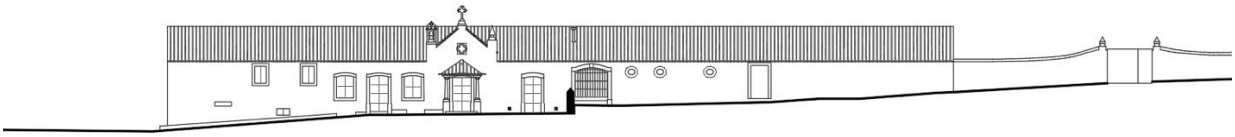

Desenho Bioclimático e Feng Shui

Um estudo na Quinta de Chão de Maçãs, em Ourém

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Dissertação para obtenção do Grau de Mestre em

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Julho 2021

INTRODUCTION

The present work makes a confrontation between the bioclimatic theoretical architectural design and the Feng Shui design.

Based on these two theories is analyzed a traditional rural house located in Chão de Maçãs, Ourém. The most important topographic, climatic, cultural and economic factors which justified the typology of the construction and the materials used were examined.

The dissertation is organized into four chapters.

The first chapter discusses the various theories of Feng Shui and their implications in the choice of location and architectural design. A comparison between Feng Shui strategies and bioclimatic design is also made. Some international examples of architecture including Feng Shui principles are presented. In the second chapter we refer to the bioclimatic theoretical aspects to be considered in design strategies, and we present what Feng Shui refers to about this matter.

The rural house under study, as well as its geographical, climatic and historical context, will be analyzed in the third chapter, being followed by the recommendations for better energy efficiency in the fourth chapter.

1 – IS FENG SHUI BIOCLIMATIC?

The design of bioclimatic buildings takes into account the specific conditions of the place to which it is intended, takes advantage of local natural resources in a sustainable way, without jeopardizing their use for future generations, uses renewable energies and has good integration with the environment. Sustainable practices are already found in the vernacular architecture of antiquity.

Feng Shui also has remote origins and was developed in China. The most interesting topics begin in the third phase, between 403 and 222 BC. With Taoism, or Daoism, Chinese philosophy and religion have developed, taking into account the dynamics and driving force behind all that exists. This philosophy emphasizes life in harmony, serenity, moderation of desires, simplicity, spontaneity, contemplation of nature, compassion and humility. Taoism had a profound influence on Chinese culture over the centuries and also had a great influence on Feng Shui. Thus, three great principles of Feng Shui were developed in this period: the theory of Qi (cosmic and vital force that created and permeates the entire universe), the theory of Yin and Yang (dualism / two polarities) and the theory of the five elements (earth, metal, water, wood and fire).

The fourth phase occurred between 202 BC and 221 AD and was related to Chinese scientific and technological development, creation of the chinese calendar, development of astronomy and the study of constellations. Magnetic north was identified and compass was invented.

In the fifth phase is created the Form School (618 to 907 AD). This school is based on the study of orography, soil types, watercourses and solar orientation needed to choose the best location for a new settlement or construction. The sixth phase, developed between 960 and 1,279 AD, corresponds

to the Compass School, uses the Feng Shui Luopan compass, and is based on metaphysical speculations of cosmology. Currently it is generally accepted that both theories are necessary, but that the considerations of the Form School are more interesting than those of the Compass School.

Equilibrium

The symbol of Tai Qi / Great Energy, representing the universe in perfect balance, is composed of two polarities – Yin and Yang. Together they create a visualization of the universe, with the two polarities in perfect harmony.

They show opposing and complementary forces or energies existing throughout nature. Everything is made of Yin and Yang and cannot be separated. When one is created, so is the other automatically. There is only balance with a couple of opposites offsetting themselves (e.g. heat/cold, dry/humid, light/dark, ...). Yin is negative and female and Yang is positive and masculine. In the universe everything is produced by change, this is the result of the reaction between Yin and Yang and the attempt to achieve balance.

Feng Shui theory starts with the belief that human events and natural processes (terrestrial and celestial) interact with each other. Everything is made of energy (Qi) that interacts permanently. There is concern that the universe, nature and the human being are in harmony and that the built environment does not harm this harmony, because the well-being of the inhabitants depends on it.

This is a common aspect with the objectives of bioclimatic architecture and also with the way many western architects think.

By way of example Gustavo Cantuaria refers that bioclimatic / sustainable architecture is not only what is seen, but also what is not seen, includes what is extrasensory and non-dimensional, comprises space without walls, influences emotions and peace of mind. When nature and architecture complement each other positively the beauty appears. The friendly environmental architecture is related with humans and healthy environment, and gives life to the "Genius Loci" / Spirit of the place, allowing man to find his place within the totality.

Christopher Day also tells us about the soul of the locals and the healing, soothing, enriching and renewing effects that the places with soul transmit to us. It is necessary to create positive energies and the existence of "conversation" to achieve a balance. For him it is fundamental the respect for the context, the insertion in the topography and in the place, the positive contribution to the place. The different rhythms, such as the ones due to the seasons, solar incidence and impacts on luminosity, are renewing and life-giving. The living silence is timeless and peaceful.

For Pallasmaa the interaction with nature invigorates us and has a healing effect, due to contact with all senses.

Form School

For the Theory of Form and to choose the location of buildings it is important to study the orography of the territory, the solar orientation and the water lines. The best choice for the location of the construction of a settlement or building has to do with the protection given by the mountains and hills (wind and defense), proximity to the water without danger of flooding, protection of alluvial zones.

The back of a building should be facing north and the front should face south. The principles of Feng Shui apply both to the shape of the city, the plot, the exterior of the buildings and their interior.

The theory is appropriate to the high altitude zones of northern China. In flat areas the approach is different, the site will have to be determined in view of roads, rivers, lakes, surrounding buildings, etc. Currently ancient Feng Shui has to be translated into different physical contexts.

In terms of criticism it could be said that settlements / cities when they are planned have several objectives in mind. The main objective may not be agriculture, but, for example, defence, war, fishing, administrative control of a territory, control of the population, the gods, trade, road support, the need for a port, which impact differently on how the city is going to be built.

The Form School has in common with bioclimatic theories the search for a sheltered place with good solar orientation, favoring the main orientation to the south, with high energy gains.

The concern not to compromise the best agricultural areas with construction and that the dwellings are not subject to floods reflect a spirit in common with the Environmental / Sustainable Design because this one analyzes the various systems (resources, environment, people, communities) and search that they are in harmony. Natural resources should not be exhausted, the needs of the present should not compromise the future, the inhabited space must be more pleasant, harmonious and conducive to well-being.

In the dissertation is presented a table that compares the favorable and unfavorable Feng Shui criteria with the thoughts of bioclimatic theory in terms of relevance and not advisable.

Colors, materials, internal layout

Feng Shui's concept of the five elements (water, wood, fire, earth and metal) is a tool that allows the architect to create more balanced and therefore more comfortable, pleasant and productive environments to maximize the potential of a specific individual.

Elements can be represented by an object, color, shape.

The main question when creating each environment is what is the main purpose of this space. The use and characteristics of people will help define colors, shapes, materials, lighting, sound, decorative and artistic objects, plants and water-related objects.

They all have both physiological and psychological, conscious or under-conscious effects that impact the mind and well-being. The important thing is the feeling they convey.

Feng Shui's use of materials and colors in order to create user perceptions bears resemblance to the thinking of several western architects.

For Kevin Lynch, the value of things lies not in the things themselves, but in our perception of them.

According to Jonathan Hill a house is an object, while a home is a perception. The experience of users depends on all the senses and the appropriation they make of space. Perception is also cultural and depends on how architecture is perceived, inhabited and managed.

Pallasmaa also refers to the importance of all the senses that connect us to the world around us, in the importance of peripheral vision, in natural materials such as stone, wood and brick that are more true and allow us to detect the passage of time.

Christopher Day, follows very much ecological principles, agrees greatly with Feng Shui with the concern for colors and materials, the aggressiveness of acute exterior angles in the form of the house, the concern with access to housing and the creation of positive energies. For him places only take life through sensory qualities, but we have to feel variety or otherwise we numb our spirit. Only multisensory manifestations give the reading of a place and its spirit in a lasting and meaningful way. The same goes with the small irregularities, the smoothness or curved shape of geometric lines, the changes of level, the differences in the height of rooms, the easy relationship with the outside.

Feng Shui describes red, orange and yellow as energetic colors and green and blue as calming and tranquil. These colors were compared in the dissertation with current scientific studies. These studies refer to the impact of colors on the perception of heat and cold, which allows a bioclimatic design that enables energy savings.

Compass School - Eight Mansions Method and Flying Stars Method

These two methods are based on metaphysical speculations of cosmology, and do not compared with bioclimatic theory. However productive and destructive cycle of the five elements established in this school has something similar with the concern of bioclimatic theory with efficiency and with the intention of preserving existing natural reserves.

International examples

The examples presented are the Beijing city, the old Tai Fu Tai House in Hong Kong, a house in Guarajuba / Brazil and some houses designed by architects with Feng Shui ideas incorporated: Bangkok - Junsekino Architect and Design Co., LTD, Singapore - Aamer Architects, South Korea - Hyunjoon Yoo Architects and Melbourne / Australia - Steffen Welsch Architects.

2 - BIOCLIMATIC DESIGN STRATEGIES AND FENG SHUI

Under this point, the theoretical aspects of the bioclimatic design were presented: climatic context, shape and orientation, shading, reflective coating, insulation, glazed areas and glass types, natural ventilation, inertia and comfort.

Regarding these points it is found that exists a great relationship between bioclimatic design and Feng Shui in what concerns climatic context, shape and orientation, natural ventilation and comfort. As to the remaining points there is no explicitly relevant relationship, but Feng Shui is concerned with comfort, well-being and harmony between nature and people.

3 - CASE STUDY: RURAL HOUSE IN CHÃO DE MAÇÃS

Chão de Maçãs is a small village, belonging to the district of Santarém, located simultaneously in the municipality of Ourém, parish of Seiça and in the municipality of Tomar, parish of Sabacheira.

The village is situated on the southern slope of Ribeira de Seiça. The hills to the south and north of the river, with a maximum height of approximately 200 m, delimit the relatively open valley, whose alluvial lands, extremely fertile, are rich for irrigated agriculture. As you climb the slopes the land becomes less rich and sometimes more sandy. Since in this area only part of the water seeps into great depths, there are springs with superficial runoff. The stone of the area is limestone, there are several quarries.

With Mediterranean climate the annual thermal amplitude is moderate. Looking at values of a few years, we can, however, verify that the minimum temperatures in January or December, can reach lows of -5º C and highs in August do to 43ºC.

The wind is from the north for 9.5 months, and in the rest of the period from the east. Overall it is weak or moderate.

Unprofitable agriculture and very divided property makes living off the land increasingly a supplement to other activities. Small industry and services give jobs to today's inhabitants.

The "Portus Auren" of the Romans gave way to the present-day Estremadouro and Chão de Maçãs. Here passed the Roman road, one of the main axes already in the 1st and 2nd century, which later gave way to the Coimbrã road of the Middle Ages and then to the Royal Road and the N113.

The rural house under study belongs to Quinta de Chão de Maçãs and currently has 25 ha of agricultural properties. An important part of these properties is located in the alluvial area next to the stream, then climbing up the slope with olive trees, oaks, holm oaks, poplars and pine forests. Agricultural activity has gradually been reducing. The same is happening with the agricultural warehouses of the house, which transforms into habitable zone.

The house was initially located by the royal road, certainly for practical reasons of disposal of its agricultural products

The house is more than two hundred years old, the date of the initial construction is unknown. There are records that the farm already existed in 1650. Along the years several modifications were introduced in the building. A carbon dating test (C14) was performed on a beam and the result was that for the highest probability (40.6%) the sample belonged to a wooden beam dated between 1808 and 1888 of the AD calendar.

Regarding the construction, not only the exterior walls have a thickness of 60 cm, but also 2/3 of the interior walls; the other walls are lighter. The floor and ceiling are supported by wooden beams inserted in the walls, so the spans are not very wide. This reason, combined with the support of the roof structure, determines the existence of stone interior walls, also with 60 cm thick. The roof structure rests on the walls and the triangular roof truss does not exist, as the ridge beam of the roof rests on the central wall. The set of rafters and slats is double, the first to support the "roofmate" and the second the tiles. The insulation of 4 cm was essential in reducing the humidity of the house and infiltrations caused by displacement of tiles, in the acoustic insulation derived from the train and in the thermal insulation.

The useful interior floor area is 334 m2, the covered balcony is17.5 m2, the storage rooms and the room for pressing grapes 102.8 m2 and the attic 192.6 m2 (half the house).

Given that the public supply of water and sewage was late, the house has its own water supply through a hole for water extraction and a spring, and there is a septic tank.

The building is located in a valley on the slope, so there are ditches and protective walls from the rainwater descending the slopes.

Bioclimatic performance

The length of the house develops in the north/south direction. The north-facing interior is protected from the wind, as it only has three medium-sized windows and two aeration openings on the façade. The trees have a damper effect, but the wind can circulate through the low part of the trunks.

Windows, doors, ventilation openings and vents allow air to flow into the house and under the floor. The north and east wind, as well as the temperature difference between the east and west side, promote air circulation. Daytime ventilation is not possible when outside temperatures are too high in summer, but with daily thermal amplitudes of 11ºC, it is possible to cool the external walls and the house with ventilation at night.

The sheds to the east, south and west protect from radiation in the summer. The east side is subject to more radiation than the west side, as there is a hill to the west 11 m higher than the top of the roof of the house.

Outside and indoor temperatures were measured on a very hot July day. The conclusion is that if people are careful to keep the wooden doors closed when the sun hits, the indoor temperature is acceptable in summer (maximum 25ºC at 16h) and there is no need for air conditioning. On the other hand, in winter there is a need for heating. Electricity, oil, gas and three iron heaters (biomass) are used. The pine forests belonging to the farm ensure all the needs of firewood. Its burning produces an ecological heating because it only releases the amount of carbon dioxide that was extracted from the air while being alive. The CO2 balance is null.

Passive and active areas were determined and it was verified that the percentage of active areas is low.

As for insulation there is the "Roofmate" below the tiles, a loft above most of the living areas, double glazed windows, dark brown wooden doors 3 cm thick and stone walls 60 cm thick with a lot of thermal inertia. However, the coefficient of thermal transmission (U) of the wall is 1.75 W/(m2.ºC), above the maximum legally allowed value of 0.5 (Port. 349-B/2013, as amended by Port. 379-A/2015). This value would pass to 0.37 W/(m2.ºC) with an insulation 8 cm thick.

The glazed area, with the exception of part of the west façade, does not reach the 20% recommended as maximum. As already mentioned above, due to the existence of hills to the west the period of exposure to the sun is reduced (in winter at 15h there is no sun). Overall it is considered that the glazed area is adequate, although some shadings is lacking.

With the Revit / Insight / Solar Analysis program, calculations were made for the determination of the accumulated radiation in one year, considering the specific location and altitude of the house. The irradiation received in the heating season (249 kWh/m2) exceeds heating needs (153.1 kWh/m2.year).

As the design in Revit was made with materials whose thermal characteristics were defined it was possible to compare with the ASHRAE standard and would allow the calculation of heating and cooling loads. However, these were calculated, through the PTnZEB software that determines the energy class, according to portuguese standards

Revit / Insight was also useful for the calculum of the shading hours. It also enables lighting studies, but although these are very interesting in the design of new projects, they did not seem to be relevant in an already built dwelling where there is a predominance of passive areas.

Feng Shui Aspects

The house was studied from the point of view of the theory of the Form School. Given that winds from the north are moderate in the area, there does not seem to be a great need for protection by the rear mountains, as the theory predicts. Thus, the fact that the front is not facing south would not be an inconvenience. However, for reasons of sun exposure, facing south would be a better choice for the most active area of the house.

A pre-established Feng Shui grid with forty-two conditions was applied to this house. Only seven of conditions did not comply with the stipulations of the theory of the Form School. Here too a comparison was made with bioclimatic theory.

It was also made an analysis from the point of view of the theory of the Compass School, by the Method of the Eight Mansions. Here too, it was found that a good classification could have been obtained if there was a quantitative classification. The most serious point is the proximity of the train line, which was constructed after the existence of the house.

4 - DESIGN RECOMMENDATIONS

Calculations were made to determine the current energy class, which obtained a classification of B. For this purpose the PTnZEB program (program advised by Adene technicians) was used.

With the placement of adequate insulation (by the outside) to lower the "U" of the walls, and insulation on the ceilings, with the replacement of single glass glazing by double glazing in windows and the colour the painting on the doors, classification would move to A. And with solar panel to use solar irradiation for heating water an A+ would be reached.

In addition, the following steps could be taken:

– In the east windows, not protected by the shed, place clear external sun blinds in summer or replace wooden interior doors with 3 cm thickness by other more isolated or install white venetian blinds (low emissivity glasses and reflective films would be harmful in winter because they would avoid heating).

– Replace the exterior doorways with other with more insulation, which would protect not only from the heat in summer, as indicated above, but also from the cold in winter and the noise.

– Place covers on the air intake on the façade at night in winter and during the day in summer.

– Place insulation in the shed in the south, to avoid heat in summer.

CONCLUSION

With the present work, bioclimatic theory and theory related to Feng Shui were studied and a comparison was made between both, verifying the existence of many points in which the two theories are interconnected, and, in general, they not only live peacefully, but also have a common main objective: a relationship of equilibrium between the human being and the environment that surrounds him, natural or built, resulting in general well-being. The means and methods for implementing the strategy are often different: Feng Shui speaks of Qi, of the balance of positive and negative energies, of the productive and destructive cycle of the five elements, while bioclimatic theory is concerned with efficiency and with the intention of preserving existing natural reserves. Bioclimatic theory quantifies results while Feng Shui is more subjective. Both theories are in constant development, and nowadays it is not very clear who first presented some ideas. However, both complement each other for the enrichment of the various architectural projects.

When look at Feng Shui and authors such as Jonathan Hill, Pallasmaa, Christopher Day or Gustavo Cantuaria, it is found that all of them have a concern with the integration of the architectural object in the environment where it will be built and that it is intended that this object contributes positively to the place, not only visually, but also as a living experience. The harmony, balance and perceptions induced can make the inhabitants feel happier.

Several examples of Feng Shui oriented architecture were analyzed and it was studied more closely, from the bioclimatic and Feng Shui point of view, a rural house of traditional architecture, located in the Ourém area, making it easier to understand the options taken in its construction. The empirical knowledge of several generations has allowed the development of sustainable strategies adapted to the surrounding environment. This house was part of a farm.

The construction was carried out on a hillside, above the alluvial areas, not harming the richest agricultural spaces and, at the same time, not being subject to flooding in the Ribeira de Seiça. Being the predominant wind of north, the elevation turned to this orientation is narrower and protective, with the east and west elevations being the longer.

The building materials are of local origin: stone and wood. The quarries and trees necessary for construction and maintenance exist in the area. These materials have great longevity and can be reusable. The 60 cm thick stone walls, both inside and outside, support the entire floor structure, ceilings and roof. It was found that in the summer months it is not necessary to use air conditioning to keep the house below 20º C, due to the great inertia of the thick stone walls and the existing insulation, but that in winter heating is indispensable. The farm's pine forests provide biomass and a radiation study, in the heating season, showed that the radiation on the roof allowed to capture more kWh than necessary.

To move from the current energy rating from B to A+ it would be necessary to place insulation on the exterior of the walls and on the ceilings, should be replaced single glass glazing windows by

double glazing, the exterior-facing doors shoul be painted in light color and a water heating panelshould be installed. Thermal insulation should be of low environmental impact.

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