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**AN EXAMINATION OF THE RELATIONSHIP BETWEEN  
CLIMATE, CULTURE AND BUILT FORM WITH SPECIAL  
REFERENCE TO  
HOT-HUMID CLIMATE**

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A Dissertation presented to the  
University of Moratuwa  
For the Final Examination in M.Sc.  
Architecture  
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## CONTENTS

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	Pg. no.
ACKNOWLEDGEMENT	i
LIST OF ILLUSTRATION	ii
ABSTRACT	iii
INTRODUCTION	01
<b>CHAPTER ONE: APPROACH TO CLIMATIC DESIGN THE TROPICAL CLIMATE AND ITS RELATIONSHIP TO ARCHITECTURE</b>	
1.1 INTRODUCTION TO THE CLIMATE AND DIFFERENT CLIMATIC TYPES	05
1.1.1 SPECIFIC ELEMENTS OF CLIMATE	05
1.1.2 GLOBAL CLIMATIC ZONES	09
1.2 CHARACTERISTIC FEATURES OF THE CLIMATE OF SRI LANK	10
1.2.1 WARM HUMID REGIONS WITH LOW RAIN FALL	11
1.2.2 WARM HUMID REGIONS WITH HEAVY RAIN FALL	11
1.2.3 COOL MOUNTAINEOUS REGIONS WITH HEAVY RAINFALL	12
1.3 CLIMATIC APPROACH TO ARCHITECTURE	13
1.3.1 INTENTION OF ARCHITECTURE	13
1.3.2 SHELTER AND CLIMATE	14
1.3.3 RECOMMENDATIONS FOR DESIGNING IN THE SELECTED REGION	18
1.3.3.1 SITE LOCATION	18
1.3.3.2 ORIENTATION	19
1.3.3.3 FORM OF BUILDING	20
1.3.3.4 OPENINGS AND SHADING DEVICES	21
1.3.4 PRINCIPLE FOR COMFORT IN THE WARM HUMID CLIMATE	21
1.3.5 CLIMATE MODIFICATION STRATEGIES	21
1.3.5.1 VENTILATION STRATEGIES (PASSIVE)	23
1.3.5.2 SKY LUMINANCE AND SHADING STRATEGIES	25
1.3.5.3 INSULATION STRATEGIES	28



1.4 COMFORT AS THE NEED FOR CLIMATE RESPONSIVE STRATEGIES IN ARCHITECTURE	29
1.4.1 ATTRIBUTES OF COMFORT	31
1.4.1.1 PHYSICAL COMFORT	31
1.4.1.1.1 THERMAL COMFORT	31
1.4.1.1.2 VISUAL COMFORT	32
1.4.1.2 PSYCHOLOGICAL COMFORT	32
1.5 CLIMATE AS FORM GENERATOR IN ARCHITECTURE	33
1.6 CLIMATE RESPONSIVE DESIGN	36
<b>CHAPTER TWO: THE CULTURAL REFLECTION IN ARCHITECTURE</b>	
2.1 CULTURE	39
2.1.1 INTRODUCTION TO THE CULTURE	39
2.2 STUDY OF SINGHALESE CULTURE	40
2.2.1 HISTORICAL BACKGROUND OF SINGHALESE CULTURE	40
2.2.1.1 CAST SYSTEM	42
2.2.1.2 MAN'S SOCIAL STATUS	43
2.2.1.3 KINSHIP	43
2.2.1.4 FAMILY STRUCTURE	44
2.2.1.5 THE WAY OF THE GAINING LIVELIHOOD	44
2.2.1.6 RELIGION	45
2.2.1.7 FUNCTION AND CEREMONIES	46
2.2.1.8 MYTHS, BELIEFS AND SUPERSTITIONS	46
2.2.3 EXPRESSION OF SINGHALESE CULTURE	47
2.3 SINGHALESE CULTURE AND RESIDENTIAL BUILDINGS	49
2.3.1 INTRODUCTION OF THE BUILDING TYPES IN EARLY SINGHALESE SOCIETY	49
2.3.1.1 FEUDAL LANDOWNERS HOUSE OR "WALAWWA"	49
2.3.1.2 PEASANT'S HOUSE	49
2.3.1.3 POOR PEASANT'S HOUSE	49
2.3.2 GENERAL CHARACTERISTICS OF THE BUILDINGS	49
2.3.2.1 LOCATION	49
2.3.2.2 3D COMPOSITION	50

2.3.2.3 PLAN FORM	50
2.3.2.4 STRUCTURE	52
2.3.2.5 FINISHES	52
2.3.3 THE COMMON CHARACTERISTIC FEATURES	52
2.3.4 THE SYMMETRICAL ARRANGEMENT OF ACTIVITY AREA	53
2.3.5 THE AXIAL PLANNING OF THE SPACE	53
2.3.6 THE REGULARITY OF THE GRID USED	54
2.3.7 THE INTERNAL COURTYARD	54
2.3.8 IDENTIFICATION AS A REFLECTION OF CULTURE	58
2.4 DRVIDAN CULTURE AND RESIDENTIAL BUILDINGS	59
2.4.1 SOCIO CULTURAL BACKGROUND	59
2.4.2 DRVIDAN CULTURE AND RESIDENTIAL BUILDINGS	61
2.5 CLIMATE RESPONSES SEEN IN NATURE AND IN DIFFERENT CULTURES	66
 <b>CHAPTER THREE: AN EXAMINATION OF THE RELATIONSHIP BETWEEN CLIMATE, CULTURE AND BUILT FORM</b>	
3.0 CASE STUDIES	77
3.1 CASE STUDY 01	77
3.1.1 TRADITIONAL PEASANT HOUSES AND THEIR RELATIONSHIP TO CLIMATE AND CULTURE	77
3.1.2 KANDYAN PERIOD HOUSES	79
3.1.3 CLIMATIC ANALYSIS	80
3.1.4 CULTURAL ANALYSIS	82
3.2 CASE STUDY 02	83
3.2.1 TRADITIONAL TAMIL HOUSES AND THEIR RELATIONSHIP TO CLIMATE AND CULTURE TYPES OF HOUSES	83
3.2.1.1 TRADITIONAL HOUSES	83
3.2.1.2 TRADITIONAL VILLAGE HOUSE	83
3.2.1.3 SINGLE CELL UNIT	83
3.2.1.4 THREE COMPARTMENT UNIT	83
3.2.2 TRADITIONAL COURTYARD HOUSES	88
3.2.3 COLONIAL INFLUENCED HOUSES	88



3.2.4 A COURTYARD HOUSE, THE MOST CULTURAL-INTER GRATED FORM	88
CONCLUSION	93
BIBLIOGRAPHY	



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## LIST OF ILLUSTRATION

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Pg. no.

- Fig. 01: Water bodies provide the water vapour to the air
- Fig. 02: Wind; change the Topography of given region
- Fig. 03: Global climatic zones
- Fig. 04: Main climatic regions of Sri Lanka
- Fig. 05: Climatic data collected for wet zone
- Fig. 06: Climatic data collected for dry zone
- Fig. 07: Climatic data collected for hilly zone
- Fig. 08: Active and passive climatic data
- Fig. 09: Arabian houses with small openings to reduce heat gain during day and heat loss at night
- Fig. 10: Eskimo Igloo
- Fig. 11: Different cultures express through the different symbols; Sinhalese, Dravidian and Islamic Cultural symbols
- Fig. 12: Agricultural base Sinhalese culture
- Fig. 13: The Communal feeling, significant character of Sinhalese society
- Fig. 14: Self-sufficient Sinhalese society Sri Lanka
- Fig. 15: Agricultural ceremony
- Fig. 16: Simple life style with harmony with nature
- Fig. 17: Low- rise simple buildings with a high plinth
- Fig. 18: Residential buildings; Plan forms
- Fig. 19: traditional houses of Jaffna, are high parapet fence of palmyrah leaves
- Fig. 20: sacred oil lamp in the shrine room, which is lit throughout the day and night also produce] smoke
- Fig. 21: All the family activities are carried out in the center courtyard
- Fig. 22: Lotus are blooming with first morning sun shine
- Fig. 23: Big animals like buffalos, elephants, and hippopotamus respond to the heat of the sun by using the insulation properties of mud and water in the ambient environment
- Fig. 25: Sun controls the entire planet
- Fig. 25: Poya day
- Fig. 26: Hindus celebrate Thai Pongal, in January to honor sun deity
- Fig. 27 Egyptian cotton clothing, applied black eye liner to protect eyes from excessive heat at night
- Fig. 28 People in barbarian tribes colored their body with mud to protect their bodies from excessive heat
- Fig. 28 Indians/Sri Lankans, sarees and sarongs to keep the body cool

- Fig.29 Boats with simple sails.
- Fig.30: The verandah of a traditional rural house
- Fig.31: A simple rural dwelling
- Fig.31: A slight large rural dwelling
- Fig.32: The Kandyan courtyard
- Fig.33: Plan of a courtyard house
- Fig.34: Section through the Courtyard house
- Fig. 32: Traditional village house of Jaffna
- Fig.33: Typical layout of the single unit house
- Fig. 34: A round house with Thinnai and Nadai at pointpedro
- Fig. 35: Round house at Chavkracahchari
- Fig. 36: general composition three compartment house  
at Alaveddu
- Fig.37: Plan of the three units of the traditional house
- Fig. 38: A Cortyard house with two courtyards at Vannarponnai
- Fig. 39: A courtyad house at Poinetpdro and Vannarponna





## ABSTRACT

It is the need for protection from climate that compelled man to build shelter. Since then, his endless thirst for comfort evolved this basic skeleton into new forms thus creating architecture. Human comfort is identified as physical comfort and psychological comfort. These two are closely linked with each other. Physical comfort facilitates psychological comfort. Therefore achieving physical comfort has a close relationship with climatic response of a built environment, which is manifested by climate responsive design strategies. Strategy is the art of planning the way to achieve something or to be successful in a particular field. The term strategy is used to mean a list of actions taken by a designer, in order to transform an initial brief into a final design. In any field, not only in architecture, people have advocated strategic methods to achieve best results therefore climate responsive design strategies in architecture are list of methods or combination of design decisions that one can intend to use to achieve best results in the field or architecture, in a specific climatic condition. The unique climatic conditions and comfort needs, along with other socio-cultural factors create unique forms and unique places throughout the world.

"Climate is clearly one of the prime factors in culture, and therefore built form. It is the mainspring for all the sensual qualities that add up to a vital tropical architecture."

Tan Hock Beng (1994: 13)

Climate is the most important factor that brings unique characteristics to different regions of the planet earth. For example Alaska is different from Africa due to its unique climate. Therefore the culture is also should be unique in those unique places, which generate unique built form. Climate responsive design strategies should contribute immensely to enhance the culture of those places. Therefore

the essay would be an attempt to combine the qualitative aspect (Uniqueness of place) along with the quantitative aspects (climate) of architecture.

↓ Scope & limitations  
indicates a quantitative approach





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## INTRODUCTION

## 0.1 IMPORTANCE OF THE STUDY

The present day context in almost all parts of the world is subjected to a rapid change, posing challenges in all aspects of human life. Sri Lanka offers no exception in this regard. And the population growth and urbanization, etc have compelled its people to built houses and other buildings on smaller plots of land. Due to aesthetics and great variety of other qualitative and quantitative requirements to be fulfilled in designing the buildings, climate has been pushed into an unimportant secondary position. In most of the design methodologies used by architects, the climatic factor is identified as a secondary force or a modifying factor. Climatic factor is so inherent in all aspects of the built environment that people have taken it for granted. This has resulted in uncomfortable unlivable meaningless, buildings, which in turn have made negative impacts on human behavior.

Climate controls each and every aspect of life. Identity of a society or a culture is determined primarily by climate. For example the rhythm of music used by a culture, which is unique to that culture, has great relationship with the climatic factors such as the sun, rain and wind of that region. If this identity is lost the sense of belonging also will be lost. This situation causes serious social problems such as people loss their identity, relationship between neighborhoods, behavior pattern and personality.

## 0.2 INTENTIONS OF THE STUDY

In this study, it is intended to examine the relationship between the climate responsiveness in hot humid climate and its relationship to the culture.

Since the culture and climate responsive building designs are two of the most important issues in the present architectural field, this study would enable

one to understand their importance and incorporate them in making meaningful and successful building designs in the built environment.

### 0.3 SCOPE AND LIMITATIONS

Very little work has been done from the point of view adopted here, and this study must be exploratory. No essay or book on such a vast subject can be final – and this one, in fact, represents a generally accepted or shared body of thought. Many of the conclusions will, no doubt, have to be elaborated and revised in the future.

And also due to the limitations of time and resources the study would focus only on the hot humid climates.

According to Christopher Day (1990 : 46) , " *The create nice and more importantly, meaningful, appropriate atmospheres, we need to focus out attention not on the quantities but on the qualities.*" Likewise, in this essay I have chosen a qualitative approach (Using the writer/my self as the indicator / meter) rather than evaluating climatic impact by means of a set of numerical values.

quote made from notes.

The photographic medium is primarily used to strengthen the statements made. However, this medium is not totally successful in capturing the spatial quality and time because space is always experienced as a totality. Egyptian architect Hassan Fathy once defined architecture as, "the space between the walls and not the walls". The photographic image can only capture the walls.

#### 0.4 METHOD OF STUDY

The study would be in three phases. At the first phase, the hot humid climate and its relationship to Architecture will be discussed. After discussing the climate, in general, along with global and local climatic zones, climate responsive designs, especially in hot humid climates will be discussed in depth.

The second phase would start by discussing the culture in general. The later part of that phase would talk of cultures in response to climate. The third phase would focus on the contribution of climate responsive design strategies in enhancing the particular culture. Local and international examples would be given. Case studies would be given to strengthen the statement.





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## CHAPTER ONE

# APPROACH TO CLIMATIC DESIGN THE TROPICAL CLIMATE AND ITS RELATIONSHIP TO ARCHITECTURE

## **CHAPTER ONE: APPROACH TO CLIMATIC DESIGN**

### **THE TROPICAL CLIMATE AND ITS RELATIONSHIP TO ARCHITECTURE**

#### **1.1 INTRODUCTION TO THE CLIMATE AND DIFFERENT CLIMATIC TYPES**

The word 'climate' comes from the Greek word, 'Klima', referring to the inclination of the sun. Sun is the natural source of light and heat. The earth gets its heat from the sun. The earth's movement around the sun (Revolution) and its rotation around its own axis, also determines the different climatic condition of the world. Besides effects of solar radiation and earth's movements; climate is also influenced by the complex structure and composition of the atmosphere and by the ways in which it and the ocean transport heat. Thus, for any given area on earth, not only the latitude (the sun's inclination) must be considered but also the elevation, terrain, distance from the ocean, relation to mountain systems and lakes, and other such influences should be considered.

The climate of a given region is defined as a description of the prevailing environmental conditions, which are determined by the pattern of several elements and their combinations and interactions. The principle climatic elements are solar radiation, temperature, humidity, wind, precipitation, including special characteristics such as lightning, earthquakes, dust, snow, cyclones etc.

##### **1.1.1 SPECIFIC ELEMENTS OF CLIMATE**

###### **(a). Solar radiation**

The sun's heat comes to earth in conduction, convection and radiation. The amount of heat that comes in radiation is very much. It can either be direct or diffused. In tropical countries, the diffused radiation is relatively high due to very high cloud cover. A larger fraction of radiant heat reaches a building in 'short wave' radiation (from sun, sky vault, cloud cover, surrounding terrain) and some radiation also comes as 'long wave' (from a heated building surface in the vicinity).





Radiation affects indoor climate in two ways;

1. Direct radiation, gain through the openings of the building envelop
2. Re-radiation, gain through the building envelop

(b). Air temperature

Air acquires heat by the direct radiation from sun and by its contact with the earth. During the day, as surfaces are heated by solar radiation, the air nearest to the ground acquires the highest temperature and creates an upward eddy of warm lighter air. During night as earth gets cool very fast, the direction of heat flow is reversed; then the lowest air become cooler.

Generally, air temperature is at its lowest just before dawn (5.00-6.00 a.m.) and the highest temperature occurs just after noon (at 2.00 p.m.). The heat exchange varies between day and night, latitudes, with the season, the time of the year and according to the cloud cover.

(c). Humidity

This is defined as the amount of water vapour suspended in the air at a given temperature and described in terms of absolute or relative humidity. Absolute humidity is the mass of water vapour suspended in a unit volume of the air at a given temperature. Relative humidity is the ratio of the amount of water vapour per unit volume of the air to the amount of water vapour per unit volume of saturated air at the same temperature. It is normally explained as a percentage.



Fig. 01: Water bodies provide the water vapour to the air

(d). Wind

'Wind' is the natural form of air movement. The distribution and characteristics of the wind over a region are determined by several global and local factors such as,

- i. The seasonal global distribution of air pressure
- ii. The rotation of the earth
- iii. The daily variations in heating and cooling of land and sea
- iv. Topography of the given region and its surrounding

The average wind speed is likely to be higher during the day and it frequently drops at sunset especially if skies are clear. The path of the air movement is very important for building design. 'Ventilation' is the process supplying unconditioned or conditioned air to and removes it from a given space by any method.



Fig. 02: Wind; change the Topography of given region

(e). Precipitation



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Koenigsberger (1973) states that, "large scale cloud formation and precipitations results from adiabatic cooling of large air masses, and are effected greatly by the vertical stability of the air." A mass of rising air cools by expansion, (the energy required for the expansion is drawn from within the air mass causing the cooling) and cools moisture comes down to the earth as rain. Air masses which are made to rise for different reasons produce three main types of precipitation, convective orographic and convergent.

According to Koenigsberger (1973), "climate is integration in time of the physical state of the atmospheric environment, characteristics of certain geographical locations ... the integration in the time of weather conditions." Weather is momentary composition of individual elements such as wind, rain, and sunshine experienced at a particular instant or over a very short period.

Due to the regularity and predictability of climatic variations over the earth's surface, the climate of a given region can be classified according to its chief seasonal characteristics. This would be more specifically defined as the local climate of that region.

According to Richard Hyde (2000:15), climate by definition is related to the atmospheric condition of temperature, humidity, wind, vegetation and light specific to a geographical location. He further states that there are three levels of climate conditions, and the first are the global condition of the region created by the dominant geographical features of land, sea, sun and air. Next, these are modified by local conditions depend on dominant features of water, topography, vegetation and built environment. Finally, there are the site condition and building context, which are an interaction of local conditions and the building. These factors modify climate at a macro and micro level. This description of climate belies a continuously changing set of conditions where the only certainty is that today will not be same as yesterday. Thus the weather, that momentary state of atmospheric conditions, is so difficult to predict. Yet the designer has to examine pattern in the climate that are discernible and use these as basic parameters for design. Not only the macroclimate but also the microclimate associated with the site has to be taken in to account.

Climate affects the human comfort. In designing a building, the above-mentioned principle climatic conditions (solar radiation, temperature, humidity, wind and precipitation) are considered in determining the comfort levels of people.

In the present times, due to rapid urbanization there is a large number of buildings. It has been found that the buildings have a large impact on the micro climatic conditions. This may be by deflecting or obstructing the wind flow, casting of shadows on the ground or other surfaces, radiation emitted by reflective surfaces, etc.

Many different systems of climate classification are in use for different purposes. Climatic zones such as tropical, arid, temperate and cool are commonly found for representing climatic conditions. For the purpose of building design, a simple system of zoning, based on the nature of the thermal issue in the particular location is often used.

### 1.1.2 GLOBAL CLIMATIC ZONES

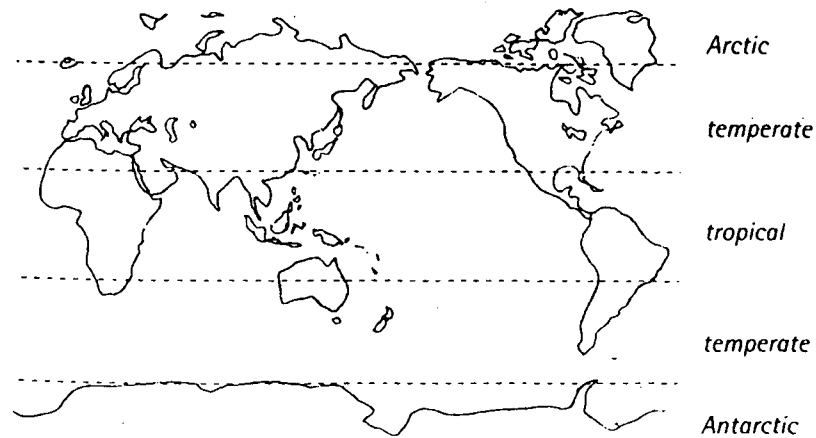


Fig. 03: Global climatic zones

The world comprise of different place with unique geographical conditions. Those unique geographical conditions result variation in the presence of principal climatic elements of those places. Due to the variations of the presence of principal climatic elements (solar radiation, temperature, humidity, wind and precipitation), there are different groups of climatic types. According to the classification developed by Miller (1961), groups of climatic types are as follows:

- A. Hot climates
  - 1. Hot-dry (arid): hot desert
  - 2. Warm-wet: equatorial and tropical-marine
  - 3. Hot-dry and Warm-wet: tropical-continental and monsoon
  
- B. Warm-temperate climates
  - 4. Western margin type
    - i. Mediterranean continental
    - ii. Mediterranean marine
    - iii. Mediterranean mountains
  - 5. Eastern margin type
  
- C. Cool-temperate climates
  - 6. cool-temperate continental
  - 7. cool-temperate marine
  
- D. Cold climates
  - 8. cold continental: Siberian

- 9. cold marine: Norwegian
- 10. cold desert
- 11. Artic

## 1.2 CHARACTERISTIC FEATURES OF THE CLIMATE OF SRI LANKA

According to the Givoni's classification of tropical climate, Sri Lanka is generally described as having a warm humid climate. The island is situated north of the equator between latitudes of 5 and 9 and receives rainfall from northeast and southwest monsoon winds, and from convectional rains (which are often referred to as afternoon heat thunderstorms). The Island's geographical factor which mainly creates divisions of climate within the Island is the central hill range. Shielding of trade winds laden with moisture which result rains by the central hills basically decide the dry zone and the wet zone of the Island and hilly zone remain as a highest rainfall region.

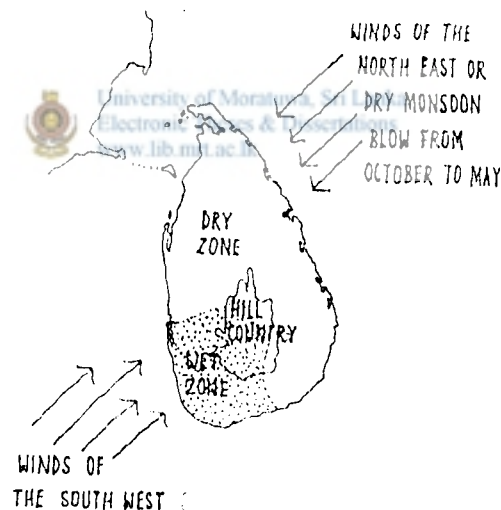


Fig.04: Main climatic regions of Sri Lanka

The topography and the rainfall pattern of the island provide Sri Lanka with a variety of microclimates, which for design reasons may be classified into three basic groups.

1. Warm humid regions with heavy rain fall (wet zone): South-west region
2. Warm humid regions with low rain fall (dry zone): North-east region
3. Cool mountainous regions with heavy rainfall (hilly zone): Nuwara Eliya

### 1.2.1 WARM HUMID REGIONS WITH HEAVY RAIN FALL

This region is normally referred to as the 'Wet zone'. Extent of the wet zone is relatively low compared to the dry zone. It is the most densely populated of the regions and is located in the South West part of the island.

The months of March and April are the warmest months of the wet zone while December and January become the coolest months. The maximum temperature of 32 °C during the warmest months and minimum of 23 °C during the coolest months can be generally experienced.

During the months of June, July and August the wind movement comes to maximum. It comes to minimum in months of March and April. Afternoon thundershowers are experienced all over the Island during this period. The other source of rain is the South-west monsoons, which are in duration from May to September. The annual rainfall in this region is around 2000mm.

An average temperature of 28°C and relative humidity of 80% is generally experienced. The humidity increases in April just before the onset of the Monsoon season and drops during the cooler months of November and December. The clouds cover during these months increase which results in losing radiation and reducing the temperature with the reduction in temperature and the presence of clouds, the relative humidity drops.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	De
Temp. mean (max) °C	31.1	31.2	31.8	31.9	31.9	30.6	30.6	30.4	31.1	30.0	30.5	30.
Temp. mean (min) °C	22.1	22.2	24.4	25.1	25.9	25.3	25.3	25.7	25.7	23.8	23.2	22.
Humidity pm/am	70 84	69 87	72 90	78 89	77 89	80 87	87 85	77 83	74 84	77 83	72 83	72 8
Precipitation mm	78.8	55.2	144	142	317	302	121	88.8	112	353	292	79.
Wind speed m/s	4.3	5.3	2.4	4.9	5.0	8.3	6.7	8.2	6.1	4.1	4.3	4.9

Fig. 05: Climatic data collected for wet zone

### 1.2. 2 WARM HUMID REGIONS WITH LOW RAIN FALL

This region is generally described as the "Dry zone" and is situated in the north, northeastern and southeastern regions of the Island. Regions in the southeastern sector also have similar weather conditions and can be grouped in this category. Dry zone is harbors many of agricultural lands. It still retains a relatively high forest cover. The region receives an average annual rainfall from 875mm to 1875mm. This includes areas that receive less than 875 to 1250mm of rain. However, the rainfall it occurs is intense.

This region often experiences draught due to the unpredictability of the rain. A marked dry season is experienced from May to September, during which a high parching wind prevails. The temperature of the region varies between minimum of 21 °C and maximum 35 °C through out the year. The Relative humidity in this region is about 90% and at times ranges between 88%-95%.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. mean (max) °C	30.7	32.6	35.4	34.7	35.1	31.6	32.8	34.1	35.2	32.1	30.7	30.2
Temp. mean (min) °C	22.6	21.1	23.5	24.3	25.1	24.8	24.8	24.8	24.5	23.5	22.5	21.1
Humidity pm/am	75 91	65 86	83 86	65 89	66 89	74 84	66 85	61 82	57 83	71 89	78 93	76 93
Precipitation mm	59.5	15.0	74.3	153	145	49.7	17.9	3.3	32.2	211	503	190
Wind speed m/s	2.0	2.0	1.9	2.7	3.9	5.7	5.4	5.5	4.5	2.9	0.9	0.6

Fig. 06: Climatic data collected for dry zone

*Source*

### 1.2.3 COOL MOUNTAINEOUS REGIONS WITH HEAVY RAINFALL

This region can be classified as the area, which is over 1000ft above sea level. A marked temperature depression, high rainfall, humidity and wind patterns on the undulating ground conditions of the hill country can generally be considered as deviations from the other climatic regions.

The region normally receives the highest rainfall compared to the rest of the island. The annual rainfall in this area sometimes exceeds 5000mm. The northeastern part of this region is comparatively drier being shielded from the southwest monsoons.

The mean maximum temperature varies from 18 °C to 23 °C, while mean minimum temperature is generally between 10 °C to 14 °C, due to higher altitudes resulting in lower temperatures. January is the coldest month in this region; low night temperatures cause frost to occur high cold winds are experienced in this region, especially during the monsoons.

High cold winds are experienced in this region, especially during the southwest monsoons.

The higher range of this hill country has a climate, which is very similar to a temperate climate. The humidity in this region is lower compared to the other areas of the country.

No!

perhaps same as elsewhere

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	De
Temp. mean (max) °C	20.0	21.5	23.0	22.8	22.8	18.6	18.6	18.7	20.3	18.2	19.5	18.
Temp. mean (min) °C	10.4	9.7	10.4	11.3	12.6	14.0	13.6	13.7	12.7	2.7	11.7	11.
Humidity pm/am	68 70	59 66	68 83	69 79	72 83	77 83	73 80	76 82	71 82	77 84	72 81	73 8
Wind speed m/s	1.7	2.9	2.1	2.2	2.1	10.9	7.4	6.9	4.4	5.9	3.9	4.7

Fig. 07: Climatic data collected for hilly zone

Source?

### 1.3 CLIMATIC APPROACH TO ARCHITECTURE

#### 1.3.1 INTENTION OF ARCHITECTURE

*"The incomparable satisfaction connected with every created act and soul-uplifting feeling of having offered a work in the making of civilization is great rewards of Architecture."*

Gauldie, 1972



A work of Architecture is the aggregate of, response to environmental constraints, function, form and economy. The major expectation of Architecture should be to fulfill all those factors, to be able to transcend triviality, to move emotionally and to uplift the spirit to levels that enhance the essence and meaning of life of mankind.

Anthony C. Antoniades (1980, p.19) says that, there is lot more to being and becoming an Architect than to 'draw the plans' for a building. One must know the language of Architecture which is based on the making of sound and appropriate sentences, one must learn, therefore the principles and the ingredients of design. Then one must learn how to build his proposals and make his conception reality. One must know, therefore, about structures, mechanical equipments of building, materials and methods of construction. The Architect should also know a lot about the uses of his buildings. He should be able for design for uses indoors as well as outdoors and he should design in contextual harmony and respect of his surroundings. He should learn about current issues and consider them in his design; finally he should always bear in mind that he is not alone, but being in society and therefore, his creation should serve the needs of the society, not his private ones. It has become clear that Architecture is not just 'form, function and economy', but is this plus 'response to every thing else' which make it more comprehensive and clearly a more demanding affair. By saying this, Antoniades, emphasizes the importance of responding to the ambient environment in making Architecture. The ambient environment comprises of two categories, which are the man made environment and natural environment. In the present context of Architecture, **more priority is being given to responding to the natural environment**, because of many critical issues, that question the survival and the well being of the human species. As Christopher Day writes, 'Most of our environmental experience is affected by Architecture, which is, potentially a dangerous tool. Environment can use to manipulate people: because we so readily take our surroundings for granted and rarely bring them to full consciousness, they can be use to influence our actions' (1990:21). Another reason for giving priority to the environmental aspect is the energy crisis and pollution. This is expressed by Christopher Day by the dictum, "...yet whenever buildings require energy inputs to provide a physical environment that could have been achieved by design means, we must recognize that building design is responsible for completely needless pollution" (1990:32).

*"We must always say what we see, but above all and more difficult, we must always see what we see".*

Le Corbusier (1972, p.9)

Richard Hyde (2000) says that, in the present context there is an emerging design culture which focuses on the environmental design of buildings. The thrust of this design direction is to utilize concepts that minimize environmental impacts of building through selecting an appropriate response to the climate. As a matter of fact, if we look carefully we would see that the 'climate' is inherent in all aspects of life; especially on our ambient built environment. Therefore this essay is written considering climatic factor as the major generator of Architecture.

Architecture is an innate capability of man. It implies his capability to use his intellect and sensitive nature to organize ambient spaces for himself, in order to achieve a more meaningful and comfortable way of life.

Architecture more than what we perceive. This is manipulated by Le Corbusier by the dictum, ".....you employ stone, wood and concrete and with these materials you build houses and places. But suddenly you touch my heart ..... that is Architecture".

When considering Architecture, the nuance of 'space' is very important, because Architecture manipulate space. According to the German poet, Goeth, "Architecture is frozen music and spatial drama". "Space, place and Architecture" are phenomena which are inseparable from each other. When the boundless place is captured and made inhabitable, it becomes a 'place', where Architecture comes in to being. Architecture as a place making process needs to go beyond making visually pleasing objects, and in to more meaningful and soul-uplifting places. Therefore more attention should be given to the qualitative aspects of Architecture such as the sense of place in the present time.

*"To create nice and more importantly, meaningful, appropriate atmospheres, we need to focus our attention not on the quantities but on the qualities."*

Day, Christopher(1990:46)

*“Architecture is a discipline, a profession, a state of mind, and a cultural index”* (Antoniades, 1980:18). According to Anthony C. Antoniades, Architecture takes different forms in different civilizations and frames of politics. It deal with the process and the final creation of the man-made environment in ways that the functional, economic to build and emotionally appealing to the user and the independent viewer or appreciator.

As Le Corbusier points out, ‘Architecture is matter of “harmonies”’ (1931:19). It harmonizes many things into one: the tangible physical form and intangible space within, the visible physical form and the invisible human feelings and emotions in bedded in it. In a good work of Architecture each component part: tangible and intangible, visible and invisible, harmonizes with itself, with each other and with the rest of the world. All of them together form the single entity, the creation.

“Architecture is many things in one. Some things tangible, others intangible. Some things visible, others invisible. Where all things tangible and intangible, visible and invisible, are in balanced harmony among themselves and with thereat of the world, constituting a useful and minded elevating whole, then this whole is ‘Architecture’.”

Antoniades, 1980:18

Pier Luigi Nervi(1965:108), the Italian structural engineer who grasped the meaning of Architecture, wrote the following on the difficulties and gratification of Architecture: “No other creative act is so long and difficult, because no other expressive language(word, sound, colour and sculptural form) is as rebellious as the Architectural one, formed as it is by limitations and ties of function, statical and constructional nature. He further says that, to overcome the difficulties in Architecture is to reach the point when function, form, economy and all other environmental constraints are bought together in an equilibrated compromise, and harmonize spontaneously with one another in a play of forms and volume s capable of expressing the Architectural idea.

Architecture is one of the oldest professions in the human history. Mankind is attracted to Architecture because of his affinity to art, science and mysteries of the universe. Architecture is media where one could express and experience his abilities in art and science. Above all, Architecture is the most

successful medium that one is able to capture; not only physical but psychological 'comfort' as well.

The above thoughts show that Architecture is a very significant profession to the well being of mankind and should handle with great responsibility and care. Therefore it is important that, the Architects handle their work with intellectual knowledge, rather than spontaneous thoughts. They should identify the ultimate need, the appropriate Architectural strategies and the relevant implementations of a given project.

To create good and meaningful design Architectural strategies are act very important role, specially environment responsive strategies such as climatic responsive strategies and energy efficient strategies. Those strategies concern about natural ventilation, natural lighting and shading and materials and insulations of buildings. As mention earlier in this section, one of the main intentions of Architecture is, to create physical as well as psychological comfortable environment. The comfortable is mainly related with the climate and environmental responsive strategies are very important in Architecture, especially in adverse weather conditions. While considering the environment responsive strategies, it automatically determines the form of the building/shelter.

### **1.3.2. SHELTER AND CLIMATE**

The physical flexibility and capacity for adaptation of mankind are relatively feeble when compared to those of many animals, who posses natural defenses against a wide climatic conditions. Adaptation to climatic environment in the forming of animal shelter as well. A typical example is the building to habits of birds, which show an innate instinct cope with their environment.

Many scholars from Aristotle onwards believed that, climate had pronounced affects on human psychology and temperament. Climate has been defined as one of the 3 great factors determining the conditions of civilization, ranking with racial inheritance and cultural development.

The inventiveness of man enabled him to defy the discovery of fire. The shelter becomes his most elaborate defense against hostile climates, fulfilling the requirements of comfort. The form of shelter evolved with the pace of time, accumulated experience and ingenuity, diversifying it to meet the challenges of the varying climates.

The shelter acts as a modifier of the natural environment to create optimum conditions of livability. It functions as a filter to absorb or repel environmental elements according to their beneficial or adverse contributions to human comfort.

### **1.3.3 RECOMMENDATIONS FOR DESIGNING IN THE SELECTED REGION**

This study is concerned with the climatic type referred to as group one although reference may be made occasionally to the other climatic regions if required.

#### **1.3.3.1 SITE LOCATION**



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In this type of climate where air movement is essential for comfort enclosed valleys or very sheltered sites should be avoided. Valleys or depressions would also be liable to flooding during the heavy monsoon rains. Locations close to swamps or lakes though being aesthetically desirable would have the disadvantage of being a source of insects that cause nuisance. On the other hand, highly exposed sites can cause problems due to excessive wind.

There may be locations where the requirements for avoiding radiation, and catching breeze, will be in conflict. The sites, which receive breeze, should be selected in such cases, even though they receive increased radiation.


Sites near the sea or large bodies of water may have lower temperature ranges and higher humidity. But the effect will be small. The coastal sites will generally experience higher wind speeds. This advantage is very useful since wind speeds tend to be low in this kind of climate. However, the disadvantage

experienced in very exposed coastal sites is the presence of salt from the sea spray.

In built up areas the surrounding buildings can effect the direction and speed of wind. Therefore it is important that a detail study is made of the building and vegetation surrounding the proposed site. The surrounding buildings also tend to radiate heat absorbed from the sun, and the air temperature surrounding them may be very much higher than the normal air temperature. In contrast, the vegetation surrounding the proposed site absorbs the radiation and evaporates moisture drawn from the ground thereby reducing the air temperature of the surroundings. Furthermore large trees deflect the wind down to the site.

Urban sites are subject to pollution by noise, dust, fumes etc. from traffic and industrial sources. The direction of these pollutants has to be examined before decisions are taken regarding the positioning of openings.

#### **1.3.3.2 ORIENTATION**

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The highest intensity of radiation fall on the roof and west walls, and it is slightly less on the east walls. This is because the morning temperatures are lower. The relative areas of the building surfaces may be adjusted to minimize heat gain due to solar radiation. (This may be done by reducing the areas of east and west walls, and increasing the north south wall areas. The only alternative to reducing roof area is to increase the number of stories. )

When the sun and prevailing wind both come from the west it is advised to stagger the building form to deflect the wind and provide the openings on north and south sides. Larger west facing windows should be essentially avoided. Shading devices in west facing windows may heat up the air before it enters the room, in addition to obstructing the view. Use of vegetation may be more successful, yet there are disadvantages since it is not a permanent solution, and can harbor insects or other animals. However small openings, which are well protected, are an alternative since they increase wind speed, which counteract the radiation received in the interior. (See section under openings and devices).

Buildings must be well spaced to allow wind to return to ground level when it has been deflected upwards by buildings on the windward side. For most proportions of building a space between of five times the height of the windward building is sufficient. (It has to be greater in the case of long slab building).

In this region where rain is well distributed throughout the year it is essential to provide protection for rain, the most critical direction is the southwest. Openings facing this direction should be well protected. It should be noted that the wind direction in this region is mostly from the west and the southwest. The openings, which allow for sufficient air movement, and keeps out the rain and radiation heat are necessary.

#### **1.3.3.3 FORM OF BUILDING**

Buildings, which are raised off the ground, are an advantage in this type of climate. This helps to avoid the rising damp, and also reduces the conducted heat from the ground, allowing the building to cool more rapidly in the night. Ideally the buildings should be raised on stilts, to allow for cooling the floor of the building by continuous airflow underneath. Where ceilings are provided, air movement should be provided for the roof cavity.

In this climate it is necessary to provide through ventilation to rooms to avoid discomfort due to excess humidity. Most activities could be centered in semi open areas, which provide shade and free airflow.

Due to the heavy rains, which are common occurrence in this area, roofs have to be sloped sufficiently to drain off the water. The slope will depend according to the materials used. Wide eaves are necessary to protect the walls from rain as well as from radiation heat. Ventilation of the roof cavity also is an advantage in that it helps to remove the heated air underneath the roof surface.

#### **1.3.3.4 OPENINGS AND SHADING DEVICES**

Opening size is normally determined by its function. Before an opening is placed in a building it is necessary for the designer to study the exact location in terms of the site conditions. He would then have to study its effects on the building. In the humid tropics air movement should be given a high priority and in doing so it should be made certain that its design does not increase the inflow of radiation into the building. At times the above two factors cannot be avoided. Therefore it may be necessary to design openings that would permit adequate light and ventilation and exclude undesirable radiation.

#### **1.3.4 PRINCIPLES FOR COMFORT IN THE WARM HUMID CLIMATE**

The physical environment consists of a complex relationship of many elements, including the climate. These elements act directly upon the human body, which can either absorb them or try to counteract their effects. The condition under which man adjusts himself to the environment, with the minimum expenditure of energy, is defined as the 'comfort zone'.

The feelings of comfort also varies according to regional and national preferences and attitudes. The comfort levels of a group of Eskimos would be quite different to that of a group of Bedouins.

Even in warm climates, the human body continues to lose heat to the environment. In order to keep cool when the external temperature is warm, the body has to lose heat by evaporation in the form of sweat. This is relatively easy in a dry climate, but under humid conditions, this becomes a problem. In a warm humid climate, air movement becomes an essential factor for comfort, since it aids evaporation-cooling process.

#### **1.3.5 CLIMATE MODIFICATION STRATEGIES**

The basic climate modification strategies involve the use of airflow, solar gain, evaporative cooling, thermal mass, shading etc. The design basis selecting the appropriate climate modification strategy is to define the physical characteristics of the particular climate and the design objectives. The more



challenging design problems are where there is an inherent conflict between the design objectives and climate factors. For example, it may be that the best views from the building face west so the contrasted with the need to respect the view. This presents the designer with a particular challenging climate design problem.

According to Richard Hyde (2000:55) the building aspects of climate modification is of two calibers. There the active model and passive model. A passive makes use of the 'natural energy' in the environment which is available to the building through the microclimate as well as building form and fabric are used to modify climate. In the active model primarily man made energy, through plant and equipment is used to achieve climate modification.

### Climate modification

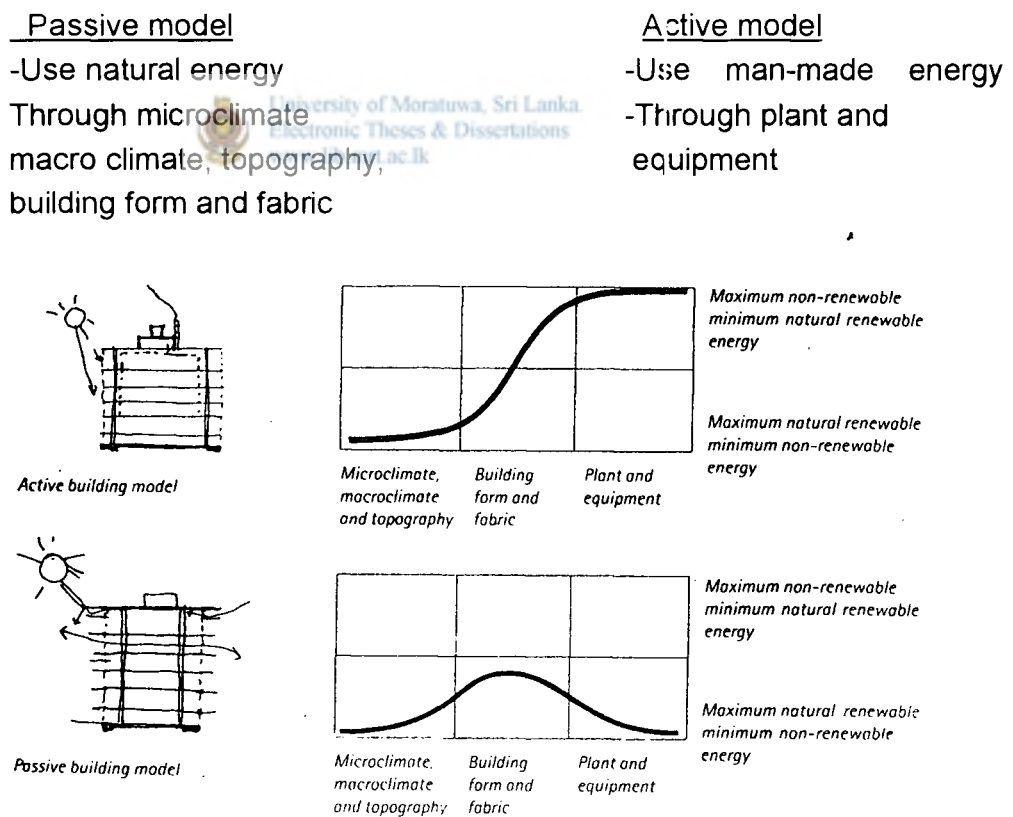


Fig. 08: Active and passive climatic data



The above diagrams convey the message of the importance of giving priority to passive building model.

Since this essay focuses on the passive means, the following table shows passive climate modification strategies and building tactics for warm climate.

Few of the climate modification strategies would be discussed in general below.

### **1.3.5.1 VENTILATION STRATEGIES (PASSIVE)**

Ventilation can be defined as the effects of air movement in the building. There are three main functions of the ventilation. They are,

- (1) Provision of a sufficient quality and quantity of air for people's life process and activities
- (2) Provide occupants with personal cooling
  - This is also called thermal comfort ventilation created by the passage of air across their bodies.
  - It is related to the availability and velocity of cooling air from outside the building.
  - The velocity of air to achieve thermal comfort increases with temperature, until the skin surface temperature is reached at approximately 35°C. (In hot-dry climates, since the summer temperature raises to 42°C, bringing air into the building is problematic for personal cooling).
- (3) Provide structural cooling
  - Cool the fabric of the building.
  - Depend on relative temperatures of the materials and the air.
  - Air entering the building that is cooler will absorb heat from the materials and vice versa.

It would be correct if said that, ventilation is highly context specific. Nature of prevailing wind flows is modified by the site topography, vegetation and through the building skin through the disposition of elements, so as to funnel cooler breezes.

The amount of mass, the volume of air flow through the building as well as temperature difference are crucial parameters for the effectiveness of ventilation. Thus in designing for ventilation the main issues are as follows;

- (1) The exposure provided by the site.
- (2) The amount of opacity in the building skin.
- (3) The function of the ventilation.

“Natural ventilation is generated by pressure differences in and around the building.”

“Pressure difference comes from air movement generated by air temperature and by wind.”

“There are two types of natural ventilation such as,

- (1) Temperature-driven ventilation (Stack effect)
- (2) Wind-driven ventilation (Cross ventilation)

#### (1) Temperature-driven ventilation (Stack effect)

- Temperature-driven ventilation is called 'stack effect', because it uses the natural buoyancy of the hotter air to rise and displace cooler air.
- Effectiveness is in situations where external temperature is lower than the internal temperature.
- Therefore not effective in warm climates.

So long as the outside temperature is lower than the inside, the simplest way of cooling the dwelling is by natural ventilation; simply open the window. With sensible design the cool air can be helped around the building.

#### (2) Wind-driven ventilation (Cross ventilation)

- More commonly used in warm climates.
- According to Givoni(1969: 259), the design factors effecting wind-driven ventilation are follows:

- Reduction of plan depth and increase openness of section to facilitate cross-flow and vertical flow of air.
- Optimum orientation of rooms to the prevailing breeze and the linkage between leeward and windward side to utilize pressure differences.
- Maximize the skin opacity through the number and size of opening, single- double or three-sided openings to room, horizontal versus vertical stacking or openings.
- Reduction of internal obstructions
- Site selection and building situation to increase exposure to air flow effects.

### **1.3.5.2 SKY LUMINANCE AND SHADING STRATEGIES**

Designers, especially traditional designers never forgot that sun and daylight are fundamental to the quality and delight of the building. The authors of the book "Climatic Dwelling", says that 'in the past it was unthinkable for a building to be constructed without access to day light. Lives of people revolved around the availability of light.

The climate dependent issues come from the quality and quantity of day lighting found in different climates. This in term is related to the sky conditions. And the levels of solar radiation, which vary in the different types of climates. As an example let us consider three differing types of warm climate-hot humid, hot dry and moderate.

Hot humid climates are fairly cloudy during the year, with 60%-90% convex. Luminance from the clear sky is high but is reduced with over cast conditions. Solar radiation is less than that of the hot-dry and moderate climates. The high humidity causes the reduction in the transparency of the atmosphere in hot-humid climates leading to low solar radiation unlike in moderate and hot-dry climates.

### Typical lighting levels and solar radiation for warm climates.

	Hot-humid	Hot-dry	Moderate
Typical sky luminance (Lumens)			
Clear skies	7500	10800	100000
Over cast, obscured	9000	9000	20000
Typical solar radiation ( $Wm^{-2}$ )			
Clear skies	750	1080	1000
Over cast, obscured	90	90	200

Source: O.H. Keonigsberger et al, 'Manual of Tropical Housing and Building', 1993, Longman, p.23

Although according to the above table, there is ample day light for interior lighting in warm climates, there is a problem of admitting large amount of solar radiation in to the building. For example, in moderate climates,  $1m^2$  of square sky light will admit up to 1000W of heat. Therefore, utilizing the natural light to avoid electric lighting, without heat gain is a challenging for the designer.

The quality of light in these climates also varies considerably. In the warm climates brightness of light, due to high intensity, give high contrast between sunlight and shaded areas. This contrast can cause high levels of reflected glare from highly reflective surfaces. The main problem occurs with interior spaces where low light levels are used. Glare can be found from contrasts between exterior light levels, sky glare and the wall surface around the window.

Few strategies in reducing glare as follows:

- (1) Verandah with a pergola cover acts as a transitional space between inside and outside, with the play of light and shadow. This reduce glare by reducing contrast between the exterior and interior light levels.
- (2) Interiors painted with light colors to reduce glare.' Obscuring the source of light from the field of vision within the room can avoid glare and produce a softer quality to the perceived internal luminous environment.

- (3) Thick walls are used to obscure the windows from the view down its length. Also it is possible to sculpt out a thick wall around the window openings to create reveals which grade light from exterior to interior.

Daylight contains both sunlight and diffuse light. Diffuse light is the indirect light, that is reflected from external surfaces, where as sunlight is the direct light from clear sky. The main concern with day lighting in the warm climates is that the access of sun light in to the building brings heat and ultraviolet light. Diffuse light, on the other hand, is more being; it has a much lower component of heat. Hence the need to shade the openings to reduce the direct solar access and increase the amount of solar access and increase the amount of diffuse light.

"Sadly, in many recent buildings in the rapidly developing urban, warm humid tropical regions, there is little apparent design efforts associated with window design. .... window openings are often formed in unshaded walls and fitted with least cost aluminum sliding sashes. This leads to rapid indoor over heating, extreme indoor glare and reduced air as the effective area of sliding windows in only 50%".

R. Aynsley (1997:01)

By focusing the view on the diffused light on the wall (without showing the source of direct light), can reduce glare.

Shading devices reduces glare by diffusing light.

N.V. Baker (1994), has declared four climate, responsive design issues concerning 'day light'. They are as follows;

(1) Diffuse light

Use diffuse light where possible, rather than direct sun light; to avoid heat given UV that causes the degrading of interior materials and furnishing.

(2) Heat gain from glazing

- The provision of external shading to reduce direct solar gain but allow sufficient lighting from natural lighting.

- Optimize the glazing ratio to provide appropriate natural lighting conditions, and provide ventilation to remove the heat gain associated with glazed areas.

(3) Glare

- Use materials and colours to avoid high contrast in the external and internal lighting conditions.

- Elements such as landscaping, tinted glass and screens are of use as buffer to moderate internal and external conditions.

(4) Light transition and threshold

- In situations where contrasts occur, avoid sharp contrast in light levels to avoid disabling glare.

- Set electrical lighting threshold for smooth transition from natural light.

### 1.3.5.3 INSULATION STRATEGIES

Apart from the possibilities of reducing heat loss or gain by restricting the size of external openings, as seen in Arabian houses, in the above figure, insulating the external envelop reduce inside-outside heat transfer.

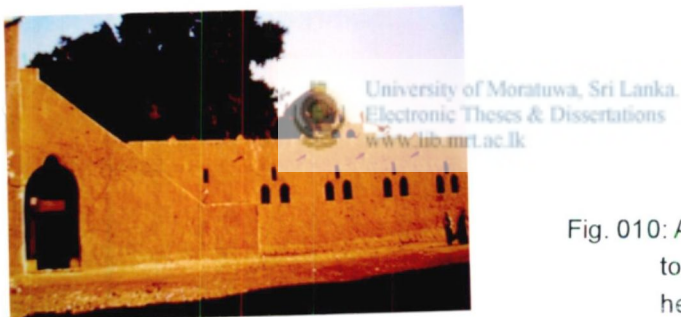


Fig. 010: Arabian houses with small openings to reduce heat gain during day and heat loss at night

However, the control ventilation by opening and closing of vent, and the appropriate location of glazing to the south façade, means that the use of highly insulated opaque elements for the building envelop need not conflict with the wish to exploit solar gain.

High insulation levels in certain forms of construction may result in potentially damaging condensation in the building fabric. Problems can arise in high thermal mass construction, particularly when building is intermittently occupied. Ventilation of roof spaces and wall cavities could be needed to combat this.

Soil/earth is a very good insulator. At 1m-1.5m below the ground the temperature is relatively constant, 10°C or 50°C, through out the year. Therefore, the partial burial of the building not only reduce exposure, and hence heat loss by convection, but also moderates loss from the interior by conduction because the ambient air temperature in many areas is considerably lower than that of the ground. Ground contact is more frequently used to help cool the buildings.

Example 01:

The cellar in traditional Mediterranean dwellings, used to store wine and some foods, benefits from contact with the constant cool ground.

Example 02:

**'Hut Earthship'**, Taos, New Mexico, USA, 2000

Architect Michael Reynolds.

This building has its main structural walls made of car tires tracked and packed with earth, then rendered extremely.

"These massive heat retaining walls are always placed on the shadow side of a house in conjunction with the long glazed façade facing the sun to maximize solar gain".

Nicolas Pople (2000:191)

Thick masonry walls are also good insulators. They offer potential to control the impact of solar gain and provide for its storage, and they will moderate temperature swing by damping both heat gains and losses.

Building materials play a significant part in the subject of insulation. Mud, thatch, tile, masonry has better insulation properties than concrete, aluminum etc.

## **1.4 COMFORT AS THE NEED FOR CLIMATE RESPONSIVE STRATEGIES IN ARCHITECTURE**

Humans constantly seek comfort, which could extend to mean satisfaction. Comfort can be termed as the sense of well being generated within a person. A person's comfort within a built environment has many aspects like thermal, visual, aural, olfactory and mental and is broadly divisible



into physiological and psychological comfort.

Comfort is not easily questionable as a set amount of heat, illumination, window view etc., but its qualitative parameters can be described. The perceptual processes that underlie comfort are universal through what individuals find comfortable varies according to their expectations, age, activities, physical conditions, life style etc.

“Different people have different comfort levels based on their individual physiology, psychology, experience and life style. The ultimate test of the buildings performance is not decided by computer stimulation or physical measurements, but by the reactions of the buildings occupants”.

Carter, e. et. Al (1987:11)

Comfort is a sensation and therefore a subjective factor varying from person to person. Even for any given human activity there is no such thing as a perfect combination of conditions to satisfy every one at the same time.

The ultimate need of Architecture is comfort. Architecture that evolved for the need of comfort goes through wisdom and ultimately attains joy.

“The Architectural environment function is three ways. It maintains the physiological state necessary to sustain behavior, it provides the necessary behavior setting and it supports the psychological states through the use of symbols”.

Lang, J., et. At.(1979)

Therefore it could be said that an environment that provides the correct physical and psychological setting for a given human activity will result in the user comfort that environment; and result good Architecture ultimately.

Climate and comfort are interwoven aspects. Comfort is the resultant of climatic issues; and climate responsive Architecture is a resultant of the need for comfort. Therefore it is understood that there is a significant relationship between comfort and climate responsive Architecture, which are connected by “human needs”.

## **1.4.1 ATTRIBUTES OF COMFORT**

### **1.4.1.1 PHYSICAL COMFORT**

The quantitative attributes of the living environment depicts the dimensions of physical environment and its sensibility. This sensation owes to provide physical comfort.

The quantitative attributes of an environment stimulate basic senses of a person, to make a comfortable perception of that particular environment.

These quantitative attributes of the environment are two fold. There are as follows;

#### **(a) Social organization of the environment**

This includes both static elements such as natural landscape, man made structure and dynamic elements such as movement of people, vehicles, flowing water, air etc.

#### **(b) Natural elements**

This includes elements such as climatic features (temperature, rain, snow fall, wind, etc.), smell, sound etc., which are directly subjected to the sense of a person.

As discussed in earlier, climate is the main determent of comfort. Therefore in the climatic point of view, physical comfort consists of two factors. They are;

- Thermal comfort
- Visual comfort

#### **1.4.1.1.1 THERMAL COMFORT**

Thermal comfort can be defined as the state of thermal equilibrium between the human body and its environment.

Human thermal comfort depends on several major environmental variables such as;

- Air temperature
- Radiant temperature
- Relative humidity
- Air movement
- Clothing
- Activity and metabolic rate

#### **1.4.1.1.2 VISUAL COMFORT**

Visual comfort is necessary to achieve functional purposes, completion of visual tasks, human safety, etc.

Lights become the prime consideration in obtaining the visual comfort, as the vision of humans are based on it. Therefore quantity and quality of day light, glaze, brightness balance, colour of light, etc. should be considered in providing visual comfort. Other than light, views and degree of enclosure are also need to consider.

#### **1.4.1.2 PSYCHOLOGICAL COMFORT**

Psychological comfort is a personal; feeling that varies from one individual to another.

It is well known by everyone that, physical comfort facilitates psychological comfort. Therefore, all the factors that effect physical comfort also affect the psychological comfort. Other than those quantities attributes that effect physical comfort, there are few qualitative attributes that effects the psychological comfort. They are, imageability, territoriality, privacy or sense of community, sense of belongingness that leads ultimately to the sense of place.

Fine example for this situation is the Archi. Basnayaka's house at Bollatha. Although its interior looks thermally very comfortable, the measurements showed that there was no significant difference between this place and another place that was considered comparatively uncomfortable.

## 1.5 CLIMATE\_AS FORM GENERATOR IN ARCHITECTURE

The term 'form' means the building elements and materials used in the building and associated landscaping of the site. In vernacular architecture there is a strong relationship between site, climate and the elements of buildings in generation of the building form. According to Szokoloy (1991: 13), "although from time to time, these forms have been distorted by architectural metaphors and spiritual requirements, the basic need for the physical performance of the building to respond to the climatic region in which it is placed remains a valid form determinant.

Since vernacular structures, or 'architecture without Architects', provide many basic lessons for Architects, a few examples would be derived from that caliber to strengthen the above statements.

### Example (1)

#### **Eskimo Igloo**

It is familiar in illustration and in its authentic form, it clearly demonstrate how resources, technology, settlement patterns, life styles, values, meanings, environment and especially climate play their part in shaping a dwelling type appropriate to the particular culture.

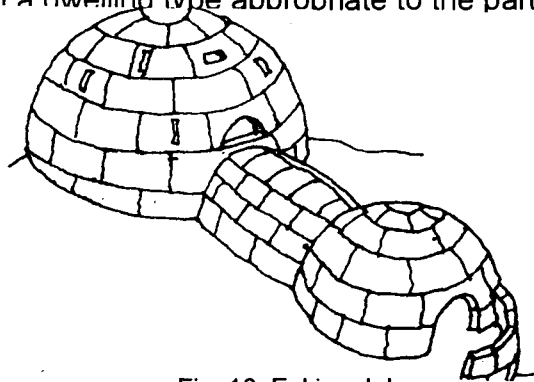


Fig. 10: Eskimo Igloo

### Example (2)

#### **Tropical Architecture**

***"Climate is clearly one of the prime factors of culture, and therefore built form. It is also the mainspring for all the sensual qualities that add up to a vital tropical architecture".***

Tan Hock Beng (1994: 13)

The tropical house type can be seen in the broad verandahs, the fluid interaction between inside and outside, cool courtyards, steeply pitched roofs with wide eaves and deep overhangs, concern for shade and cross ventilation, and the prevalent use of timber. The use of timber as a building material is sensible since it has a low thermal mass so that minimal heat is transmitted into the building.

Light - weight, semi - permeable walls have always been a feature of buildings in this part of the world. Their role is to maximize the interface between the inside space and the surroundings. Instead of excluding the weather and isolating buildings occupants from the external environment, the architecture filters the outside selectively through the system of louvered openings. The buildings thus offer immediate and direct contact with the lush landscape. Open lattice screens reinforce the physics of feeling comfortable. High ceilings also encourage the free flow of air through the building.

The above explanation of the tropical house type strengthens the climate's ability in generating the buildings form.

Example (3),



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#### **Arabian Architecture.**

This architecture is called adobe or earth mounted architecture, more than ventilation, insulation is considered. Therefore openings are very small. Earth is used as the building material. Buildings are light coloured and earth coupled. Plan shape is compact but thin to facilitate night ventilation.

Climatic determinism has been widely accepted in architecture as well as in cultural geography, although in the latter it has recently found less favor. Amos Rapoport (1969: 19) says that one need not deny the importance of climate to question its determining role in the creation of built form. In Architecture the climatic determinist view, still rather commonly held, states that primitive man is concerned primarily with shelter, and consequently the imperatives of climate determine form.

**" We build houses to keep in a consistent climate, and to keep out predators".**

*Bruce Archer(1964: 02)*

Though some researchers, such as Amos Rapoport(1969: 19,83), show doubts in considering climate as the primary generator of all house forms(because there are many forms of houses within limited number of climatic zones), admits that climate is, nevertheless, an important aspect of the form-generating forces, and has major effects on the forms man may wish to create for himself. He further says that, this is to be expected under conditions of weak technology and limited environmental control systems, where man cannot dominate nature but must adapt to it.

But in the present context it would be correct if said that the statement made by prof. Rapoport has changed, due to the up coming new trend of environmental conscious design attitude.

Therefore in the recent times, environment conscious designers no longer consider climate as a modifying factor (secondary force), but the generator (primary force) in evolving forms in architecture.

Example from the contemporary architecture to strengthen this statement is;

"Budaya tower", Kuala Lumpur, Malaysia, designed by Ken Yeang in 1992.

Source: "Bioclimatic Sky Scrapers" by Ken Yeang 1994, p.70

The building is design to integrate with the site. Many of its design ideas are generated from bio diversity of natural fauna and flora on the site the climate response strategies that form part of ecological sustainable design ( ESD ) approach mean that it reduces energy use by making best use of available daylight, passive solar heating, and passive cooling through ventilation

source:Hyde Richard," climate responsive design" 2000

Example:

**Habitat House**, designed by Richard Hyde and Mark French in 1997:p. 33.

This design has used an environmental brief to develop the design. The use of climate modification strategies has harvested the natural energy of the microclimate resulting in zero operational energy for heat and cooling. Therefore this design is a fine example for a climate responsive design.

Source: Climate Responsive Design ' Richard Hyde (2000: 48)

Diagram? Visual? Geographic?

The rectangular site is oriented diagonally north south and the site conditions are such that the geometry of the site and that of the sun path do not coincide. To overcome the difficulties of the site, a capsule-shaped floor plan with semi-circular ends is used. This form geometrically reduces the length of the north-south and east-west external walls, and hence the direct isolation.



## 1.6 CLIMATE RESPONSIVE DESIGN

Climate responsive design is based on the way a building form and structure moderates the climate for human good and well-being.

**" Climate responsive design is an integral part of the environmental framework that is being developed to reduce environments impacts and provide for human well-being".**

Richard Hyde (2000: 07)

Climate responsive design, which is also known as the 'climatic conscious architecture', is just one aspect of designing for a sustainable future. In other words; climate responsive design has a foundation first in the wider context of environmental sustainable design and second in the practice of architecture through effective design management. This involves selection and evaluation of strategies applicable to a particular design problem.

### Kemsey Museum by Architect.Glen Murcutt, 1990

The building is designed to integrate with the site. Many of its designed ideas are generated from biodiversity of natural flora and fauna on the site. The climate response strategies that form part of ecological sustainable design (ESD) approach mean that it reduces energy use by making best use of available daylight, Passive solar heating, and Passive cooling through ventilation.

Source: Hyde Richard, 'Climate responsive design',\_2000

### Example (1)

'Habitat House', designed by Richard Hyde and Mark French in 1997:p.33.

This design has used an environmental brief to develop the design. The use of climate modification strategies has harvested the natural energy of the microclimate resulting in zero operational energy for heat and cooling. Therefore this design is a fine example for a climate responsive design.

Source: 'Climate Responsive Design', Richrd Hyde (2000:48).



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Climate responsive design requires of the Architect, both analytical and synthesis skills to optimize the relationship between the site, climate and briefing requirements.

Buildings, which use climate as a form determinant in both the Pragmatic and Poetic sense result in climate responsive architecture.

The following examples demonstrate architecture of this caliber.



### Example (2)

'Kanchanjunga Apartments', Bombay, 1970-83 by Charles\_Correa.

- Oriented - east -west to catch the prevailing sea breezes, and to open up the best views in the city. (Arabian Sea on one side and the harbor on the other side)
- But east west is also the direction of sun and heavy monsoon.
- The solution inspired by old bungalow method that is wrapping a protective layer of verandahs around the main living areas, thus providing the occupants with two lines of defense against the elements.
- Its minimalist unbroken surfaces are cut away to open up the double height terrace gardens at the corners, thus revealing (through the interlocking form and colour) some hint of the complex spatial organization of living spaces that lie within the tower.

M. S. S. S.



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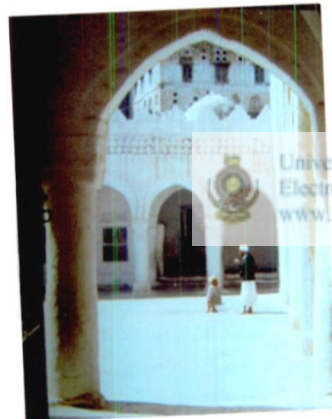
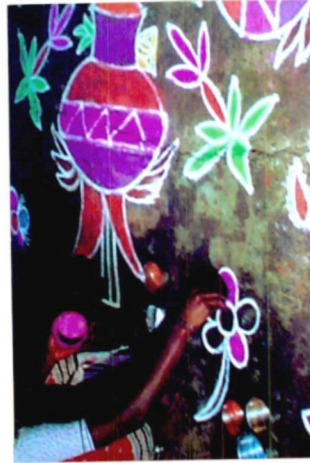
## **CHAPTER TWO**

# **THE CULTURAL REFLECTION IN ARCHITECTURE**

## CHAPTER TWO: THE CULTURAL REFLECTION IN ARCHITECTURE

### 2.1 CULTURE

#### 2.1.1 INTRODUCTION TO THE CULTURE



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Fig. 11: Different cultures express  
Through the different symbols;  
Sinhalese, Dravidian and Islamic  
Cultural symbols

The world consists of a large number of different human races with different cultures. Each of this race expresses an individuality which is particular to its own, and this individuality is primarily determined by its own culture. As it seems this culture also determines the progression of particular human race, among civilized human beings. It gives value to the particular human race and personality too. Therefore it is understood that the death of one culture, which could be, identified as the spine of human race, will definitely extinct the particular human race.

The term culture encompasses various divers aspects, such as social needs, social organizations, and institutionalization, means of livelihood, religious background, mythical beliefs and customs etc. In order to obtain a clear understanding of this concept it is important to consider some of the most famous exposition of culture.

Amos Rapoport described culture as. "The total equipment of ideas and institutions and conventionalized activities" and Magaret Mead's more detailed description would perhaps serve the purpose better,

*"Culture is an abstraction from the body of learned behavior which a group or people who share the same tradition, transmit entire to their children and in pool, to adult immigrant who became members of the society. It covers not only the arts and sciences, religions and philosophies, to which the word culture has historically applied, but also..... the small intimate habits of daily life, such as the way of preparing or eating food or hushing a child sleep....."*

However as a result of different philosophers attempt to understand the culture in a various ways. There numerous definitions of the word culture existed. But there is no completely satisfactory yardstick has yet been devised to measure culture and the following definition has been selected from among the explanation of this complex concept.

*"Culture consist of pattern explicitly and implicitly of and for behavior acquired and transmitted by symbols, constituting the distinctive achievement of human groups including their embodiment in artifices".*

Thus, culture determined what a man learns, accepts and how he behaves. All his mental acquisition, language, customs, habits, values or attitudes are currently derived.

Sri Lanka as a multiple nation, containing different cultural groups, mainly based on either race or religion. There are three main cultural groups can be identify according population density.

01. Sinhalese culture
02. Dravidian culture
03. Islamic culture

## **2.2 STUDY OF SINGHALESE CULTURE**

### **2.2.1 HISTORICAL BACKGROUND OF SINGHALESE CULTURE**

The Singhalese society was based on un equal feudal system with marked difference in the status of the people. The king was the almighty. His Ministers "Adikarama" and the Buddhist priests were there to advise him on matters, pertaining to the ruling of the country, but he was not bound to listen or work according to their advice. At, that period the land was considered as the most important thing, and the status of the people were determined by the amount of land, which belonged to him. Many times the ministers and war heroes were granted land according to the amount of satisfaction that the king

got from their work. It would be the highest prize, which one could obtain from the king.

The Singhala village credo apply described as,

*"..... Respect according to veneration for aristocracy, in a pure ancient and unblemished family descent (which) pervades over every class, their fastidiousness with respect to it in their family alliances in one of their strongest characteristics"*

Thus the above statement clearly interprets and helps one to understand the general structure of the society. The traditional Sinhalese society in period was based on agriculture. The paddy cultivation been the main occupation of these people and the settlements were found in a form of villages in irrigatable areas in up country. Generally these villages were independent from each other. They had every essential thing except salt and luxury items like cloth etc. and the social organizational pattern of the village provided all the skills and production, which they needed to perform their daily life, social life and family life.



Fig. 12 : Agricultural base Sinhalese culture

Dr. Coomraswamy identify this and stated,

*"The villages were to a grate degree isolated and self content, dependent on the outside world for little, but salt. A small external trade in Indian cloths and such things may have been carried on by the Muhammedan 'Thavaln merchants' who carried goods on back bulls. Along the steep and narrow jungle paths that led from village to village".*

Another significant character of this Sinhalese society was the communal feeling among them. In these villages no body worked for other persons for wage. They supported each other in their work and some time the whole village helped one person who wanted to get his high skilled work done, like constructing of a house, farming and so on.



Fig. 13: The Communal feeling, Significant character of Sinhalese society

Knox as described this,

*“Just after the English manner the old town, as I said before, as they joint together in tilling so in their harvest also, for all fall in together in reaping one man's field, and so to the next, till every man's corn be down”*

Thus it is clear now, the Sinhalese society consisted of self-sufficient group of villages, which was based on agriculture. This little agricultural community always showed some significant movements, such as communal feeling, cooperate living and so on. Which was particular to them, this particular movement seem to be occurred due to their advanced culture which evolved a particular individuality in that society.

Therefore in order to get a broader perspective of Sinhalese culture, it is essential to study the aspect of that culture, such as, the cast system, man's status, kingship, family structure, way of gaining livelihood, religion and mythical beliefs, which had played the major role in that society.

#### 2.2.1.1 CAST SYSTEM

The Sinhalese social structure in medieval period seem to has been based on some form of cast distinction. This was deeply rooted within these communities and the differentiation shown was shown by the use of term “Kula” which was meant caste, and the caste of particular human group was determined by their occupation.

In Sinhalese society there was two major divisions in occupation known as agricultural and non agricultural. Those who engaged in a agriculture was considered as the highest caste which was name as the ‘Govi kula’. Among that there was a divisions of status, such as the top most being the chief who held high position of the state, next the title man and finally peasant farmer.

*“Radala the top crust of ‘Govi- Kula’ caste monopolist not only high offices of the state, but high ecclesiastical positions too, according to the available evidences”*

The non-agricultural people were considered to be lower rank 'Hina - Kula'. They were divided into number of groups, such as the fishing people- 'Karawa', the toddy makers- 'Dddurawa', goldsmiths- 'Nawandanna', washers- 'Rada' and so on. The lowest caste was the 'Chandala-Kula' who performed the meanest occupation like, sweeping streets, removing refuse and caring a corpse".

The caste system could be considered as the basis of social organization in Sinhalese society. Each caste more or less an inherited occupation and no caste were ever allowed to change their occupation as a tradition.

It was also significant that this caste system creator some particular moment in these Sinhalese society. Such as the marriages, which strictly should be occurred between the same caste groups, and so on. In traditional functions and ceremonies like Esala perehara and some religious festivals too, this caste distinction was highly exposed and the each caste was determine to perform its particular work.

#### 2.2.1.2 MAN'S SOCIAL STATUS

The social status of families differed widely from each other. In Sinhalese society. Economic differences, which created this caste differentiation, were the basic determine factor of these social status, because the lives of families were regulated according to their income. From the earliest history the rich led a comfortable life with domestic servants to attend to their needs and the poor had to work even their daily needs.

*just*  
In ancient society the noble man who were the top class of "Govi-Kula" belong waste acres of lands and became wealthy in that society. Those people were generally allowed to spend a distinguished life, and it was reflected by their dwellings, dresses and so on.

*tenant*  
Therefore, in ancient society only the feudal landowners were allowed to put up, sustain houses, with large number of rooms and lesser landholder and tenet farmers living in simpler of mud and thatch. The rest of the population like laborers and the artisans hardly owned any lands and lived in single or bi-roomed huts, which was made out of mud and thatch.

#### 2.2.1.3 KINSHIP

The network of social relationship between individuals and groups of individuals found their application through social institutions like kinship and marriage. The kinship pattern was more an expression of the behavior pattern of the ancient society, and this implies taboos on sex relationship. Certain categories of kin were rigidly debarred from marrying each other while cross

cousins were held to be ideal marriage partners. In this society marriage was almost an informal union of two members to set up a common household to share pot and bed. The marriage was permissible only within the same cast group and the parties to the union must be in the correct and tolerable, kinship category and generation. These marriage partners should have been one who was permitted to be taken home and dined with. These kind of endogamous marriage help to achieve unity and harmony while alienation of the property was prevented, and hence the continuity and solidarity of the family and society was simply encouraged and achieved by means of preferred crossing marriage.

#### **2.2.1.4 FAMILY STRUCTURE**

The family has remained in that day as the basic unit of society. Generally this basic family unit consisted of man, wife and un married children, and each new marriage created a new household, typically located in husband's village. The professions and the property in movable and immovable were given to the children when they married and a property was given to the son's in place of daughters. Probably because the daughter's share would be given when she got married as a dowry. This family was considered as the fundamental unit of the traditional village.

Davy put it very succinctly when he wrote, *"Amongst few people I believe the family attachment more strong and sincere, there is little to direct or weaken them, a family is the forecast on which all the tender affection of a native are concentrated"*.

Family welfare was considered above the individuals and hence an individual had no dependent, existence in the traditional society., as yet another important principal underlying the traditional system, the male supremacy, was the accepted norm. Generally the husband was the in charged of all work done in paddy fields and wife did not originally labor in the fields, but are kept busy in the house with cooking and the looking after the children. She was also responsible for collecting firewood, fetching water, etc.

#### **2.2.1.5 THE WAY OF THE GAINING LIVELIHOOD**

The country was predominantly agricultural as such would have had no difficulty in supplying in habitants with the necessary food. Thus there was no evidence mentioned in history about the importation of foodstuffs from other countries. The most frequent diet was the cooked rice with various dishes consisting of fish, meat and vegetables.





Fig. 14 : Self sufficient Sinhalese society

In a typical rural setting, the lowest location was always selected for the paddy fields which were adjoining the village with the stretch of jungle land covering the upper end of the village, which services the villagers in their common needs like, timber, fire wood etc. Those paddy lands and product of jungle would provide all domestic requirements like rice, coconut, vegetable, betel, areconut, honey, etc. making them self-sufficient in everything but not in salt and cloth.

#### **2.2.1.6 RELIGION**

The traditional culture of the Sinhalese people was deeply rooted in that agrarian society as described earlier. This system was further molded and conditioned by the influence of Buddhism the state religion and the whole society was knitted together by this bound of religion which exercised its control over all the spheres of life, whether political, economical or social. Due to influences the healthy co-ordination between the Buddhist temples and these people, was found among those societies. Also the Buddhist monks of the village temples had always become the advisor of the villages in all important instances of their life. Very often people consulted monks on matters of ill health and forecast and also the temple function as a village school too.

Thus it is clear, these Buddhist monks became an essential partner of medieval society and they were placed in a supreme position among the traditional Sinhalese society these monks were subjected to receive the expectations of the people and the society, as they preached the philosophy of lord Buddha. The great truth of the nature. These monks had also enlightened a the society, with numerous teaching of Lord Buddha which basically thought the only way to destroy the sorrow of life and the only way to get rid of cycle of birth as to become a simple man. Therefore this philosophy cause the people to spent rather simple life, as this religion will absorb in that society, had played a major role.

### 2.2.1.7 FUNCTION AND CEREMONIES

Sinhalese society had an important traditional function, such as marriages, puberty ceremonies, alms giving, pirith chanting, house warming ceremonies and funerals, etc.

In addition to these, there were other significant functions like, feeding of the first meal of rice to the child, the boring of a little girl's ears, the first cutting of children's hair, the formal institution in to studied at the age of five and many other similar functions. Normally in these ceremonies all the relatives expected to be invited and hold the feast at the end.

Villagers also were celebrate their national festivals such as Sinhala new year , religious festivals like Vesak, Poson and some agricultural ceremonies such as threshing floor rituals and offering to god etc. The people of the villages should essentially participate in these activities so as to highlight their communal feelings, co-operative living and social solidarity, which were some of the characteristics of that society.



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Fig.15 : Agricultural ceremony

### 2.2.1.7 MYTHS, BELIEFS AND SUPERSTITIONS

*"The ancient Sinhala peasant who like his modern counterpart was engaged in a constant struggle against nature, did believe that techniques derived from the accumulated knowledge and experience of his ancestors and efforts alone could bring the desired results from agriculture. To protect his cultivation from such dangers as drought, flood and pestilence he kept faith in superstitions and astrology and therefore rational behavior was intermingled with rituals and superstitions".*

Thus the astrological and mythical belief of the ancient Sinhalese becomes an essential part of their life pattern. These rituals and superstitions got deeply rooted in their culture. Each and every work of this society was primarily based on this superstition and mythical beliefs.

Therefore in that society the important activities and functions were essentially started on an auspicious date and time fixed by astrologers. Thus adhering to these norms people expected protection from natural disasters and to receive better results on their work as well as other activities.

### 2.2.3 EXPRESSION OF SINHALESE CULTURE

As it was discussed before, the numeral aspects of Sinhalese culture seemed to be the spirit of that advanced culture and these different aspects would create a particular individuality in it. This particular individuality could be identified as the formal expression, which was reflected by the significant characteristic features, found in that culture.

Basically there were two significant characteristic features, which could be recognized in Sinhalese culture. The one of the most prominent character was the formal quality which was reflected through its each and every aspects, and this character of formality generally survived due to numerous, rules, regulations and social norms which was introduces by various aspects.

These numerous social norms, rules and regulations played a very important rule in this society. Those had always become the deciding factors of all the movement of the people as well as the society and there by would have formed the living pattern and their behavior pattern accordingly.

As it was discussed before those various aspects such as caste systems, social status, kinship, family structure, the ways of gaining livelihood, religion, functions and ceremonies and the myths, beliefs and superstition, would have become the predominant factors of their various activities, such as the occupation, the way of behavior in the society, the marriage, the ways of behavior in the home etc.

*In cause of violation?*

In these society the living pattern and the behavioral pattern of the people, should have essentially adhered to these numerous rules, regulations and norms. In cause of violence of these they were pulled up by the social pressures and sometimes sever punishments imposed by the king.

Thus due to this formal character of the Sinhala culture, there was a strict discipline with dominated all the movements of the people and the society. Therefore it is obvious that this culture reflected the message of discipline, which sprung up due to its formal character, and this sense of discipline could be identified as one of the major expression, which conveyed by the Sinhalese culture.

Another significant character, which was identified in the Sinhalese culture, was the character of mundeness, which was recognized in all activities of the people of the society. This character was basically originated due to the influence of Buddhist phenomena, which was one of the major aspects of that culture.

The influence of these religious phenomena paved the path to restrict all the activities by the teaching of Lord Buddha. As it was discussed before these teachings of the lord Buddha let the Sinhalese people to live a simple life, in an minimal society in which their needs were little. Therefore these people always spent the simpler life pattern rather than to go for a luxurious life, an as a result of that this pretty humble society began to show the harmony with nature which could be identified as another significant characteristic feature in the Sinhalese culture. This character of neutrality was also enhance by the other aspects of Sinhalese culture like the caste system, man's social status, kinship, family structure, ways of gaining.



Fig. 16: Simple life style with harmony with nature

Livelihood, function and ceremonies and mythical believes and superstitions, which simply determined the work one had to do for his survival, the hierarchy of the society, the living pattern an so on. Therefore it seems that the influence of this culture made people to live simple resulting them to become mundane and more humane. They always lived in harmony with nature and their life pattern was always enriched with the endowments of nature. Therefore by all these movements, these pretty humble society reflected the naturality which was perspective as the major expression of the nature, Thus it is understood that the Sihalese culture has reflected the message of mundanness which sprung due to the naturality of the moment of and this sense of naturality could be identified as another major expression conveyed in Sinhalese culture.

## **2.3 SINHALESE CULTURE AND RESIDENTIAL BUILDINGS**

### **2.3.1 INTRODUCTION OF THE BUILDING TYPES IN EARLY SINHALESE SOCIETY**

#### **2.3.1.1 FEUDAL LANDOWNERS HOUSE OR "WALAWWA"**

As the ancient Sinhalese society was based on feudal system, there were wealthy nobleman who possessed vast acres of lands. These people held the high administrative positions of the society and their residences were generally known as 'Walawwa'. These houses were generally constructed with several courtyards and with many rooms.

#### **2.3.1.2 FREE PEASANT'S HOUSE**

The ancient Sinhalese society was generally known as agrarian community and the large number of people were found as farmers, who did cultivation as their main occupation. Those people were generally known as free peasants and lived in a small house where they had only a few rooms which were arranged around center courtyard.

#### **2.3.1.3 POOR PEASANT'S HOUSE.**

In ancient Sinhalese society, the people who were not engaged in agriculture were categorized as the poor peasant. These people were generally treated as the lower cast people and lived in huts, where they had only one or two rooms.

### **2.3.2 GENERAL CHARACTERISTICS OF THE BUILDINGS**

#### **2.3.2.1 LOCATION**

In Sinhalese Society, there was a tendency to locate those residential buildings in isolated places, which marked the individuality of the person, who belong to that house. Thus each and every house was kept separately with a piece of land attached to it, which was called 'Watte'.

In 'Walawa', watta or the land was fairly big and the house was generally put up in a high land.

In a free peasant house, this 'watts' was rather small and very little land was allocated for the poor peasant's house, as they were not engaged in farming. However these residential buildings were put up in an isolated open places, where there were at least no trees close by. Each house was surrounded by well-swept sand courtyard and with a low fence made by cactus, for the protection from animals.

### 2.3.2.2 3D COMPOSITION

The residential building in were always recognized the low-rise scale, simple buildings, which consisted tiled hipped roofs, and with a high plinth. In its 3D composition the particular shape of the tough geometry appeared and due to that tough geometry these buildings were always give a rectangular shape, 3D composition. These residential buildings also exposed the solidity as they were enclosed by thick walls. But the introduction of internal courtyard into the house reduced that solidity and allowed nature to flow into the buildings.

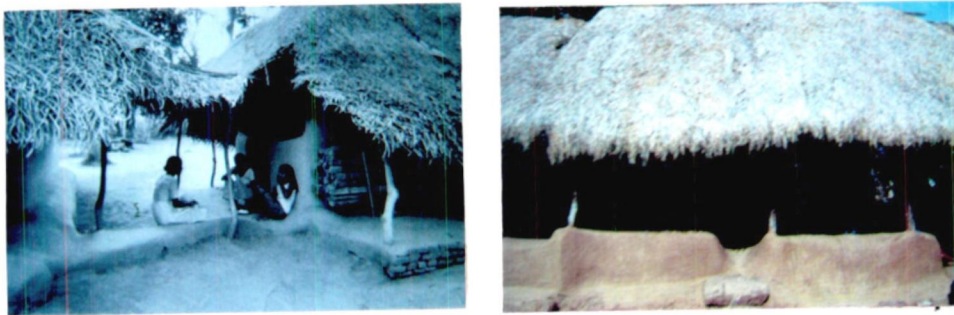


Fig.17 : Low- rise simple buildings with a high plinth

### 2.3.2.3 PLAN FORM



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The plan form of these residential buildings, except poor peasants house contained many activity areas, which was arranged around the courtyard. This arrangement reflected a particular type of geometry, which was similar to rectangular plan forms.

It was also noticed in these plan forms the lot of design devices which helped to create that particular geometry. Those were as such,

- i. The simple clear space without any hidden corners and niches,
- ii. The symmetrical arrangement of the activity areas.
- iii. The axial planning of the spaces.
- iv. The symmetrical arrangement of the circulation areas.
- v. The similar width of the, activity areas.
- vi. The regularity of the grid used.
- vii. The internal courtyard



In poor peasants houses also this rigid geometry was seen in its plan form where one or two rooms were arranged.

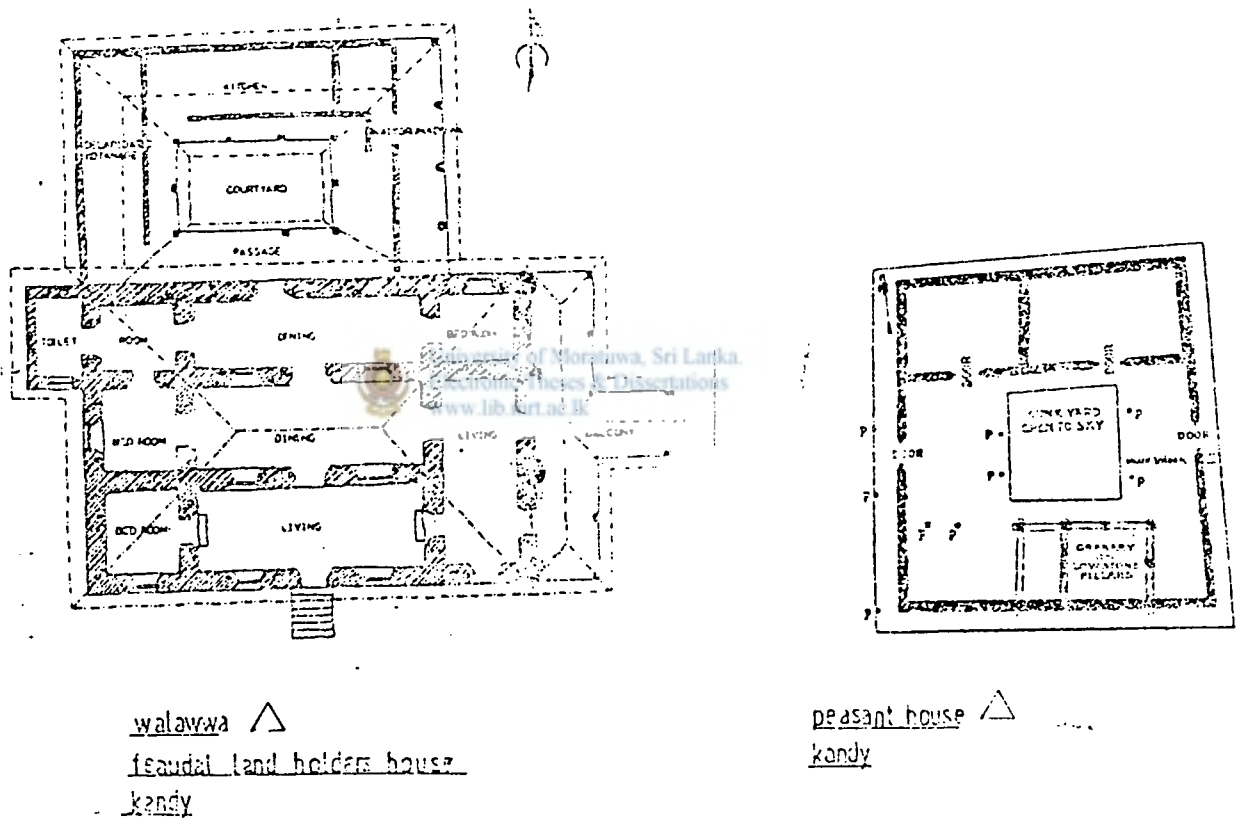


Fig. 18: Residential buildings; Plan forms

#### **2.3.2.4 STRUCTURE**

The residential buildings of the society are always consisted of mud and timber structure, and these buildings were always recognized as single storied, uncomplicated, low-rise structures.

The substructures of these buildings were consisted of high plinth, which was made out of stone and mud or wattle and daub, and the timber columns. In these residential buildings the hipped roofs were always used to cover these buildings, and the roof structure was completely made out of timber.

#### **2.3.2.5 FINISHES**

The residential buildings of ancient Sinhalese society were treated poorly in terms of finishes. This occurred due to, social norms which did not allow applying exclusive finishes, even pure white, wash in those residential buildings. Therefore in those residential buildings, mud was commonly used as a finishing material mixed with cow dung, and this was applied on the plinth, floor, and on the walls. The roof of these buildings were generally used to cover with material of nature like thatch grass or straw.

#### **2.3.3 THE COMMON CHARACTERISTIC FEATURES**

As it was recognized before the Sinhalese Architecture portray, numerous characteristic features through its products the buildings. These characteristic features were generally identified in the design aspects of such buildings like location, 3D composition, plan form, structure, and finishes. But among those numerous characteristic features, it was obvious that there were several characteristic features, which were common to all buildings. It was also significant that there were lot of means and devices, which had been used to create such common characteristic features in those buildings.

Thus as it was recognized before, the one of these significant character, could be named as the rigid geometry which was common to all these buildings. This particular geometry was clearly noticed in 3 D composition and plan form of all these buildings and always evolved the rectangular shape buildings where the movements of spaces were adhered according to that tough geometry. Therefore due to that rectangular arrangement of the spaces the hidden comers niches, and jutting outs were hardly seen, except in the instances like, irregular site conditions, and climatic features, that which caused a little change in this rigid geometry. But even in those buildings too a tough geometry could be identified as the significant characteristic feature.



Thus it is clear that this rigid geometry had become a predominant character, which was found in all Sinhalese buildings, and it was also a fact to understand. That the means and devices, which were used to create particular geometry in those buildings. The most prominent devices were identified as such:

- a. The simple clear arrangement of the spaces
- b. The symmetrical arrangements of the activity areas
- c. The axial planning of the spaces
- d. The regularity of the grid used
- e. The internal courtyards

The simple clear arrangement of the spaces

In ancient Sinhalese buildings, a simple clear space arrangement was apparent and this was recognized in the 3D composition and the plan form of these buildings. All the spaces of these buildings, were given its individuality because they were used to arrange in such a way with straight line, without any hidden corners, niches or jutting outs. Therefore due to that space arrangement the overall building was allowed to adhere to a particular rigid geometry where the projections, niches and irregular arrangements of the buildings were hardly seen.

Thus it is clear this simple space arrangement, which was seen in these buildings helped to create that rigid geometry which was particular to them.

### **2.3.4 THE SYMMETRICAL ARRANGEMENT OF ACTIVITY AREA**

The symmetrical arrangement of activity areas was visible in all these Sinhalese buildings and this was reflected through their 3D composition and plan form. All these spaces were balance positioned along the axis of the lengthwise and this significant symmetrical arrangement had strongly positioned all the activity areas within that rigid geometry. Therefore this symmetrical arrangement of activity areas had put all the spaces in a rigid framework, which helped to create particular geometry in these buildings.

### **2.3.5 THE AXIAL PLANNING OF THE SPACE**

In Sinhalese buildings the leaner arrangements of activity areas were always apparent in building s3D composition and plan form. Generally all the activity areas in such buildings were chained together along its lengthwise axis within the particular geometry of each building. This particular arrangement of the activity areas was clearly recognized in the buildings like image houses and devalayas where they were symmetrically placed in a leaner way. This situation was also visible in the buildings like monk's residences, royal palaces, etc. in which many activity areas were arranged within this rigid geometry of those buildings.

As it seems, this axial planning had been taken to discipline the movement of these activity areas and to arrange these, within that particular geometry. Thus it is clear that the axial planning of these activity areas had strong positioned the each space and thereby helped to create a rigid particular geometry, which appeared in the Sinhalese buildings.

### **2.3.6 THE REGULARITY OF THE GRID USED**

The plan form of these buildings depicted the regular grid pattern, which was used in designing those buildings. Generally one or two grid patterns can be seen in these buildings and all the activity areas, were arranged in accordance with that grid pattern within a particular geometry. Therefore each building always showed the simple clear spaces, without any corners, niches and jutting outs and that particular arrangement of the grid had helped to design the building within a particular geometry. Thus it is clear this regular grid pattern disciplined the movements of activity areas and there by helped to create a particular rectangular geometry in Sinhalese buildings.

### **2.3.7 THE INTERNAL COURTYARD**

In Sinhalese buildings, the courtyards, which were found inside the buildings, were a common scene. These internal courtyards were mostly found in the residential buildings like 'Walawa', peasant houses, monk's residences and in some royal buildings, etc. The use of these internal courtyards had given way to arrange their many activity areas according to a particular geometry, appeared in those buildings and it was clear that these internal courtyards were always used in the multi roomed buildings. It was also apparent that the fact the number courtyards, were increased according to the number of activity areas and result of that the several courtyards were found in the buildings like 'Walawa', palace complex. It is clear that these internal courtyard always allow these activity areas to be arranged within a particular geometry appeared in the buildings.

In these buildings there were some more features, which enhanced the particular character of formality or them. Those would be identified as,

- a. The buildings with hipped roof' or roofs.
- b. Isolated location,
- c. The open neighborhood and the sand. swept courtyards
- d. High plinth.

a. The building with hipped roof or roof

The buildings were always covered with hipped roofs finished with flat tiles or thatch. This sort of roofs gave a particular individuality to these buildings and disciplined all the spaces within a particular geometry. This hipped roof also made those buildings more outstanding among its surrounding and there by enhanced the particular character of formality.

b. Isolated Location

The Sinhalese buildings were always located in an isolated way where there were no adjacent buildings close by. This solitary location created a particular individuality in those buildings and made these buildings become more out standing among its surrounding and thereby enhanced the particular character of formality of these buildings. The open neighborhood and sand swept courtyards.

The buildings were always located in an open area where there were no trees in their immediate neighborhood. There were also surrounded by sand swept. Courtyard and this solitary location made the building more outstanding among its surroundings, which enhanced the particular character of formality.

c. High plinth



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The buildings always rested on high plinth. This plinth had helped to create a particular individuality in those buildings and the movement of these spaces was also disciplined by this plinth. As a result of that they had become more prominent among their surrounding which enhanced that particular character of formality in these buildings.

Thus it is clear that the above mentioned ways and devices, were used to create the particular rectangular geometry in these buildings. All these above mentioned design devices had provided numerous rules, guide lines, which disciplined the movements of all the spaces accordingly. Therefore such organism found in Sinhalese buildings had let to the formal Architectural style, in which all the spaces of these buildings were essentially added to these numerous rules and guidelines. Therefore these Sinhalese buildings reflected character of formality occurred due to their formal Architectural style, which could be identified as one of the prominent character, which was common to all buildings.

Another prominent character, which could be identified in those buildings, were the character of mundanness that they expressed. In another words these buildings were framed within the natural phenomena and had never become a burden to the human in instincts. Thus it is clear that these

buildings were design in a way that they would go hand in hand with the nature and these attempt were visible through the lot of ways and devices, which had been used to create the particular character of mundanness.

These were identified as,

- a. The open buildings
- b. The buildings with internal court yards
- c. The use of materials
- d. The finishes

- a. The open buildings

Most of the medieval Sinhalese buildings were identified as very open buildings, without walls right round them. These buildings were consisted only with serious of columns, roof and with one or two small chambers which were used to keep either the shrine or valuables. For a example the buildings like image house, Devalaya and audience hall depicted this particular type open buildings enriched with natural serenity.

- b. The buildings with internal court yards

The internal courtyards and open verandahs were commonly used devices of some Sinhalese buildings. These were mostly used in the buildings like monks residences, Walawas, peasant houses and in some royal buildings, which were enclosed by walls for the purpose of privacy. These buildings reflect solidity as well as integrity as they were enclosed by walls. Therefore the introduction of internal courtyards and open verandahs would have help to reconciled the solidity of the buildings and made the buildings to go in harmony with nature.

c. The use of materials

The Sinhalese peoples had always used natural materials in construction of their buildings. They commonly used the freely available materials like stone, mud and timber. The sub structure was generally constructed of mud and stone and the super structure was made out of mud and timber. For the roof structure timber was extensively used and the heavy timber sections had always taken for purling, wall plates and rafters. Thus the use of these materials in these buildings had promoted the human instinct in a natural environment. For example, the very thick walls of mud and serious of timber columns and the extensive timberwork in roof structure would focus the natural jungle environment in the human mind.

d. The use finishes

In the Sinhalese society the natural materials were always being used to finish their buildings. The commonly used material was raw mud and this was applied as a finishing material on the mud walls and some times on the floor, mixed with cow dung. The roof was generally finished with natural materials like thatch or straw and the clay tiles were being used in some important buildings like religious buildings and some royal buildings. The walls were generally plastered with white clay and the floor was finished with leveled stone. Thus it is clear these buildings were always tend to use natural materials as finishes and these finishes have provoked a particular natural serenity in these buildings.

Therefore it is understood that these buildings more or less similar to that of the products of nature in which the inherent quality of nature were found. Thus due to that natural exposition these buildings did not relate any burden to human instinct. They were ideally married to its surroundings and the outcome of this situation let those buildings to promote another significant style which was identify as organic Architectural style in which the inherent qualities of nature were absorbed.

Thus it is understood that the Sinhalese buildings had reflected to major significant characteristic feature, which were common to all the buildings. These were identified as the character of formality, which occurred due to tough and rigid arrangement of the spaces, and the character of mundeness, which occurred due to the naturality of these buildings. These two characters led those buildings to reflect a particular Architectural style, which was formal and organic Architectural style, as determined many scholars. Dr. Bandaranayake, to have the stated,

*“ These popular building tradition have often survived from the earliest spaces of man’s Architectural activity and preserved to this day archetypal concept and designs which constitute the basis of formal Architectural development. This relationship between organic and formal Architecture is well displayed in the village temple and other monuments of the Kandy and Gampola periods.”*

### **2.3.8 IDENTIFICATION AS A REFLECTION OF CULTURE**

The Sinhalese buildings were depicted by to significant characteristics features, which were common to all buildings. These common characteristics would have created to major expression in these buildings, which have contributed some message to the Sinhalese society. Thus as it was recognized before the character of formality and character of mundanness were identified as to significant characteristics and as a result of that, these buildings had expressed the highly disciplinary behavior pattern in activity areas as well as the harmonize relationship between these buildings with nature respectively. Therefore these buildings began to reflect to expression, which could be identified as the sense of discipline, occurred due to the disciplinary behavior of the spaces and the since of naturality which occurred due to the mundanness of these buildings.

This expression had evolved in this culture due to the numerous guidelines and norms, prevailed in that society and due to the simple life pattern of these people, which showed close relationship with nature.

The house is an institution, not just a structure, created for a complex set of purposes. Because building a house is cultural phenomenon, its form and organizations are generally influenced by the cultural milieu to which it belongs. There have been some attempts to take a deeper and more theoretical look of forces that create house form. The principal type of explanation, including physical ones involving climate and the need for shelter, material and technology, social ones relating to economics, site, defense and religion. Form is in turn modified by climatic conditions and by methods of construction; materials available and the technology are the tools for achieving the desired environment. Hence the socio cultural forces primary and the other secondary in modifying.

## **2.4 DRVIDAN CULTURE AND RESIDENTAL BUILDINGS**

### **2.4.1 SOCIO CULTURAL BACKGROUND**

The social and cultural field is ever widening. Fresh avenues open themselves before the mind's eye as we proceed. On grounds of ancestral racial and cultural heritage, the Veddas, the Sinhalese and the Tamils are the three primary races of Ceylon<sup>1</sup>. The Veddas are the aborigines of the island. Practically, all authorities are agreed that the Tamils have been in occupation of the island over 2000 years.

The more significant role that Jaffna filled in the annals of the Tamils in Ceylon, is to be sought in the fact, was the earliest to come under strong social, cultural and political influences from South India, and was occupied by the Tamils earlier than the rest of Ceylon, going back to the legendary days.

The social system of the Ceylon Tamil has been appropriately termed the Dravidian system, with the Dravidian culture predominant. True to the concept of Jaffna social system, the Saiva Gurukkal", a "Vellala", fills his role in the social life of Jaffna, a stronghold of "Saivaism". The "Vellala gurukkal" is the spiritual preceptor of the laity, as distinguished from the "Brahmin" priest with his place in temple rituals. The "Brahmin" in Jaffna is largely a heritage of the generations of priests indispensable to the temple services.



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The "Brahmins" living in Jaffna are for the most part, men of great morality, clean, industrious, civil, obliging and very moderate both in eating and drinking. They use no alcohol, wash or bathe twice a day, eat nothing that has had or may have life, yet are much addicted, like all the rest of the people to pleasure. They never marry out of their families but frequently the brothers and sisters children marry.

The Vellalas are the great farmer caste. Tamil community is strongly represented in every Tamil district

The tribes of the "Carreas" live upon fishing, which they perform with monstrous large net, they inhabit near the seashore of Jaffna, and the banks of the Salt River.

The "Nallawas" are generally slaves to the "Vellalar" and much blacker than the rest. Their business is to gather toddy a kind of liquor from the coconut and playmyrah trees and such as drudgeries as is commonly done by the coolies or ordinary labourers.

It is observable that the tribes of the upper rank, look upon the inferior once with the great deal of scorn, these being obliged to salute the others in the streets with deep reverence and other ceremonies to show their submission on the other hand all the men of what rank or quality so ever exercise a great authority over their wives, whom they rarely honor so far as to eat with them, but commonly dine alone. Non of all these tribes eat cow's flesh which is the reason that no cow's are killed by these people and also the cow being looked upon as a sacred animal.

A complex of customs, which prevail in different societies in different ways, are the coming ages customs. Despite differences they have one thing in common, the importance adolescence attached to customs of initiation, in passing from adolescences to manhood or womanhood. Customs in "Vellala" society relating to these initiation rites are an interesting institution; an idea to the importance to the society attaches to the turning point in a maiden's life. When a Vellala girl attains puberty, she has the companionship of a "kovier" woman who is deputed to attend on her, throughout the period of her seclusion. The girl remains secluded from contact with the rest of the household. The cloth she wears reaches down to the feet. The toes are filled with silver toe rings. On odd days from the fifth day, she has a bath, helped by the "Kovier" woman and the girl cousins. After the bath is duly given the girl walks on a "pavada" a white cloth spread on the ground, the Kovier woman holding a canopy over her head. The girl sits facing the pot full of water (the "kumbam"). The prescribed ceremonies are performed by her relatives. The grethi ("alathi") is the ceremonial of counteracting evil influences, which the girl is particularly open to at this stage of life.

Isolated from South India from long ago, Jaffna developed its own way of life. A rather small point, yet significant to the observer, is the secluded Jaffna house, screened off by a thick hedge of cadjan and palmyrah leaves interlaced and supported between posts, the whole, reinforced at intervals by well grown small-sized trees with a crown of foliage. This makes for a seclusion of family life characteristics of Jaffna society in general. Facing the house is the typical gateway, the "Sankada Padalain well set in the cadjan walls. The Technology of the gate is such pushed open, it automatically closes by the action of the weight attached.

In observing the Tesawalamai code of customary law, that it is agreeable to the people, and specially it conserves the right of women, they could have separate property, a portion of "the acquired property, and their husband cannot dispose of their property. Tesawalamai is both a personal and local law. It is personal in the sense it is applicable to certain persons only in Jaffna, and local in the sense that it is applicable to Jaffna only. These two traits of Tesawalamai distinguish it from such laws as the Roman Dutch Law. Tesawalamai, obviously gives us a foothold, from which to carry forward further inquiries in the cultural field.



## 2.4.2 DRVIDAN CULTURE AND RESIDENTIAL BUILDINGS

The social system of the Sri Lankan Tamil has been appropriately termed the Dravidian system, with the predominantly Dravidian culture. The caste system in it is 50 remarkably comprehensive and the functions rooted against each group, give us an insight into the very purpose of such an exhaustive list, prescribing the services each caste has to render. Other complex. Customs, which prevail in, is the coming of age ceremony, which is an interesting turning point in a maiden's life and importance the society attaches to a girl after that. In observing the customary Tesawalamai code of law, it is agreeable to the people of Jaffna and it obviously gives firm foot-hold from which to carry forward further inquiries in the cultural field.

The general elements, which characterize the traditional houses are high parapet fence of palmyrah leaves, "Thinnai" (a raised platform), Nadai" (walkway) and "Mutham" (open space). The traditional village house is composed of a dwelling unit, cattle shed, store and well, which are detached from each other.



Fig. 19: traditional houses of Jaffna, are high parapet fence of palmyrah leaves

The houses of Jaffna with the central courtyard differ from courtyard houses found in the other parts of the Island. This house type of Jaffna belongs to the period of 18th century and is the most cultural integrated form in the domestic architecture of Jaffna. The traditional courtyard houses are characterized by "Thinnai" (platform) "Nadai" (pathway), low eaves and the courtyard. Unlike the traditional house with detached units, the habitable units are brought under one roof. At the main entrance, a gateway with Thinnai" and n Nadai" which leads to the house is one of the distinctive character of these houses.

In Hindu culture dark spaces with limited fresh air are accepted like the Eskimo accepts very high concentration of odor inside the Igloo and the smell of the toilet is accepted in' the traditional Japanese house. Even\_ the Hindu temples the shrine rooms do not have any form of window. In courtyard houses, there are rooms without any windows, in some places with the small window with timber sash usually in the South sidewall. The entrance door to the room is also very short and the door sash is usually thicker than 2 inches.

The levels of the eaves are very low where a man has to bend and walk in and it also reduces the light level.

Smoke is considered as sacred and is encouraged in the house. Lighting Joss sticks and incense, which fills the room with the fragrant smoke, is a common day-to-day activity for the housewife early in the morning. The sacred oil lamp in the shrine room, which is lit throughout the day and night also produce] smoke, still they never try to keep the window and door big enough to eliminate the smoke. Other good example is the kitchen where no chimney or at least a small window is provided. The housewife is used to work in the dark kitchen with full of smoke.



Fig. 20: sacred oil lamp in the shrine room, which is lit throughout the day and night also produce] smoke



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The toilet is considered as most unhygienic and the smell unbearable. Therefore it is built in the extreme corner, which is far from the house and the well.

In Jaffna the high fence right round the premises and the courtyard houses facing inward, express the need for privacy in the culture. Other than the entrance verandah all the other areas are facing inward and facing the internal courtyard. In some places there' are two courtyards where the second one is exclusively for women. All the family activities are carried out in the center courtyard where the main room, shrine room, Nadaikudam (platform to sit) are situated.

Sitting is a basic need and it has great influence over the design of a courtyard house. According to the culture in Jaffna, people rest by sitting in the form of squatting and they do not use any furniture to sit or relax. Therefore the need for a special floor is necessary to sit comfortably. Lot of arrangements have been made in the design of the courtyard house to provide comfortable places in different areas in different levels.



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Fig. 21: All the family activities are carried out in the center courtyard

The verandah in front of the kitchen facing the courtyard is the place for dining and they wash their hands in the courtyard. No furniture is used to have the meals and after having meals all the left over will be stored inside the kitchen.

Sleeping habit is significant in the furniture; arrangements and space used which affect the house. Open verandahs are the place for men to sleep and women sleep in the room. They sleep on mats and carpets. A separate room is allocated for young girls as they are not allowed to go into the main room and shrine room during their menstrual period.

Marriage is regarded as sacred in Hinduism. It is prescribed for the sake of development of personality as well as the continuance of the family ideal. In the courtyard house, better places and status are given to married people than to bachelor or spinster. The importance and the respect to marriage are shown in the courtyard houses. The carvings and sculptures of God and Goddess on timber doors and walls express the significance of marriage. The -Thulasi Madam- (a bed of holy tree) is essential for the women to go around early in the morning, praying for early marriage and the married women for blessing of their husbands show the importance of marriage in the design aspect of courtyard houses. Wedding is a function for the relations and friends to get together. Courtyard house is an ideally designed house, with more open verandah space for the people to have the wedding at home than in the temple. While the bride and groom are seated on the verandah, the courtyard' is used to light the sacred fire.

When we are thinking about the social institution of the family we have to distinct between the primary and nuclear family, which refers to parents and children and their extended family. One can argue that the traditional courtyard house is a birth of the three-unit system (which we have discussed before) to satisfy the extended family system.

The care and protection of the very young, the handicapped, the old and the infant were used to be largely the responsibility of the family. The house facing inward such as courtyard house is designed in such a manner \_ to control the children very easily. The courtyard is their playground and while supervising the children the parent or the grandparent can relax in the courtyard verandah. Elderly people also feel secure in a courtyard house because they can be' easily looked after by somebody. They relax and sleep on the courtyard verandah, which is visible from any point including the kitchen.

The majority of the children were able to learn all that they needed in order to support themselves when they grew up by picking up crafts and skills from their parents. . Most learning acquired informally within the family group. The courtyard being the focal point for most of the activities in the house which gave opportunities to the children to watch their parents, while they talk and work, and it is also very convenient for the parents to explain certain things while they perform their duties.

According to Hinduism, one of the most important duties of the family members is to keep alive the sacred fire. Signifying this they have made niches in the wall to keep the 'oil lamps burning throughout the day and night particularly in the shrine and main room. Courtyard is ideal place for men to pray the Sun and women to pray the bed of holy tree. The special religious function such as "Thaipongal" is also celebrated in the courtyard.

Position of women and their activities in the courtyard houses have been made easy and, is not disturbed or distracted by men's activities. The service entrance and the rear verandah is exclusively for women. Other than visitors and distant relatives, all the close relations among ladies and the female workers to help the housewife are entertained in this verandah.

The meeting of people is also an important aspect since man has been defined as a social animal. People are very conservative. Though the major part of interaction takes place in temple, they like to entertain people in their house as well. The courtyard houses are of special kind even in the field of social interaction. So much of thoughts and arrangements have been made to provide such as built-in seats, verandahs, Nadaikudam, courtyard etc. for different category and caste of people to sit in places provided according to their status and talk from morning till evening without disturbing others. Provisions are made even at the entrance gate. There are separate places allocated for men and women to interact and common places for close relatives.



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Inviting and hosting methods are very peculiar in compared to other cultures, but inviting and respecting visitors are, very much appreciated by the people. The specialty of the inviting and hosting methods differ from people to people according to their caste and status.

As the caste system is comprehensive, the design aspect of house to cater to the visitors from different levels and castes are also very comprehensive. Different places are allocated for different all have to act accordingly caste of people and

So the traditional courtyard houses are the classical examples, which now clearly show the relationship between the lifestyle of the people and their design of houses. This study proves the social life style of the people has the major influence on the design of a house and attempts to make the designers more socially aware when designing houses for the people from a particular culture.

## 2.5 CLIMATE\_RESPONSES SEEN IN NATURE AND IN DIFFERENT CULTURES

Our ambient natural environment, itself, is entirely a response to climate. Blooming of flowers, migrations of birds, croaking of frogs, ..... etc, are nature's responses to climate. According to Liza Heschong (1979:7), 'Nest building is in a way a more advanced version of choosing a micro climate, an animal, seeking out a rock crevice or hole in the earth as a place to rest and be cool is indeed seeking a favorable microclimate. Digging the hole deeper and adding a bit of shed fur for insulation are simple improvements.



Fig. 22: Lotus are blooming with first morning sun shine

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Further, big animals like buffalos, elephants, hippopotamus, etc.; respond to the heat of the sun by using the insulation properties of mud and water in the ambient environment'.





Fig. 23: Big animals like buffalos, elephants, hippopotamus, etc.; respond to the heat of the sun by using the insulation properties of mud and water in the ambient environment

The sun controls the entire planet. Since sun and climate are interconnected, it could be said that climate influences all kinds of life on planet earth and so inherent in all aspects of the nature.

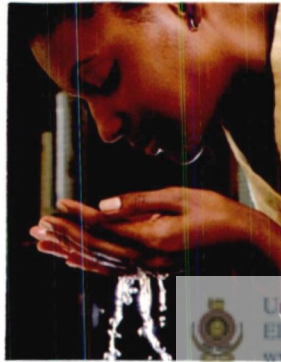


Fig. 25: Sun controls the entire planet

Human cultures have also evolved basically as a response to climate. The rituals, food types, clothing, behavior, etc., which forms a culture, are determined primarily by climate. For example some cultures worshiped sun, wind and rain.

#### Examples (1)

Most of Sinhalese festivals are based on sun path and moon phases. For instance, Sinhalese celebrate new year when sun complete the solar circuit. It does not begin at the customary hour of mid night on the designated day, but is astrologically determined. All the traditional events take place on astrologically determined times, which are known as auspicious time.

Another situation is that all the Buddhist ceremonies and festivals happen in response to the phases of the moon. Buddhist visits the temple on 'Poya day', which is a full-moon day. Other religious festivals such as Vesak, Poson take place on full-moon days. Sinhalese have not only believed in the mystic powers of the moon on living things but also respond to the aesthetic of nights with moon.



Fig. 25: Poya day

Example (2)

In certain time of the year (December - January) the sun moves up and down three times at dawn. Sinhalese believe this as the sun God worshipping the lord Buddha's foot print at Adam's peak (Siri Pada). Therefore during this time Sinhalese have made a custom to visit this place in large numbers along with many other customs.

Example (3)

Hindus celebrate Thai Pongal, in January to honor sun deity.



Fig. 26: Hindus celebrate Thai Pongal, in January to honor sun deity

Example (4)

People of Bengal worship the 'Ushas'. Ushas is dawn, a Vedic deity, daughter of sky and sister of night.

Poetry resembles believes, rituals and behavior of people in different cultures. It is a strong medium to express how cultures perceived phenomena of nature. The following Sanskrit poem of ancient Aryan civilization, translated by William Water field exemplifies this statement.



"Hymm to Ushas (dawn)  
Ushas I praise  
Of the brilliant rays,  
Who hath dwelt in heaven of gold?  
The gates of the sky,  
as the sun draws nigh,  
Her lovely hands unfold..

*Call the laborers from rest;  
Call the birds from out their nest;  
Call the priest to the hall of praise  
but let the niggard sleep,  
In the dark unlovely deep  
Afar from thy lightning rays.*

Source: "The plate of gold", 1949, p.56.

Cloth, which are identical/unique to some cultures, are also response to climate.

Example 01; Arabian cloths to cover the entire body



Fig. 27

Example 02; Egyptian cotton clothing, applied black eye liner to protect eyes from excessive heat at night

Example 03; People in barbarian tribes colored their body with mud to protect their bodies from excessive heat



Fig. 28

But let the niggard sleep  
In the dark unlovely deep  
Afar from thy lightning rays



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Source: "The plate of gold", 1949, p. 56

Kalidasa, the greatest Indian dramatist and lyric poet, flourished in the fifth century. Arthur W. Ryder (who has translated his poems) says about him, 'Rarely has a man walked the earth who observed the phenomena of living nature as accurately as he'. He had a tendency to speak of the phenomena of the nature such as the rain, sun and wind, in term of human beings, particularly Indians. Therefore s poems give a kind of imagery that shows the relationship between climate and Indian life.

Ex. "Summer" by Kalidasa

*Pitiless heat from heaven pours  
By day, but nights are cool; Continual bathing gently lowers  
The water in the pool;  
The evening brings a charming peace; for summer - time is here  
When love that never knows surcease is less imperious, dear.  
Sweet friends at evening, and a spot cool after burning days".*

Source: "The plate of gold", 1949, p. 72

Example 04; Eskimo's fur clothing to keep warm

Example 05; Indians/Sri Lankans, sarees and sarongs to keep the body cool



Fig. 28

It is quite evident that some countries with similar climatic conditions have common characteristics in their cultures.

For example R. Lewcock and J. Kirkman, who wrote research papers on "Architectural connection between African and parts of the Indian ocean littoral" (1976: 13 - 23), says that in the pre- historic period there were many more contacts around the Indian ocean littoral than had hitherto been suspected, to such an extent that it is possible to postulate the existence of an Indian ocean littoral culture, with many characteristics in common, which brought together or lesser extent the vernacular cultures of Sumatra, Malaya, Bengal, Sri Lanka, Kerala, Gujarat, Oman, Madagascar, and the east coast of Africa.

In the book, " The Architecture of an Island" (1998: xx), it says that one of the factors shared by the above mentioned regions around the Indian", ocean is toe similarity in their climates -many of them are hot, humid, and rely on the annual monsoons for rain and trade. It further says that the monsoons also make possible easy steady winds, which blow for up to four months at a time in one direction and then reverse to blow for an equal period in the opposite direction, allow commerce to proceed securely and predictably using fairly small boats with simple sails.



Fig. 29

The similarity of climate around much of the edge of the Indian ocean has meant that development in response to physical conditions - methods of cultivation, the design of houses and towns, and innovations in crops and technology - could be easily and rapidly transferred from one region to another.

Eastern cultures, rather than western cultures celebrated climatic factors and other related natural forces and incorporated those forces into their advance technologies; and sciences. Though they analyzed and understood the principles of those climatic forces and transformed them to technologies, they manipulated and used them with great honor and protected their mystic qualities.

For example, Egyptians knew that extreme temperatures and a certain climatic condition could preserve a corpse, and they used that technology to build a structure that create that certain kind of climatic condition, that would preserve mummies. Those structures are the great mystic pyramids.

The climatic response of Eastern cultures is very different from Western cultures.

For example, Eastern cultures have an affinity to shadow, darkness, uncleanliness etc., which westerners like the opposites. The book, "In praise of shadows", written by Jun'ichiro Tanizake (1977), talks about the issue frankly.

"Why should this propensity to seek beauty in darkness be so strong only in Orientals? The west too has known a time when there was no electricity, gas, or petroleum, and yet so far as I know the west has never been disposed to delight in shadows. ... We prefer the colours compounded of darkness, they prefer the colours of sunlight".

Jun'ichiro Tanizaki (1991: 46)

Jun'ichiro Tanizake ( 1991 :30 ), also says that, in making places to live, they first spread a parasol to throw a shadow on the earth, and in the pale light of the shadow they put together the house. He further says that though western houses too have roofs, they are less to keep off the wind and the dew; even from without it is apparent that they are built to create as few shadows as possible and to expose the interior to as much light as possible. If the roof of a Japanese house is a parasol, the roof of a western house is no more than a cap, With as small a visor as possible so as to allow the sunlight to penetrate directly beneath eaves. There are no doubts all sorts of reasons - climate, building materials - for the deep Japanese eaves.

In India and south east Asian countries the climatic responses were a bit different from the Japanese responses, where they celebrated the sky and sunlight.

*"..... At the deep structure level, climatic conditions, culture and its expression, its rites and ritual. In itself, climate is the source of myth: this the metaphysical quantities attributed to open - to - sky space in the cultures of Indian and, Mexico are concomitants of the warm climate in which they ....."*

Charles Correa, 1992

Mass Journal of the University of New Mexico, vol. ix.

Charles Correa (1996: 18) says, *"Throughout human history, the sky has carried a profound and sacred meaning. Man intuitively perceived it as the abode of supernatural". Sky as the abode of supernatural... .."*

A strong influence on Sri Lanka's history and culture is her position in the Indian ocean; and therefore its climate.

Sri Lanka was exposed to different cultures because it is located on the path of the trade winds. Arabians, South East Asians penetrations in to the island were prompted not by military expansion, but by trade. Drawn by the abundance of precious stones, ivory, teak and spice, these sea-faring traders established trading colonies and brought with them their languages, religions, political concepts and architectural principles that influence the original cultures. Those influences still exist.



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## **CHAPTER THREE**

# **AN EXAMINATION OF THE RELATIONSHIP BETWEEN CLIMATE, CULTURE AND BUILT FORM**

## **CHAPTER THREE: AN EXAMINATION OF THE RELATIONSHIP BETWEEN CLIMATE, CULTURE AND BUILT FORM**

### **3.0 CASE STUDIES**

#### **3.1 CASE STUDY 01**

##### **3.1.1 TRADITIONAL PEASANT HOUSES AND THEIR RELATIONSHIP TO CLIMATE AND CULTURE**

The peasant houses in Sri Lanka essentially reflect the attitudes of the community based on agriculture, with simple life patterns and needs. The structures were a direct transformation of their needs into material form.

The houses were very simple structures, made with the materials found in the vicinity and built by the occupiers themselves. The building skills were learnt informally. All the houses in a community had very similar appearance. This was also governed by tradition, it being considered unlucky to make undue expression of once wealth.

During the ages, modifications were made to the traditional model, as was seen necessary, such as the addition of rooms, extension of verandah, etc. The buildings were based on human scale. The size of the dwelling was based on a multiple of "riyana", a measurement equal to the distance between the elbow and the tip of the small finger.

In the early villages the dwellings were located around and facing a central open space, which functioned as the village square. This is typical of village layouts in the hot humid tropics. This allowed for air movement in between the dwellings, and also shaded the much used central space from the heat of the sun. This was in wide contrast to settlements in arid lands, where they are clustered together, to offer minimum surface area to the sun.

The simplest form of dwelling had a single room with a verandah in front. The front section of the verandah was raised and broadened to form in to a platform, which was used for sitting, sleeping etc.



Fig.30: The verandah of a traditional rural house

The low eaves protect the verandah from glare, whilst allowing for free air movement through the space. This is a typical example of a life pattern influenced by the climate, where most of the activities are performed in the open. Only a very few activities were taken place inside, which were regarded as essential due to reasons of privacy or security.

The location of the kitchen varying in different localities clearly show the influence of the climate. In the north central province, it formed a projection of the climate. In the north central province, it formed the projection of the rear wall of the main house, in Jaffna, it was located separately, whilst in the hill country, it formed part of the main house.



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Fig.31: A simple rural dwelling

The raised plinth gave protection from crawlers, such as reptiles who frequented the area, and also gave structural stability to the walls, as they were made integral with the plinth. Climatically it served three purposes; it acted as protection against rising damp, which become a health hazard during the rainy season; it protected the earth walls from coming into contact with water during the rainy season; it reduced the amount of conducted heat being absorbed into the dwelling from the surrounding ground.

The wide eaves of the roof protected the walls from the rain as well as shading the walls and the verandah from the sun's heat. The insulating nature of cadjan or straw is comparatively higher than that of tiles. In parts of the dry zone where a high wind prevailed for most parts of the year, the eaves were made as low as 4-5 feet above ground.

The walls have high insulative qualities being earth based. In wattle and daub construction, a gap of 8 inches was essentially kept between wall and the roof timber. This may have been to keep the termites away from the roof timber. But this served an additional purpose in allowing through ventilation through the house interior. The small opening set into the wall allowed minimum light inside, prevented the interior from getting heated up unnecessarily.



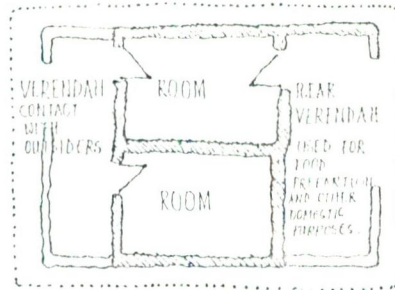


Fig.31: A slight large rural dwelling

### 3.1.2 KANDYAN PERIOD HOUSES

The earliest recorded descriptions of Sri Lankan houses date from the Kandyan period. The houses belonging to this period could be basically divided into two; houses belong to the elite, or the chiefs, and houses of the peasants.

The houses belonging to the elite of this period undoubtedly show the most developed concepts of house design peculiar to this period. These houses were a development of the peasant houses, but more introverted in form. This may have been due to socio-cultural reasons. In this society, caste played a major role. Also existed the need for security and protection from the enemy.





Fig. : The Kandyan courtyard

The materials used in the houses were governed by tradition. The peasants were not allowed to use tiled roofs for their houses. The permission of the king had to be granted in the use of tiles. A remarkable achievement of this period was the acquired skill in timber detailing. Intricately carved timber elements were used in the houses of the elite.

Astrology played a vital role in the activities concerned with the design and construction of house. Technological concepts were handed down through generations in the families of craftsman. Much of the building rules were woven around astrology, and legend. Often examples are found where these concepts prove to be of structural or climatic value.

### **3.1.3 CLIMATIC ANALYSIS**

A simpler form of the courtyard house is seen in the peasant houses of this period. The house was totally covered from the outside except for the entrance doors. The interior consisted the of one or two rooms and a verandah which open into a central court the house was raised on a low terrace of 2-3 feet height the roof was often a combination of pitch roof types, depending on the size of the building. The materials used in the structure were similar to those used in earlier peasant housing.

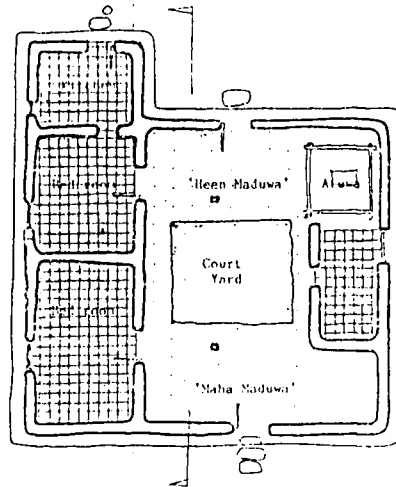


Fig. : Plan of a courtyard house

The houses of the elite differed in that tiles were used for the roofing. The size of the houses were bigger, including a number of courtyards. An external verandah also was included.

The astrologer was consulted to demarcate an area within the plot for the house. This known commonly as 'Pada bedeema', involved the dividing of the plot into a number of squares, which were reserved either for domestic or other activities. This was the very positive way of avoiding congestion of the environment, since it allowed for open spaces in between the built-up areas.

The orientation of the main door was decided by consulting the horoscope of the head of the house. This essentially avoided the west. The rural life pattern was normally on an early rise and early retiring to bed. Thus light was essential early morning. This was assured by orientating the main door on an easterly direction.

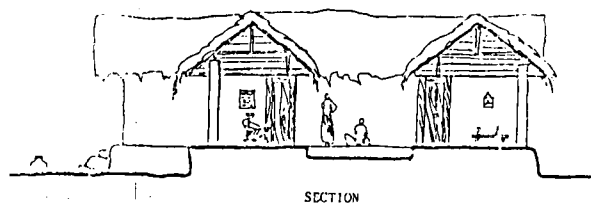


Fig. : Section through the Courtyard house

The courtyard concept of these houses was shown an instinctive response to the climate. The climate of Kandy, being in the lower region of the hill country is cooler and thus the average humidity is less critical for comfort. It is an area, where extremely cold winds (by the measure of the average Sri Lankan) are experienced during the cold season.

The other problem was the high winds, which came in with the rain, and the rain fall received by this region is torrential in its duration. It was an advantage to have the house enclosed from these forces of the climate. The external walls served as a barrier to keep the cold winds out.

### **3.1.3 CULTURAL ANALYSIS**

The Sinhalese buildings were depicted by to significant characteristics features, which were common to all buildings. These common characteristics would have created to major expression in these buildings, which have contributed some message to the Sinhalese society. Thus as it was recognized before the character of formality and character of mundanness were identified as to significant characteristics and as a result of that, these buildings had expressed the highly disciplinary behavior pattern in activity areas as well as the harmonize relationship between these buildings with nature respectively. Therefore these buildings began to reflect to expression, which could be identified as the sense of discipline, occurred due to the disciplinary behavior of the spaces and the since of naturality which occurred due to the mundanness of these buildings.

This expression had evolved in this culture due to the numerous guidelines and norms, prevailed in that society and due to the simple life pattern of these people, which showed close relationship with nature.

The house is an institution, not just a structure, created for a complex set of purposes. Because building a house is cultural phenomenon, its form and organizations are generally influenced by the cultural milieu to which it belongs. There have been some attempts to take a deeper and more theoretical look of forces that create house form. The principal type of explanation, including physical ones involving climate and the need for shelter, material and technology, social ones relating to economics, site, defense and religion. Form is in turn modified by climatic conditions and by methods of construction; materials available and the technology are the tools for achieving the desired environment. Hence the socio cultural forces primary and the other secondary in modifying.

## **3.2 CASE STUDY 02**

### **3.2.1 TRADITIONAL TAMIL HOUSES AND THEIR RELATIONSHIP TO CLIMATE AND CULTURE**

#### **TYPES OF HOUSES**

The traditional domestic architecture of Tamil had brought about new blend of architectural style due to the colonial influence, and "Colonial influenced" houses have become the milepost in the development of domestic architecture.

##### **3.2.1.1 TRADITIONAL HOUSES**

High parapet fence of palmyrah leaves "Thinnai" (a raised platform) and " Nadai" (walk way) "Muttam" (open space) are the general elements, which characterize the traditional houses of Jaffna. The eaves of houses are low. There are few openings, which encourage outdoor life. The main entrance is not facing directly the house and the tall parapet fence are above men's height on both sides of the walk.

##### **3.2.1.2 TRADITIONAL VILLAGE HOUSE**

The traditional village house is composed of a dwelling unit, cattle shed, store and well and are detached from each other. The open space in-between the units also becomes a utility space. The wall may be common to three or four houses of the surrounding dwelling units as either a single room or a single structure of several rooms or a detached unit of three sub units.

##### **3.2.1.3 SINGLE CELL UNIT**

Other than the cattle shed and the store, the dwelling unit is of single structure, which is called as "Veedu". This is developed from the single structure of single unit.

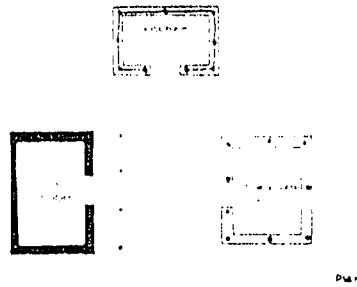


Fig. 32: Traditional village house of Jaffna



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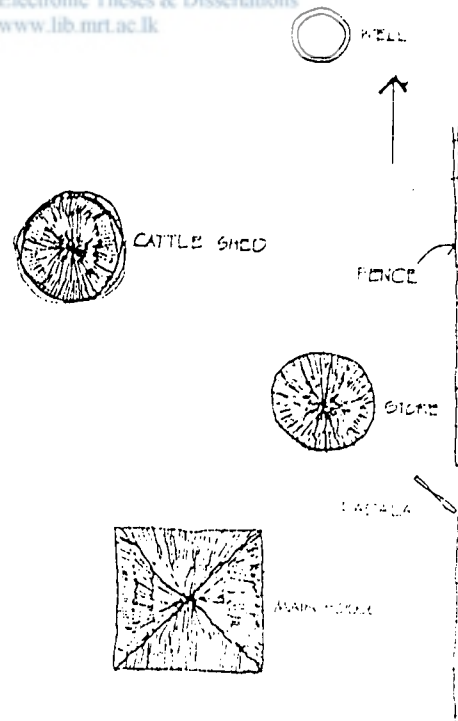


Fig.33: Typical layout of the single unit house

The main room or "Veedu" is normally a single room with a "Thinnain" front and a "Nadain" which leads to the room from the "Muttam" (front open yard). The shape of the single room is either rectangular or circular. In the case of circular house type the "Thinnai" and "Nadai" take the shape of a curve (part of a circle or ellipse) and the circular room space is not divided further.

Paddy and other household articles are stored in the room. In some places pits were dug in the ground and served as secret safe for keeping money and jewels. The clothes are kept on a rope, which is tied from one rafter to another. In most cases the "Thinnai" is extended right round the main house and a part of the floor is used for cooking and the other side of the extended thinnai is used for keeping the agricultural tools and the other equipments. Fireplace is in a corner, the roof of which is an extension of the main roof, and the preparation of the meals are done here, but the cooked meals are kept inside the main room.

#### 3.2.1.4 THREE COMPARTMENT UNIT

Other than the cattle shed and storage space the dwelling unit is composed of three sub units and each constituting a separate architectural element such as "mal" (living room), "Veedu" (main room and Kitchen

The out house such as the cattle shed and the storage space are said to be respectively located to the south east corner and rest of the house. The well should not be sited to the north, southeast or in the middle of the house and the position is related to the entrance and masters the lagna of the Mall (Living room)

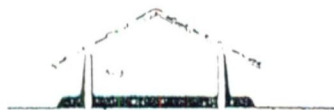
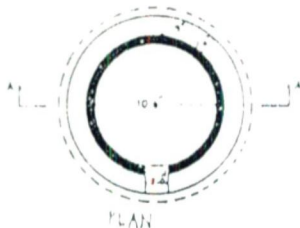
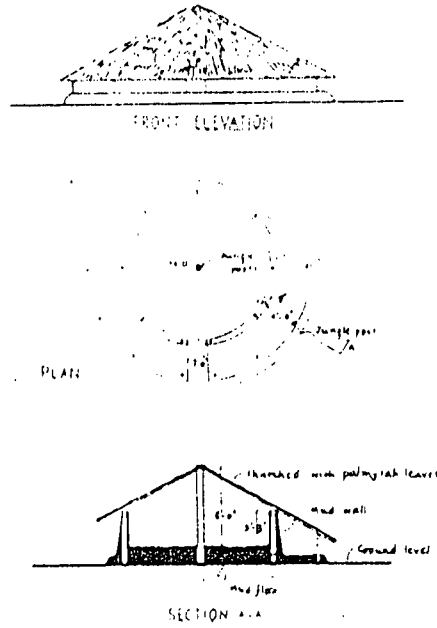


Fig. 34: A round house with Thinnai and Nadai at pointpedro



*Diagram  
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Fig. 35: Round house at Chavkracahchari

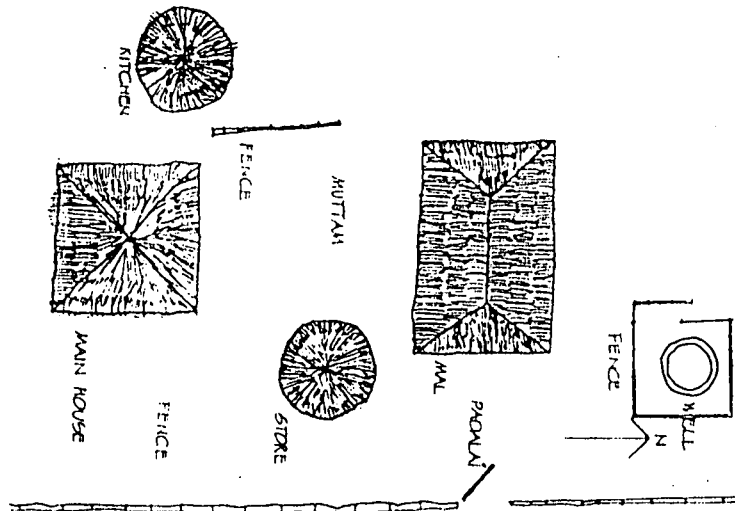


Fig. 36: general composition three compartment house at Alaveddu



A rectangular open type of structure with hipped roof supported on columns in all four sides. The "padalai" (gate) to the house is always indirectly facing the "mall". The "mall" generally serves as a living room and is called "Thalaiwasa1" (main entrance). The open space is strictly meant for malls in the family to use for relaxing, dining and sleeping. The visitors are also entertained in this space. Two feet wide short wall which runs right round the "mall" is used as seats where people can sit on both sides.

### VEEDU (MAIN ROOM)

The structures and the form are similar to the "Veedu" but is different from the single cell unit. This is strictly meant for females and also used as storage space.

### KITCHEN

Kitchen and the space around it is hidden by the fence from the main activity core between "mal" and "Veedu", but this is built also close to the "Veedu". In some cases kitchen may have "Thinnai" raised up to one foot and "nadai" which leads to the interior and the space is very dark. Mud, grille work above the door provide ventilation.

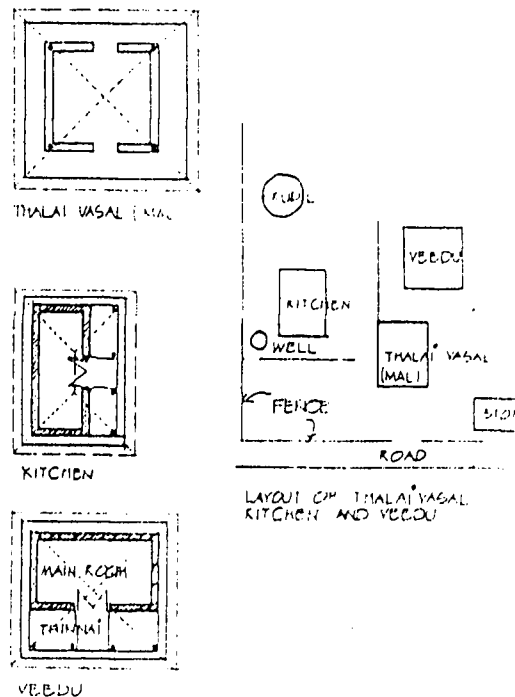
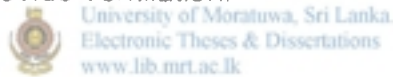


Fig.37: Plan of the three units of the traditional house

### **3.2.2 TRADITIONAL COURTYARD HOUSES**

The courtyard houses are found in many countries. In the past, the concept courtyard was followed in the religious royal architecture of Anuradhapura, and Polonnaruwa before the 19th century and the domestic architecture in Sri Lanka. The houses of Jaffna, with the central courtyard differ from courtyard houses found in the other parts of island. It is said that this type of house is also seen in some parts of south India especially in

The traditional courtyard houses are characterized by "nadai", lower eaves and the courtyard. Unlike the traditional rural house with detached dwelling units, the habitable units are brought under one roof. At the main entrance a gate way with "Thinnai" and "Nadai" which leads to the house is one distinctive character of these houses. The materials such as stone, brick, tiles etc. used gives an impression of permanence to the house.

### **3.2.3 COLONIAL INFLUENCED HOUSES**

It is observed that the influence of Portuguese architecture was very little in the northern soil compared to the Dutch influence. Dutch houses are found in the heart of the fort and along the bazaar in Jaffna. Massiveness was one of the distinctive characters in the planning of these houses.

The rooms are more spacious and large doors and windows which permitted enough light and ventilation made people live inside. It is found that the basic planning of these houses to a great extent follows the traditional planning. But a new blend of architecture style can be identified in these houses. These houses can be described as the house of traditional planning with Dutch appearance. Some elements of these houses are symbolic of the status of the owner.

### **3.2.4 A COURTYARD HOUSE, THE MOST CULTURAL-INTER GRATED FORM**

A stone built tiled house was the best form of the respectable nature inhabitation. Similar houses of mud, covered with coconut or palmyrah leaves are built by the middle class were numerous.

Especially in the traditional courtyard houses the location of the house and the orientation of to the entrance are determined not only according the lagna of the owner but also to the caste of the owner. The outer houses such as cattle shed, storage and services are generally detached and located according to astrology. In the case of double courtyard houses, the outer houses are also brought into the main habitable unit. The service and

storage are grouped together and is connected with the second courtyard

The frontage of "Thinnai" and "Nadai" with two drawing rooms on both sides of the "Thinnai", II Nadakudam" (living room) two adjacent room to the "Nadaikudam", courtyard, a set of three rooms including main room in one side of the courtyard and kitchen and service once with back "Thinnai" are the common features in the internal planning of the traditional courtyard house

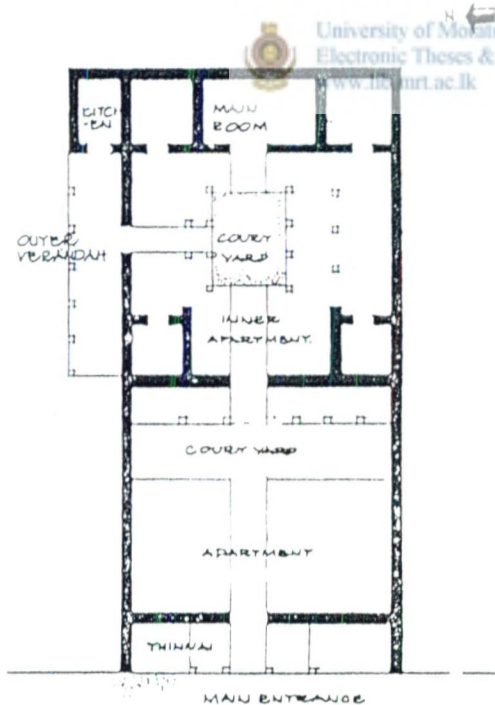


Fig. 38: A Corthyard house with two courtyards at Vannarponnaji

### **THINNAI (RAISED PLATFORM)**

It is found that some of the houses are abutting on to the road and have a resting space in front. In the houses, which are placed inside, the premises especially in the villages resting spaces are detached and built separately at the gateway. The resting space have a front "Thinnai" (raised platform) which is divided into two sections by nadai that leads to the inside of the house. There is always a semi circular step with no decorations. In some houses two small rooms are placed on both sides of, the "Thinnai" the frontage is covered by the lower roof which is supported by short timber columns. The height of the eave is below our average man's height, that it makes the people to bend down at the entrance and it denotes the social bias of the people.

"Thinnai" is open to the passersby to take rest and sleep. Due to the lack of entertainment at that time, this has become convenient for the neighbors and even the strangers to get together and chat and play. The females in the Jaffna society are not allowed to congregate with males therefore the "Thinnai" is strictly for males. The "thinnai" as raised up platform serves a seat for a leisurely conversation.

### **NADAI KUDAM (LIVING HALL)**

The nadai kudam like a lobby, which is adjoining the front, is approached by nadai from the exterior of the house, the space is divided in two by nadai, has thinnai on either side of the nadai with two rooms which has an entrance from the thinnai.

The space serves as a barrier to the female occupants of the house from the outside world} once the thinnai was mainly meant for sitting and sleeping. It was said that the open space is a living area to receive only the relations and the well-acquainted people. Therefore the females of the house can entertain the relatives in the nadai kudam.



Fig. 39: A courtyard house at Poinetpdro and Vannarponnai

## **COURTYARDS AND THE SURROUNDED VARANDHA**

The "nadai" begins at the exterior of the house leads to nadaikudam and then terminates at the courtyard. Courtyard an open space that is about half a foot below the "nadai" is either paved or sanded. The verandah around the courtyard an open structure is raised up to about half a foot above the ground. The verandah is protected by roof sloping down from all four sides towards the courtyard and is supported by timber columns in all sides of the courtyard.

The verandah and the courtyard is strictly for females, the verandah being an open area flows into the courtyard and most of the outdoor activities like playing indoor games, conversing with neighbors, weaving mats, boxes etc. takes place here. In the center of the courtyard there is always a potted plant "Thulasi" which symbolically represents the God of "Vishnu" and early in the morning married women walk round the plant three times and recites prayer and even men pray here to the sun. During ceremonies the verandah, courtyard and the "nadai kudam" serves as "hall" and courtyard is the focal point to the visitors and the activities as mentioned earlier are especially for ladies.

## **VEEDU (MAIN ROOM)**

Sets of rooms usually three are opened to one side of the courtyard through the verandah. The main room, which is in the center of the row, is provided with the Nadai from the courtyard. The direction of the main room entrance is an important factor to name the house.

The other two rooms are generally shrine room and bedroom. Main room is usually used to keep the valuables while one of the other rooms is used as a bedroom by the females. The rooms are usually dark and people cannot live inside during the daytime.

## **KITCHEN AND SERVICE VARANDHA**

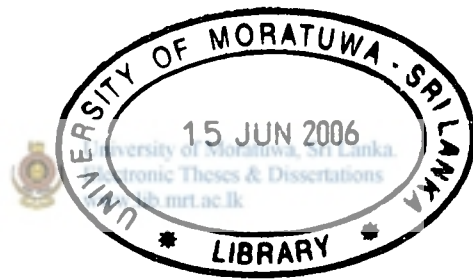
Kitchen and other service verandah are not directly facing the courtyard but it is connected to one side of the courtyard by a nadai which runs through the verandah then passes through the kitchen verandah and terminates at the back garden. This section is covered by the roof which is extended from the main room. The smoke inside the kitchen is expelled by a small window, and no such structure as a chimney is built. In some cases a nadai from the central courtyard towards the rear leads to the second courtyard surrounded by the kitchen and the service verandah.

The space inside and around the kitchen yard is mainly for females. The kitchen is very small and very dark. Except for cooking, the preparation of food and having meals etc. takes place in the kitchen verandah, in some places. a separate kitchen is kept for the preparation and cooking of non-vegetarian

meals.

## **SERVICES**

Other services such as bath and lavatories, were built away from the house. Jaffna people, bathe at \ the we 11 provided with washing facilities and the whole area is surrounded by a high fence of cadjan and the entrance to the well is not visible from outside. Storage is built at the rear section adjoining the kitchen verandah and in some cases this is detached from the main house.





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**CONCLUSION**

## CONCLUSION

House design of different periods of time reflect the different solutions advanced by each period to the containing problem securing the small controlled environment within its large scale natural setting. The house was seen as a container, a main purpose of which was to shelter its occupants and contents from the undesirable effects of the surrounding (which climate play the major role).

The survival of all living species depends on their adaptability to the climate of the region. The same theory applied to the shelters created by man during the ages. Peasant house design of Sri Lanka reflects the effort made by the builders to create structures, which fulfilled the basic requirements of shelter from the climate. The reason for the survival of traditional peasant house from through generations was their successful adaptation to the warm humid climate and the satisfaction their functional requirements.

In most settlements the functional requirements depend on their socio-cultural background. So every people in particular settlement has their unique functional requirements of activities based on their culture. People tend to prepare their houses/build form accordance to ease to fulfill those requirements.

But those shelters are cannot only fulfill the people's requirements They also response to their surrounding environment, specially natural environment. That is one of the reason people accept from their shelters.

As mention above, climate is the primary factor that determined the built form. Human functional requirements/cultural aspects are act as a secondary factor. Because some cultural characteristics are determined by climate of that region.



Through this study, it can be identify, that people are tend to fulfill their functional requirements through their climatic responsive shelters and those shelters are express the culture of occupants, inhabitant that particular shelter.

So it can determine, that there is a direct relationship between culture and climate through built form or shelter.

CLIMATE



Built form

CULTURE



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