضيح خصوصية المواد البدائية وكيف ان تطويرها وتحديثها قد يكون مفتاحا للتحقيق بيئة بنائية مستدامة، حيث ناقش البحث أن استخدام الطين والحجارة من أوائل المواد المستخدمة فى بداية البناء حيث إتخذت العمارة من خلالهما شكل خاص وان هذة المواد كانت دائما مفضلة من قِبَل صناع البناء فى الدول ذات المناخ الحار لأنها هى الأكثر قدرة على تحمل هذا المناخ، ومنذ ظهور الأسمنت وبعده الخرسانة، التى سمحت للمعماريين تحقيق انجازات جديدة وجريئة تصل الى توقعاتهم وتلبى رغباتهم، فقد أصبحت هذه المواد مهمشة تستخدم نادرا فى الهندسة المعمارية، حتى أنها أصبحت رموزا للتراث، غير مواكبة للحداثة بل أنها أحيانا تعتبر عامل من عوامل التصنيف الأجتماعى، ويؤكد البحث أنه نظرا لان موضوعات الطاقة والأستدامة والعثور على طريق بناء جديدة صديقة للبيئةأصبحت أمرا هاما فان إعادة أستخدام وتحديث هذة المواد النظيفة أصبح ضروريا و عليه فان تطوير هذة المواد، بإستخدامها بطريقة أكثر فاعلية وكفاءة، سيسمح بإستعادة مكانها في الساحة المعمارية. كما أنه سيتم قبولها من قِبَل الطبقات الإجتماعية العليا حيث ستقدم الحلول المعمارية الحديثة بإستخدام مواد نظيفة قابلة لإعادة التطوير بإستهلاك الحد الأدنى من الطاقة.