A Study of Local Identity and Local Environment Factors Influenced Architectural Design

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Abstract

This study is aim to describe the complex relationship between many variables from 3 factors which effect the architectural design. The three groups are (1) Environment (2) Architecture and (3) Human. The first group, ENVIRONMENT, can divide into 4 major basic elements consist of fire, water, air (wind) and earth. The second group, ARCHITECTURE, is the modifier to fulfill the basic need and changeable requirement of the third group, HUMAN. The methodology of this study is to extract the important factors which effect the architectural design and apply new guideline to the sample project. Then, evaluate the performance of the outcome. The RCE (Regional Centre of Expertise on Education for Sustainable Development) TRANG project is the example of following the architectural design guidelines. The design of this project is already completed and its outcome is fulfillment, energy efficient and sustainable. For the unique climate of Trang province which is 8-month of raining and 4-month of sunshine. This identity causes many problems in the past are now converting into useful asset. Rain is use for visual satisfaction and MRT cooling effect without more energy consumption. Finding the essence of environment, architecture and human, DNA of Land, is like seeking the DNA of human body. They will survive and sustainable us in this present time and in the future.

Keywords: *Sustainable Design, Environment, Architecture, Energy, DNA*; Energy

Introduction

People and environment are one of the influenced factors to architectural design. Since the climate change has become to the major issue, today, only conventional, technological, and vernacular architectures could not enough for users' needs. The question was how building design would fit to local people's need, climate change, energy conservation, and be real sustainable. This paper has presented the way to find out the local dignity which makes the building design to answer those questions. The paradigm started with understanding local dignity as local climate, lifestyle, environment, and energy characteristic. Each local dignity has been analyzed. Local climate and local site climate environment explain the appropriate comfort zone and character every hour all year. Technical data were collected and analyzed and then calculate to find out the extended comfort zone of local users. Human comfort factors as thermal, lighting, acoustical, and visual were applied to the design guideline including IAQ, safety and etc. Then, it affects the design concept as control, semi-control, and passive zones of usable areas. Local users and activities as modifier factors were considered to shape architecture response to each comfort level. Finally, the identity factors would provide design guideline (which can develop to design principle) and frame work: cooling load, energy use, opening characters, material for envelopes, and control zone to frame building characters, building system alternative as well as its energy consumption character.

Methods

The methodology of this study is to extract the important factors by collecting environmental data and analyzed. The three locations in Thailand were chosen to study. The Central, the Southern and the Northeastern Region of Thailand has difference environment and people. Bangok, Trang and Nakhon Ratchasima provinces were selected along with the architecture in energy efficient performance.

Results

The studies begin with compared and analyzed weather data amount 30 years from 1961-1990. Data consist of minimum, maximum temperature and rainfall. In this stage will show the identities of its location. By adding thermal and RH comfort range, 22-27 degree Celsius and 40-75%, to the analysis will help to understand the architectural design problems.

By comparing temperature of the three selected' provinces, the highest temperature is 36.5°C in April, Nakhon Ratchasima. The lowest temperature is 16.8°C in January also at Nakhon Ratchasima. (see table 1) Temperature range in each month of Nakhon Ratchasima province is larger than Bangkok or Trang province. Only minimum temperatures of all 3 provinces are in (or below) thermal comfort zone.

Table 1. Temperature comparing between the three selected provinces of Thailand.

Location	BANGKOK		NAKHON RATCHASIMA		TRANG	
Month	Min. temp.	Max. temp.	Min. temp.	Max. temp.	Min. temp.	Max. temp.
Jan	21.0	32.0	16.8	30.6	21.2	31.9
Feb	23.3	32.7	20.0	33.5	21.2	34.0
Mar	24.9	33.7	22.2	35.8	22.0	35.2
Apr	26.1	34.9	24.0	36.5	23.1	35.2
May	25.6	34.0	24.5	34.9	23.5	33.0
Jun	25.4	33.1	24.3	34.1	23.3	32.1
Jul	25.0	32.7	23.9	33.6	23.0	31.6
Aug	24.9	32.5	23.7	33.1	23.1	31.5
Sep	24.6	32.3	23.6	32.1	23.0	31.2
Oct	24.3	32.0	22.6	30.9	22.9	31.4
Nov	23.1	31.6	20.2	29.7	22.7	30.8
Dec	20.8	31.3	17.1	29.3	22.3	30.7

Source: Thai Meteorological, Department (2010)

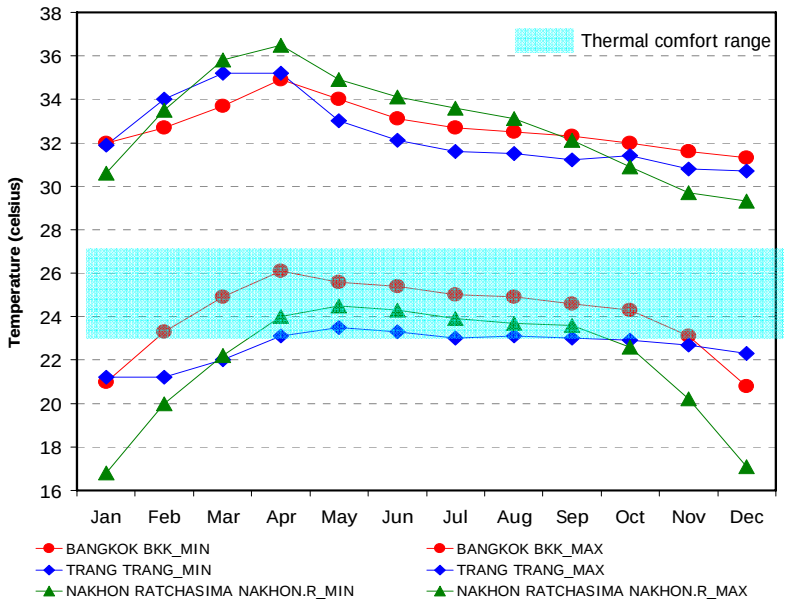

Fig. 1Comparing average temperature of 30 years (1961-1990) between Bangkok, Trang and Nakhon Ratchasima provinces.

To understand character of the location, hourly temperature and relative humidity in daytime is analyzed. More data is added (DEDE & Silpakorn University, 2005). The results are as follow:

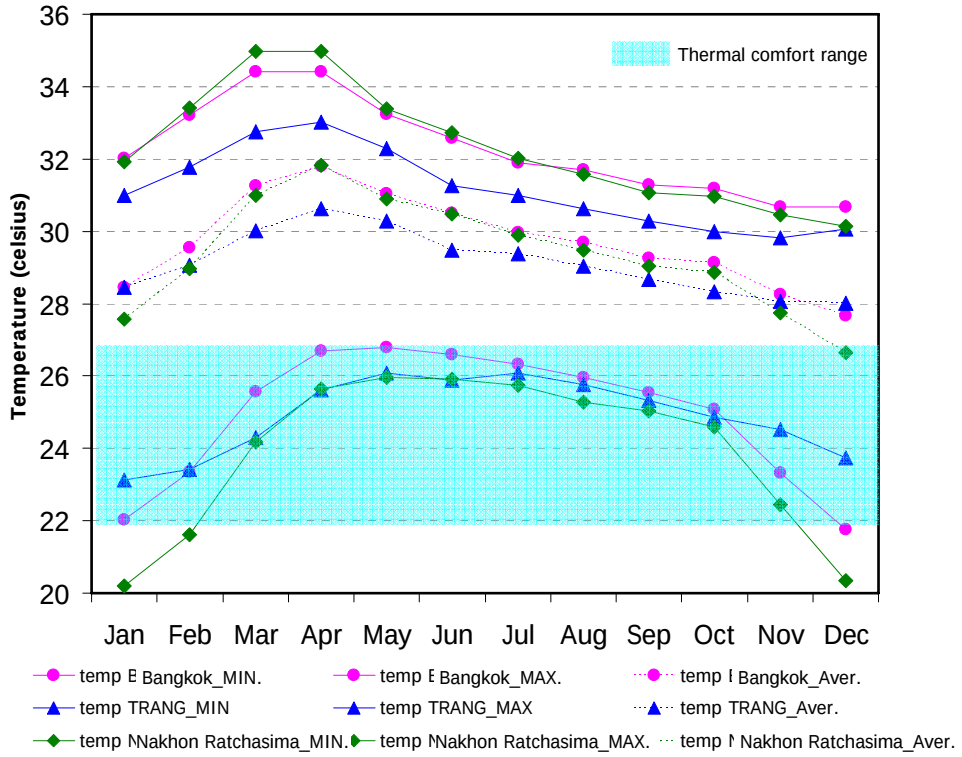

Fig. 2Comparing average daytime temperature.

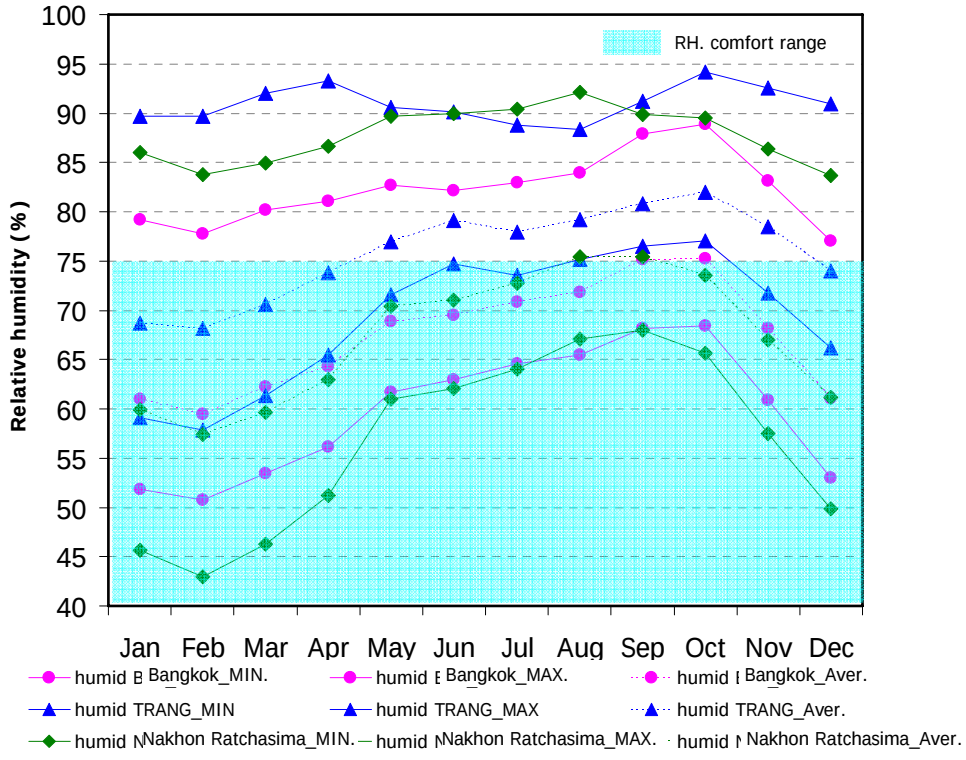

Fig. 3Comparing average daytime RH.

Case study of energy efficient building

Energy efficient buildings from the study location are selected to find out how they have good performance. Shape and space of them are below:

Fig. 4 Case study No.1: The Government Complex Commemorating His Majesty The King's 80th Birthday Anniversary, 5th December, B.E. 2550 (2007), Thailand.

Fig. 5The atrium of the Government complex.

Fig. 6Case study No.2: The DNA resort and spa at Khao Yai, Pak Chong district, Nakhon Ratchasima province.

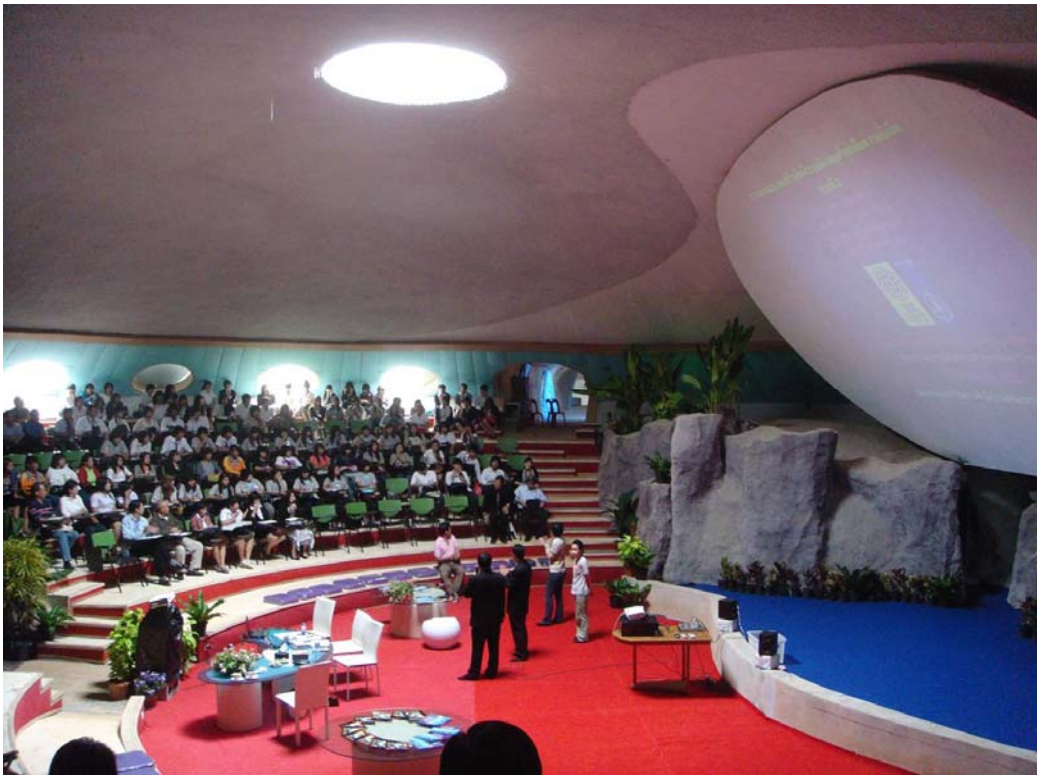

Fig. 7Interior space of the natural classroom at DNA resort and spa.

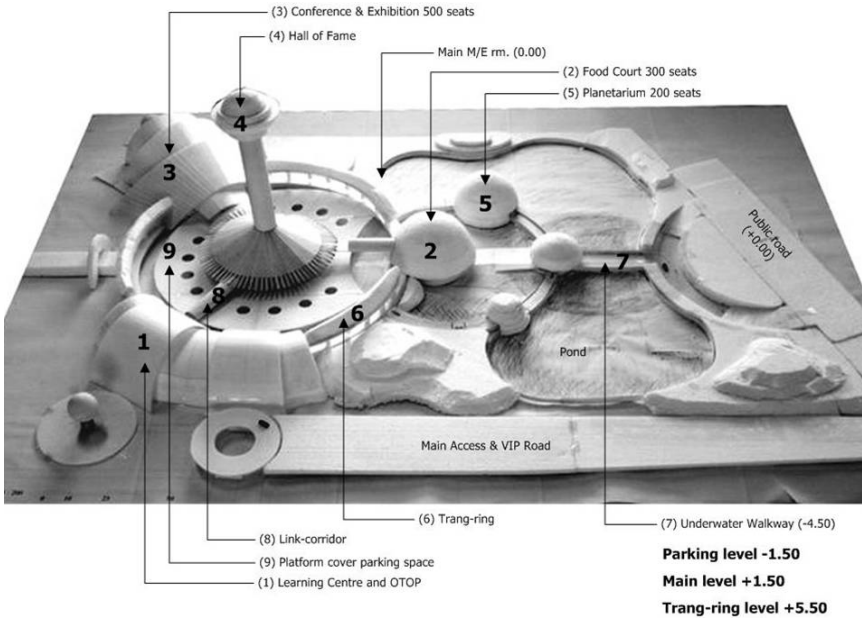

Fig. 8Case study No.3: The RCE (Regional Centre of Expertise on Education for Sustainable Development) TRANG.

Fig. 9Model of the RCE TRANG Project.

Discussion

From Bangkok weather data amount 30 years (1961-1990), the highest temperature is 34.9°C in April and the lowest temperature is 20.8°C in December. The highest temperature is 35.2°C in April and the lowest temperature is 21.2°C in January of Trang province. And the highest temperature is 36.5°C in April and the lowest temperature is 16.8°C in January of Nakhon Ratchasima province. From the local identity and environment factors in these 3 locations, Nakhon Ratchasima province has the most temperature swing all year round. Trang province has high relative humidity all day because of the unique character: rain 8 months sunshine 4 months. Bangkok has not much hours

in thermal comfort zone due to heat island problem.

Case study no.1: The Government Complex Commemorating His Majesty The King's 80th Birthday Anniversary, 5th December, B.E. 2550 (2007), Thailand. The success of energy efficient comes from preventing heat by using insulation, high performance glass and envelopes, air-flow window and etc (Design report, 2010). Innovative design concepts of this huge office building are using thermal storage technique to create cooling MRT effect in atrium, reduce surface exterior wall to floor area ratio (S/A) and optimize natural light use.

Case study no.2: The DNA resort and spa at Khao Yai, Pak Chong district, Nakhon Ratchasima province. This unique design comes from truly understanding every factors of the site (Lohasuwan, 2009). Unlike the usual building, this building is the real green design with do not be the consumer like other buildings, but it is the energy producer for itself. Natural elements around the location are harvested to use in the design. The outcome is fantastic and innovative. By using nighttime cooling effect, proper insulation, high performance glass and so on.

Case study no.3: The RCE (Regional Centre of Expertise on Education for Sustainable Development) TRANG. The new paradigm of design concept is to transform problem into assets. During rainy season which is the problem of users (people) becomes the magnet for tourists. Gravity force is consider to the design. This construction will start shortly in next year and will become the prototype of the real sustainable building in hot and humid climate.

Table 5. Comparison of Environmental factors usage.

Environment usage	Environment Factors	Government Complex the 1st case	DNA resort and spa the 2nd case	RCE Trang the 3rd case
Fire	Daylight	✓	✓	✓
Fire	Temperature (Daytime)	×	✓	×
Water	Humidity	×	✓	×
Water	Water Bodies	✓	✓	✓
Water	Rainfall	×	✓	✓
Air	Wind	×	✓	×
Earth	Vegetation	×	✓	✓
Earth	Thermal Capacity (soil)	×	✓	✓
Earth	Land slope	×	✓	×
Earth	Season	×	✓	×

Table 6. Possible relation of Human and Environment group

		Human		
		Good (+)	Moderate (0)	Poor (-)
Environment	Good (+)	E+H+	E+H0	E+H-
	Moderate (0)	E0H+	E0H0	E0H-
	Poor (-)	E-H+	E-H0	E-H-

Conclusion

In the past, men must totally live in nature by adapting themselves into it, and the past nature is lack of technology to create better environment. However, nature was cleverly adjusted to fit existing climate by Traditional Thai house. When our environment has strongly changed, as it has been happened in capital cities; the complete former living in nature is impossible now, unless we resist diverse discomfort. Total mechanical system is a solution and it has been continuously used till now, but an enormous energy has also been used.

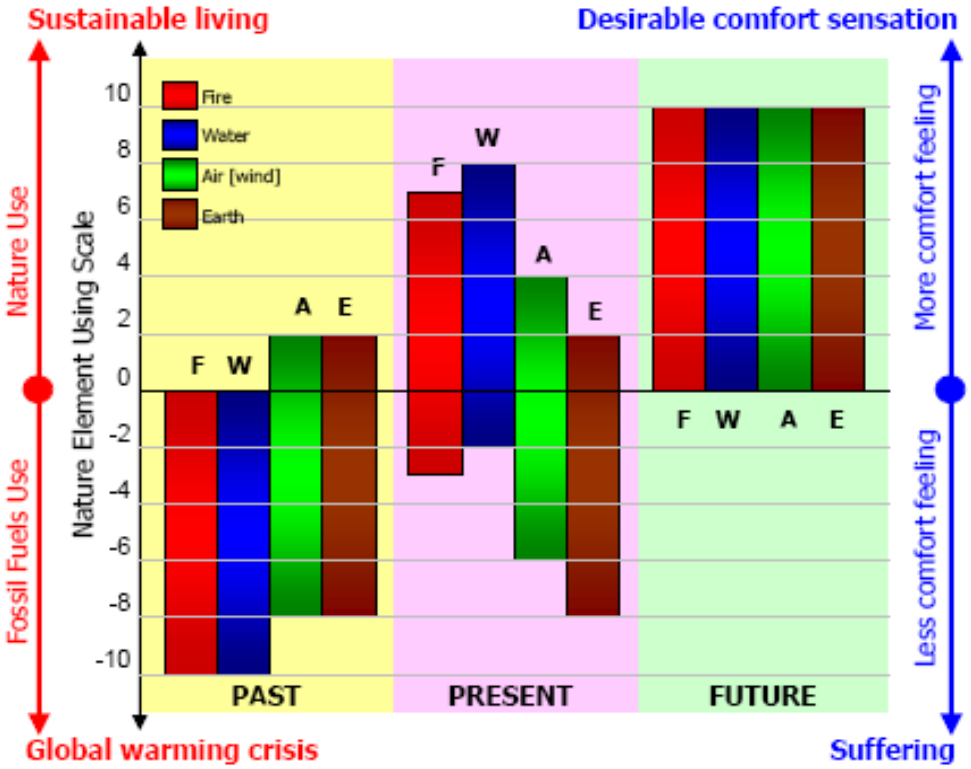

Fig. 10 Diagram of the Environment usage (fire, water, air and earth) in the past, present and future combine with Human comfort sensation.

However the best energy saving is living within nature system by avoiding non-replaceable energy consumption. The idea of maximizing consumption of natural energy, but still desirable life quality, is a searching of nature and new technology integration for minimizing energy consumption. So environmental adjustment of existing nature can cause a maximum benefit. Installing air-conditioning in Thai house can not save any energy because it is still heat insulation and air leakage problems. Thus the method of architectural design for modern energy saving is an integration of nature into suitable technology to create new architectural style that fully fit hot-humid climate. Together with complete studying and understanding of hot-humid climate; which are knowledge of heat, humidity, air motion, air velocity, and other techniques that promotes energy saving; will help creating more effective methods.

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