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Journal of Architecture and Design

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The works must be unpublished and refer to issues of international architecture, technological innovation in architecture, industrial design, business design techniques, multimedia design, advertising design, web system design, residential architecture and other topics related to Engineering Sciences and Technology.

Presentation of the Content

In Issue 12, is presented an article *Vernacular housing in Teziutlán, Puebla, by* CASTILLO-REYES, Alberto Rosendo, VÁZQUEZ-TORRES, María del Rayo, MORALES-ORTEGA, José Alejandro and MONTERO-URRUSQUIETA, Rubén Ángel, with adscription at Benemérita Universidad Autónoma de Puebla, in the next article *Neuroarchitecture: Beyond a spatial sensation*, by XOCHITEMO-PÉREZ, Aneli & PUJOL-MARTÍNEZ, Iván, with adscription at Universidad Iberoamericana Puebla, in the next section *The importance of geotechnical research in building projects: case study sustainable rural housing*, by RODRÍGUEZ-URIBE, Juan Carlos, SERRANO-ARELLANO, Juan and TREJO-TORRES, Zaira Betzabeth, with adscription at Instituto Tecnológico Superior de Huichapan, in the next section *Architectural proposal for the rehabilitation and improvement of the houses of the city Yagúl housing unit, Oaxaca*, by HERNÁNDEZ-RODRÍGUEZ, Miguel Adrián, GÓMEZ-BARRANCO, Heidy and RODRÍGUEZ-SÁNCHEZ, Luz Cecilia, with adscription at Universidad Autónoma Benito Júarez de Oaxaca.

Content

Article **Journal Architecture and Design**
December 2021, Vol.5 No.14 1-10

Vernacular housing in Teziutlán, Puebla

Vivienda vernácula en Teziutlán, Puebla

CASTILLO-REYES, Alberto Rosendo*†, VÁZQUEZ-TORRES, María del Rayo, MORALES-ORTEGA, José Alejandro and MONTERO-URRUSQUIETA, Rubén Ángel

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Abstract

This research aims to identify the characteristics of Teziutlán's vernacular architecture, for its dissemination awakening interest in this architecture in the process of disappearing. The methodology used in this research is qualitative, the review and analysis of documentary sources, visits to Teziutlán and interviews with locals and information of daily life in relation to space were carried out. As for the limitation of the research work is that being very large Teziutlán could not visit the whole place, through which the information was concentrated in the municipal head and the auxiliary board of San Juan de Acateno. The contribution that this work is that allows to identify the characteristics of vernacular housing and proposes an architectural proposal that arose in a master's degree from the Faculty of Architecture of BUAP. This work consists of three sections: The first is the so called "Geographical Location" where the location and characteristics of the place are identified; the second part is called "The Concept" where the meaning of vernacular architecture and its characteristics is defined and the third part "Alternative Project" where the work done by the architect Anabel Garate Hernández is exhibited.

Place, Features, Adaptation

Resumen

Esta investigación tiene como objetivo identificar las características de la arquitectura vernácula de Teziutlán, para su difusión despertando el interés en esta arquitectura en proceso de desaparición. La metodología utilizada en esta investigación es cualitativa, se realizó la revisión y análisis de fuentes documentales, visitas a Teziutlán y entrevistas con habitantes del lugar e información de la vida cotidiana en relación al espacio. En cuanto a la limitación que tiene el trabajo de investigación es que al ser muy grande Teziutlán no se pudo visitar todo el lugar, por los cual se concentró la información en la cabecera municipal y la junta auxiliar de San Juan de Acateno. La contribución que este trabajo es que permite identificar las características de la vivienda vernácula y plantea una propuesta arquitectónica que surgió en una maestría de la Facultad de arquitectura de la BUAP. Este trabajo se compone de tres secciones: La primera es la denominada “Localización geográfica” donde se identifica la ubicación y características del lugar; la segunda parte se llama “El concepto” donde se define el significado de arquitectura vernácula y sus características y la tercera parte “Proyecto alternativo” donde se expone el trabajo realizado por la arquitecta Anabel Garate Hernández.

Lugar, Características, Adecuación

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Introduction

When man passed the stage of food collection, he was involved in new needs such as building the first architectural models of housing generating the concept of population and later of city. Among his first ephemeral constructions he had to use materials that he had in his path such as branches, leaves, skins and bones of animals. However, when established it requires more resistant constructions and at first it copies the forms of nature and later the orthogonal space composed of two straight lines perpendicular to 90 degrees. This was a key moment because from there came the development of architectural models and the first prefabricated materials, supported by the concept of community where everyone worked for the common good. The use of the curve and the line became part of the design of spaces and together with the materials product of nature produced what is now known as vernacular architecture.

Location Geography

The Sierra Norte de Puebla is an extensive area of the final part of the Sierra Madre Oriental that covers approximately 100 kilometers long and 50 kilometers wide; it is made up of 65 municipalities, with an approximate area of 5000 km^2. It is divided into the coffee zone, the lower zone, the southern slope or southern slope and the Bocasierra area where Teziutlán is located.

The municipality of Teziutlán is located in its largest territory in the Sierra norte de Puebla and a part in the Sierra Madre Oriental, has 92.6 km² whose limits are: to the north with the municipality of Hueytamalco, to the west with that of Chignautla and Hueyapan, to the southwest with that of Chignautla, to the southeast with that of Xiutetelco and to the east with that of Jalacingo of the state of Veracruz. It is a place that is located in a rugged, mountainous place with large or small plateaus staggered towards the coast, of the Gulf of Mexico. Teziutlán has large, wooded areas with trees such as: ocote, oak, red pine, liquidámbar and soap and fruit trees such as pear, avocado and peach. In this municipality is preserved the ecological reserve of El Colihui one of the last fog forests of Mexico and the world.

The climate of the Municipality of Teziutlán is humid and cold in the winter, temperate and rainy in the summer and autumn, subject to sudden changes in temperature and pressure due to the frequent atmospheric disturbances of the Gulf, due to its proximity. The prevailing winds, during the day, are from the North, and at night, from the South. In the spring, strong winds usually run from the South. In the winter, frost and water-snow. (INAFED, 2021).

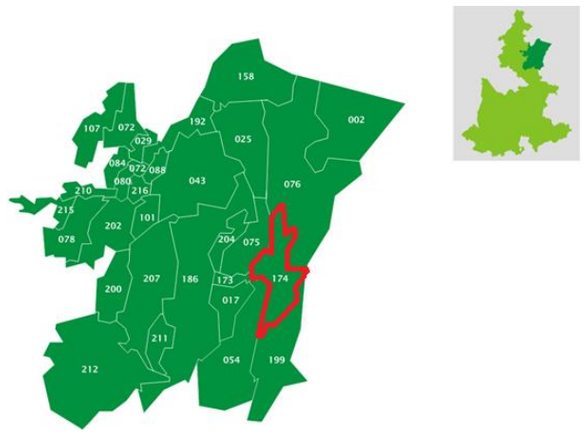

Figure 1 Map of Region II of Teziutlán, state of Puebla. Description: 002 Acateno; 017 Atempan, 025 Ayotoxco de Guerreo; 0.29 Caxhuacan; 043 Cuetzalan del Progreso; 054 Chignautla; 072 Huehuetla; 075Hueyapan; 076 Hueytamalco; 078 Huitzilan of Serdan; 080 Atlequizayan; 084 Ixtepec; 088 Jonotla; 101Nauzontla; 107 Olintla; 158 Tenampulco; 173 Teteles de Ávila Castillo; 174 Teziutlán; 186 Tlatlauquitepec; 192 Tuzamapande Galeana; 199 Xiutelco; 200 Xochiapulco; 201 Xochitlán by Vicente Suárez; 204 Yaonáhuac; 207 Zacapoaxtla; 210 Zapotitlán de Méndez; 211 Zaragoza; 212 Zautla; 215 Zongozotla and 216 Zoquiapan
Source: INAFED, 2021

The Municipality identifies three climates: humid temperate climate with rains in summer in a small area of the extreme South of the Municipality; Humid Semi-warm climate in the north of Teziutlán, with abundant rains all year round. In the center of the municipality where the city is located is characterized by humid climate with a humidity index between 75 and 80% during most of the year, it is a cold area with an average annual temperature is 12.6 °C and enveloped by large blankets of mist and light rain. Teziutlán is considered the foggiest region in the country, with 280 days a year. (INAFED, 2021)

ISSN 2531-2162

It is for this reason that the house in Teziutlán usually has porticoes to allow the inhabitants to carry out some outdoor activities of two pillars up to 8 pillars, depending on the length of the houses. Also, the housing and enclosed spaces for cellars occupy 30% of the land, the porticos have 5% and 65% is free area. Because of the climate, social life takes place inside the house and in the porticoes and when the weather permits it occurs in the church, the pantheons, the municipal presidency, in the sports fields and in the rivers where women wash clothes and the family transfers water to their homes; however, this activity has decreased due to the provision of drinking water.

Figure 2 1) Location of the area where the project is located in the auxiliary board of San Juan Acateno belonging to the municipality of Teziutlán, Puebla. 2) Faculty of Agrohydraulic Engineering, Buap.3) University Street. 4) 12 December street

The concept

Currently there are multiple definitions according to the areas of knowledge, but the most accepted is to define it as native architecture product of the community; where everyone participates in its construction so the inhabitant is his own builder; although he does not have the profession of mason..."Vernacular: It refers to that type of architecture that has been designed by the inhabitants of a region or historical period determined by empirical knowledge, the experience of previous generations and experimentation". (Carranza, 2010, p. 22).

Tradition is an important part of vernacular architecture as the use of local materials in construction was transmitted and is now transmitted orally and intergenerationally; whose techniques are taught to the new generations when they participate in the erection of new homes. This process was given by trial and error until the communities generated a type of construction that was efficient and that could only be learned in a practical way when working on site. (Carranza, 2010, p. 17)

When building large works, the native house was seen as a functional architecture and as a simple link in the architectural evolution. However, until the second half of the eighteenth century some architects and builders began to look at this traditional architecture and to express interest in construction techniques. This was due to a moment of crisis, as it required new styles with nationalist tendencies produced by information written to the masses, specifically by illustration. In addition, the rise of the Industrial Revolution caused the emergence of new materials of industrial origin and that in some social sectors of conservative court saw as a danger of dehumanization of architecture." (Warrior Baca, 2010)

To these elements, functional concepts and identity are annexed because all forms of vernacular architecture are the result of the needs of individuals probe values, behaviors, the way of life and climatological conditions are introduced that are intertwined to form an architectural trend, without theoretical or aesthetic pretensions. The climate is the guiding element of this type of architecture because it allows thermal insulation in cold areas, using materials of high thermal mass with few windows or none to create an airtight space and thus conserve heat. In warm areas to cool the buildings requires light enclosures, with lattices or the use of techniques for natural ventilation. The location and orientation of the houses go according to the orientation of the wind and the sun, because in regions with very strong winds or places of high precipitation are located in such a way as not to be dragged by the wind or are flooded by the rain.

ISSN 2531-2162

However, the location of the housing sites may correspond to other factors such as culture, environmental materials, environmental characteristics or productive activities in the region. The latter may modify the concept of the program of needs of the inhabitants of the house, since it is also used for the production of handicrafts, crafts or wineries. In the case of the economic position of the families, it will affect the possibilities of making significant improvements in the house where the application of resources to strengthen the structure, maintenance, add new materials, expand the spaces of the house, add new spaces or replace the vernacular housing that represents the economic level of the inhabitants of the house predominates. This is a factor that causes the deterioration or disappearance of vernacular architecture because natural materials are replaced by processed materials that represent the development and consequently the deterioration of the environment. (RODRIGUEZ, 2021).

As in many countries where vernacular architecture still exists, in Puebla rural areas are the ones that maintain a large number of vernacular dwellings, while in urban areas they have disappeared impressively since the 1970s due to the introduction of materials such as concrete. Although there are architectural trends that seek to rescue vernacular architecture by considering it sustainable, it is a difficult struggle against the concepts of modernity or progress. Another factor that has displaced vernacular architecture is the social breakdown of communities, either by population growth or by the migration of their inhabitants to places that allow them better living conditions. However, the inhabitants of traditional communities have a strong sense of community and familiarity that cross borders, that is, people working abroad send resources to their communities for the improvement of their homes or for the agricultural production of their land. This occurs because there is a strong cultural identity that exists as a consequence of individual and collective memory, of symbolic elements, customs and traditions.

Architecture is a part of the identity expression of a place, it is recognized as an important manifestation of culture where the traditional experience of formal design of the is based on physical characteristics of the environment, in its materials, construction systems, and spatial configuration produced by historical phenomena and symbolic references of the site. Although the symbolic elements have been lost, even the communities recognize some symbols in the constructions such as fertility, fecundity, male virility and magical powers. In addition, rural architecture is between the environment and its products with social practices where housing prevails organized in three areas: for service, rest and social relations. Therefore, there are architects who in recent years have tried to identify and rescue vernacular values through their insertion in contemporary architecture, aligned to the concept of sustainability. (GARCIA, PAREDES, MORENO, & PEAK, 2021)

The characteristics of the house

The houses were built with bioclimatic criteria to contain the heat within them and allow the oxygenation of the space without receiving the constant rain, for which they were forced to use materials from the region in such a way that the result as a whole is homogeneous. In the vernacular house predominates the massif over the vacuum, since there are houses that lack windows or with few windows, usually rectangular.

As for the houses, in the historic center or haciendas are 2 levels; in the mountainous area wood is used and in the highlands between mountains adobe is used and in the stone area stone is used and on a smaller scale adobe. It is common to observe one-bedroom homes with toilets, sometimes semi-detached, although it predominates to move this type of services away from the house. On the other hand, by using materials from the region, a harmonious set is achieved that has been reproduced by artists and that characterizes Teziutlán.

In the city you can see the houses that are in front of the street or around patios, to ventilate with small windows, although there are cases that lack them and distribute spaces such as cellars, corrals, orchards and living areas.

ISSN 2531-2162

On the other hand, the configuration of the space is based on the topography and environment, made up of pastures, shrubs, banana palms, orange trees, tangerine, guava, peach and coffee plantations. The interior space contains 1 or 2 beds made up of wooden platforms, a table for the altar, a table to eat with chairs or benches that they place around the interior space, space for settling clothes, coat racks, sometimes they have sewing machines and space for cooking. In the space of attached kitchen or near the house and there can be 3 types of kitchen: the first is the "tlecuil", floor stove made by rocks in a circular shape that serves as a base to place on pots or comales; in the center the firewood is placed and the person sits on a small bench where he rests to carry out his activity. The second is a stove made with wood at the height that allows the person to stand and a bed of earth with large stones that serve to support the pots and comales. The third is the wood-saving stove or Patsari stoves "the one that cares or the one that protects", disseminated by the federal government program of construction of Ecological Decent Housing for rural areas. There are different types but the most common is the one that consists of a base of partition or stone, wooden frame or sheet that serves as a shoring where the burners are placed. Then it is filled with a mortar leaving the fuel gap free.

For the sanitary services the "temazcal" is used, although not all the houses have it, in this space the function of assigning healing properties close to the house with minimum dimensions of 3.3x1.8m is a space with walls are made of stone with an entrance of 0.5m wide by 0.95m high and platforms. The latrine is built with different materials and once it is filled it is built elsewhere because it lacks a septic tank with approximate dimensions of 2x2 m away from the kitchen.

Each built space has areas of vegetation and in the front a space with grass and vegetation is left, although there are cases that in front is placed a patio with stone or concrete firm that is used to dry seeds, as part of the family business or for different activities. There are no pens and they are only built when they are large animals.

Figure 3 Vernacular housing of adobe
Source: (GARATE, 2016)

Figure 4 Living place in Teziutlán, Puebla
Source: (GARATE, 2016)

It is common that natural materials do not have coatings, but when it exists lime with red and ochre colors or without dye is used directly on the adobe and stone. Although in some areas lime mortar coatings are used. The artisanal construction system used for the construction of the houses consists of stone foundations with overgrowth, stone walls, adobe and wood, ceilings with wooden beams and tile with slopes of one and two waters so that the rainwater is displaced and to protect from the heat and that the roofs are not over hot, with eaves to protect the perimeter of the construction. When the covers are flat, lids are used leaving a considerable height for the air to flow and contain the interior temperature.

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Figure 5 Vernacular housing of stone walls, adobe and ceilings of wooden beams and tile
Source: (GARATE, 2016)

According to the 2010 population census (INEGI, 2010) housing conditions are as follows:

Type of housing level 1. It represents 40% of the total of houses with an area of less than 40 m2, housing of 1 level, with stone or wood walls such as boards, sticks and morillos; tile beams or cardboard sheets and earth floors.

Type of housing level 2. It represents 51% of the total of houses with an area from 40 m2 to 100 m2, of a level with stone or adobe walls with or without coating; reinforced concrete tile or slab beams and concrete floors with or without ceramics.

Type of housing level 3. It represents 9% of the total of houses with an area of more than 100 m^2, predominate from one to two levels, but you can find constructions of more levels; with walls of partition, block and cement stone with or without coating; concrete slabs or shingles and concrete floors with or without ceramics.

In recent decades there has been a gradual change of the urban image in Teziutlán due to population growth, economic development and especially the income of remittances that are aimed at creating new constructions that have little or nothing to do with traditional architecture. On the other hand, the deterioration of vernacular dwellings was already evident in the 2010 population census (INEGI, 2010) as the following information was found: 9% of the dwellings are in acceptable conditions, 54% in regular conditions and 37% in precarious and visibly marginal conditions.

Another aspect that causes this deterioration of the urban image is the so-called phenomenon of the "architecture of remittances", which is a process of change which has 3 aspects. The first is to use resources for the maintenance of vernacular architecture, the second is to replace the roofs with another type that requires less maintenance or "strengthen" the construction with castles and / or chains of reinforced concrete, and finally to build with prefabricated materials and in some cases with architectural styles that migrants observe in the regions where they have to migrate; either inside or outside the country.

However, in the northern Sierra these buildings still exist and show well-preserved sites, according to the climate and the environment. This architecture is the testimony of the presence of the indigenous peoples who inhabit this land as Otomi, Totonacas, Tepehuas, Nahuas and Huastecos, its conservation allows its identification before their community and outside it.

The Sierra Norte de Puebla from the pre-Hispanic period until the nineteenth century, was part of the Totonac region, Totonacapan. However, because of the strength, of the Totonac population, who dominated a very large region, the Mexican government divided that territory into two states; the state of Puebla and Veracruz.

This area is vulnerable due to the earthquakes and the constant rain, as well as the changes of temperature that produces contractions and crumbling in the building materials.

The vernacular constructions in Mexico have been considered as evidence of the poverty and lack of economic, material and technological resources of the country. Therefore, the institutions have encouraged the use of modern materials as a symbol of progress.

However, due to the deterioration and destruction of the cultural heritage caused by the earthquakes, it has caused the Universities to disseminate the artisanal construction processes; therefore, research and cooperation projects on the phenomenon of seismic vulnerability.

ISSN 2531-2162

This has been encouraged in places like the state of Puebla where the 2017 earthquakes caused the irreplaceable loss of its cultural heritage. This led to investigations being directed towards seismic vulnerability in relation to the consequences of humidity. As well as the rescue of the constructive tradition and the study of the local materials that allow its replacement at low cost. (NIÑO, RESTREPO, & SOLARTE, 2021).

The vernacular houses are perceived as unsafe because they are not very resistant, despite the fact that the 2017 earthquakes showed that this is not totally true because the damaged buildings in the state of Puebla were colonial buildings and the vernacular constructions had little impact.

However, there is a perception in users that they prefer to start a reconstruction with new materials offered by the institutions to repair the damage suffered by the earthquakes, causing that there is no compatibility between the materials and between the construction processes. The concepts of culture and seismic vulnerability allow to assess the determined risk of the house being susceptible to damage, that is why there are still communities that repair their homes with materials from the region because they recognize this activity as something traditional and natural of their community. (NIÑO, RESTREPO, & SOLARTE, 2021).

On the other hand, the use of materials such as concrete, steel or the manufacture of blocks impact the environment, whose conditions will affect future generations. This is encouraged by the thought that the damage to the environment is very long-term and that others will be able to restore the conditions to their origin and that natural resources are unlimited- As well as to the techno centrist consciousness where the need for progress prevails, seen as the implementation of materials and constructive systems of the industrialized countries. That is why research has been directed towards sustainable technologies such as ecological hydro-sanitary systems, rainwater harvesting and the rescue of artisanal construction materials. (BORJA & ANGUMBA, 2021).

Alternative project

There are projects that aim to rescue the constructive tradition, giving it an architectural distribution according to the new needs of today, such is the case of the project for rural housing in Acateno, Teziutlán of the architect Anabel Garate.

In his project he establishes some considerations: The relationship with the environment and the integration of housing into the natural environment; the social and cultural relationship of the communities manifested in the social spaces and conservation of the typology and configuration of the house. The urban structure is a system of broken plate in relation to the topography with irregular lots with an approximate area of 450 m^2 whose longest width is located towards the street, surrounded by vegetation.

> "The location of the house within the lot, responds in most cases to the pre-Hispanic conformation characterized by dispersed housing unlike the Hispanic, where the parameters of the houses are united, forming a compact city. Thus we find that the houses are mold at the foot of the valley protected among the vegetation, submitting to the general image of the landscape". (GARATE, 2016, p. 48)

Among the needs that the project had to respond to are the lack of private areas, lack of a spacefor food storage, lack of the delimitation of a spatial area for the cultivation and storage of domestic animals, lack of maintenance and conservation of homes and the use in some cases of materials that do not completely isolate their inhabitants from external environmental effects and harmful insects.

Figure 6 San Juan Acateno, Teziutlán-Puebla

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As for the construction systems, it is intended to strengthen the use of materials from the region to reduce costs and to use the values of bioclimatic architecture, in accordance with the physical environment and agricultural work of the region. Due to the conformation of the terrain and the plateaus between the hills and mountains allows to have interesting views that go in relation to the natural environment.

For the elaboration process it is important to choose the area where the house will be located favoring the circulation of north-south air and the bedrooms to the east and west. One of the problems is to remove the roots of plants, shrubs and trees especially if the wooded area is found. The foundation must be of stone that abounds in the region where the following dimensions are used: base of 90 cm. crown of 30 cm. and variable depth because the ground can present large depressions and it is necessary to place retaining walls and for danger of landslides deep foundations are used. There are foundations at the base of the walls when they are adobe; Also, you can use stone walls of 30cms. For the enclosures in windows and doors will be used wooden beams taking care that they have at least 40 cm. of embedding in the wall, in addition it is recommended that the joints of the masonry, so that they do not house insects, dust and maintain a clean environment.

In this area it is frequent the use of wood with beams and wooden planks with overlapping joints to seal the interior, in this case it is not necessary to place stone masonry foundation and you can anchor the wood in the ground, however, the humidity deteriorates it quickly so it is recommended to place foundations or a reinforced concrete slab. Bahareque is also used with branches or reed placed vertically interwoven with mud coating and short fibers such as straw or dried grass, filling the spaces that remain between the branches or reeds. It is recommended that before burying the branches, diesel or some material that can protect the branches or reeds be placed.

In the case of the floors will be used floors of rammed earth, stone, brick or firm polished concrete with or without dye of 5 to 6 cm. thick ..."Due to the type of climate that presents all the northern Sierra of the State of Puebla, it will be necessary to place a layer of gravel stone of 10 cm thick on the surface accommodating it uniformly (due to the high percentage of rain that this area presents during the year) and then a layer of pomex stone 10 cm thick will be placed to add thermal insulation". (GARATE, 2016, p. 48)

The ceilings can be made of wooden beams and resinous wood cover, sheet or tile, which must be well attached to the beams with a minimum slope of 30% and take care that the summit is well protected at the junction by means of joints to half wood joined and reinforced by means of screws or bolts. If wood is used, it is necessary to apply a flaxseed, wax or diesel. The project has a yard, an animal unit formed by corrals, separated from the house at a distance of 8mts delimited by vegetation, orchard or family vegetable will be delimited by a wooden fence or sticks to prevent the passage of animals, area of trees.

GARATE (2016) proposes for the spatial configuration of rural housing in 4 areas: coexistence area, rest area, service area and green area. The living area is composed of living room, dining room, altar and green areas proposed to the outside of the house; the rest area or bedrooms; the service area consists of patio, kitchen, toilets, area for washing and laying; and the area of green areas and corrals as presented below.

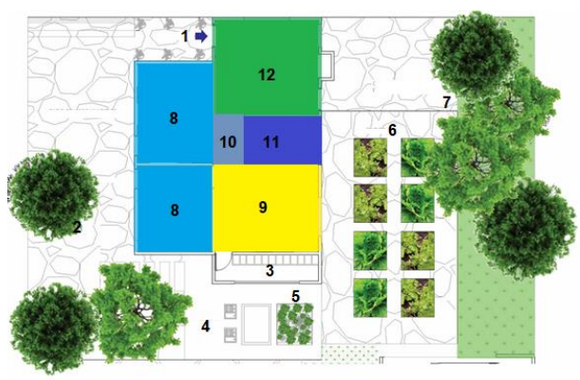

Figure 7 Zoning by areas of the rural housing improvement model in the Municipality of Teziutlán, Puebla. 1 entry; 2 multipurpose yard; 3 winery; 4 services; 5 biofilter; 6 vegetables; 7 tree cultivation breaks winds and fruit trees; 8 rest area, 9 kitchen; 10 lobby; 11 health services area and 12 coexistence area

ISSN 2531-2162

The housing project contemplates the collection of rainwater. In addition, it uses the treatment of soapy waters by means of a biofilter will be stored for irrigation of the vegetable.

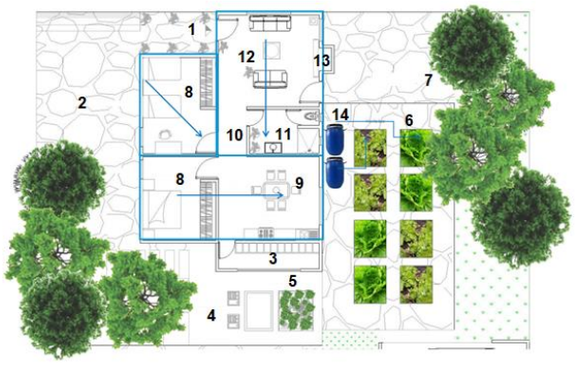

Figure 8 1 entrance; 2 multipurpose yard; 3 winery; 4 services; 5 biofilter; 6 vegetable; 7 tree cultivation breaks winds and fruit trees; 8 bedroom, 9 kitchen; 10 lobby; 11 bathroom and 12 family room: 13 altar; 14 mannexed of organic waste for the creation of compost to be used for the restitution of agricultural land

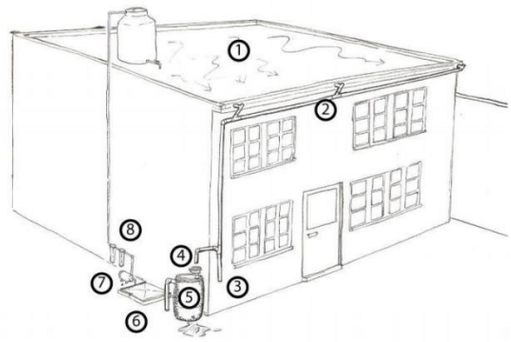

Figure 9 Diagram of the components to be used for rainwater collection

1) The Roof. 2) Downs and / or gutters. They can be made of PVC or stainless steel, it is important to keep them clean. 3) Leaf filter is a mesh that prevents leaves and other basurites from entering the cistern. 4) Interceptor of first rains separates the dirtyest part of each downpour so that it does not enter the cistern; it must be drained at least every three days. 5) tank. 6) Cistern and chlorination.

Conclusions

Thanks to the favorable geographical location and its natural riches of the municipality of Teziutlán, it favored the development of vernacular housing.

The vernacular house was designed by the inhabitants of this region using the characteristics of the materials of the area, the location of the construction, orientation with respect to the sun and protection from the rain.
On the other hand the construction system is also very much in line with the location allowing a high quality workmanship and excellent execution therefore the project allowed that, perfect relationship in the execution of the project because it is totally sustainable if it affects the environment of the area. The proposal is of great importance because in its entirety it respects the characteristics of vernacular architecture, which today is one of the most interesting works within architecture, to continue preserving this type of vernacular architecture, in our times, because it marks in some regions, such as the studio, to remain a landmark of the region.

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Neuroarchitecture: Beyond a spatial sensation

Neuroarquitectura: Más allá de una sensación espacial

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Abstract

Architecture and urban space go beyond satisfying functional, formal, technical or social needs, it is the space in which we are immersed in our daily lives, where spatial limits maintain a dialectical relationship with the human being. It is from this spatial experimentation that the effects generated go beyond any sensation, it is then that we go from an embodied experience to a somatosensory experience, from which we get emotional responses, but also physiological and behavioral ones, result. That is why being able to control these effects play an important role in improving the habitability of the space, since the design of the stimulus, that is, the design of the architectural or urban object will depend on the effect to be generated. It is here where Neuroarchitecture acquires relevance, since it is from its neuroscientific basis so strategies can be provided that contribute to the design process.

Neuroarchitecture, Senses, Space, City

Resumen

La arquitectura y el espacio urbano van más allá de satisfacer necesidades funcionales, formales, técnicas o sociales, son los lugares en los que nos vemos sumergidos en nuestro día a día, en donde los límites espaciales mantienen una relación dialéctica con el ser humano. Es a partir de esa experimentación espacial, que se generan efectos que van más allá de una sensación, es entonces que vamos de una experiencia corporeizada a una experiencia somatosensorial, de lo cual, resultan respuestas emocionales, pero también fisiológicas y conductuales. Es por ello, que el poder conocer y controlar dichos efectos, juega un papel importante en la mejora de la habitabilidad del espacio, pues del diseño del estímulo, es decir, del diseño del objeto arquitectónico o urbano, dependerá el efecto a generar. Es aquí donde la Neuroarquitectura adquiere relevancia, pues es a partir de su base neurocientífica que se pueden aportar estrategias que coadyuven en el proceso de diseño.

Neuroarquitectura, Sentidos, Espacio, Ciudad

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Introduction

THE GENERAL WELFARE OF INDIVIDUALS CAN BE SEEN SIGNIFICANTLY INCREASED BY THEIR CONTACT WITH ENVIRONMENTS CONSIDERED OF HIGH AESTHETIC VALUE.

CORRALIZA & GALINDO (2012)

The main object of this paper is the analysis of the relationships between urban space and the human beings that inhabit it. Some advances of an ongoing research project are presented here, with the purpose of showing the sketch of a methodology that allows describing and interpreting the interaction between urban space and the human beings that inhabit it. Human perception, in its interaction with the environment -particularly the urban-architectural environment- is the key element to be understood.

This work is essentially divided into two parts plus a conclusion. The first part describes some concepts and the essential notion to understand the phenomenon of perception, its ways of acting with the environment, and the effects of this interrelation. From this, in the second part, a methodological sketch is given to show the importance of neuroarchitecture as an essential discipline for the field of urban and architectural studies.

Finally, some reflections on the implementation of the proposed methodology are presented, based on some preliminary results of the field work. At the same time, a series of questions are posed to broaden the debate on the importance of human perception, both in the development of urban studies and in the formulation of strategies and policies for the spatial configuration of human environments.

Perception: sensations and emotions

We live in a world composed of environments and objects, where the only way to know and live them is through a perceptual experience, where the relationship between environment, sense and brain are the main vertebrae of this experiential process.

As human beings, we are endowed with a complex system that allows us to develop physiologically and mentally in a physical environment and in a society. In this system, there is a set of organs with infinite functions and interrelationships. In the following, we will refer to those linked to the phenomenon of perception, alluding to the relationship between the human being and the environment.

To speak of perception is to speak of the senses, since it is identified that this alludes to a sensory impression that is activated from an experiential experience, that is, from the experience of some activity, object, thought or physical space, where each of the senses are immersed, acting before diverse stimuli, such as sounds, temperature, colors, shapes and flavors.

According to Goldstein (2010), perception is in charge of explaining the functioning of the senses, such as experiences and behaviors, that are the result of their stimulation. Goldstein (2010) classifies them into six categories, the first refers to the cutaneous senses (touch, pain, itching, tingling), the second is the chemical senses (taste, smell, flavor), the third the vision, the fourth the hearing, the fifth the proprioception and kinesthesia (awareness of body positions as well as the position and movement of limbs) and the sixth the vestibular or balance sense.

However, it is important to emphasize that none of them act independently, but are affected by each other (Goldstein, 2010). For her part, Galvez (2019) starts from this general theoretical basis, but she makes different groups, referring to the somatosensory, auditory, taste-olfactory, visual and interoceptive systems. In this context, two terms that have a lot to do with the topic stand out, they are the somato-sensory and proprioceptive.

The former alludes to tactile, thermal, itch, pain perception, as well as proprioception, while the interoceptive refers to the internal, physiological and affective atmosphere of the human being (Goldstein, 2010). That is, we are beings that are constituted of elements that condition the translation of our perception of any agent with which we are in contact.

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Talking about the concepts that interfere in the subject, such as sensation and emotion, represents something complex, since they are phenomena that are interfered by multiple factors and contexts. At least, in the case of emotion, Cano-Vindel (1999) points out that it influences people's behavior, and also enables adaptation to the environment and vice versa.

On the one hand, sensations represent those impressions derived from each of the sensitive organs caused by the stimulus to which it is subjected. In this sense, Arriagada (2004) considers that it is precisely the sensations that makes an emotion feel in a certain or specific way.

While emotions refer to those reactions that occur at a later time to the sensations caused by a stimulus, Fernández (1995) structures this concept as a process that is originated by the evaluative assessment of a situation, which produces an alteration in the physiological activation of the organism. It is precisely from this appraisal that personal well-being is interfered with, since positive and negative aspects emanate from this appraisal. The former are produced by a particular kind of benefit, while the negative emotion derives from the evaluation of a kind of harm. It is relevant to recognize that this evaluation is influenced by a set of beliefs, objectives surrounding the person and environmental circumstances.

On the other hand, as mentioned, emotional activation is a complex process, since it involves several systems, at least Cano-Vindel (1995) refers to 3, the cognitive-subjective or experiential-subjective (feeling or moods of the subject), the motor or behavioral expressive (reaction identified by an observer or the subject himself before a stimulus) and the neurophysiological-biochemical (changes in the organism at the physiological level).

For her part, Corraliza & Galindo (2012) consolidate this approach, referring to that aesthetic activities are an essential element for the health of human, recognizing the capacity of all the stimuli that intervene in the environment, since under their characteristics, they modify the basal activity of people, having a direct impact or reflection on human behavior.

In this way they emphasize the importance of the aesthetic qualities in the human health.

It is necessary to point out the results provided by the study by Corraliza & Galindo (2012), as this forms part of the background of this research. Corraliza & Galindo (2012) identify the reasons that essentially determine the two poles of aesthetic valuation, high and low.

In relation to the first is attributed in the first place, to the naturalism of the place (existence of vegetation, absence of noise, natural place), secondly to positive affects (amplitude, light, harmony of elements, central location) and thirdly to the organization spatial (historical and known). While the low valuation, is attributed in the first instance to the absence of naturalism and in the second, to social aspects (Corraliza & Galindo, 2012).

Sensory experiences in space

Recognizing the role of perception allows us to see the probability of the infinite perceptions that can be of a physical environment; in this sense it is important to emphasize that no decision in relation to the design of the environment is absolute, however, if we can interfere in the improvement of environments that by their appearance are causing negative sensations in a majority, or potentiate those environments that are causing positive sensations.

From this, it can be alluded to perceptual experiences, because through these there is a relationship between design and spatial experience, where the experience of light, smell, sound, touch, temperature, etc., are the elements responsible for producing or sending electrical signals to the human brain and thus perceive the world we inhabit (Goldstein, 2010).

In this sense, it is worth emphasizing this psychophysical approach that seeks to determine or identify the stimuli that are associated with each sense and how the qualities of each of these stimuli influence perception (Goldstein, 2010).

With the above, it is pertinent to mention that the stimulus acquires the role of independent variable, since it is based on the qualities of the stimulus that the type of reaction will be defined. Yale (1996) considers that "[...] a stimulus is an elemental energy that affects a sensory receptor and that it is also a physical process in which the physical causes are physical, a physical process in which physical causes mechanically produce a physical effect" (p.99).

It is this that leads to the questioning of which are those stimuli that generate reactions or positive or negative effects and how these effects impact on the physical or psychological state of people.

Effects of space and neuroarchitecture

It is important to mention that what it wants to be discussed here is not recent, there are several case studies that show a similar concern, but it is not the only one. There are several case studies that show a similar concern, but these are approached from different perspectives. As an example, it is worth mentioning a huge number of works associated with the soundscape of cities, or those that study visual pollution. In the case of this reserch, it is chosen to give a neuroarchitectural approach, since it is considered that, being a multidisciplinary discipline, it allows to approach the subject in a more comprehensive way.

The origins of neuroarchitecture are associated with the discovery of the polio vaccine by Jonas Salk (Mombiedro, 2017, p.1).

> "This discovery came at a very specific moment in his life; after many months of research and work, the American scientist decided to take a spiritual retreat to an Italian basilica. It was there, in the basilica of Assis, that he found inspiration, and managed to come up with the solution to the vaccine issue. When he returned to the United States, he contacted the American Institute of Architects (AIA), explicitly asking for research into how the layout of architecture influences the brain and, consequently, human behavior." (Mombiedro, 2017, p.1).

This begins to take shape, when the 1971 finding of John O´Keefe, May -Britt Moser and Edvard Moser is taken up. The clues reveal the discovery of hippocampal neurons that encode the position of the subject in space called, "place neurons". Their studies revealed that the frequency of firing increased when the subject was in a specific location in a habitat (Roblero, 2015).

To have a broader picture of what neuroarchitecture is, This will be referred to the formal establishment, which is framed with the rise of these was the Academy of Neuroscience for Architecture (ANFA), which is an institution created in the city of San Diego, United States, as part of the origin of a multidisciplinary scientific current, called Neuroarchitecture, whose main objective is to demonstrate the impact on health and behavior, generated by the spatial configuration of the environment in which we live, light, color, sound, surface texture and the arrangement of physical space, with the understanding that "[. ...] that neurons are activated and form spatial networks, depending on the external physical environment." (Manzano, Muñoz & Sanz, 2015, p. 1).

From this, investigations have been developed that reveal the effects of spatial design in humans, however, not all have seen the light in its application.

Some of the themes in which he has been honored have been those that have evidenced the importance of each "piece" of design that intervenes in a process of embodied experimentation of a space.

One of the most outstanding investigations are those of Chatterjee, Coburn, & Vertanin (2017) who have examined visual permeability, identifying that closed rooms caused users to decide to leave the space, because certain regions of the space were activated. the amygdala. On the other hand, they explored the issue of height of ceilings, where the highest were classified as beautiful because they activated specific structures of the brain. This author also identifies that it is more effective to be coupled to understandable designs as opposed to those that present too many complexities.

ISSN 2531-2162

Sketch of a methodology

Until now, the importance of the production of positive stimuli or environments has been pointed out, however, little has been said about how to create this type of space. Undoubtedly there are studies that are responsible for assessing environments, these are preference studies, which are instruments that review categories such as the descriptive scale, the affective scale and the evaluative scale (Corraliza & Galindo, 2012).

These scales pursue two major objectives, one that seeks to solve a "landscape problem" and another that focuses on the development of conceptual and theoretical frameworks so that an explanation regarding aesthetic judgments is given (Corraliza & Galindo, 2012), but In both cases it is an evaluation that is generated from the aesthetic tastes of the subject that evaluates a representation, in which the imagination and the feeling of pleasure or disgust generated are prioritized.

Despite the constant use of these instruments, what is identified is that they are only governed primarily by an aesthetic judgment, not referring to neurophysiological effects. Although there are many neuroscientific researches related to physical environments, many of them are not implemented in the design processes, essentially due to the high complexity of the use of language, lack of dissemination or because these studies are considered to have application only in the study site.

This is why the need arises to develop a methodology that allows the professionals involved to implement strategies that are scientifically recommended for their effectiveness in the development of positive effects in the desired site.

For this purpose, a methodology of qualitative and quantitative approach is proposed, which in essence values and identifies design strategies derived from previously generated scientific studies, based on the use of instruments structured under Kansei engineering, the latter recognized for extracting the value of emotional design.

The approach methodology combines aspects of Kansei engineering for its recognized efficiency in design, in addition to including elements that allow obtaining a perceptual characterization of the territory.[1]

The methodology consists of 5 phases:

Phase 1: selection of scientific studies,

Phase 2: extraction of perceptions of the study site,

Phase 3: extraction of desired perceptions,

Phase 4: strategy selection, and

Phase 5: immersive evaluation of strategies applied to the virtual stimuli generated.

As a first aspect, it is sought to identify the impact on the perception generated by spaces that include neuroarchitectural properties. To do so, it began with phase 1, in which was reviewed with scientific studies that refer to the impacts generated by formal characteristics that allude to each of the senses. Subsequently, a table of the most related properties that could be applied to public space was extracted. Subsequently, a formal and perceptual survey of the study site was made, so that, together with the elements and properties previously extracted, the three stimuli to be evaluated in phase 2 and 3 could be elaborated.

In total, 4 stimuli will be evaluated, each one consists in a photorealistic image and a virtual environment of an urban proposal of the study site.

In both, '1' and '2' were applied all the formal strategies were applied and which were identified as positive, the difference is that in the first, straight counters were applied, while in the second the curved counters were applied. The stimulus '3' is a proposal that contains a formal solution 'typical' of the interventions that are applied in the region. And the stimulus '4' refers to the current state of the study site.

[1] It is important to point out that, given the current situation generated by the Covid 19 epidemic, the fieldwork had to be restructured, so that its application was mainly digital.

ISSN 2531-2162

It is therefore that it arises an assignment of values to each identified strategy, where 'o' means the absence of this and '1' the presence (see figure 1).

Main senses to stimulate	Element through which it will be stimulated	Strategy	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4
Sound	Water (Water fountain types)	Water fountain type "gush" (Ideal)	1	1	0	0
		Water fountain "typical" (Not recommended)	0	0	1	0
Tactile	Origin of materials	Prevail naturals materials (Ideal)	1	1	0	0
		Prevail Synthetic materials (Not recommended)	0	0	1	1
	Types of surfaces	Texture synthetic surface (Ideal)	1	1	0	1
		Flat surface (Not recommended)	0	0	1	0
	"Antigravity effect" application in formals compositions	With antigravity (Ideal)	1	1	0	0
		Without antigravity (Not recommended)	0	0	1	1
	Spatial opening	Permeable space (Ideal)	1	1	0	0
		Closed space (Not recommended)	0	0	1	0
	"Tension effect "application in formals compositions	Include elements with visual tension (Ideal)	1	1	0	0
		Not include elements with visual tension (Not recommended)	0	0	1	1
	Contour types applied to formals elements	Curved contour (Ideal)	0	1	0	0
		Straight contour (Not recommended)	1	0	1	1
	Color combinations	Harmony combination (Ideal)	1	1	0	0
		Without harmony combination (Not recommended)	0	0	1	1
Smell - Sound	Types of vegetation	Wooded areas with endemic species (Ideal)	1	1	0	1
		Low vegetation areas (Not recommended)	0	0	0	1

Figure 1 Table of assignment of values of each property in each stimulus, according to its presence or absence
Source: Own elaboration based on data processed in IBM SPSS (Statistical package for the social sciences) and collected through digital questionnaires

Secondly, in order to identify those elements and properties that are key to the stimulation of positive emotions according to the study site, it is proceeded to phases 2, 3 and 4. Phases 2 and 3 allowed to extract the perceptions generated by the study site under the conditions it currently has, as well as the desired ones. These desired perceptions will be obtained using the Kansei methodology (Nagamachi, 2020) (quantitative and qualitative approach) and from the evaluation of 3 stimuli derived from the study site.

Finally, from the results obtained in phase "4", it was determined which are those elements or spatial characteristics that, supported by a scientific study, have a similar perceptual impact on the community, since from this it will be possible to associate a possible beneficial impact.

As the last part, there is phase 5, in which a portion of volunteers from the original sample is subjected to an immersive experience of the 3 stimuli, with this is intended to make a specific evaluation for each of the selected strategies, in order to determine the impact generated by each of them.

Based on the analyses carried out in each of these phases, a brief synthesis of some preliminary results of the research project is presented below.

Preliminary results

Under the application of this methodology and the corresponding analyses (descriptive, discriminant, semantic universe, correlation between the semantic universe-properties and multilayer perceptron) of the extracted data, which were carried out by means of a software called IBM SPSS (Statiscial, package for the social sciences) in its version 21, the following results were found.

The properties with scientific support that were identified are:

The sound of falling water jets as elements that promote relaxation. On the other hand, it can act as a barrier to reduce the perception of environmental noise, as well as acting as a visual attraction.

As part of the tactile stimulation, it is advisable to include materials with textured surfaces or with changing surfaces. On the other hand, due to the stimulation of tranquility and stress reduction it causes, the use of natural materials, such as wood, is recommended.

In visual aspect, the permeability of the space is a feature to be promoted, as it helps to reduce stress or fear levels, unlike what is caused in enclosed spaces. Even though no scientific evidence was found, the visual and antigravity tension of elements will be tested at a formal level, since in literature it is considered as an element that determines the permanence in space.

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In the visual and olfactory theme, tree barriers will be promoted, since a direct association with base and survival characteristics was identified. In addition, it was found that the aromas given off by the vegetation contribute to relaxation and neutralization of bad odors. On the other hand, it was formally found that curvilinear contours cause greater attraction and relaxation than straight contours.

According to the analysis of the results of the questionnaires applied, it was identified that there is indeed a correlation between the properties studied and positive emotions. On the other hand, the 5 factors that group the perceptions of the stimuli, attractive, daring, open, calm and invasive, were identified, the first being the most desired by people. From the latter those properties were extracted which contributed to obtain these perceptions, in this sense the main properties were (the order given indicates their relevance: 1) wooded areas with endemic species, 2) harmonious combination of colors, 3) with antigravity, 4) predominance of synthetic materials, 5) contains elements with visual tension, 6) "jet" type fountain, 7) textured surfaces, 8) curved contour and 9) closed space (see figure 2).

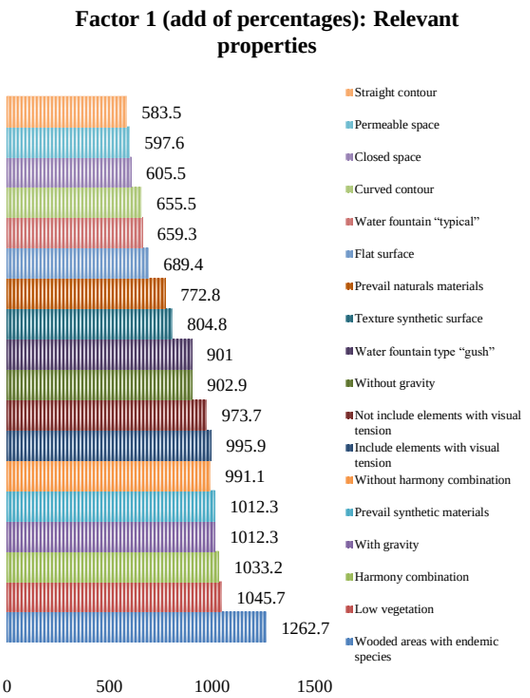

Figure 2 Graph of the percentages of the properties identified in factor 1
Source: Own elaboration based on data processed in IBM SPSS (Statistical package for the social sciences) and collected through digital questionnaires

Conclusions

It is hoped that, from these results, interest will be generated to continue applying this methodology, so that more positive properties can be extracted for other types of environments. This allows the extraction of strategies, so that professionals involved can implement in their designs, since from the exploration of these, they will be able to identify their variants and use them in a way that suits their design needs. In this way, it could contribute to the development of urban and architectural design spaces that are committed to their habitability, rather than just an aesthetic need, which does not always satisfy the needs and sensory effects described here.

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The importance of geotechnical research in building projects: case study sustainable rural housing

La importancia de la investigación geotécnica en los proyectos de edificaciones: caso de estudio vivienda rural sustentable

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Abstract

When conceiving the project of a building, we understand that it will be interacting with the ground through a "soil-structure" system, and that it will be the appropriate interaction between the ground and the foundation that will guarantee functionality and stability from the geotechnical perspective as structural of the project. Today we identify buildings that present problems concerning structural stability due to a deficient geotechnical study that entails a negative impact from the point of view of safety, functionality and economics of the project. The professional in charge to determine the geotechnical conditions of a site is the Geotechnical Engineer or Engineer specializing in Soil Mechanics, in fact, it must be a professional with comprehensive training with knowledge in various disciplines such as geotechnics, structures, foundations and construction. The document with which we base ourselves to establish the guidelines to follow from an analysis and design perspective is the geotechnical study. This document also allows us to understand the possible threats to which the project will be at some point and how to carry out the analysis and design of the buildings, so that they can interact in perfect harmony with their surroundings. By means of a case study concerning the project of a sustainable rural house, we show the stages and elements that make up the report of the geotechnical study that was carried out, indicating the development, analysis and methodology of the study, as well as the various elements that comprise it.

Geothecnical, Architecture, Project

Resumen

Al concebir el proyecto de una edificación, comprendemos que la misma estará interactuando con el terreno mediante un sistema “suelo-estructura”, y que será la adecuada interacción entre el terreno y la cimentación la que garantizará la funcionalidad y estabilidad desde la perspectiva geotécnica como estructural del proyecto. Hoy en día identificamos edificaciones que presentan problemas concernientes a la estabilidad estructural debido a un deficiente estudio geotécnico que conlleva a un impacto negativo desde el punto de vista de seguridad, funcionalidad y económico del proyecto. El profesionista encargado para dictaminar las condiciones geotécnicas de un sitio es el Ingeniero Geotécnico o Ingeniero especialista en Mecánica de Suelos, en realidad debe ser un profesional con formación integral con conocimientos en varias disciplinas tales como geotecnia, estructuras, cimentaciones y construcción. El documento con el cual nos basamos para establecer las pautas a seguir desde una perspectiva de análisis y diseño es el estudio geotécnico. Este documento nos permite, además, comprender las posibles amenazas a las cuales estará sometida el proyecto y el cómo realizar el análisis y diseño de las edificaciones, de forma tal que puedan interactuar en perfecta armonía con su entorno. Por medio de un caso de estudio concerniente al proyecto de una vivienda rural sustentable evidenciamos las etapas y elementos que conforman el informe del estudio geotécnico que se llevó a cabo indicando el desarrollo, análisis y metodología del estudio, así como los diversos elementos que lo integran.

Geotecnia, Arquitectura, Proyecto

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Introduction

In most of the bibliographic sources specialized in geotechnics and city regulations in which construction regulations are dictated, the need to carry out field exploration and laboratory research complemented with engineering analysis on the use of physical and mechanical properties is highlighted. and hydraulics of the soils and on the construction process, to achieve an adequate interaction between the support ground and the structure.

For some, this practice may seem unnecessary for "small-scale" projects. However, and regardless of the magnitude of the project, experience has shown us that many failures, losses of time and money are due, for the most part, to the lack of geotechnical studies or incomplete studies [1].

The most important reason to carry out the geotechnical study is to have a reasonable safety for the work, at the lowest possible cost, thus avoiding setbacks and delays during construction.

The complementary technical standard for the design of foundations 2017 of the RCDF establishes that every geotechnical study must include a memory where the soil is described in detail, the foundation to be used is justified, the analysis methods used and results according to these standards. The description of the expected behavior of the foundation in each of the limit states must be included, in addition to attaching the results of the explorations, laboratory tests, magnitudes considered for design and expected future behavior of the construction and neighboring properties.

In general, two types of geotechnical studies are considered: At a preliminary level, to obtain an approximation to the geotechnical characteristics of a land, to establish the feasibility of construction of a project, including geotechnical threats, general foundation criteria and works for the adequacy of ground. At the definitive level, for design and construction purposes for a specific project, in accordance with regulations [1].

The geotechnical study includes two fundamental aspects: Investigation of the subsoil, which includes the study and knowledge of its geological origin, field exploration and field and laboratory tests necessary to quantify the physical, mechanical and hydraulic characteristics of the soil. Engineering analysis, includes the technical interpretation that allows the characterization of the subsoil and the evaluation of the possible failure mechanisms that make it possible to supply the parameters and the necessary recommendations for the design and construction of the foundations and other works related to the subsoil [1].

The definitive geothenic study must contain at least the following aspects:

Regarding the project: Identification, location, objective of the study, general description of the project, structure system and loads.

Regarding the subsoil: Summary of the research carried out, terrain morphology, geological origin, stratigraphy, physical-mechanical characteristics, groundwater level, with an analysis of its impact on the behavior of the project. Geotechnical analysis: at this point the analyzes are summarized and the geotechnical criteria adopted to determine limit states of failure, failure modes, etc., are justified.

Design recommendations: include type of foundation, depth of offset, bearing capacity, differential settlements and calculated totals, stratigraphic profile, etc.

Recommendations for construction: procedures for construction, tolerances, instrumentation, verification and controls [1].

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Methodology

It is proposed to establish an organized and clear methodology that allows determining how it is intended to meet the objectives proposed in this document, this, in order to identify and analyze the technical requirements that must be followed for the formation of a definitive geotechnical study, in addition to be able to structure, develop and evaluate a case study which was carried out in a practical way for a real situation. Therefore, the procedure will be carried out through 3 stages as evidenced in Figure 1.

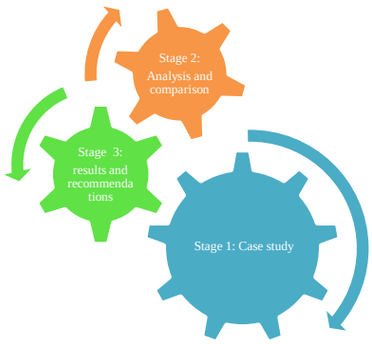

Figure 1 Geotechnical study / analysis methodology
Source: Own authorship

When developing this methodological system, it is sought not only to establish and determine a structural order for the execution of the soil studies carried out, but also to evaluate and verify its functionality and correct applicability in terms of procedures, techniques and other activities that are often used. In this way, said procedure will be carried out as shown below.

Field exploration

The exploration of the subsoil corresponds to the first phase of geotechnical studies in general, this phase basically consists of making open-pit wells in the land under which the proposed project will be executed in order to determine the stratification of the soil and thus, to be able to obtain samples, whether altered or unaltered, for analysis in the laboratory. The company “Laboratorio de control para la Construcción S.A. de C.V. " For its part, it carried out the drilling with a manual equipment for drilling the open pit by mechanical means (pick and shovel). The samples, in general, are of the unaltered type, which determines the tests to be carried out [3].

Testing and laboratory

In order to be able to determine the main properties and characteristics of the soil, the company makes use of field tests and laboratory tests as is generally recommended. For the analysis of the gravimetric properties, the tests of natural humidity, unit weight, specific gravity, Atterberg limits and granulometric distributions are carried out.

Regarding the soil resistance parameters, simple compression, consolidation and triaxial tests were carried out to obtain the resistance parameters of the granular material.

Case study

Background

The services of a specialized geotechnical laboratory were requested to carry out a geotechnical-mechanical study of soils on the land where the rural housing project will be located. The land is located within the facilities of the Higher Technological Institute of Huichapan. The purpose of this study is to know the physical characteristics of the subsoil up to the analyzed depth, to determine the load-bearing capacity of the natural ground in a stratum, and to provide recommendations for the type of foundation and its depth of abutment.

Project location

The project to be carried out is located 8.15 km in a straight line to the municipal seat of the municipality of Huichapan, with a heading of 45.55 ° NE, in the state of Hidalgo. Its geographical location is 99º 42 ’21.56” of West longitude and 20º 19 ’24.61” of North latitude, with an altitude of 2155 m.s.n.m. Figure 2 shows the location of the study site.

ISSN 2531-2162

Figure 2 View of the terrain location
Source: Google Maps

Site conditions

The topography of the property under study is flat, with a slight downward slope from southeast to northeast.

It is recommended to reference the surface level of the natural terrain in the analyzed site with the project level bench.

The surface geology at the study site corresponds to sandstone sedimentary rock (ar) as well as the presence of igneous rock.

Figure 3 shows the surface geology of the site in the geological - mining chart F14-CF78 from INEGI [2].

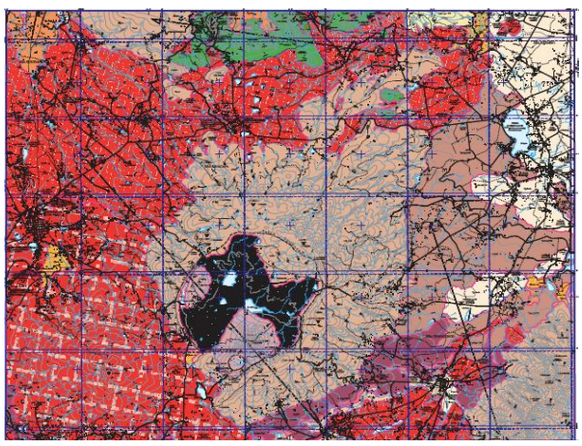

Figure 3 Surface geology of the study area
Source: INEGI

Description of the project (architectural and overall plan)

The project to be built in the study area corresponds to a rural house which will be built within the facilities of the Higher Technological Institute of Huichapan (ITESHU), in the town of El Saucillo, Municipality of Huichapan in the state of Hidalgo. This project consists of a total of 59.30 m2 built, equipped with a functional distribution of each architectural area, solving the needs of each of the possible inhabitants of this project, the prototype is of a single level, making it stand out due to the combination of slabs as it contains slabs inclined at a slope of 16% and straight or flat slabs.

The project will be carried out with the sole purpose of providing a home and meeting the necessary needs to carry out the daily activities of certain people who at some possible time may inhabit this house. Therefore, it is intended to carry out an effective and efficient project, thus causing the need to study and analyze more thoroughly the soil of the property where it is intended to move said construction, to know the quality of the materials to be used and the degrees of compaction of the soil already once modified.

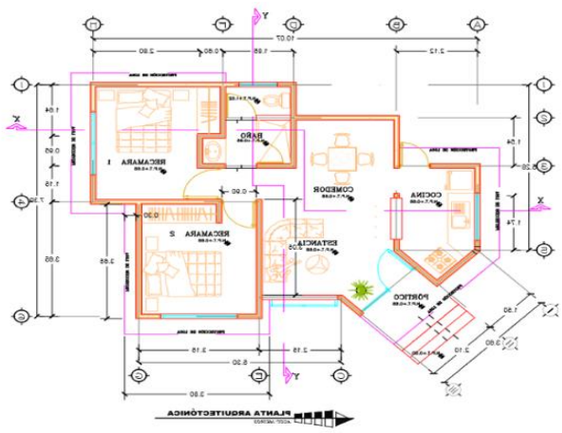

Figure 4 Architectural plan of social interest type house
Source: Own authorship

Investigation

For the purpose of the exploration of the terrain, an open pit was carried out with the help of mechanical equipment to a depth of 0.65 m, suspending at that depth due to finding materials that can hardly be excavated with the equipment used.

ISSN 2531-2162

Figure 5 shows the physical site where the geotechnical study (open pit) was carried out within the facilities of the academic center.

Figure 5 Site within the academic center where the geotechnical studies were carried out
Source: Google Maps

First, a visual inspection of the walls of the well was carried out to proceed with the sampling of the materials.

From the horizon of the soil profile in the exploration area, samples of the altered type and small samples of the unaltered type were obtained, which were transferred to the laboratory to obtain the following parameters: natural water content, liquid limit, plastic limit, plastic index, particle size composition, SUCS classification, solid density, void ratio, degree of saturation and natural volumetric weight. Figure 6 shows the open pit exploration well located in the study area.

Figure 6 Open pit exploration well
Source: Own authorship

At the beginning of the third stratum of natural terrain, at a depth of between 0.30 to 0.60 m with respect to the current surface level, fragments of the volcanic tuff found were obtained, which were determined for shear stress resistance.

Characterization of the subsoil

Taking as a reference the current surface level of the natural terrain. Stratigraphy up to the analyzed depth can be described as follows:

In the first stratum of natural terrain, it occurs between depths of 0.00 to 0.15 m, being composed of a mixture of sand and yellowish-brown clay, with traces of vegetable matter, classified according to the unified soil classification system (SUCS) of SC [3].

The second stratum of natural terrain found in the exploration, occurs between depths of 0.15 to 0.30 m, being composed of a mixture of clay and sand of medium compressibility of dark brown color, classified according to the unified soil classification system (SUCS) of CL [3].

The third and last stratum of natural terrain found in the exploration, which occurs from 0.30 m and up to the explored depth of 0.65 m, is composed of a consolidated, stratified volcanic tuff, of a light yellowish-brown color, which when extracted is classified as a mixture of gravel, sand and silt, classified according to GM's Unified Soil Classification System (SUCS) [3].

Until the depth explored, the groundwater level was not found. Figure 7 shows the walls of the open-pit exploration well carried out in the area of the project.

Figure 7 View of the walls of the open pit exploration well
Source: Own authorship

ISSN 2531-2162

In Figure 8 we identify by means of the stratigraphic profile the materials present in the subsoil of the area where the ground is ruled.

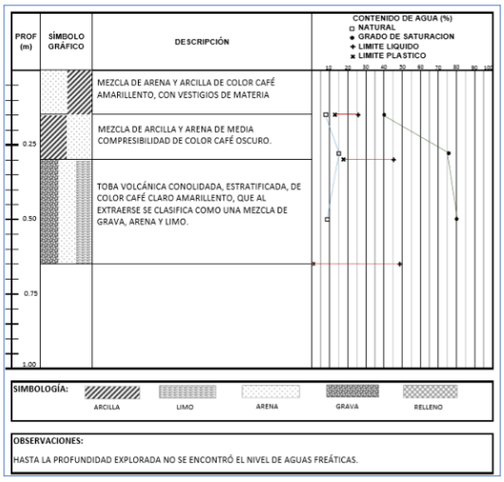

Figure 8 View of the stratigraphic profile of the open heat well
Source: Own authorship

Permissible load capacity of natural terrain

To the fragments of volcanic tuff obtained at the beginning of the third stratum of natural terrain, at a depth of between 0.30 to 0.60 m with respect to the current surface level, the load capacity was estimated using Terzaghi's theory [4], based on the results obtained from the unconfined simple compression test. The admissible load capacity of the land for the design of the foundation for its upward movement in the third stratum, which in the analyzed site, which occurs from a depth of 0.30 m, is 1.66 Kg/m^2.

Seismic coefficient

Taking into account the regional geology and the stratigraphic conditions determined in this work, and in accordance with the design manual for civil works, earthquake design, edited by the Federal Electricity Commission (CFE) [5], the spectrum for design Seismic for structures of Group A (schools), for the seismic zone B of the country and for a type II soil (intermediate terrain) that is the one that corresponds to it, is presented in the following Table 1.

Seismic Zone	Soil Type	a_0	c	T_a (S)	T_b (S)	r
B	II	0.08	0.30	0.3	1.5	2/3

Table 1 Seismic coefficients
Source: Own authorship

Where "a_0" is the ground acceleration coefficient, "c" is the seismic coefficient and t is the natural period of interest: "T_a" and "T_b" are two characteristic periods that delimit the plateau, and "r" is the exponent that defines the curved part of the design spectrum. Figure 9 shows the seismic regionalization in Mexico. The seismic regions in Mexico are divided into four zones, which are classified according to the frequency and intensity of the earthquakes. A) Low seismic zone, B) Moderate seismic zone, C) High seismic zone and D) Severe seismic zone. The seismic coefficient for the design of the structures is considered a significant value due to its way of acting in the analysis for the dimensioning of these. The seismic coefficient for the design of the structures is considered a significant value due to its way of acting in the analysis for the dimensioning of them. The seismic coefficient, c, is the quotient of the horizontal shear force that must be considered acting at the base of the structure as a result of the earthquake, divided by the weight of the latter above said level. To this end, the level from which its displacements with respect to the surrounding terrain begin to be significant should be taken as the basis of the structure.

Figure 9 Seismic regionalization in Mexico
Source: Manual for the design of civil works, earthquake design, Federal Electricity Commission (C.F.E.), 1993

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Results

Recommended type of foundation.

According to the results obtained from the different tests carried out on the materials recovered in the exploration, the stratigraphy that the terrain presents in the explored site and the characteristics of the project to be built, it is concluded that the foundation of the structure is composed by means of isolated reinforced concrete footings joined by means of counter beams, by continuous reinforced concrete footings, or by a combination of both. It is also recommended that the design of the foundation be carried out for each section with a different load, in order that the loads of the structure are transmitted to the ground in a uniform way, to avoid areas with higher concentrations of load and thus limit settlements. spreads. Finally, the project's structural designer will define the type of foundation based on the loads and the way in which they are transmitted to the subsoil.

Recommended tread depth

A total thickness of 0.30 m. Will be eliminated from the construction area, the second layer corresponding to clays with expansive characteristics, which, when presenting changes in their water content, present changes in their volume, which would cause movements in the structure and in the floors; This increase in water content may be due to a leak in the drinking water supply or drainage pipes, caused by rain, excessive irrigation of green areas, neighboring properties, etc.

Then, the floor of the excavation will be that of the beginning of the third layer of natural terrain that is identified with the yellowish light brown color then, the floor of the excavation will be that of the beginning of the third layer of natural terrain that is identified with the brown color clear yellowish.

The second stratum of natural land, according to “the ghazzaly and Vijayvergiya criteria for predicting the expansion potential in clays”, is 2.5% expansion.

The grounding of the foundation of the structure will be in the third layer of natural terrain, which in the explored site occurs from a depth of 0.30 m and is identified with a light yellowish-brown color.

The value of 1.66 Kg / m^2, obtained in the natural terrain at the recommended depth for its uplift, will be used as the admissible load capacity of the ground for the design of the foundation.

The foundation will rest on a poor concrete template (f'c = 100 Kg / cm^2), 5 cm thick, in order to transmit the loads more uniformly to the ground, to increase the distance between the reinforcing steel of the foundation and the natural terrain, thereby reducing the oxidation of the steel, in addition to protecting the supporting soil against its weathering during the execution of the works, and working on a smooth surface that lends itself to the proper placement of the steel and that be able to clean thoroughly before placing the foundation concrete.

To support the floors, an embankment will be built with Inert material (tepetate), compacted to at least 90% with respect to its weight.

Maximum dry specific (standard aashto test), in layers no greater than 20 cm thick to ensure uniform compaction, and no less than 10 cm to avoid coating (fatigue) of the layer. The total thickness of this layer depends on the levels of the excavation and the finished floor.

Conclusions

Geotechnical studies must always be carried out previously for the construction of all types of buildings.

The geotechnical study can be preliminary or definitive. In the first, it is about evaluating the land to determine the feasibility of executing a work or knowing its geological characteristics or performing soil quality zoning; The geotechnical study at a definitive level is carried out for design and construction purposes.

The magnitude and content of the geotechnical study depends on the importance and disposition of the foundation of the work and the complexity of the soil conditions.

Geotechnical studies allow obtaining information concerning the following aspects:

ISSN 2531-2162

Determine the soil profile and the geotenic characteristics of the subsoil and estimate its mechanical behavior under the project loads.

Estimate the settlements that the building has to experience.

Classify the type of soil in the area where the building will be located (fine soil - coarse soil) and the conditions in which it is found (expansion, dispersivity, collapsibility, to name a few).

Analyze the feasible foundation alternatives, taking into consideration safety, technical variability, construction process and behavior over time.

Obtain the basis for the seismic design recommendations [1].

The definitive geotechnical studies developed by the company “Laboratorio de Control para la Construcción S.A. de C.V. " They adequately meet the established requirements, not only by current legal regulations, but also, due to what the scientific literature proposes regarding geotechnical analyzes and their derivatives,

In the development of the definitive geotechnical studies, the phases corresponding to the field work (field exploration and tests) represent a fundamental and vital part, because the results obtained from these will be made available through the geotechnical analysis, therefore, it is important to emphasize field work at a general level and try to minimize as much as possible the methodological errors that may occur, in order to be able to carry out a more precise characterization of the soil properties and thus be able to provide a comprehensive and adequate solution through a functional foundation system that is capable of supporting the loads generated by a structure to the ground [3] .

Thanks

We appreciate the work of the company "control laboratory for construction S.A. de C.V." who developed the geotechnical study of the present investigation.

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Architectural proposal for the rehabilitation and improvement of the houses of the city Yagúl housing unit, Oaxaca

Propuesta arquitectónica para la rehabilitación y mejoramiento de las viviendas de la unidad habitacional ciudad Yagúl, Oaxaca

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Abstract

This article presents the results of an investigation carried out in the Yagul city housing unit in the state of Oaxaca, in order to study the deterioration problems that have caused the abandonment of the houses, and in this context, to propose strategies that solve these problems in addition to improving the quality of life of the inhabitants. For this investigation, non-destructive tests were carried out on the houses of the place, such as: Concrete compression resistance test using a digital sclerometer, temperature tests with a thermographic camera and infrared digital thermometer, detection of reinforcements using a portable Pachometer and soil mechanics. . The results obtained have allowed us to know the current state of the houses and based on these data, make an architectural proposal for the rehabilitation and improvement of said houses, generating a bioclimatic environment and comfort for its inhabitants.

Rehabilitation, Bioclimatism, Non-destructive testing

Resumen

En este artículo se presentan los resultados de una investigación llevada a cabo en la unidad habitacional de ciudad Yagul en el estado de Oaxaca, con el fin de estudiar los problemas de deterioro que han provocado el abandono de las viviendas, y en este contexto, plantear estrategias que solucionen estos problemas además de mejorar la calidad de vida de los habitantes. Para esta investigación se realizaron pruebas no destructivas a las viviendas del lugar, tales como: Prueba de resistencia a compresión de concreto mediante un esclerómetro digital, pruebas de temperatura con cámara termográfica y termómetro digital infrarrojo, detección de armaduras mediante Pachometro portátil y mecánica de suelos. Los resultados obtenidos han permitido conocer el estado actual en que se encuentran las viviendas y a partir de estos datos hacer una propuesta arquitectónica de rehabilitación y mejoramiento de dichas viviendas generando un ambiente bioclimático y de confort para sus habitantes.

Rehabilitación, Bioclimatismo, Pruebas no destructivas

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Introduction

In recent years, the discourse of "social housing" has been characterized by real estate voracity, uninhabited housing, vandalized and far from the workplace. Today, the way of building housing in Mexico is based on a nondescript and generic model of serial repetition[2].

In this article, an architectural proposal was carried out in the housing unit of the Yagul city, Municipality of Tlacolula Oaxaca.

Non-destructive tests were carried out on the houses, as well as a soil mechanic to determine the causes of the problems that afflict the inhabitants.

A sample of 5 dwellings was carried out, which allowed us to analyze the results of the state in which they are located.

The architectural proposal was born with the intention of improving the homes that currently exist, both in the structural aspect and the comfort of the inhabitant, in addition to generating a complex and raising awareness of the environment of the area, proposing several elements that help the user of the houses to learn and live with the nature of the environment, the culture and the social and economic activities directly related to the place through its evolution and history of this complex.

Problem statement

Currently the subdivision has 2,865 homes, of which approximately 45% are in a situation of abandonment, after a study carried out it is declared that the homes do not comply with the quality of materials or regulations established in the construction regulations of the state of Oaxaca.

The inhabitants of the few occupied dwellings have manifested the low quality of life, problems in the structure of the dwelling, lack of water, intense heat and distance from the city with respect to their workplace.

Justification

In order to carry out the proposal, it was necessary to know the current state of the subdivision, as well as that of the houses, materials used, construction system, regulations among other data, for this it was determined that non-destructive tests were the most suitable to avoid damaging the structures of the place, these tests gave us the necessary information to identify the origin of the aforementioned problems, and thus be able to make a proposal and intervention that solves the current problems.

Hypothesis

Analyzing the state of the houses and their structural quality, a proposal can be generated that solves the needs detected and the problems mentioned by the users, as well as the abandonment of the houses, proposing an architectural solution that provides thermal comfort, and improves comfort and quality of life of the inhabitants.

Objectives

General objective

Carry out an Architectural proposal of the houses through site analysis of the place through non-destructive tests for the improvement and rehabilitation of the architectural spaces of the houses of the Yagúl Tlacolula city housing unit, Oaxaca

Specific objectives

- Make a planimetric survey and visual inspection of the houses.
- Perform non-destructive tests on homes to determine their structural and bioclimatic status.
- Perform soil mechanics through open pit (PCA) sampling to find out the type of soil.
- Develop an architectural Proposal based on the results for the improvement of homes and the subdivision in general.

[2] Juan José Kochen (2017) "El ideal del multifamiliar: A 70 años del primer centro urbano moderno" Archdaily ISSN 0719-8914.

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Analysis of the house

Mexican Housing Regulations

The regulations on housing at the government level are: the National Housing Commission (CONAVI), the Institute of the National Housing Fund for Workers (INFONAVIT), the ISSSTE Housing Fund (FOVISSSTE), and the Housing Fund Military (FOVIME).

The national housing law is regulated in article 4. of the Political Constitution of the United Mexican States on housing, which establishes the right of every family to enjoy a decent and decent home. Housing is a universal right of every human being.

In addition to the aforementioned, the following laws and regulations should be taken into account when designing and building the aforementioned housing unit.

- Regulation of subdivisions.
- Regulation of construction and structural safety of Oaxaca.

Within the INFONAVIT Law, in the table "Minimum dimensions of housing according to official provisions and regulations" (INFONAVIT, 2006), the necessary surface for each space in the house, the heights, the circulation and the natural ventilation. The minimum free area per space must correspond to what is established in Table 1. According to the UNE-EN ISO 7730: 2006 standard, the ideal temperature for a house in winter is 21 degrees Celsius.

Living space	Minimum area	Minimum side
LIVING ROOM	7.29 m^2	2.70 m
Dining room	4.41m^2	2.10 m
Recharge	7.29 m^2	2.70 m
Bedroom	3.60 m^2	2.00 m
Auxiliary space		
Kitchen room	3.30 m^2	1.50 m
Bathroom	2.73 m^2	1.30 m
½ Rectangular Bath	1.69 m^2	1.30 m
½ Long Bath	1.44 m^2	0.80 m
Laundry	2.56 m^2	1.60 m
Playground	1.96 m^2	1.40 m
Patio- Laundry	2.66 m^2	1.40 m
Overlapping	**Spaces**	
Living-dining room	12.00 m^2	2.70 m
Living room-dining room-kitchen	14.60 m^2	2.70 m

Table 1 Minimum dimensions for Living and Auxiliary Spaces (CONAVI)

Materials and methods

Description of the structure and visual inspection

The research focuses on a hypothetical-deductive method, in which the quality of the dwellings and their thermal comfort in relation to the inhabitant are considered, this method is part of the qualitative approach for the analysis of the dwellings.

For this analysis, 5 random homes were selected from the subdivision, these homes were built by the company "Genesis 2000", these have a height of 2.50m at the bottom of the slab and consist of 2 bedrooms, a full bathroom and a common kitchen area. and dining room, as well as a service patio, having a total of 40m2 of construction.

During the visual inspection, several signs of deterioration in the structure could be observed, as shown in figure 1, which include cracks, humidity, signs of exposure and corrosion of the reinforced steel and the presence of leaching salts in the bed. bottom of the slabs, also subsidence of the ground in some houses.

Figure 1 Cracking and moisture in the walls and slabs

Non-destructive tests in concrete

Derived from the damage observed during the visual inspection process, it was determined to carry out the diagnosis of the state of deterioration of the structure by means of non-destructive tests of concrete, this in order not to damage people's houses.

Tests were carried out on 5 random houses, which will represent the mass of housing that currently exists in the subdivision.

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The properties to be evaluated were: the compressive strength (f'c) by means of rebound hammer tests (sclerometer), estimation of the quantity and location of the steel reinforcements in the houses with a portable patchometer for reinforcement detection. In addition, temperatures were recorded during the day and at night with an infrared digital thermometer.

In the same way, a thermography of the houses was carried out with a thermographic camera, additionally, a soil mechanics was carried out to know the properties and the bearing capacity of the land (qr) and thus be able to determine if the proposed foundation was the ideal one or the soil should be considered. as a major factor of cracking.

Determination of the f'c by rebound hammer

The rebound hammer (MR) readings were performed in accordance with NMX-C-192, using an ASTM C805 model E5541 digital sclerometer.

The steel readings were marked on the perimeter walls and central walls by making 10 divisions horizontally and 10 vertically with the help of the pachometer, then 10 blows with the hammer were made in the center of the divisions starting from zone 1, up to zone 10, this was done in order to achieve, as far as possible, run the tests in areas with little congestion of the reinforcing steel, a total of 100 readings were recorded in 10 walls of 5 different houses.

The results of the compression tests obtained by means of sclerometry are shown in Table 2, the average value of the aforementioned readings was considered as the final f'c.

With this we can rectify that the concrete used in the construction of the houses is of very low quality, f'c being the general average of 199.11kg / cm2 which is below what is established in the aforementioned guidelines, which shows the deficiencies in the materials used and the lack of supervision in the housing construction processes.

House 1		General summary	
Perimeter wall 1	Wall 2 center	House 1	
18.82	19.22	average f´c =	19.02 Mpa
18.82	19.24	House 2	
18.83	19.22	average f´c =	19.41 Mpa
18.82	19.22	House 3	
18.82	19.26	average f´c =	20.11 Mpa
18.82	19.22	House 4	
18.82	19.22	average f´c =	19.55 Mpa
18.82	19.22	House 5	
18.84	19.22	average f´c =	19.64 Mpa
18.82	19.22	Total f´c average	19.54 MPa
18.82	19.23		
Note: units in Mpa (Megapascals) 1Mpa=10.19kg/cm^2			

Table 2 Results of sclerometry tests

Estimation of the amount of steel and location of the reinforcements by means of digital pachometer

The scan was carried out using a Profoscope model DA 103 digital pachometer (rod detector).

The readings made will indicate the diameter of the steel used in the construction, as well as the mm of the wall covering.

The detector equipment uses electromagnetic pulse induction technology to detect the rods.

The coils of the probe are periodically charged by current pulses, which generates a magnetic field, eddy currents are produced on the surface of any material that conducts electrical current within the magnetic field, these currents induce a magnetic field in the opposite direction and Depending on the magnitude of the pulse reflected by the rod, the team can estimate the location, orientation, and diameter of the reinforcement.

The resulting change in stress can be used for the detection of embedded steel in the concrete structure, up to a depth of 100 mm, depending on the measurement range indicated to the equipment.

To determine the location and quantity of the reinforcing steel, the perimeter walls and center walls of the house were taken as a reference, each one was divided into 10 parts in its horizontal direction and 10 in the vertical direction, taking a total of 40 readings per housing, a standard measurement range was used, this division will help us to perform f¨c measurements with the sclerometer.

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Galvanized Steel Multimalla Mesh 15x20 cm Cal 14 was used for the construction of the houses, with an average covering of 14mm, the reinforcement details are shown in figure 2.

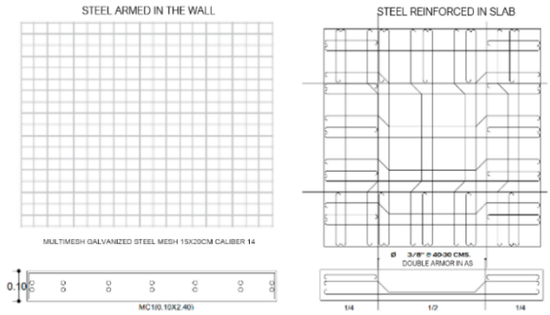

Figure 2 Detail of steel reinforcements

Thermography

The thermal imaging camera is a device that measures temperature and offers a thermal image of objects, without the need for contact, from their infrared radiation emissions. Objects emit an amount of infrared radiation based on their temperature.

For the measurement, a Fluke FLK-Ti400 9Hz Thermographic Camera model E554-1 was used, with which it was possible to exemplify the influence of emissivity on the surface temperature error, two thermograms were taken: the first with emissivity 0.9 (probable value very close to the real one) and with emissivity 0.1 (value very far from the real one).

The ceiling temperatures indicated by the camera when the emissivity is close to its real value, oscillate between 36 and 39oC, (figure 3) unreasonable values for interior surface temperatures, it should be noted that, for qualitative applications, the use of a u Another emissivity does not affect more than a change of scales to adjust the colors of the image, finding a lot of humidity in these adjoining all the walls.

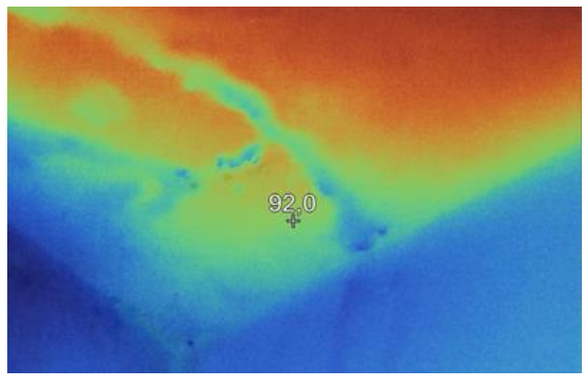

Figure 3 House bedroom thermography 2

The analysis of 5 dwellings was carried out at specific times of the day, one reading in the morning (9am), another in the afternoon (3pm) and another at night (8pm), in their different spaces and on their façade.

A great accumulation of heat was found, mainly in the slabs, due to the fact that they are made of concrete and are located at a very low height, in addition, a large amount of humidity is appreciated in the upper and lower part of the walls.

Moisture in reinforced concrete, usually occurs by capillarity, when the water rises from the ground through the material; or filtration, when water (usually rainwater) enters the interior of the building either by absorption, infiltration or penetration.

The results obtained can be seen in table 3.

Temperature			
-	Morning	Afternoon	Night
House 1	29.6 ℃	37.4 ℃	34.3 ℃
House 2	31.3 ℃	37.8 ℃	35.1 ℃
House 3	29.9 ℃	38.1 ℃	33.7 ℃
House 4	30.2 ℃	37.2 ℃	34.4 ℃
House 5	30.8 ℃	38.3 ℃	35.4 ℃
$\bar{x}$ Temp.	30.36 ℃	37.76 ℃	34.58 ℃

Table 3 Thermography test results

Soil mechanics

The purpose of soil mechanics tests is to know the mechanical and physical properties of the soil, based on a series of samplings, as well as to identify and classify the material, determining its physical and mechanical properties.

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The results obtained in mechanics are relevant for the design and calculation of the foundation of the work, therefore there will be an immediate and necessary correlation between design-mechanics of soils.

Granulometry is a mechanical process by which the particles of a soil are separated in their different sizes, called the smaller fraction (Sieve No 200) such as silt, clay and colloid. A run is carried out using sieves in descending order. The results of the tests carried out are shown in Table 4.

For seismic design purposes, the Civil Works Design Manual of the Federal Electricity Commission in its Seismic Design section; establishes that the Mexican Republic is divided into four seismic zones, the study zone corresponding to the type C zone with a soil type 2, having a coefficient of 0.64.

Granulometría tierra tipo A-1	mm	Columna1	Columna2	Columna3	Columna4
Malla	Apertura en (mm)	Peso retenido	% retenido	% acumulativo	% Que pasa
1	25.40	0.6	30.3030303	30.3030303	69.69697
3/4	19.05	0.38	19.1919192	49.4949495	50.50505
1/2	12.70	0.26	13.13	62.63	37.37
3/8	9.52	0.15	7.58	70.20	29.80
4	4.76	0.14	7.07	77.27	22.73
8	2.38	0.12	6.06	83.33	16.67
16	1.19	0.1	5.05	88.38	11.62
30	0.59	0.08	4.04	92.42	7.58
50	0.297	0.05	2.53	94.95	5.05
100	0.149	0.05	2.53	97.47	2.53
Charola		0.05	2.53	100.00	0.00
Suma		1.98	100	100.00	
Módulo de finura					
MF=∑ de malla #8 hasta #100/100				1000	
				MF=	7.46
				2.72	3.55
PESO VOLUMETRICO H/S				PESO VOLUMETRICO S/S	
1M³		1308		1M³	1305.1

GRAPHIC GRANULOMETRIC SAMPLE A-1.00 mts

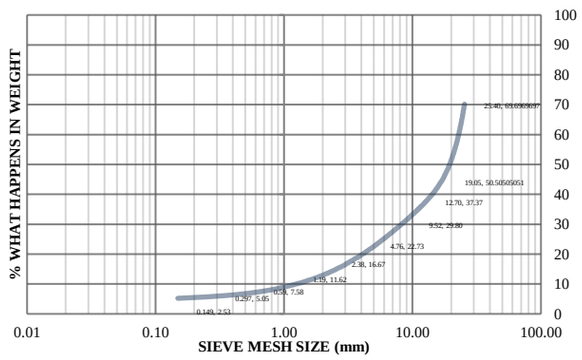

Table 4 Results of granulometric tests

The soil exploration was carried out by taking two samples: An altered open pit type to a depth of 1.0 meter, following what is indicated in the Mexican standard NMX-C-431-ONNCCE-2002 "Sample Collection Altered and Unaltered".

In order to determine the stratigraphy of the soil on which the dwellings were placed, (Figure 4) and obtain representative samples of these strata and considering the type and consistency of the existing material, it was decided to carry out samplings using:

Open Pit Wells (PCA).

In the surveys, samples were taken of the soil material that was considered homogeneous in its characteristics throughout the area, the studies were used to determine the bearing capacity of the soil (qr), these samples will be tested for physical and granulometric characterization in order to classify them with the SUCS parameters according to the standard (ASTM D2487).

The results showed that the type of soil is defined as follows: Poorly graded sands, a mixture of silts and clays of low compressibility, which indicates that the soil has a qr = 7.5 kg / cm^2.

Having said this, we can determine that the type of foundation used is not adequate and because of this the house can be affected by sand displacement or subsidence since clays of low compressibility are present.

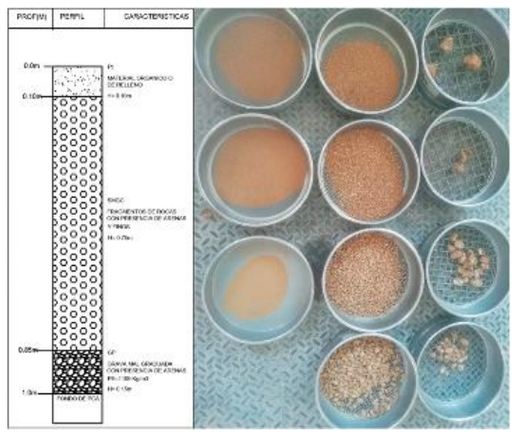

Figure 4 Stratigraphic profile and granulometry of the soil

Architectural Proposal for housing rehabilitation

After analyzing the houses and knowing the main problems they present, a better structure is proposed, which is expected to improve the comfort and comfort of the inhabitants and improve the view of the housing unit.

The problems to be solved are listed below.

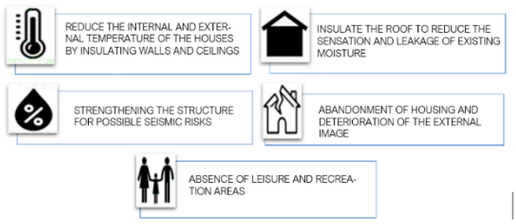

Figure 5 Problems to be solved in the housing unit

Two architectural solutions are proposed together, the first adding elements to the current home and the second expanding it. The plan of the current state of the houses is shown below.

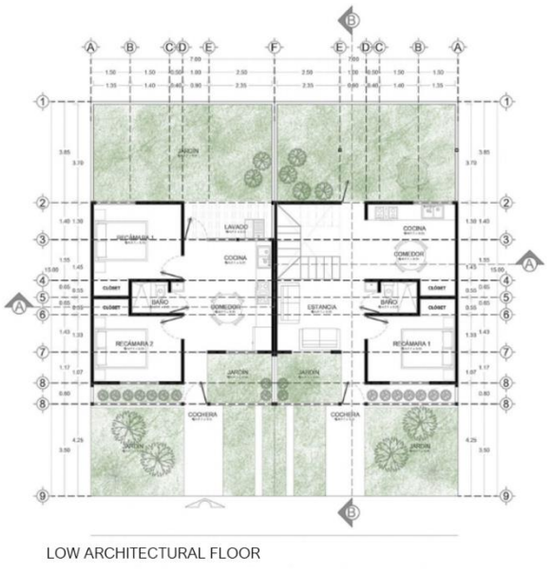

Figure 6 Current architectural plan

In this context, an architectural design with passive air conditioning is intended as a strategic approach. The objective is to manage the interior temperature of the houses without having to increase energy consumption to heat or cool them, avoiding the use of artificial systems such as air conditioning. It is important to improve the microclimate of the houses as much as possible, without the need for major or radical interventions.

The thermal improvement of houses with passive air conditioning and passive use of solar energy requires a complex optimization of all the construction elements in their interaction with the weather and use conditions; (Figure 7) passive design consists of understanding and directing well the heat fluxes in homes through design and proper management, to obtain the desired thermal comfort conditions.

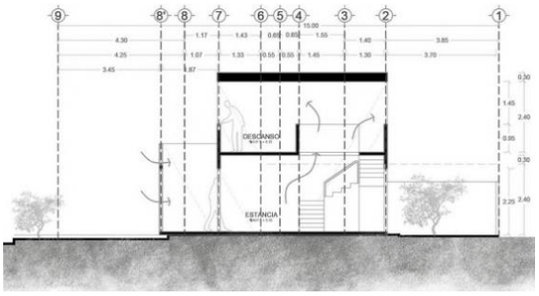

Figure 7 Air circulation diagram

The house in question has spaces that are too small, so an extension to a second floor is proposed, reorganizing the spaces: on the ground floor a guest bedroom, living room, kitchen and dining room, and on the upper part the addition of 2 bedrooms and a runner.

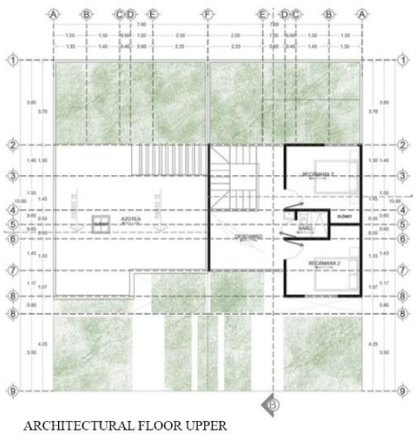

Figure 8 Proposal for the expansion of the upper floor

The scope of this passive air conditioning is to achieve:

- Superior thermal comfort.
- Minimal energy consumption for heating and cooling.
- Lower cost of energy and maintenance.
- Lower environmental impact.

In order to achieve these goals, some construction strategies are proposed in the houses.

Cross ventilation

Cross ventilation is based on generating natural air currents inside our home, that allow its renovation and at the same time improve the climatic conditions of the same.

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As can be seen in figure 9, a screen wall made of annealed clay lattices is proposed on the main façade, which in addition to functioning as an aesthetic element of the house prevents direct sunlight from entering and allows air circulation. Inside the house, the air passes through the lattice and then through a space with vegetation that helps to lower the temperature with which it will enter the house; This in order for the hot air to escape from the house and there is a constant air flow between indoors and outdoors.

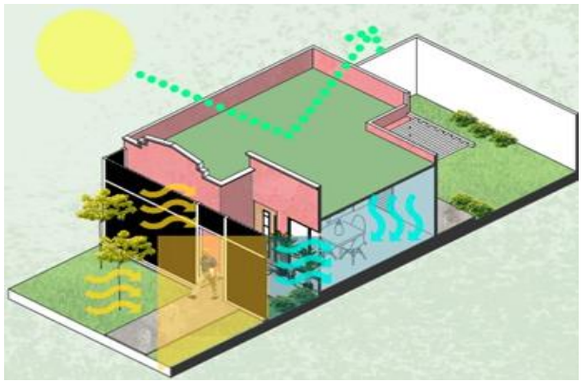

Figure 9 Climate diagram

Blocking Solar Radiation

For this, several sun protection systems are proposed:

- Roof: fixed and horizontal system that allows shading the rear façade in summer, but allows solar radiation to pass through in winter. They are a very effective method to prevent our building from overheating in summer and can reduce the incidence of solar radiation by around 40%.

- Waterproofing: an important method to prevent water seepage, causing humidity in walls and ceilings. Given the high humidity content inside the houses, it is proposed to apply red or white waterproofing to the house that will prevent the humidity from continuing to expand through the different spaces, avoiding the appearance of fungi and mold.

- Green roof: it is an alternative that consists of placing a kind of garden on the roof of the houses. The green roof system shows to decrease the interior surface temperature, reduce oscillation and have better thermal performance than the reinforced concrete roof.

This advantage is attributed mainly to the low density and thermal conductivity values of the materials that make up the green roof and reduce the passage of heat through these components. Consequently, the ceiling provides less unnecessary heat to the user, placing it in adequate thermal states

Subsequent to the great problem of high temperatures, the adaptation of green roofs is proposed, which will maintain the interior with adequate thermal comfort for the inhabitants.

- Vegetation: In the front part of the houses, the planting of trees is proposed, this to create microclimates and shade that refresh the air that circulates and enters the house, apart from providing a better appearance to the facade and the housing complex in general. , Species such as pochotes and acacias are proposed, this because they are not invasive and their maintenance is almost nil.

Inside the house a space with vegetation is proposed that helps to lower the temperature with which the air will enter the house, because the vegetation generates an effect called evapotranspiration that, basically, results in releasing moisture to the nearby environment, generating a greater feeling of freshness.

Figure 10 Housing design strategies

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Structural reinforcement and expansion

As can be seen in the non-destructive tests carried out on the houses, they are structurally weak, so a structural improvement based on confinement with castles and girders is proposed, which will give us structural security and support for the next improvement mentioned below.

The lack of space is one of the greatest adversities of the inhabitants, their small size does not allow them good mobility and not being able to have more furniture than the basic one, for this purpose, the expansion of the size of the houses is proposed, on the upper floor leaving more space for the dining room, living room and kitchen and moving the rooms upstairs.

As can be seen in Figure 11, an extension of the house with a second level is proposed, since adaptability is sought for a family of average size; also take advantage of the vertical circulation cube as a nucleus for natural lighting and cross ventilation.

Last but not least, it is intended to include water tanks for the storage of water, since the subdivision lacks planning of this supply and in times of droughts the inhabitants are affected

Figure 11 Housing expansion proposal

Security and rescue of the subdivision

As a local intervention and to solve the problem of insecurity that exists in the subdivision, it is proposed to place lights at every 50 m distance, in addition to the construction of 2 surveillance posts, in each of the 2 existing entrances.

For the rescue of the view of the fractionation, the planting of trees in the corners is proposed, species such as pochotes and acacias are proposed for planting, this because they are not invasive and their maintenance is almost nil, in addition, the creation of 2 recreation areas and social encounters, in abandoned land located in the north and south of the complex, thereby encouraging healthy recreation, coexistence and a sense of community (Figure 12).

Figure 12 Proposal for a recreational area

Results and conclusions

After analyzing the homes of the Cd. Yagul housing unit through an analysis of the place and non-destructive tests, we can conclude:

The houses were not built complying with the established guidelines, the houses are in abandonment and in a progressive and accelerated deterioration due to the poor quality of the materials used.

Sclerometry tests indicate that the concrete's f'c fluctuated between 189 and 199 kg / cm^2; Therefore, these values are not acceptable for concrete according to the Construction and Structural Safety Regulations for the State of Oaxaca, which indicates a value of f'c, equal to or greater than 200 kg / cm^2 for structural concrete.

The analysis of the quantity of steel, allowed to determine the variable or null presence of steel in the structure, using Galvanized Steel Multimalla 5x10 cm Cal 14.

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The Thermography analysis allowed to show the high temperatures inside the houses, their low height, as well as the concrete slab that they have give way to temperatures from 32 to 39 ℃ which makes it unbearable to stay inside them, according to the UNE-EN ISO 7730: 2006 standard, the ideal temperature for a house is 21 degrees Celsius.

With this test, the humidity within them was also evidenced, giving way to fungi and bad odors that put their inhabitants at risk.

With the proposal made and exposed above, it is possible to improve the thermal comfort of the houses, in addition to solving other problems such as the lack of water, expansion of spaces and bedrooms, the quality of life is improved, and the inhabitants can have a nice and worthy home to live in.

Thanks

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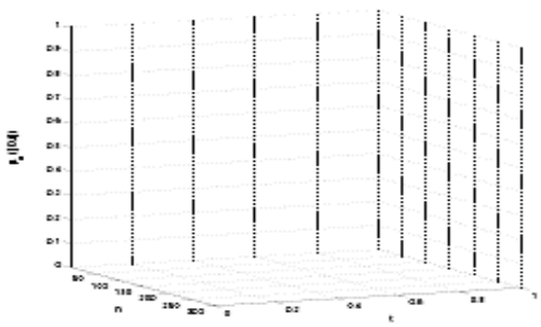

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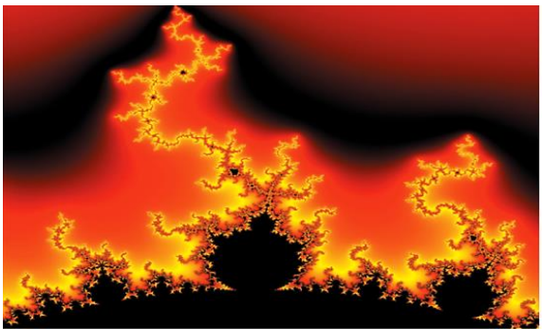

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