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CONTEMPORARY EARTHEN ARCHITECTURE IN MEXICO

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Abstract:

The purpose of this study is to put forward an appraisal of current remarkable works of earthen architecture in Mexico, where raw earth architecture, particularly in adobe, has been built since ancient times, nevertheless, it has been substituted by industrial materials that bring poor living conditions for the inhabitants both in urban as in rural areas. Recently, rather than vernacular architecture built by their users, it is within architectonic design that a kind of revival has been taking place over the past two decades. This new language is being written both with adobe as with rammed earth building techniques. Interesting to point out is that the introduced technology on raw earth, is based upon an exchange of information between traditional workmanship and building methods transmitted as knowledge and skills acquired in an intuitive way along several generations (Balkrishna, 2007), plus the contribution that architects bring with technology and design, permitting constructions to improve in addition to its living conditions and durability. As prior methodology, the results of this paper are based upon interviews made to the designers, builders and users of the works exposed, in the observation of the technical behavior that the use of raw earth has had and in consulting written references about the works exposed when available. Though still in a low scale, encouraging is to notice that both private as well as public investors are beginning to get convinced of the benefits earthen architecture represents in terms of energy saving, as costs are reduced in a considerable way, not to mention the environmental damage that diminishes considerably when industrial materials are substituted by earthen ones.

1. Introduction

As in many countries with a rich historic tradition on earthen architecture, in Mexico, there are several ways of using earth as a building material. The most common of them is adobe, widely used in cold and in hot climates, in dry as in humid areas, in combination with different roofing solutions, depending on the weather conditions of each site; in places with abundant rainfall tile roofs predominate (Aguilar, 2008), while in places with low and scarce rain plain roofs are mostly used. *Bajareque*[2] is another earthen building tradition practiced particularly, though not

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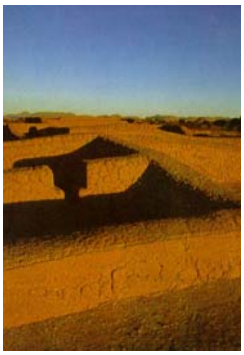
exclusively, in very hot and humid areas such as Mexico Pacific coastline, at the Peninsula of Yucatan and in the subtropical humid region of the Huastecas[3] (López, 1999). Houses are still being built with *bajareque* at the Huastecas and in Yucatan, featuring, in the latter, the well known Casa Maya[4] (Fig 1). Three decades ago its use has notoriously declined at the Pacific Coast, where traditional building techniques and their corresponding natural materials, started to become substituted by industrial ones, due particularly to cultural changes as a consequence of a lack of serious planning and badly oriented policies for tourist developments.

Fig 1: **Casa Maya, Yucatan Peninsula.**

Source: Berenice Aguilar.

Fig 2: **Paquime, Casas Grandes, Chihuaha.**



Source: Paquime Guidebook, INAH, 1994.

Rammed earth never expanded throughout the country as in contrast with Latin American countries such as Colombia (Holguín, 2008) and Chile. However, at the north part of Mexico, in Casas Grandes, Chihuahua, stands Paquime[5] (Fig 2), an eight hundred years old complex featuring rammed earth structures, partly restored today. Rammed earth has experienced a revival in the last years thanks to a small group of architects that are interested in experimenting with traditional techniques put into practice for contemporary utilization challenges.

Nevertheless, the most common use that earthen architecture has had in Mexico throughout its building history is adobe or earthen blocks. Adobe buildings have been built in Mexico since the ancient times; the Mesoamerican period[6], before the Colonial times, saw its use widely spread throughout the wide range of regions where the raw material is found[7]. A frequently used

[2] Bajareque: Latticework covered with loam. Straw is used as reinforcement. It is commonly used in tropical, sub-tropical and mild climates of the world. (Medel, 1994).
[3] Huasteca Region: It occupies a vast territory from the northeast of the country extending throughout four states and parts of other three. Geographically it is conformed of mountain range slopes facing the east and the coastal plains. (Chanfón, 1997.)
[4] Casa Maya: Ancient building habitat typology consisting of a high thatched roof and apsidal plan, wisely solved corresponding with the extremely humid and hot climate as well as a sage protection against hurricanes that lash the Peninsula of Yucatan during five months of the year.
[5] The Paquime civilization was the major Indian trading settlement in Northern Mexico between 900 and 1340 AD. Instituto Nacional de Antropología e Historia. Beatriz Braniff. Conaculta. 1994.
[6] The Mesoamerican period ends with the Spanish Viceroyalty in AD 1542.
[7] Construir con Adobe, Berenice Aguilar Prieto, Trillas, 2008.

system is the one that combines adobe walls with tile roofs[8]. In northern parts of the country the adobe system is solved with flat roofs or *terrados*[9].

Now, earthen architectural background, as it is well known, refers to the vernacular building traditions; part of local cultures, while contemporary earthen architecture, consists mainly of architectonic design, that is, buildings conceived by a learned author rather than by the inherited knowledge of a determined culture. The difference is significant in many ways, among which, one consideration is that, unlike traditional typologies that derivate from local and regional communities, the author can choose from a range of building options; his knowledge is reasoned while vernacular architecture possesses an intuitive knowledge. Starting from these premises, it is understood that contemporary architecture is focused on particular cases and therefore do not illustrate necessarily traditional building techniques, even when it sometimes has been based and inspired by a vernacular typology. It is within this understanding that this paper aims at displaying the actual panorama of earthen architecture in Mexico nowadays.

Late back in the seventies, people living in the cities started to build weekend residences using local materials and building techniques mainly adobe and tiled roof houses. In the last decade, the genre of buildings started to cover restaurants, museums, social security facilities and some even annexed buildings for state universities.

Earthen contemporary architecture in Mexico features diverse possibilities and practices, among which are new adobe buildings made with manual bricks or with btc[10] (Ecoblock, 2007), concrete is often used for the structure and sometimes even steel. Works of restoration and recycle of colonial structures can be added to this incipient revival on raw earth for building. Stabilized rammed earth system is as well experimenting an early beginning in places where climatic conditions are extreme and when massive volumes to lodge both educational necessities and even wineries, are needed.

Adobe and earth based building techniques in general, are easy to appropriate technologies. Availability of adequate soil for building adobes is an advantage that exists in Mexico as it is found in a wide part of its territory. Four climates that predominate in this country determine the building systems and design solutions of each region; Hot and dry, desert like climate, mild climate, cold and humid mountainous climate and hot and humid subtropical climate.

A regional approach was chosen based upon the places where representative architectonic designs have been actually built. Among the works presented in this paper are a rammed earth winery built on 2002, in Ensenada, Baja California. A case of recycling work on an eighteenth century property transformed into a restaurant at the historical and well preserved city of Oaxaca, a building holding the School of Arts and Crafts of the State University of Oaxaca, recently built on rammed earth at the outskirts of the city, a Center for the blind built with

[8] The tile roof system in adobe houses is mainly found at Chiapas Highlands, at the mountain regions of the State of Mexico, including the Volcan Popocatépetl settlements, at the valleys of the State of Morelos and at the Lake Region of Michoacán State.
[9] Terrado: From the lat. *terra.* Building system that consists in placing wooden boards on top of the beams, they are covered with an earth layer. Lime is added. Normally, it is covered with brick tiles.
[10] Btc: Fr. Bloc de terre comprimé. Blocks are sometimes stabilized.

tepetate[11] at an overpopulated and conurbated district of Mexico City, and a weekend house at Malinalco, a beautiful and well preserved town, north of Mexico City.

Nowadays, concrete and steel structures are used in a certain percentage for new earthen architecture where the walls stand as mere wall filling bricks. In restored adobe buildings, concrete and steel are used as well, deconstructing the traditional language of adobe but achieving innovative spaces and techniques that permit to enjoy at the same time, the advantages of adobe thermic walls that benefit both hot and cold climates (Minke, 2001).

2. The works

2.1 Ixtapalapa Center for the blind

The Center for the Blind was conceived by Mauricio Rocha, as part of a Governmental Program to provide Ixtapalapa, one of the city's most poor and highly populated borders, with social and cultural facilities. The complex, an area of 14,000 square meters, satisfies both educational and recreational necessities in a district area that has the most elevated rate of handicapped persons. The center is open to the public to motivate the social integration of blind people to daily urban life.

Bounded by two important avenues, the complex occupies a piece of land at a corner that was used as building materials waste land. Both conditions were considered to develop the architectonic concept: to surround the complex by a wall on its four sides, as an acoustic barrier against the noise; and at the same time, as a wall-slope for containing the building materials waste. The result was a 100 m² long wall (Fig.5).

The slopes of the wall in the inside generate small patios of different dimensions achieving different spatial qualities for the blind persons to experience. The layout of the overall plan can be discovered as a series of filters from the very entrance that unfolds in parallel bands. The first filter lodges the administration building, a coffee shop and toilet facilities. The second filter consists of two parallel lines of buildings organized symmetrically along a central plaza. These buildings contain a shop, the tiphlotec, phonotec, and five workshops for painting, sculpture, theater, dance, carpentry, radiophony and electricity. At the workshops exhibitions can also be hold. The third and last filter contains classrooms that face the gardens and private patios. From the access, the way the filters are displayed is by a series of volumes with a double height that contain the library, the gym-auditorium and the swimming pool.

The buildings are simple rectangular shapes based on concrete frames structure and plain roofs, in spite of which each group of buildings allows exploring several kinds of spatial and structural relationships in order to make it easy for the blind people to identify each space,

[11] *Tepetate*: A tuff volcanic stone (powder, ash or erupted clay that has gone through a consolidation process hardening into cement and forming sediment). Its volumetric weight is 1/100 kgs/m³. Yellowish in color, it is found in thick layers at open sky. A light weight but resistant material, used, instead of *tezontle* (another type of volcanic stone frequently used for building) in several ways: for creating the slope needed at flat roofs, as filler material between one floor and the next one and for the bathroom space required for installations as well. It is used as ashlar (stone to build walls) (Medel, 1994).

according to different intensities of light, proportions, wall textures and spaces, sound and noise, which corresponds with the activity being held. For instance, the administrative quarters were treated with crystal walls, unlike the second and the third filter areas, where the buildings were more solidly solved using *tepetate* walls on top of a concrete basement. The access and a horizontal line of crystal, between the ceiling line and the walls, allow natural illumination: the sole openings of these buildings.

Figs 3, 4, 5: **Library, main view and surrounding wall viewed from outside.**

Source: Luis Gordoa.

To facilitate the comprehension of the center by the blind persons, several sensory experiences were considered as part of the integral design concept; aromatic plants in the inner spaces, the sound of water from a pond that runs along the buildings, the texture of stone and of the earthen walls of *tepetate* (Fig. 4), all chosen as guiding elements; the height where the texture changes was thought according to the height of a person's hand. The constructive system utilized at the library eliminates the use of columns at the floor level, permitting to enjoy a free area to walk through (Fig. 3)

2.2 Visual Arts School, State of Oaxaca University

A recycling and low energy consuming architectonic example, the Visual Arts School of the State University of Oaxaca, also designed by Mauricio Rocha, is located in the outskirts of the city, where, in contrast with the rich historical and well preserved downtown area, the urban landscape, as a result of a lack of planning, has very poor surroundings. Therefore, the concept that guided the project is one of introspection and isolation from the outside views, neighboring land and nearby roads.

Fig 6: **School for the Visual Arts, Oaxaca. Overall view.**

Source: Carlos Facio

Fig 7: Workshop.

Source: Rafael Carrillo

The way such a challenge was achieved is by placing the school complex on a huge slope (Fig. 6) built using the rubble and the remaining soil of the rest of the campus building works. This way of solving the main purpose of the project gave place to a concept based more upon a garden that lodges a school complex rather than by a school containing a garden.

The main building system used is rammed earth walls, stabilized with cement on a 5%for a better performance against humidity, in an attempt to reduce energy costs as well because of its well known thermic value. This noble material, additionally, diminishes considerably water consumption during the building works and requires very low quantities of cement.

Stone walls contain the whole slope and conform at some points, border buildings inside. The earthen buildings house the workshops, displayed as a chessboard layout where the white squares are the open areas – patios, and the black ones are the inner spaces – workshops. The latter ones were solved in a U shape, whose only translucent façade looks to the north, where the quality of light needed for a workshop is better as it is more uniform (Fig. 7)

Fig 8: Los Danzantes, Historical District, Oaxaca.

Source: Alejandro Espinoza

2.3 Restaurant Los Danzantes, Colonial District of Oaxaca

Emblematic historic buildings, frame the rich colonial city of Oaxaca. Their inhabitants have been precautious and sage enough to preserve their value as historical heritage in its central downtown, thanks to which recycling works of old buildings are being conceived and designed to lodge nowadays necessities of urban daily life.

Within this valuable urban atmosphere, recent works of architecture add significance to the city. Such is the case of Restaurant Los Danzantes, a work of restoration, intervention and recycle, carried out by Alejandro Dacosta, who reinterpreted the historical site architectonic values utilizing a contemporary language based upon forms and volumes, clear reminiscences of the architectonic history of Oaxaca, that express a clear contrast with some of the original restored walls. The newly designed building elements, such as some of its interior and exterior walls, permit by contrast, both a conscientious appreciation of the old and the recent intervention of this eighteenth century dwelling.

Fig 9**: Restoration. Second floor.**

Source: Alejandro Espinoza

Fig 10: **Construction of the earth brick wall.**

Source: Alejandro Espinoza

The house, originally a catholic parish known as The Blood of Jesus, is strategically situated between the Cathedral and the former convent of Santo Domingo de Guzman. With 1000 square meters, this building, bearing a human scale, introduces itself as a succession of lighted and shaded spaces. After the restoration works were carried out (Fig 9), a 7.5 meters high wall (Fig 10) was built surrounding the backyard walls. The adobes were rotated to form a 45°angle to create a sculptural and dramatic atmosphere accentuated by the strategic incorporation of artificial light at night (Fig. 8), featuring for the guests, a suggesting atmosphere emphasized furthermore, by a large pond.

2.4 Paralelo Winery, Ensenada, Baja California

Located at the core of Valle de Guadalupe, well known for its vineyards, the Paralelo Winery, performed as well by Alejandro Dacosta, is an earthen cross shape building with desert vegetation carved motifs (Fig. 12), built four years ago, to embody wine culture. The landscape (Fig. 11), conformed by the red soil and the hills of granite origin, softly facing the east, acts as a frame for Paralelo Winery and its vineyards.

Paralelo Winery, a three stories building, designed to house the rich product wine is, to honor the soil and to dignify the agriculture process, unifies the enjoyment of wine through the creation of get-together spaces, with the beauty of the vineyards, whose luminosity contrasts dramatically with the shade of the mountains that define Valle de Guadalupe.

Fig 11: **Rammed earth walls under construction**

Source: Alejandro Espinoza

Fig 12**: View of winery from Guadalupe Valley**

Rammed earth walls (Fig. 11), were used for the building system; the obtainable material at the site was most efficient since the composition of the ground at the bed of Valle de Guadalupe is mostly sand, and thereby exposed walls could bear the radical temperature changes (which require 50 ºC externally and 18 ºC internally) and work in the most favorable way. The thermic flexibility needed to isolate the wine cellars was created by adding a third part clay to a small amount of cement and lime to agglutinate the mix. The final resistance came to be 50 kg / cm2. The section of the rammed earth walls is 90 cm at the base and 70 cm at the top. The highest wall reaches 6.5 meters, the rest measure 4 meters. A concrete slab foundation was the most adequate solution for the sandy soil. In this case, while the roof doesn't have a considerable weight itself (aluminum and polyurethane), extraordinary weight resistance was needed to bear the weight of trucks ascending the roof to unload the grapes; vibrations are diminished by a structure conformed by three recycled building elements: metal beams, wooden columns (Fig. 12, Fig 13) and street lamp posts (Fig 14). The roof was painted olive green to merge with the natural landscape.

Fig 13**: Paralelo Winery: lighting posts and wall finishing view.**

Fig 14: **Side view**

Source: Alejandro Espinoza

The building was finished three years ago and according to the client, the strict thermic control required has been achieved in an optimum way, concluding that rammed earth walls are an exceptionally adequate choice for extreme climate sites, environmental friendly and a low energy consuming solution.

2.5 La Casa en la Piedra: Domestic architecture, State of Mexico

Surrounded by mountains and woods, the Aztec founded town of Malinalco, is currently experimenting an adobe architecture revival trend. Malinalco has become one of the places surrounding Mexico City where weekend houses have been built during the last decades. It shares with Valle de Bravo, Tepoztlan and Tlayacapan (the two latter ones at Morelos State) a taste for contemporary architecture based on traditional adobe.

Several residences (Alva, 1995.) designed in this small town by Hector Velazquez Graham, were built at the end of the eighties and beginning of the nineties. Velazquez Graham chose adobe as building material, as a logical material used in accordance with the climatic conditions of the place; a mountainous climate and rather low temperature in the evenings and early morning and warm and sunny the rest of the day, throughout the year. The extraordinary thermic property of the earthen blocks allows a good isolation from the outside cold

temperature, while holding inside the warmth that the sun brings during morning and noon, irradiating it towards the interiors during the evening and night, when it is most needed.

Fig 15: **La Casa en la Piedra, Malinalco. Entrance view.**

Fig 16: **Portico view from the garden.**

Source: Pablo Oseguera

La Casa en la Piedra, was built on a rocky land at the low part of a crag, bounded by fruit gardens, irrigated by channels that water from the mountains and crags that conform beautiful views plus the identity of the surrounding natural landscape. The often changing luminosity of the place emphasizes the enjoyment that the richness of the combination of volumes, shades, color and texture of the adobe walls bring. (Fig. 15)

Even though the structure was decided to be solved by concrete frames and therefore the adobe walls were not calculated to work as structure, its sole characteristic of good isolation quality and high thermicity, plus the rich textures that this raw material achieve, contribute to obtain final quality living spaces and permit a dialogue between the beautiful natural surroundings and the well preserved vernacular architecture of Malinalco.

In addition to the mountain views, the mild climate that prevails at noontime almost throughout the year except during three months that winter lasts, have lead people that live in the cities nearby, to build these comfortable and harmonious residences to help soothe the body and the spirit during the weekend (Fig. 16).

3. Conclusions

Thanks to the recently revival of earthen based architecture for contemporary design, innovative spaces are being created; these works have proved to meet contemporary living requirements and to create atmospheres that differ from traditional spaces such as exclusively housing facilities. Furthermore, thanks to the combination of modern building systems and traditional ones, roofing solutions, for instance, which do not always go hand in hand with local climates, are achieved as in previous times through very logical traditional methods. New technologies and mixed systems, allow for the construction of plain roofs in areas where rainfall is abundant, whereby the logic of the original approach corresponds with natural environmental conditions, undoubtedly reducing the need for maintenance, and consequently reducing the cost of construction, among other advantages.

The intelligent Casa Maya, the best example of the *bajareque* technique that persists in Mexico today, is about to disappear. The problem with vernacular earthen architecture is the lack of confidence that people currently have in it, at a time when concrete technology is an affordable market found even in the most remote corners of the country. It means a considerable loss of quality of life for people of the Yucatan Peninsula and is consequently a typology worthy of interpretation by contemporary designers for the purpose of achieving quality living environments.

In spite of this regrettable situation for the *bajareque* technique, there is the substantial evolving trend of rammed earth contemporary architectural design, whereby, as explored in this paper, contemporary architects are willing to experiment with these techniques and to offer solutions which meet the requirements of both living spaces and very strictly controlled interior climates.

In conclusion, we can state that the current design possibilities with consideration for vernacular building traditions, which have historically been more a matter of consequence regarding local culture and natural environmental factors than a matter of choice, represent a much broader challenge, precisely because they are now based upon making intelligent and adequate choices. This stands for all contemporary design, although it refers particularly to the most logical, ethical and sustainable design choices in accordance with the critical regional attitudes towards architecture.

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