

The Building Technological Solution for Hot Humid Climatic Modification in Architecture

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Abstract

The Eastern constructional beliefs such as “*Feng Shui*” and “*Vaastu*” from ancient China and India have influenced to building design in Thailand and many countries for decades. Feng Shui and Vaastu masters usually have conflicts to designers and owners. It is found that three influential factors of these beliefs are Heaven factors (climate and changes), Earth factors (topography and landform), and Human factors (culture and comfort). The hidden goal of these beliefs is human comfort especially thermal comfort and security. This research presents the relation between the influential factors and their contents. Then, we can apply by using Earth factors as the climatic modification in architecture in order to improve human thermal comfort in the locations of hot and humid climate such as Thailand. Human thermal comfort consists of 6 factors such as air temperature, relative humidity, mean radiant temperature (MRT), wind velocity, clo-value, and metabolism rate. The Earth factors can assist and improve human thermal comfort (MRT and wind velocity) results from scientific research. MRT increases comfort up to 40% and wind velocity up to 30%. Finally, Earth factors (topography and land form) can improve human comfort from 20-45%.

Key Words: Climatic Modification, Building Technology, Thermal Comfort, Belief, *Feng Shui*, *Vaastu*.

1. Introduction

Building beliefs are found in many of areas in the world especially in ancient areas which have long history. The two famous building beliefs of this study are ‘Feng-Shui’ from ancient China and ‘Vaastu’ from ancient India. The study has four major aspects: first, delving in detail of beliefs which influence current building construction; second, comparing these two beliefs in many of aspects; third, extracting the influential factors that determine the content of beliefs; finally, recommending the building technological solutions for the regions of hot and humid climate such as Thailand.

Feng-Shui belief has originated in China around 3,000 years ago,^[1] developed from location dictation, which means ‘Chinese geomancy’. The root of Feng-Shui comes from ancient Chinese philosophical thoughts such as, Daoism of Lau Tzu, Confucianism, Buddhism, and Yi-Ching (Book of Changes). From the previous studies in this belief,^[2] its contents are mainly:

- Site and building selection
- Landscape and site design
- Building form selection
- Room and area positioning
- Interior and furniture design elements

On another area, *Vaastu* belief has originated on Sindhu river civilization in India and Pakistan about 5,000 years ago.^[3] This belief is rooted from the one of branches of Vedas named Stapatya-veda, the knowledge about art and science in architectural construction like Feng Shui’s contents. Some specialists believe that Vaastu is the origin of Feng Shui. However, this study revealed the differences between two notions in details.

2. The Definitions

In Chinese meaning, ‘Feng’ is wind or moving air and ‘Shui’ is water. However, the results of a previous anthropological studies concluded that the ancient Chinese people always used an analogy and broad meaning. The literatures describe various meanings of Feng-Shui such as:

- Feng Shui is the Chinese knowledge that realizes on nature and environment especially wind and water.^[4]
- The art and science of living in harmony with your living space. Especially, Feng Shui seeks to harness nature’s positive force and to correct the negative ones with the intention of promoting better health, wealth, and relationship.^[5]
- The knowledge of the Chinese Environmental Science.^[6]
- The traditional Chinese art and Science of living in harmony with the environment.^[7]

By synthesizing from various meanings above, we can use the universal meaning, which covers all definitions: “Feng Shui is an *“eco-social science that enhances human well-being and prosperity.”*^[2]

Similarly, various literatures have given different definitions of Vaastu such as:

- An ancient Vedic science of layout planning of buildings that has stood the test of times, influencing peace and prosperity of the habitants.^[8]
- The art of positioning your home and office to attract Nature’s auspicious influences and to block her inauspicious influences.^[3]
- The science of arranging our man-made environment so that we are in alignment with these forces of nature.^[9]

By comparing the definitions above, we can clearly see the similarity between these two beliefs. The goal of these beliefs is *“to bring people who live in building to comfortable, prosperous, and auspicious living.”* Then, the scientific methods will be used to delve the strategies and details of these beliefs in order to apply them for the locations of hot and humid climate such as Thailand.

In other hand, the western and the southern areas of China have a plenty of mountains and rivers thus, the Feng Shui belief from these areas has emphasized on using natural elements especially mountain and river. In AD 206, the Chinese sages created *The Mountain and Water Dragon Classic*. This great book has specified the characteristics of mountains, hills, and rivers which influence the dwellers into good or bad situations.

- **Vaastu and Its Location**

The Vaastu belief has originated in warm and arid climate area. (Jaisalmer precinct; Area 2) At present, this area is mostly desert. The Vaastu belief contents bring people to take advantages from both landforms and directions. Its contents will be discussed in the next section.

5. Beliefs and climates

- **The Feng Shui and climatic conditions**

First, we have to consider the climatic conditions of this area where Feng Shui belief was originated such as; sun orbit pathway, air temperature, relative humidity, and percentage of wind directions (Figures....).

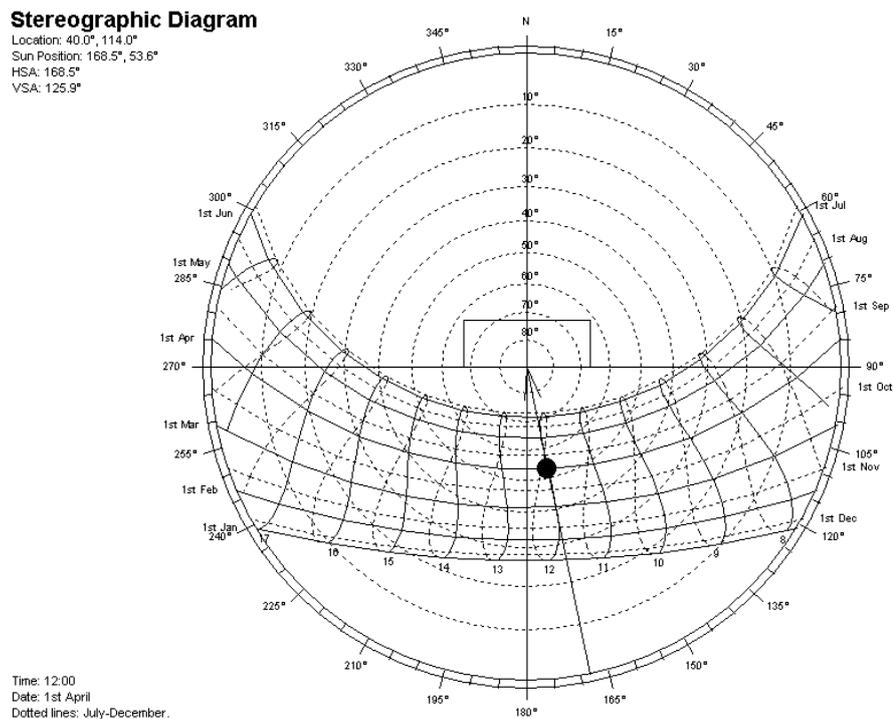


Fig 2. The stereographic diagram of 40 degree latitude area, where Feng Shui was originated (Area 1)

The stereographic diagram shows that the sunlight in this location mostly comes from south direction except in the morning and evening of June and July. Then, it is necessary to consider the Bioclimatic chart to analyze the relation between belief and climate (Figure 3).

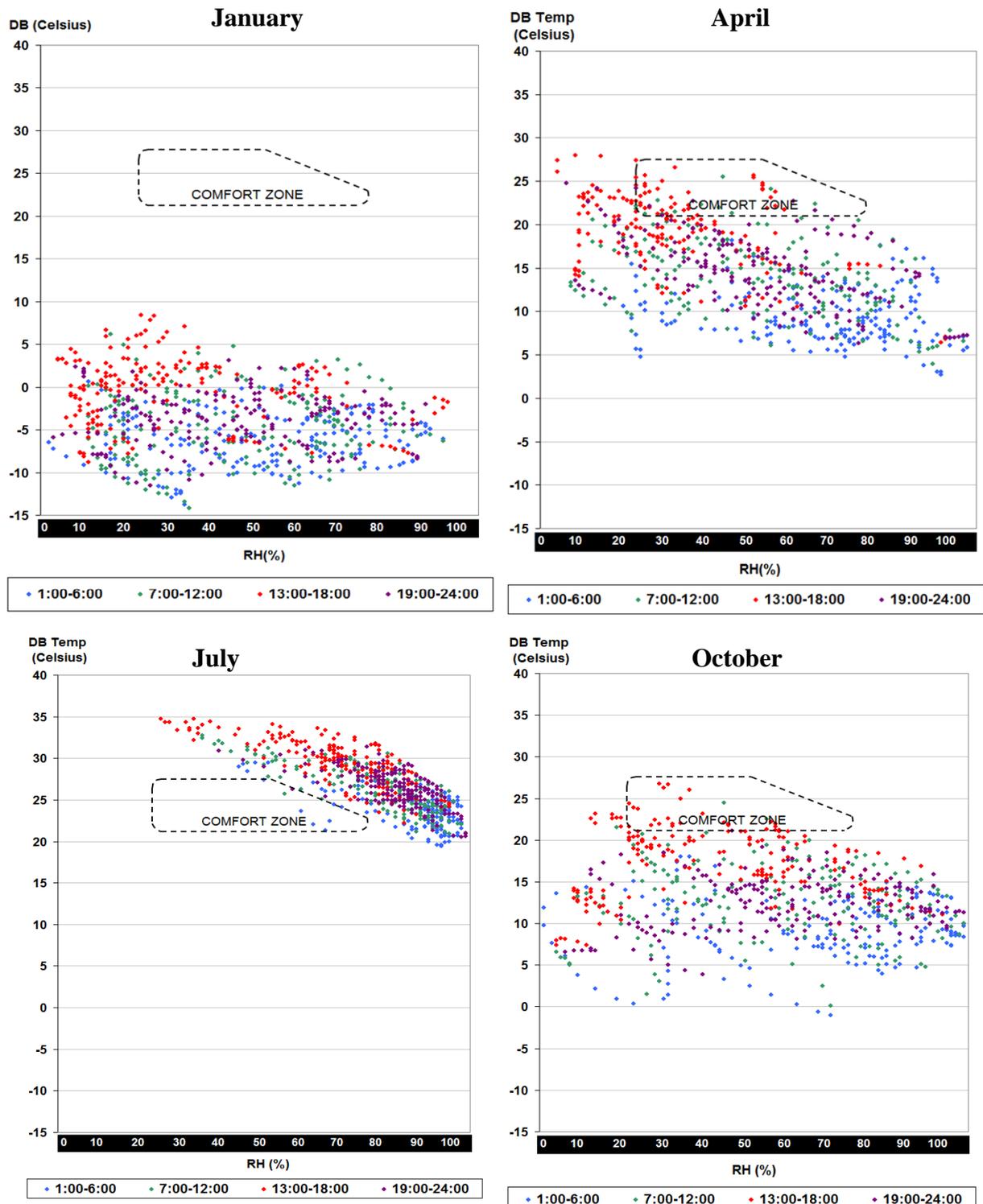


Fig 3. The Bioclimatic charts of Beijing precinct on 40 north degree latitude (Area 1) in winter (January) (top, left), spring (April) (top, right), summer (July) (down, left), and autumn (October) (down, right).

The Bioclimatic charts show the temperatures and relative humidity of area 1. The climate of this area is quite different during daytime and nighttime, and summer and winter; in other words, the climate is harsh and strong. The temperature and relative humidity are lower than that for comfort zone (the temperature is between 22-27 degree Celsius and 20-75% of relative humidity^[10]) especially in the winter except in June, July, and August; they are little higher than the values for comfort zone.

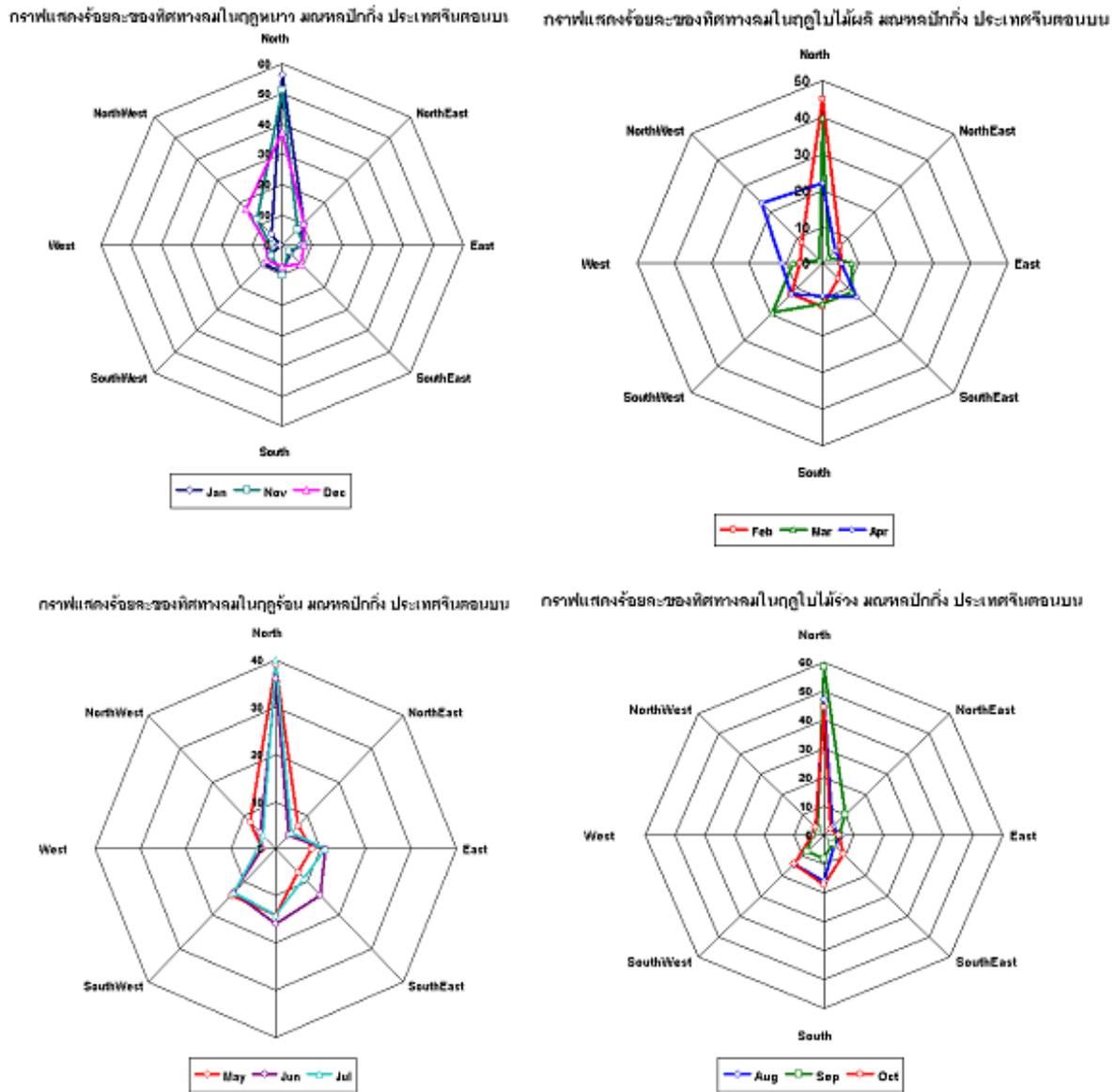


Fig 4. The percentage of wind directions of Beijing precinct on 40 degree north latitude (Area 1) in winter (top, left), spring (top, right), summer (down, left), and autumn (down, right).

From these climatic conditions, the ancient Chinese sages discovered and concluded for the *ideal location for dweller's settlement* through Feng Shui belief as shown in Figure 5, i.e., south facing dwellings.

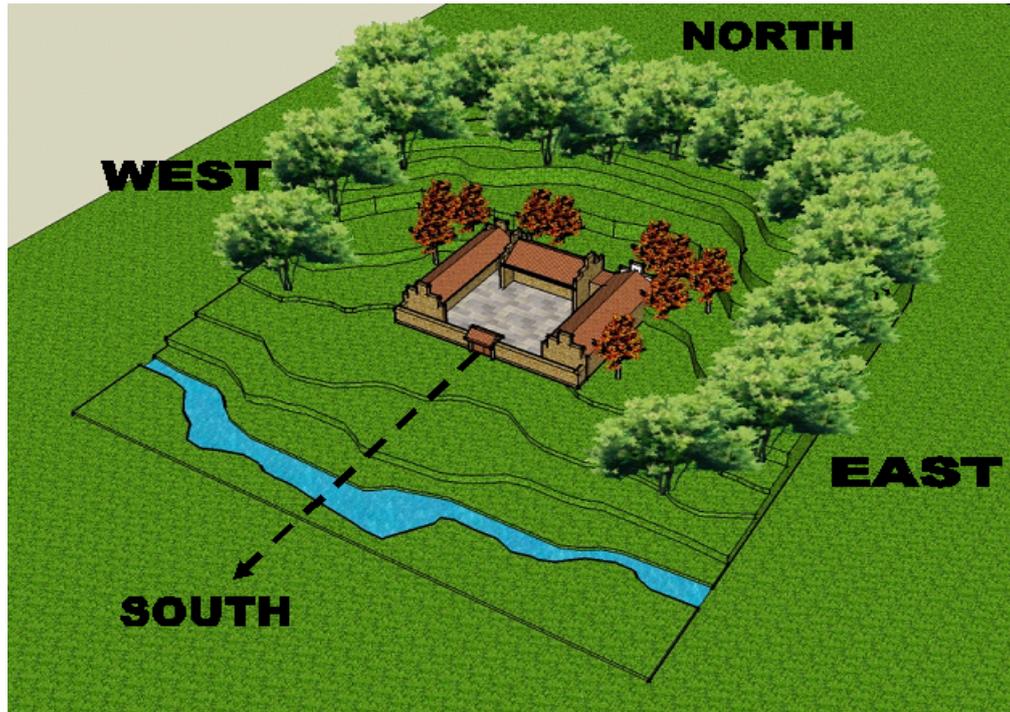


Fig 5. The ideal location for settlement of Chinese Feng Shui belief, comprise of the hills or mountains in the north direction (named black turtle), east (named green dragon), west (named white tiger), and the river or water resource in the south.

The ideal location is in harmony with the climatic data which derived from the origin area of Feng Shui belief as:

- Because of intensely cold climate (shown on the Bioclimatic charts, almost month except June, July, and August is lower than comfort zone.), this ideal location will face south^[7] or southeast^[11] to take advantages from heat and direct sunlight from these directions. (By this reason, the south and southeast are “auspicious directions” in Feng Shui belief?)
- The hills or mountains and trees in the north (black turtle), east (green dragon), and west (white tiger) can make the cold wind and dangerous sand storm jump over this site.
- The slope of this ideal location is low in the front (south) and high in the back (north) in order to take advantage of the sunlight that comes from south direction (named *hot slope*^[12]); otherwise, it is good for rain water to run off.
- This ideal location is open to the south due to get the wind from this direction which flows from south and southwest direction on June, July, and August. On these months, the air temperature is higher than comfort zone thus, the wind from this direction can promote the people more comfortable. (For increase in wind speed by every 1 km/h, human beings feel cooler than the real air temperature around 0.4 degree Celsius^[12])
- The river or water resources in the south not only give the dwellers for food, water, and transportation but also add up the moisture in the air to promote human thermal comfort.

- **The Vaastu belief and climatic conditions**

It is very important to consider on environment that determines the climatic conditions. The data is shown on the diagrams, figures, and charts as:

Stereographic Diagram

Location: 27.0°, 71.7°
 Sun Position: 124.1°, 12.6°
 HSA: 124.1°
 VSA: 158.3°

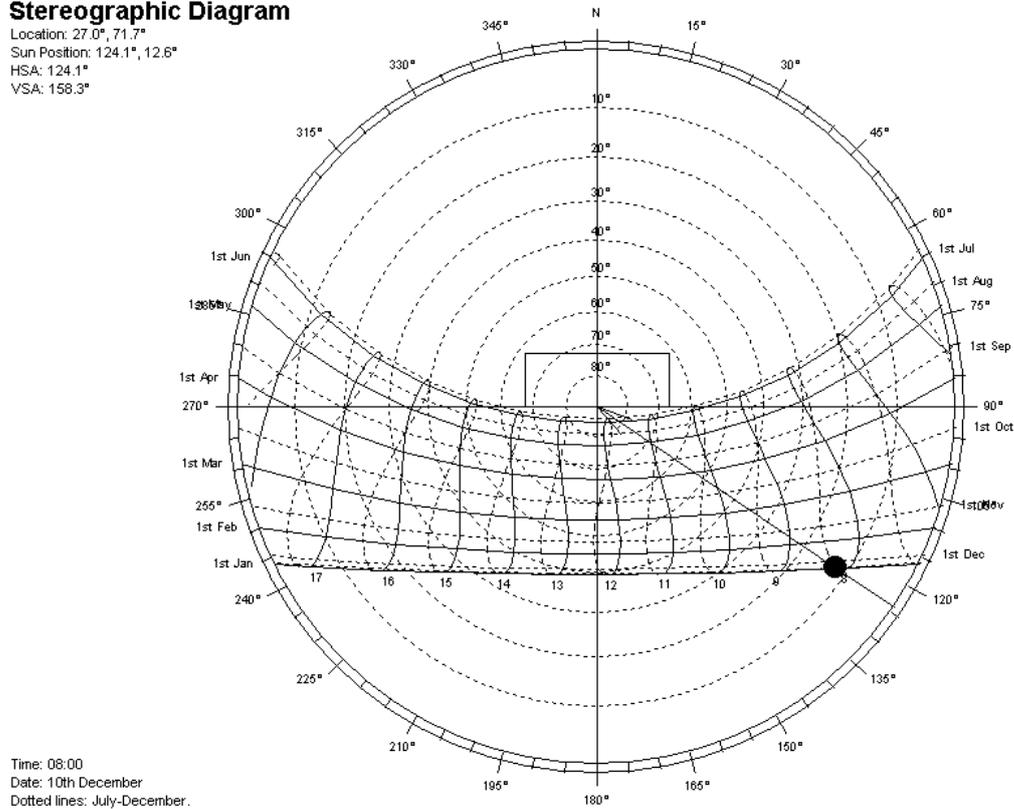


Fig 6. The stereographic diagram of 27 degree Latitude area, where Vaastu belief was originated. (Area 2)

The stereographic diagram shows that the sunlight in this location mostly comes from south direction except in the morning and evening of June and July. Then, the Bioclimatic Charts are necessary to analyze the relation between belief and its climate. These charts of this location are shown in figure 8.

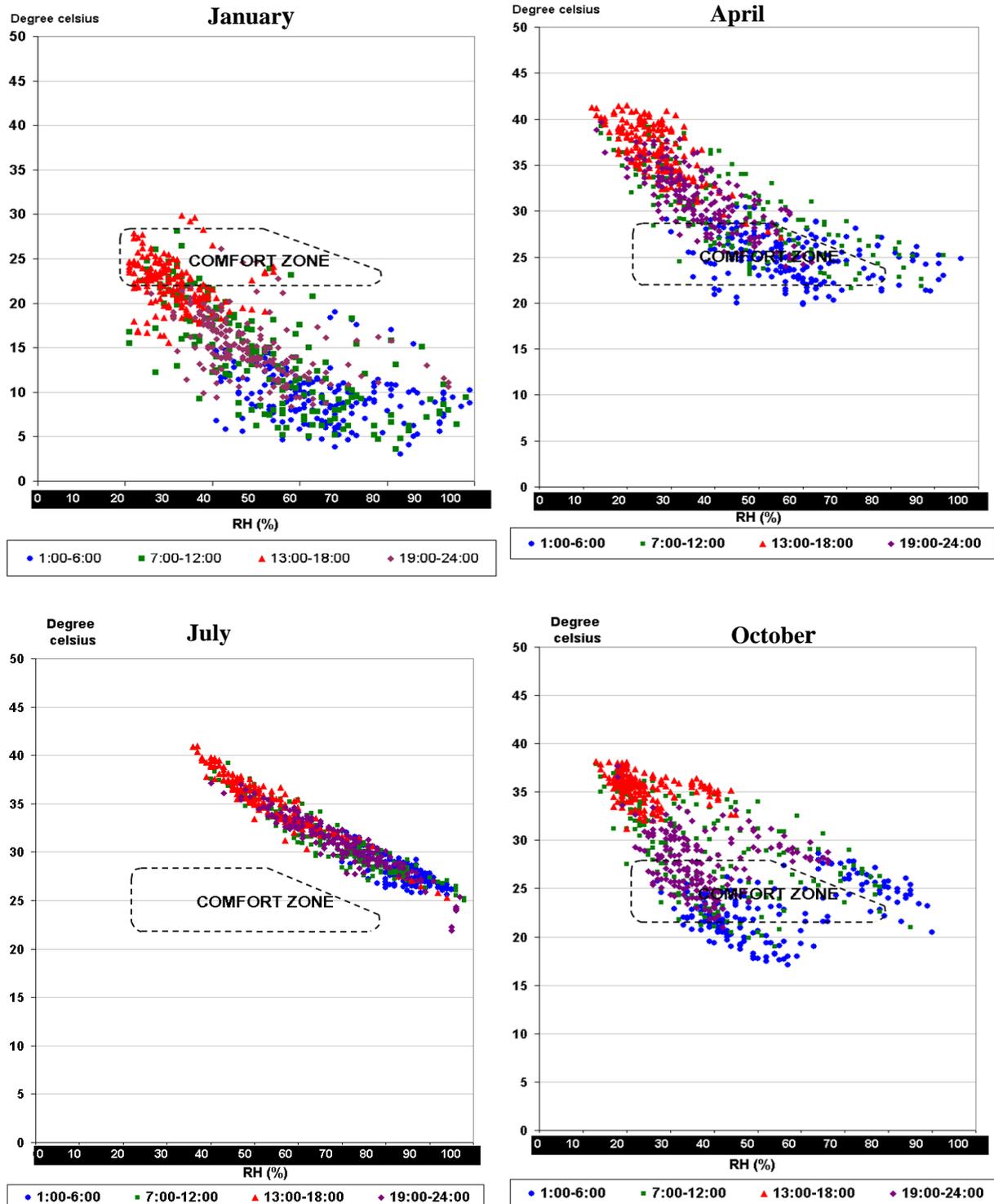


Fig 7. The Bioclimatic chart of Jaisalmer precinct on 27 degree north latitude (Area 2) in winter (January) (top, left), spring (April) (top, right), summer (July) (down, left), and autumn (October) (down, right).

From the Bioclimatic charts shown above, the temperature and relative humidity of this area are mostly in comfort zone. The local people live in comfort conditions around six months of a year, three months above, and three months below the comfort zone.

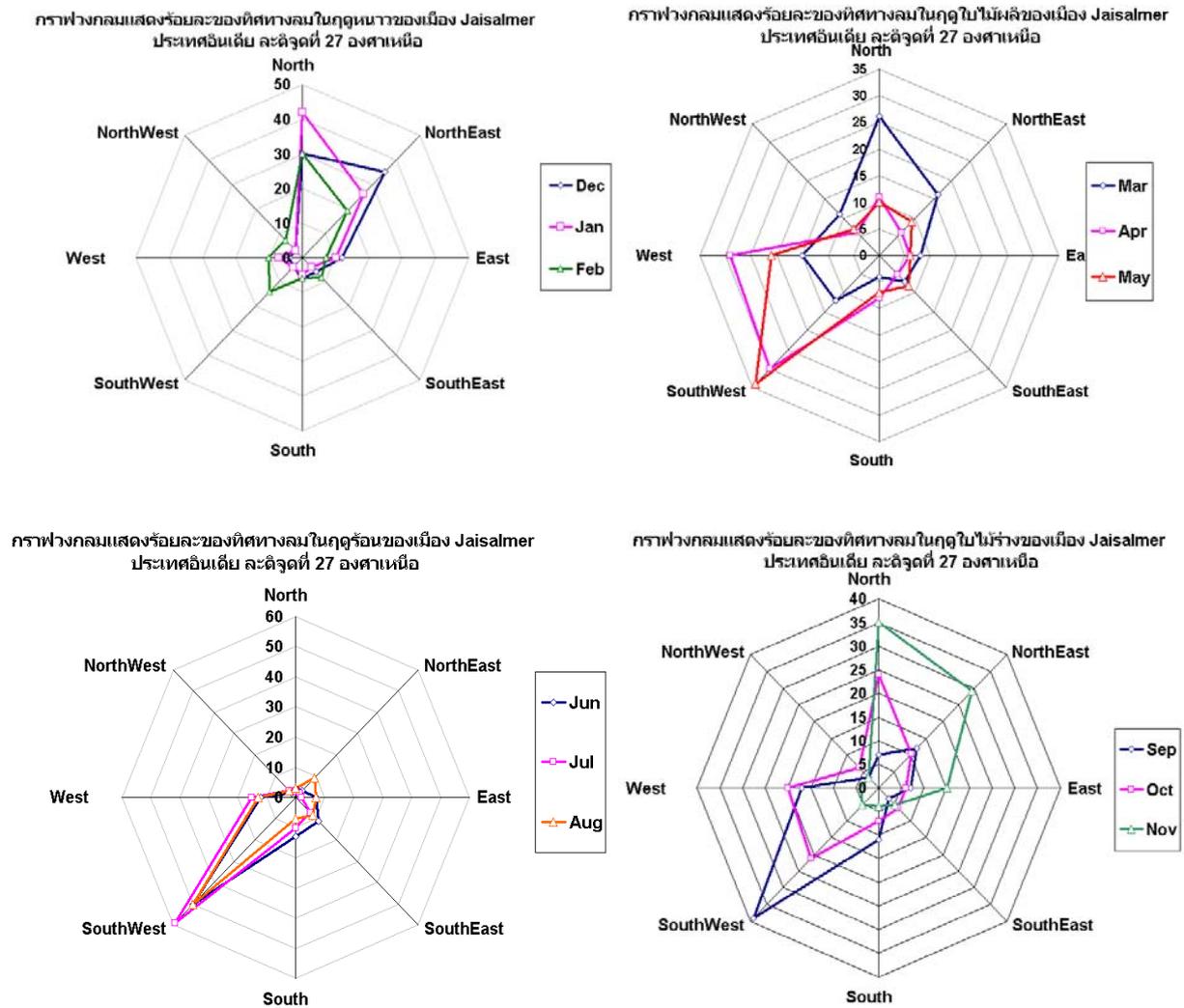


Fig 8. The wind direction percentage of Jaisalmer precinct on 27 degree north latitude (Area 2) in winter (top, left), spring (top, right), summer (down, left), and autumn.(down, right)

By this comfort condition, the Indian sages concluded and determined the ideal location for settlement via Vaastu belief as shown in Figure 9.

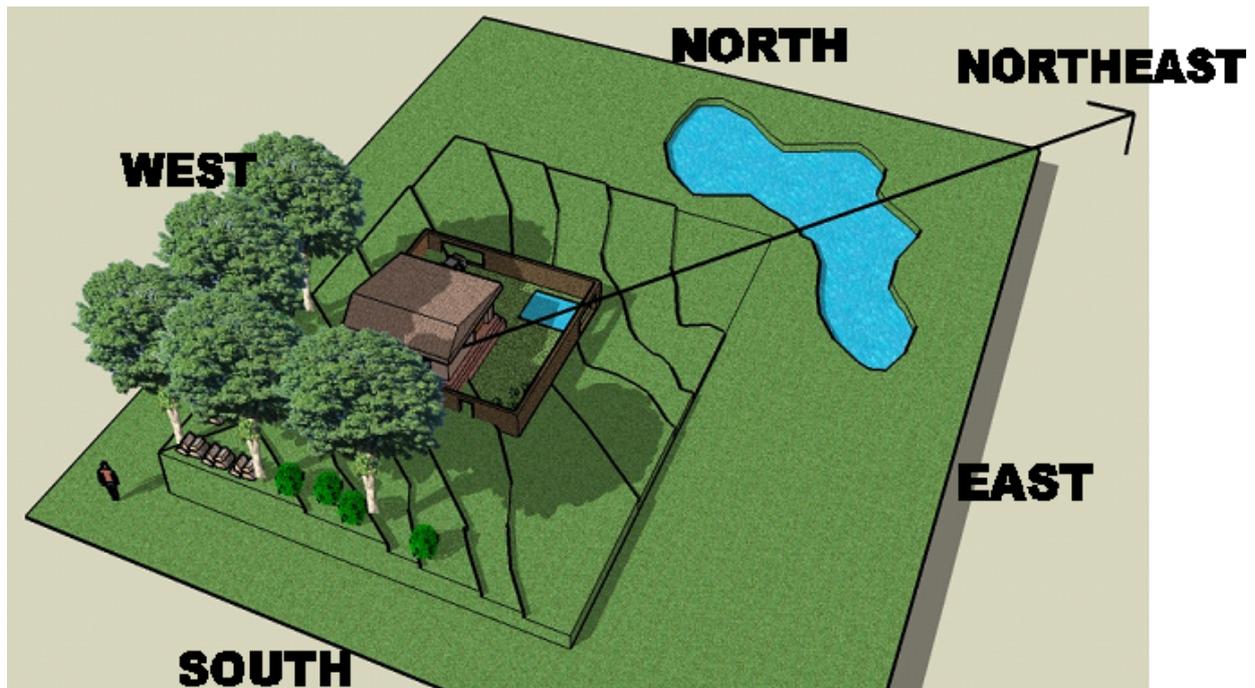


Fig 9. The ideal location determined by Indian Vaastu (Area 2), comprises of the hills or mountains with the trees in the southwest and south direction and the water resource in the northeast direction.

- Because of warm and dry climate, this ideal location is open to northeast, north, or east (especially northeast direction). These directions are cooler than others because the sunlight and heat comes from southwest, south, and west. (By this reason, the south, southwest, and west are “inauspicious directions” in Vaastu belief?)
- Trees and hills or mountains (earth or natural elements) are used to block the sunlight in southwest, south, and west directions.
- The slope of this area is low in northeast and high in southwest in order to take the advantages from *cool slope*.^[12]
- Because of the low relative humidity, the water resource (water element) is used to add up the moisture in the air. It is placed in the northeast direction where the sunlight is not reflecting to the eye of dwellers.
- The temperature and relative humidity of this area are mostly in comfort zone. Thus, the dwellers do not require the wind velocity to flow through their bodies. Therefore, this ideal location prevents the wind velocity especially the seasonal wind which comes from southwest direction (see Figure 8).

Table1 The climatic modification strategies of Feng Shui belief and Vaastu belief.

Considered issues	Feng Shui belief	Vaastu belief
Main entrance direction and front direction (auspicious direction)	South and southeast. <i>(Take advantages from heat and sunlight from these directions because of cold climate.)</i>	Northeast and east. <i>(Take advantages from coolness and shadows from these directions because of warm and dry climate.)</i>
The back direction of the building (inauspicious direction)	North and northeast. <i>(Block the coolness and cold wind.)</i>	Southwest and west. <i>(Block the sunlight and heat.)</i>
Building Layout	Square and rectangular floor plan with court yard in the southern China and compact form in the northern China. ^[2] <i>(The courtyard house can take the heat from sunlight and the compact house can minimize the heat loss from inside due to less skin area.)</i> ^[2]	Square and rectangular floor plan with compact form. ^[3] <i>(The compact form can reduce the heat gain from outside and less cross ventilation.)</i>
Topography and Position of Trees	Tree positions are; north, east, and west. <i>(Protect the building from cold wind and sand storm.)</i>	Tree positions are; southwest, west, and south. <i>(Protect the building from heat and sunlight.)</i>
Slope of site	The front direction is low (south), the back direction is high. (north) <i>(Take advantages from hot slope.)</i>	The front direction is low (northeast), the back direction is high. (southwest) <i>(Take advantages from cool slope.)</i>
Hill and mountain position	The back directions or armchair position. (north, northeast, east, and west.) <i>(Block the cold wind.)</i>	The back directions (southwest, west, and south.) <i>(Block the sun light and heat.)</i>
Water resource position	South, east, and southeast. <i>(Cool down the wind on June and July.)</i>	Southeast, north, or east. <i>(Increase the relative humidity in the air.)</i>
The position of important room (such as master bedroom)	Far away from entrance. ^[11] (north and northwest direction.) <i>(Due to safety, security, and privacy.)</i>	Far away from entrance. ^[3] (southwest direction.) <i>(Due to safety, security, and privacy.)</i>
Goal of beliefs	<i>Human comfort and security</i>	<i>Human comfort and security</i>

From Table 1, the real goal of these beliefs is the same; *human comfort and security*. Although the goal is the same but the details and contents are different. By using the natural elements such as trees, hills, mountains, water resources, slopes, and directions, these beliefs are applied to determine the building configuration for a long time and they are evaluated by the same factor- human comfort and security.

6. Discussion and Conclusion

The relation between constructional beliefs and their influential factors has the essential truth behind; it is discovered that *the constructional beliefs such as Feng Shui and Vaastu are the ancient wisdom that help to make the dwellings more comfortable and more secure*. These beliefs has determined the proper directions of the buildings and rightful position of the natural elements by superstitious method. In other words, *these constructional beliefs are ancient wisdom about climatic modifications*.

The influential factors have determined the contents and details of constructional belief (or ancient climatic modification) in many countries are just three main factors as Heaven, Earth, and Human factors; ^[2]

Heaven factors are: climate (air temperature, relative humidity, air pressure and wind), time (daytime-nighttime and seasons), and changes. These factors are difficult to change or adapt because these are the conditions from nature.

Earth factors are: topographical condition, water resources, landform, slope, geographical condition, altitude, and natural resources. These factors are selected to modify the heaven factors.

Human factors are: administration of the city, social value, human comfort conditions, and culture. These human factors are both the determining factors and evaluation factors at the same time.

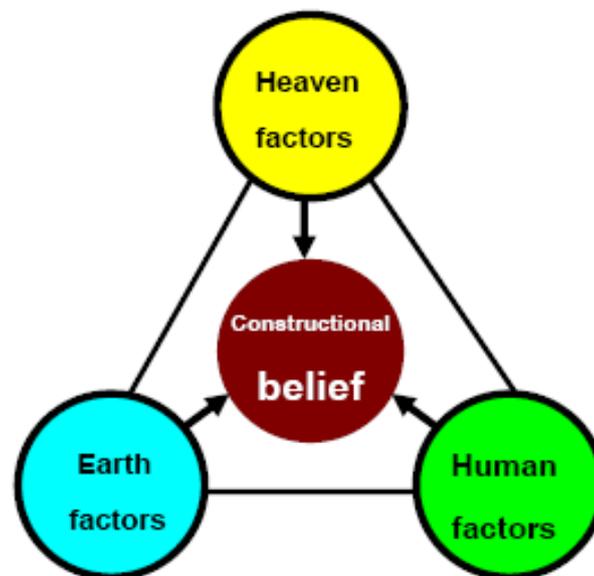


Fig 10. The diagram of the three main influential factors that can determine the constructional belief principles.

Appropriate solution for the locations with hot and humid climate is constructed by change of these factors from the old ones to the others which derived from this area (Thailand); moreover, the ancient Thai constructional belief is also considered. The climatic modification solution of this area is presented in figure 11.

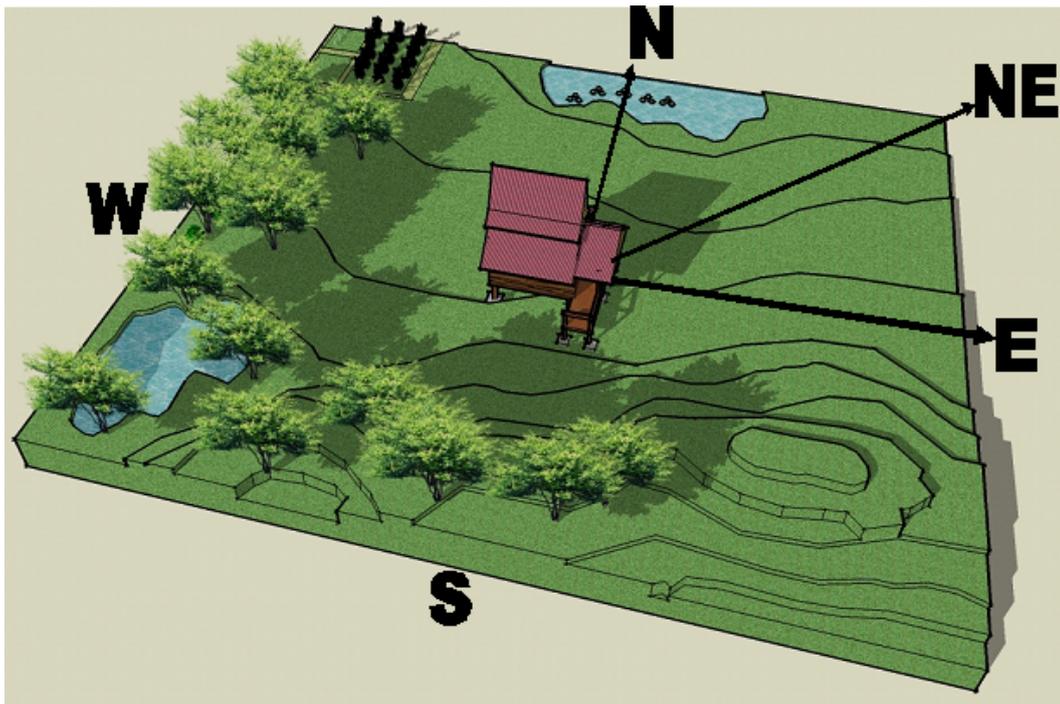


Fig 11. The modification of climatic conditions for the areas with hot and humid climate such as Thailand.

The interesting characteristics of this solution are:

- As the temperature and the relative humidity are quite high all year round ^[12], the trees are to be used in south, southwest, and west to protect the building from the direct sunlight. However, the trees should not block the wind velocity because it is necessary for dwellers to be more comfortable, especially in case of non-air conditioning buildings. For this reason, the perennial trees with high-elevated form are used on these directions because the wind can flow through their trunks.
- The hills or mountains in the west and south west can block the low-angled sunlight from these directions.
- The rivers or water resources in the southwest can cool down the temperature of the wind velocity before it flows through the building and human body. Otherwise, the water in the north or northeast helps the dwellers feel cooler because water resources can efficiently absorb the heat from the sunlight. ^[13] Furthermore, water has low surface temperature in daytime that makes the dwellers more comfortable by low MRT. ^[14]
- The building is opened to the cool directions such as east, northeast, or north because the areas of these directions are covered with the shadow of the building. The building is backed to the hot directions such as west, southwest, and south direction. (like Vaastu belief)
- The slope of this land should be high in the west, southwest, and south and low in the east, northeast, and north in order to take advantages from cool slope.
- The grass is used as much as possible to decrease the heat store up in the ground. At the same time, hardscape such as concrete slabs are used as less as possible.

The Earth factors of this solution (topography and land form) can assist and improve human thermal comfort as verified by scientific research ^[15] for 2 of 6 comfort factors as MRT and wind

velocity. MRT can increase comfort up to 40% and wind velocity up to 30%. Finally, Earth factor can improve human comfort range from 20-45%

At last, we have a few ideas beyond this study. First, exclude horoscope, many parts of constructional beliefs (the climatic modification) are scientific knowledge because they are provable and reasonable. But ancient scholars used them in a superstitious way in order to become more efficient. Second, the Feng Shui belief is specific for the Chinese people who determined their notion like Vaastu is merely specified for Indian dwellers. Finally, we should consider the reason of constructional belief before using (especially, if we bring a belief from one area to use in another area), otherwise a negative effects may emerge.

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