TRANSFORMATION OF TRADITIONAL TO CONTEMPORARY RESIDENTIAL ARCHITECTURE OF KERALA -A Critical Analysis

A DISSERTATION

submitted in partial fulfillment of the

requirements for the award of the degree

of

MASTER OF ARCHITECTURE

by

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JUNE, 2014

CANDIDATE'S DECLARATION

I hereby certify that the work, that is being presented in this dissertation, entitled **TRANSFORMATION OF TRADITIONAL TO CONTEMPORARY RESIDENTIAL ARCHITECTURE OF KERALA -A Critical Analysis,** in partial fulfillment of the requirements for the award of the degree of Master of Architecture submitted to the Department of Architecture and Planning, Indian Institute Of Technology Roorkee, Roorkee is an authentic record of my own work carried out for a period of about one year from July 2013 to June 2014 under the supervision of **Prof. S.Y Kulkarni**, **Professor,** Department of Architecture and Planning, IIT Roorkee, Roorkee, India.

The matter embodied in this dissertation report has not been submitted by me for the award of any other degree or diploma.

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CERTIFICATE

Certified that this report titled **TRANSFORMATION OF TRADITIONAL TO CONTEMPORARY RESIDENTIAL ARCHITECTURE OF KERALA -A Critical Analysis** which has been submitted by Ms. Gini Gopinath, in partial fulfillment of the requirements for the award of the post graduate degree in Master of Architecture, in the Department of Architecture and Planning, Indian Institute of Technology Roorkee, Roorkee is the student's own work carried out by her under my supervision and guidance. The matter embodied in this dissertation has not been submitted for the award of any other degree.

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ACKNOWLEDGEMENT

Foremost, I am grateful to the Almighty for granting me the wisdom, health and strength to complete this dissertation.

I would like to express my special appreciation and thanks to my supervisor Prof. S.Y Kulkarni, who have been a tremendous mentor for me. I would like to thank him for his continuous support, patience, motivation, enthusiasm, immense knowledge and supervision throughout the time of study and writing of this dissertation. I could not have imagined having a better advisor for my dissertation.

Besides my supervisor, I am thankful to all the faculty members of the Department of Architecture and Planning for their guidance and support.

I also extend my sincere thanks to Prof. Pushplata, Head of the Department, Architecture and Planning, for providing me the necessary facilities for my study.

I am also thankful to my friends, who helped me to identify the cases for case studies and for their encouragement and support.

I am grateful to my father, mother and in-laws for their good wishes and moral support.

Last but not least, I would like to express my appreciation to my husband, who supported me in every possible way to see the completion of this work.

EXECUTIVE SUMMARY

I. **Introduction**:

Traditional architecture of Kerala like most of the other similar examples of the world developed based on the needs of the users and the living conditions in the region. In many developing countries, a drastic change in architecture took place towards the middle of the 20th century. The change was so rapid, that the traditional design systems that were followed till time were replaced with modern style, with no means of adaptation. Thus, the local architectural forms, that have been responding to the physical and cultural needs of the people for thousands of years seems to be neglected.

The environment that necessitated the traditional architecture has changed and does not exist today. The houses which still survive can be conserved and maintained. Most of the traditional houses are being transformed from a common archetype to accommodate the modern facilities. Though many aspects of the traditional houses were best in its context, it is difficult to accommodate the modern living styles in a traditional way. Also, the new generation is being attracted to the easy availability of all the amenities of the modern hi-tech age.

In most of the developing countries, the contemporary buildings seem to be a failure to the local conditions because the transferred technology and the imported concepts do not meet the physical and physiological needs. Moreover, the mindless copying of the new concepts without any change is creating negative results with respect to the region's ancient social, environmental and cultural values.

The desirable architecture for the region shall be one that is evolved out of the identification and establishment of continuity with the past.

The traditional built forms of Kerala are a direct outcome of the influence of culture and the climate of the region. Today, Kerala is undergoing a lot of changes such as social, economical, cultural etc. After 1960's a trend derived from modernistic style with emphasis on concrete as medium of construction and linear, cubical and curvilinear shapes for expressing form started. After 1990's a trend of so called 'Kerala style' houses constructed of industrially produced materials with some reminding elements of the traditional style started

to appear. However, there have been some successful realizations of the contemporary houses showing the traditional architectural characteristics.

The study has been done **to analyze the transformation of residential architecture of Kerala from traditional to contemporary** based on visual analysis and interviews with the architect and the residents. The scope of the study is to assess the importance of continuity of traditional systems for adaptation in contemporary design practices. The analysis is purely architectural based on on-the-spot field observations and the interviews with architect and users.

II. Literature Review:

To be able to analyze the transformation of residential architecture, the factors determining the house form based on House, form and culture (Rapoport, 1969) is studied. The literature review covers the details of the study area, previous researches regarding the traditional built forms of Kerala, influence of climate on the built form, traditional building materials, etc. and traditional theory of design based on An Engineering Commentary on Manusyalayacandrika (A. Achyutan, Balagopal T.S Prabhu). An understanding of the architectural change after the mid 20^{th} century is also described along with the changes happened in the architecture of stand-alone residences in Kerala.

III. Case Study of Traditional Residences & Analysis

Five traditional houses constructed in between 1850 and 1950 from Central Kerala have been studied. The typology includes two double storeyed houses with single courtyard, a double storeyed - double courtyard house, a single storeyed courtyard house and a single block house. The houses without any modification have been selected for the documentation. Both visual and questionnaire survey were done. The individual houses are analyzed based on the principles and elements of design which includes the analysis with respect to traditional theory of design and other visual aspects, climatic aspects and materials and construction technology. A comparative chart of all the five houses has been made at the end of the chapter. A description of the functional use of various elements/ spaces in traditional house based on the communication with the members of the house is also provided.

IV. Case Study of Contemporary Residences & Analysis

Five contemporary houses, constructed after 1990 from Central Kerala have been studied. The typology includes two double storeyed courtyard houses, two single storeyed courtyard

houses and a single block house. Those houses which are having traditional characteristics either in the outer form or in the planning have been selected. Both visual and questionnaire survey were done. The analysis of the individual houses based on the principles and elements of design; climatic aspects; materials and technology etc. has been made and a comparative chart of all the five residences is prepared at the end. The analysis of the questionnaire survey with the architects and the users of the residence have also been provided at the end of the chapter.

V. Analysis on the Transformation of Residential Architecture

The influence of the principles and elements of design on the transformation is analyzed first. The traditional house design was entirely based on the traditional theory of design which had instructions from the selection of a site to the construction details. When it comes to the contemporary buildings, traditional theory is not followed and the building rules itself allows for 65% coverage and FAR of 3-4. Analysis based on site planning, building layout, built form, etc is done and comparison chart is prepared.

Secondly, the impact of climate on the transformation is analyzed. The climate is a major factor that has influenced in the evolution of the traditional architecture of Kerala. Each and every element of the built structure and the surrounding environment has equal importance in dealing with the climate. The technologies used in the building are very effective for managing the climate even today. But, with the scarcity of materials and also with the introduction of new materials which are economical, safe and aesthetically good, the locally available natural materials were replaced with new industrially produced materials and new construction technology. With the newer materials and technology, many of the contemporary buildings have successfully solved the climatic problems faced by other types of contemporary buildings. Based on the analysis, a comparison chart is made.

Thirdly the effect of materials & technology on the transformation is analyzed. The traditional houses are built with local building materials. Houses are usually built by local craftsmen well versed with the local technology. Both technology and tools used were simple. Industrially produced building materials were like concrete blocks, steel members, tiles etc were used for construction of modern houses, which is a major change from tradition to modern and symbolizes a transformation.

Finally, the effect of socio-cultural aspects on the transformation is analyzed. In traditional time, extended family system prevailed and one large house accommodates nearly 20-25 members. The nuclear family, the tendency of young people for living alone, high land and building cost, women working out and the fact that they do not spent much time in home have indirectly affected for not adopting traditional design strategies for new houses.

VI. Summary & Conclusion

Throughout the study, the transformations of the stand-alone residences based on various aspects influencing the house form were analyzed. The study identifies and analyses certain characteristics of the traditional wisdom which is continued in the contemporary designs as well as those which are blindly imitated.

While analyzing the effect of principles and elements, it was found that some of the strategies of the traditional houses are blindly followed in the contemporary buildings without considering the reason behind it. In some cases, the traditional wisdom is being completely neglected.

The introduction of new materials and technology has revolutionized the trend followed for thousands of years. The integration of place adaptive qualities along with the usage of new materials has been seen in some cases of the selected studies which is relevant.

The socio-cultural aspects are the major ones in the transformation. Even though some aspects of the traditional architecture were valuable and rich, the same system cannot be followed today because the conditions under which traditional architecture evolved have changed and no longer exist today. People always have the tendency to come back to their base culture which is visible in their adaptation of the traditional characteristics. So it is important that the architects and designers should try to incorporate the traditional wisdom into the modern houses, rather than adopting the new technologies as such.

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GLOSSARY OF TERMS USED IN TRADITIONAL ARCHITECTURE

Arudham: Horizontal annular wall plate of a unit structure supporting the roof. If there are more than one annular wall plate, the highest one is called *arudham.*

Angulam: Digit. Basic unit of measurement in Traditional Architecture.Actual measure changes from place to place.

Ara: The central enclosed portion of a unit house used for the storage of grains and valuables. Usually constructed independently with all sides made in wood.

Brahma: The supreme one. Occupies the zenith position of the universal sphere. In building plot, the central point of the plot is the place for Brahma.

Brahmasthanam: Realm of Brahma. The central portion of any plot.

Brahmavithi*:* The inner space of the residential plot- usually open with an open courtyard and a surrounding verandah.

Catussala: Courtyarded house having four structurally independent buildings.

Dvisala: A building consisting of two unit structures with or without an antispace. 6 combinations are possible.

Ekasala: A unit structure supported by a number of horizontal annular plates, the highest of which is termed as *arudham*.

Ettukettu: A structure with eight independent *salas.* It refers to a structure with 2 courtyards and built space around. In practice, there are only 7 *salas* (one being common).

Karanavar: The head of the joint family who controls the finance of the entire family. Usually the eldest male member of the family.

Khandam: Sector. When the plot is divided into four sectors by using two central lines, each sector is termed as *Khandam.*

Kol: Scale of measurement used in traditional architecture. Standard measurement of 1 *kol* is 72cm.

Mandalam :Representation of a three dimensional space in a two dimensional form within defined boundaries.

Mandapam : Pavillion. Usually square shaped and supported by concentric rows of columns.

Nadumuttam: The central courtyard

Nalukettu: Local name for a courtyard house with 4 *salas.*

Nilavara: Usually refers to underground chamber below *ara.* Usually accessed from interior and used for storing valuables.

Padavinyasam: Dividing a large area into smaller units.

Patinarukettu: A structure with 16 independent *salas* around 4 courtyards. Very rarely seen. In practice, there are only 12 independent *salas.*

Poomukham: Portico. Usually open. It can be within the core or can be provided as an extension to the core.

Sala: Hall. Term which denotes a unit structure with an independent roof structure.

Silpins: Craftsmen/ Experts. Refers to the four categories of experts in Traditional Architecture.

Tulsi thara: A sacred stone platform for growing Tulsi plant, positioned either in the centre of the courtyard or in front of the house in the East direction in worship of Goddess Lakshmi.

Uttupura: The dining room. The long room where people sit on the floor for having food.

Vastu: A place where living organisms reside.

Vastusastram: Science of *Vastu.* It deals with all aspects of design, planning and construction.

Vithi: Street. The horizontal concentric spaces of one *padam* width dividing the plot into different *vithis.*

Vithinirnayam: Designating *vithis*.

Chapter 1

INTRODUCTION

1.1 BACKGROUND

In many cultures and societies, traditional buildings are disappearing. In Kerala, very few traditional houses have been maintained as such in their original condition.

The traditional architecture of Kerala like most of the other similar examples of the world is developed based on the needs of the users and the living conditions in the region. There are several factors which affect the architectural style of a region such as geographical, geological, climatic, religious, social and historical factors. In many developing countries, a drastic change in architecture took place towards the middle of the 20th century. The change was so rapid, that the traditional design systems that were followed till time were replaced with modern style, with no means of adaptation. Thus, the local architectural forms, that have been responding to the physical and cultural needs of the people for thousands of years seems to be neglected.

The environment that necessitated the traditional architecture has changed and does not exist today. The houses which still survive can be conserved and maintained. Most of the traditional houses are being transformed from a common archetype to accommodate the modern facilities. Though many aspects of the traditional houses were best in its context, it is difficult to accommodate the modern living styles in a traditional way. Also, the new generation is being attracted to the easy availability of all the amenities of the modern hi-tech age.

Ismail Serageldin explains Hassan Fathy's viewpoints as "The recognition that architecture is for humans, and that human beings are not interchangeable, requires that architecture must be responsive to their psychological and cultural needs as well as their physical and physiological needs."

In most of the developing countries, the contemporary buildings seem to be a failure to the local conditions because the transferred technology and the imported concepts do not meet the physical and physiological needs. Moreover, the mindless copying of the new concepts

without any change is creating negative results with respect to the region's ancient social, environmental and cultural values.

The desirable architecture for the region will be one that is evolved out of the identification and establishment of continuity with the past.

1.2 THE NEED FOR THE STUDY

The traditional built forms of Kerala (fig.1) are a direct outcome of the influence of culture and the climate of the region. Today, Kerala is undergoing a lot of changes such as social, economical, cultural etc. After 1960's, a trend derived from modernistic style with emphasis on concrete as medium of construction and linear, cubical and curvilinear shapes for expressing form started (fig.2 & fig.3). Previous researches have proved that these modern built forms do not respect the environment to a large extent by creating spaces that are not really comfortable, and later on conditioned by using artificial means.

Figure 1: Traditional house at Varappuzha

Figure 3: Modern house 1

Figure 2: Modern house 2

After 1990's a trend of so called **Kerala style** houses (fig.4 & fig.5) constructed of industrially produced materials with some reminding elements of the traditional style started to appear. The new construction materials and techniques have to be adopted, but at the same time continuity with the past has to be established which maintains the identity of the region. Also, the traditional architecture has to be inspirational, it is not meant just to be imitated.

Figure 4: Kerala style house 1

Figure 5: Kerala style house 2

Source: http://www.manoramaonline.com/veedu/photos

However, there have been some successful realizations of the contemporary houses showing the traditional architectural characteristics.

Taking into consideration the above facts it is necessary to study- **How successfully the principles of Traditional Architecture of Kerala are adapted in contemporary residential design** and also **to identify the other potential aspects of traditional architecture**. It becomes necessary to investigate traditional and modern architectural characteristics by studying the residential buildings. The study will be focusing on field observations, general view points of the architects who design the houses and the residents.

1.3 AIM OF THE DISSERTATION

To analyze the transformation of residential architecture of Kerala from traditional to contemporary based on visual analysis and interviews with the architect and the residents.

1.4 OBJECTIVES

- To understand about the factors that affect the built form
- To understand the traditional theory of design in Kerala
- To understand the influence of climate and culture on the built form of Kerala.
- To understand the architectural change after mid 20^{th} century
- To understand the rules regulating the construction of residences.
- To study the examples of traditional and contemporary residences with traditional characteristics
- To analyze the transformation on the basis of principles and elements of design, climatic aspects, socio-cultural aspects and materials and construction system.

1.5 SCOPE AND LIMITATIONS

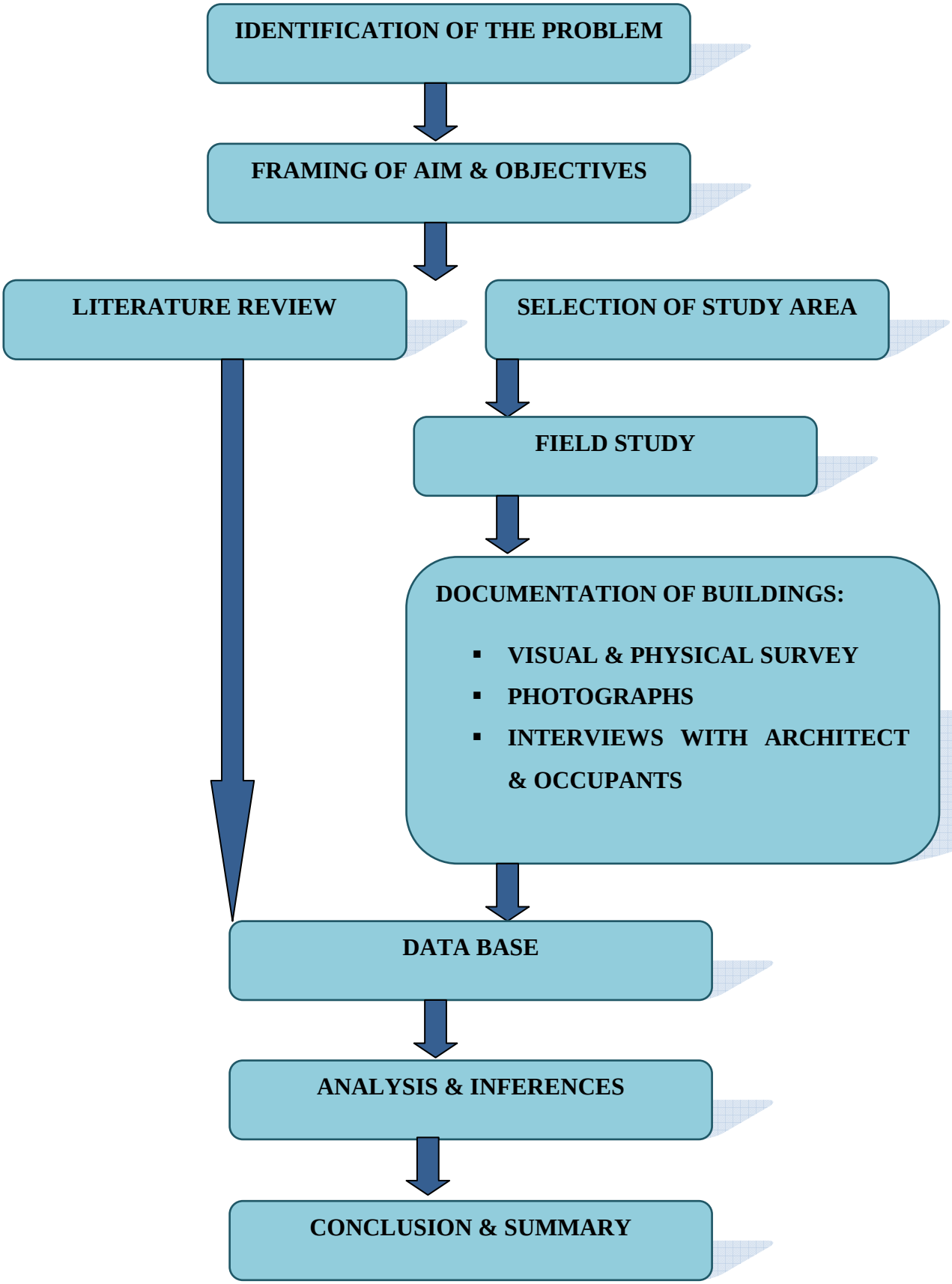
SCOPE:

To assess the importance of continuity of traditional systems for adaptation in contemporary design practices.

LIMITATIONS:

- The study is limited to stand-alone residential buildings covering the coastal regions (warm humid regions) of Central Kerala only.
- The choice of contemporary buildings is limited to those with some similarity to the traditional houses either visually or planning
- The analysis is purely architectural based on on-the-spot field observations and the interviews with architect and users.

1.6 METHODOLOGY



Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

The factors affecting the house form based on House Form and Culture is discussed here. A description about Kerala traditional architecture based on previous researches, the change in the architectural style after mid 20th century along with the examples of built structures in those periods is also given.

2.2 FACTORS AFFECTING/ INFLUENCING THE HOUSE FORM

To be able to study the transformation of house form, the factors determining the house form is studied. This study was done to cover the various parameters that influenced directly or indirectly on the organization of the dwelling. In this chapter the factors that affect the house form according to House Form and Culture by Amos Rapoport will be discussed. In Rapoport's opinion, the factors that influence house form are not physical determinist in nature as it was believe, but a more complex interaction of many factors and out of that, freedom of choice, a cultural factor is the most eminent one. The correlation of culture and house form is illustrated through a lot of examples from all over the world. According to Rapoport, "house form is not simply the result of physical forces or any single causal factors, but is the consequence of a whole range of socio-cultural factors seen in their broadest terms."

The book is divided into two parts:

1. **Modifying Factors :** factors that directly have an effect on the house form
2. **Socio-cultural factors:** factors that have an indirect effect on the form. At first the socio cultural factors are affected and then architecture.

2.2.1 Modifying Factors of House Form

2.2.1.1 Climate and the Need for Shelter

Climate cannot be considered as a determining factor of house form. A number of tribes live without house, and also some people may give more importance to other structures than house. There are examples in which, the people's way of living leading to almost anticlimactic solutions. For example the house form is related to the economic activity for Hidatsa of Missouri valley. They depend on agriculture and hunting. During farming season,

they lived in circular wooden house and during hunting season, they used tepees. A number of tribes in the Amazon area live in houses with no provision for cross-ventilation which is an essential for hot humid climate. Without considering the green house effect caused by the metal, Sumatran people prefer to alter the thatched to metal roofing, because it is easy and cheap. In China, *Feng-Shui* and in India, *Vastusastra* is more determining than any other technical consideration.

2.2.1.2 Materials, Construction and Technology

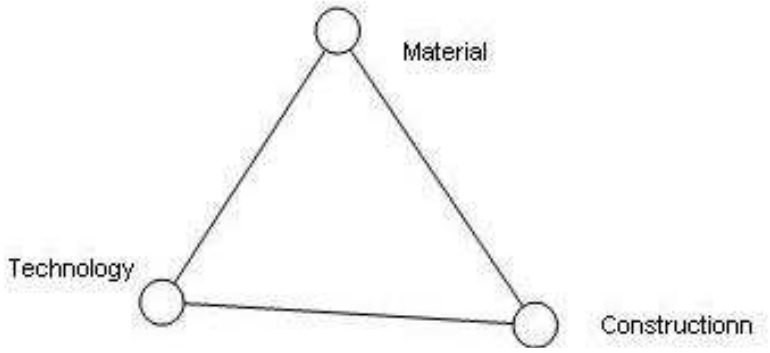


Figure 6 : interrelation between materials, construction & technology

Source: http://www.manoramaonline.com/veedu/photos

2.2.1.3 Site

As far site is concerned, its impact on the crop is considered more rather than on the house form. Both the city and the house is influenced by the site. For example, community clustering can be seen in Moslem cities.

2.2.1.4 Defense

The use of stockades, palisades and fences had defense implications. Concept of defense in traditional society, is associated with their defensive ways to protect food storage, protection against enemy or animals and for spiritual defense.

2.2.1.5 Economics

The influence of economy or the way of life in house form can be seen from the examples of Hidatsa, who had two ways of life, agriculture and hunting and according to their way of life, they had different house forms. One another example is from Annam, where a peasant builds a house, as soon as he has money. (Rapoport-1969)

2.2.1.6 Religion

The plan, form, spatial arrangements and even the orientation of the house is affected by religion. The necessity of shelter for a person is also determined by the religion. In South East

Asia, the ancestral house is not just a place for habitation, it is considered as sacred and prayers are also conducted.

2.2.2 Socio-cultural factors

Rapoport says, “Building a house is a cultural phenomenon, its form and organization are greatly influenced by the cultural milieu to which it belongs”.

2.2.2.1 Meaning in house form

Certain generally accepted goals and life values are shared by the society. Three types of meanings are being mentioned, such as high level meaning, which deals with the cosmos, world views, etc.; middle level meaning such as power, status, wealth, etc. and low level meaning such as every day things such as where to walk in, sit down etc.

2.2.2.2 Criticality and choices

Depending on the value system, if the numbers of possibilities are greater, the choices also increase. As the criticality increases, the choice is also less.

2.2.2.3 Basic needs

“It includes personal needs, family, privacy, position of women, social intercourse and relationship between house and settlement.” The house cannot be seen as isolated from the main settlement. It must be viewed as part of a total social and spatial system.

2.2.2.4 The Sites and Choice

The following classifications show the various types of interrelation between the site and the people: man is less as far as nature is concerned and the site is regarded as dominant; both man and nature are in a state of balance and the third one as man as the completer, modifier, then creator and finally the destroyer of the nature.

2.2.2.5 Constancy and Changes

Architecture will undergo changes, transformation and alteration as time passes. But architect always try to assume that architecture would not change.

2.3 INTRODUCTION TO THE STUDY AREA

The selected study area, Kerala is situated along the southwest coastline of India. The state was formed in 1956. It is bordered by Tamil Nadu to the east and south, Karnataka to the north, and Arabian Sea to the west. It is one of the densely populated states and getting rapidly urbanized.

The land is divided into three geographical regions- Highlands, midlands and lowlands.

Even though Kerala lies closer to the equator, it is blessed with a pleasant and equable climate throughout the year. It experiences warm humid climate with two monsoons, the southwest monsoon from mid May to August and the northeast monsoon from October-November. Rains are mostly the result of seasonal monsoons and it averages to about 12-140 rainy days per year. Temperature varies from 22˚C to 33˚C with high humidity.

The architectural style of Kerala is unique in India. Traditional built forms of Kerala includes residential buildings, religious and institutional buildings. Many of them are well preserved and in use even today. Timber and laterite stone are the dominant materials of construction. The primary elements of the traditional buildings tend to remain same. The difference can be seen in the ornamentation, detailing and the quality of materials used.

In developing the architectural styles, the science of Vastu plays a dominating role. *Tachusastra* (the science of carpentry) has been developed in Kerala, because of the easy availability of timber and its heavy use.

With the trend of modern materials and construction technology, changes are occurring in the architectural field and over years, the transformation is going to be more. Yet a regional architectural language exists which is vibrant and with symbols of uniqueness in the aesthetics.

2.4 KERALA TRADITIONAL BUILT FORMS

Figure 7: Traditional built forms of Kerala
Source: http://www. http://archiestudio.in/de-mystifying_m_arch/monsoon_in_kerala

Kerala's traditional built forms are the direct outcome of the influence of culture and the climate of the region. However it satisfies the prime need for a shelter in a warm humid

environment, which is accompanied by two heavy monsoons in a year. The steep sloping roofs with gables designed to facilitate air circulation, the outer walls flanked by colonnaded verandahs, fenestrations allowing controlled light and ventilation are the characteristics of traditional built forms of Kerala. Laterites, mud, lime plaster, wood are the common building materials. The built forms such as temples, palaces, public buildings, residences etc., all have common design elements –mostly they vary in the detailing, richness of the material, ornamentation etc

2.4.1 Traditional residential built forms

The residential architecture of Kerala follows the style of detached building. Residential buildings can be categorized into four types: *ekasala* (one unit house), *dvisala* (two unit house) and *trisala* (three unit house) and *chatussala* (four unit house). In Kerala, the popular types of house forms are *ekasala* and *chatussala*, where *Ekasala* is the typical residential type for the common people and *chatussala* is for the elite society such as the landlords, nobles and priests.

The different types of residential buildings seen in Kerala are:

2.4.1.1 Ekasala or Single block house

It is the simplest and basic form of residential building. It is a hall of unit bay width. With respect to the courtyard, the blocks are categorized as eastern, western, southern and northern. The main unit of *ekasala* includes generally three rooms. A front corridor or verandah is connected to those rooms. This is the general spatial structure in single hall houses. Prayer room and granary are provided in the central room. The rooms in the sides are used as living rooms. An upper storey can be added by raising the main unit and adding a steep stair positioned in the front verandah. The building may be extended horizontally on all four sides, adding side rooms for cooking, dining, sleeping etc. (Asalatha T. 2001)

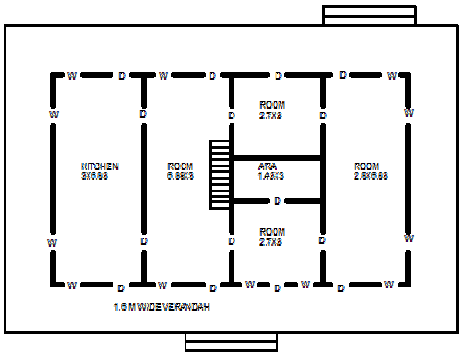


Figure 9: Plan of a typical single block house

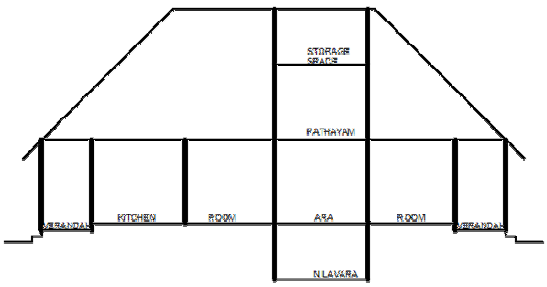


Figure 8: Section of a typical single block house

Source: An Engineering Commentary on Manusyalayacandrika, Achyutan, Balagopal T.S

2.4.1.2 Nalukettu or Single courtyard house

This is considered as the most developed form of a typical Kerala house. It forms the core structure of a joint family settlement. The building combines all the four blocks, each positioned at their respective places around the courtyard. The building consists of an interior space, an exterior space and an interface of built form. It is a well balanced built form, balanced on both axis. The design of the structure is flexible in any condition, because its orientation in all the cardinal directions takes care of the micro climatic and environmental factors. *Nalukettu* can be categorized into different types with respect to the disposition of connecting spaces, the visual characteristics of ridges and gables and the layout and roof structure. (Asalatha T. 2001)

2.4.1.3 Special buildings

The large structures such as *ettukettu* (house with seven blocks and two courtyards) and *patinarukettu* (house with twelve blocks and four courtyards) are included in this category. (Asalatha T. 2001)

2.4.2 Architectural elements in the traditional built forms

Considering the climate of Kerala, many architectural elements were evolved. Steep sloping roof which is the dominating feature of the state's architectural style is perfect for protecting the house from driving rain and sun. The extended overhangs help to avoid glare of the sun. The raised plinth is a way of protection from dampness and from the insects. The external and internal verandahs avoids the direct contact of walls to the exterior at the same time allows continuous light and ventilation. (Vyas, 2005)

Double roof system is another feature which is good for providing thermal insulation. Gables are used for ventilating the attic space which helps to reduce the temperature build in the space below. Inclined louvers are permanent openings which control direct visual contact and at the same time allow the passage of light and ventilation. (Vyas, 2005)

2.4.3 Traditional building materials

For construction of traditional houses, locally available materials were used. Stones, timber, clay, palm leaves etc. were the natural building materials available. A strong and durable building stone, granite is restricted to the highlands only. Laterite is the most plentiful stone found in the region. In many parts of Kerala, timber is available most abundantly as the structural material. The unique characteristics of Kerala architecture are the skilful crafts in

timber, accurate joinery and assembly, delicate carving etc. are. Clay was used in variety of forms for walls, floors, making bricks and tiles, etc.

The limited availability of materials led to a mixed mode of construction. The rubble work was restricted to the plinth even for buildings such as temples. Laterite was used for walls. The roof structure was done with timber and paved with palm leaf thatch or clay tiles. The exterior walls were either lime plastered or left as such. For colors, natural colors such as leaf juices were used.

2.5 TRADITIONAL THEORY OF DESIGN

Traditionally, the art of designing and building of residences remained with the craftsmen which passed from generation to generation hereditarily. “Manusyalayacandrika of Tirumangalat Nilakanthan Musat was probably the first attempt to elevate the house building from the level of a craft to that of a science, synthesizing the science contained in classical texts with the skills of the *silpins*. It gives a systematic procedure for planning, designing and constructing houses together with ancillary structures.”

“The text is divided into chapters on:

1. Investigation and selection of land

2. Analysis of site

3. Dimensional and orientation system

4. Layout and planning of *salas*

5. Parts of a house

6. Elements of roof

7. Ancillary structures”

CHAPTER 1

The first chapter, the selection of site is based on climatic considerations, topography, geology (all pertaining to the land), the availability, purity and flow of water (all pertaining to water) and fertility of soil, medicinal value and abundance of flowering and fruit bearing trees (all related to the flora). In additions, the richness of cattle life (related to the fauna) and the neighbors (related to social interactions) also are to be looked into. It also instructs about

the position of trees in the compound. Trees with thick foliages are to be planted in the north side to resist the cold winds from north. Trees which shed leaves (eg. Tamarind) and those without thick foliage (eg. Areca) are to be planted in the south side to allow sunlight during winter months (when the sun is in the southern hemisphere). Fruit- bearing trees are generally of *anthassara* (hardwood at core) type and can be planted near the house. Restrictions for construction of houses near temples and other zoning restrictions are also provided in the text. (A. Achyuthan, Balagopal T.S Prabhu)

CHAPTER 2

The second chapter on analysis of site describes the methods for determining cardinal directions, plot divisions into sectors, deciding the width of paths, arrangement of the path, deciding vulnerable points, deciding the number of cells (*padavinyasa*), the concept of *Vastupurusha* and deities in the cells. Division of plot:

In traditional design system, square is considered as the principal shape. The orientation of the four sides of the square is made in the four cardinal directions. The plot, whether it is large or small is divided into sectors for locating the house. In large plots, a suitable square area is marked at a convenient location. For small plots, the maximum square that can be accommodated is to be taken as the plot. The square plot is divided into a grid of several cells for specifying the locations.

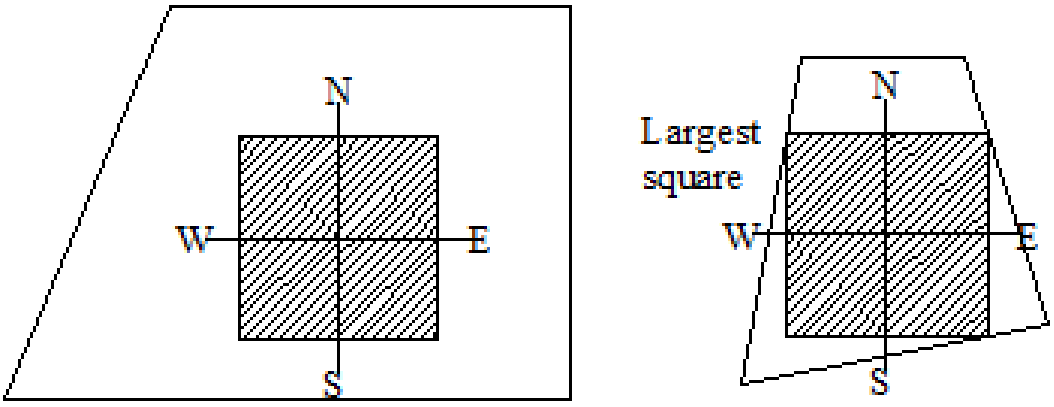


Figure 10: Deciding the buildable plot

Source: An Engineering Commentary on Manusyalayacandrika, Achyutan, Balagopal T.S Prabhu

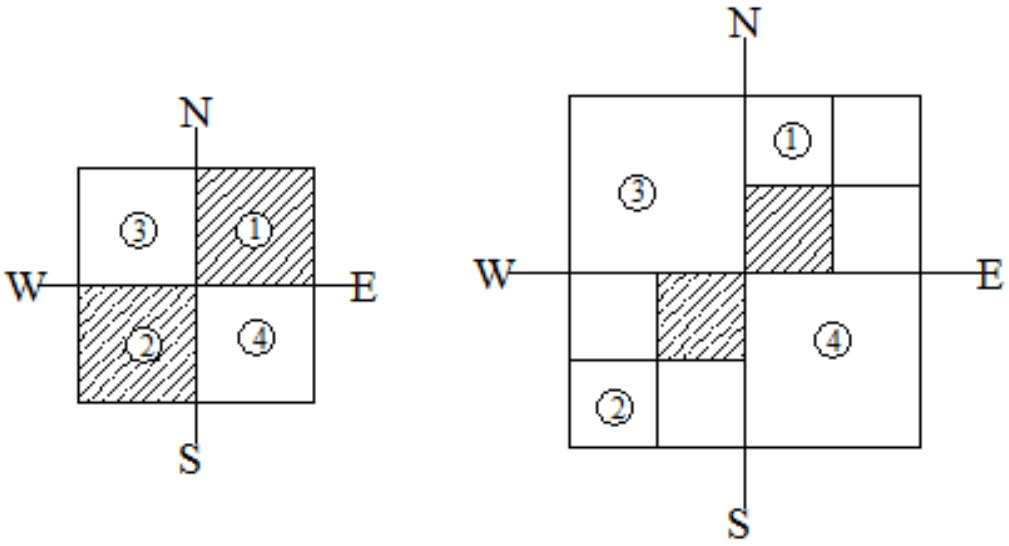


Figure 11: dividing the plot into sectors and sub sectors

Source: An Engineering Commentary on Manusyalayacandrika, Achyutan, Balagopal T.S

Concentric enveloped regions are assumed for analyzing the site and the position of the building is considered as a symbolic representation of the universe. *Brahmasthanam* is the central region , which is the terrestrial space, surrounded by eight envelopes. The width of the path is called *danda*, which is a proportionate measurement or module. The width will depend upon the size of the plot. The unit of deciding *danda* is the height of the owner.

8X8, 9X9 and 10X10 are the commonly used cell numbers for residential designs. Here, the site is made into 4 paths of concentric rectangles; one enclosed within the other and with the centre most one as the *Brahmavithi*. Immediately around the central path, 2 cells are selected which is the width of the building. (A. Achyuthan, Balagopal T.S Prabhu)

CHAPTER 3:

Size, shape and orientation are the three attributes used for defining an attribute in traditional design system. The dimensions of the building are decided with respect to human proportions. The building is defined with respect to the cardinal directions and also with respect to the centroid around which the built is developed. This concept of orientation is called Yoni, which is an astrological indicator.

Measurement system based on grain size and human scale were used in the traditional design process. The smallest unit of measurement in human scale is *angulam*, which is a proportionate unit. The standard *angulam* is approximately equal to 3cm.

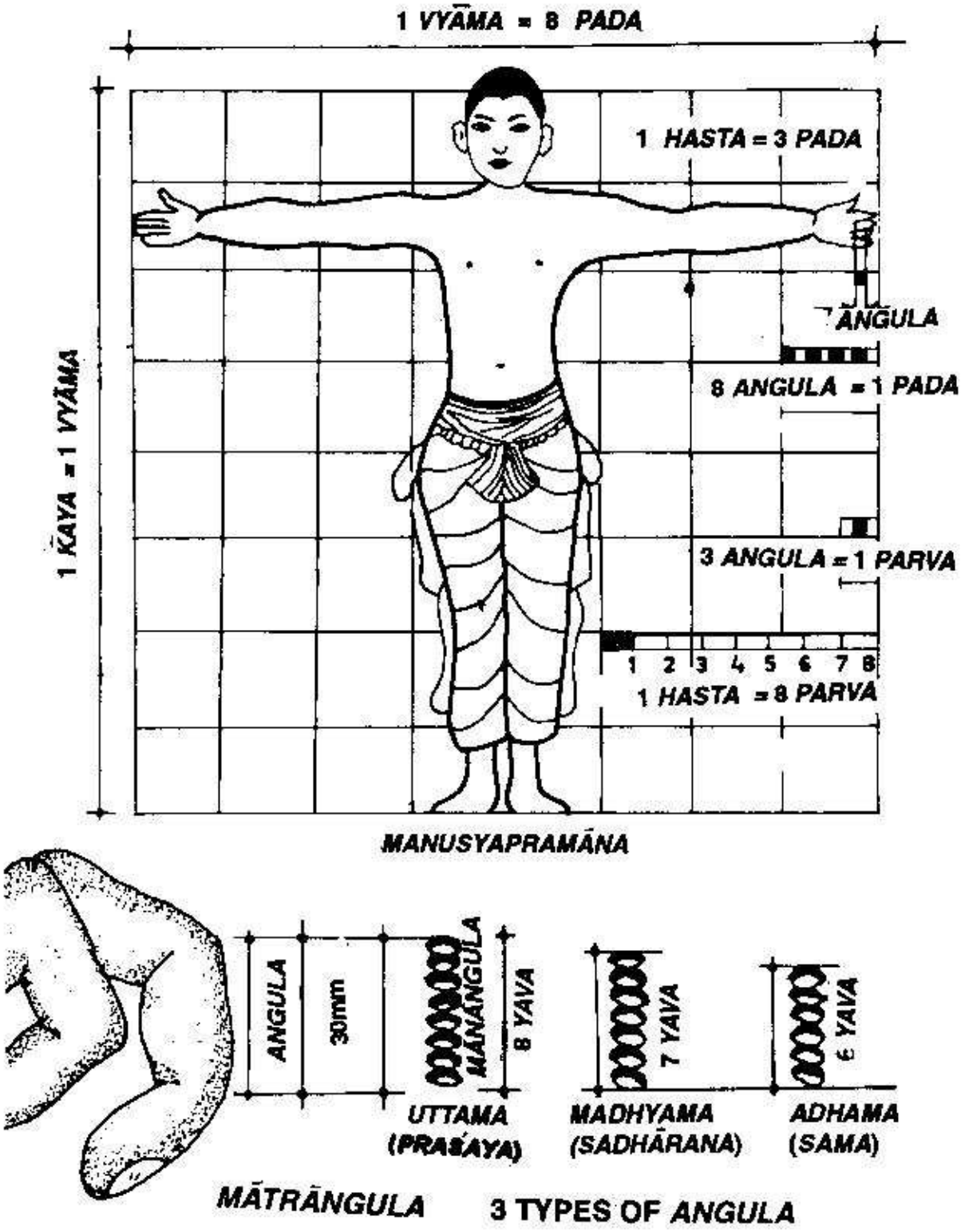


Figure 12: basis of anthropometric dimensions

Source: An Engineering Commentary on Manusyalayacandrika, A. Achyutan, Balagopal T.SPrabhu

CHAPTER 4:

The chapter on layout and planning of *salas* describes in detail the concepts of *Ishtadirgha* (the desired or selected length) , rule of fractions (*gunamsa* rule), classification of *salas*, order of priority of various blocks, nine types of courtyard houses and nomenclature of two blocks and three block houses

The typical traditional enclosed forms are called *Ekasala* (single block form), *dvisala* (double blocks), *trisala* (three blocks form), *chatussala* (enclosed built form with 4 blocks and a courtyard in the centre).

The blocks are named with respect to cardinal direction, which depends on the orientation and the centre point, *Brahmasthanam*. The block to the south of the centre point is named as Dakshinasala (southern block), to the west is *Paschimasala*(western block), to the north is *uttarasal*a(northern block) and to the east is *Poorvasala* (eastern block).

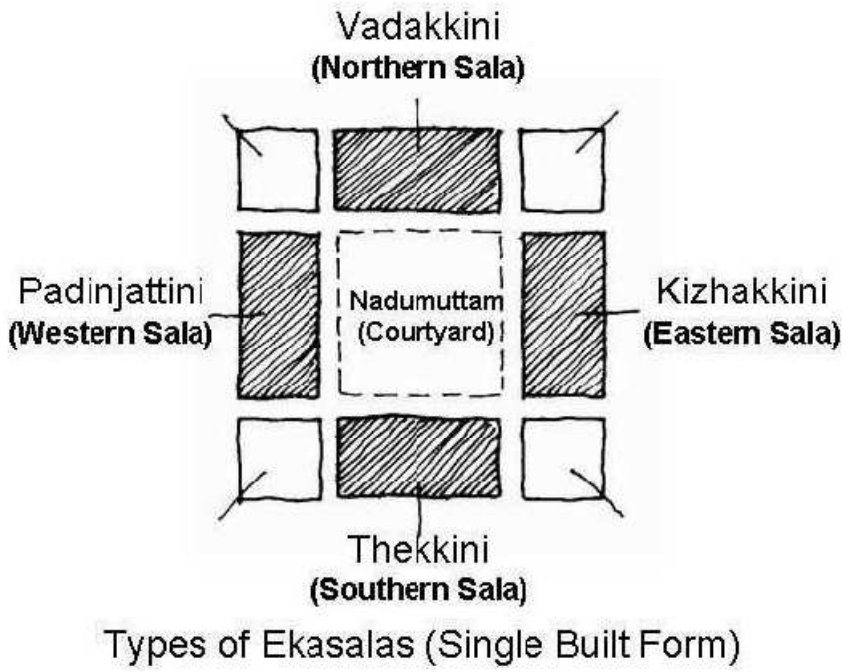


Figure 13:Different types of Single block houses/ Ekasala

Source: An Engineering Commentary on Manusyalayacandrika, A. Achyutan, Balagopal T.SPrabhu

The south side block is preferred for single block type, with reference to the centre of the courtyard. This block will easily get the morning and evening sun. During summer months, when the sun is inclined to south, the block will be at shade at noon. For avoiding the evening

sun, west block is added for houses with two blocks. To make a semi-enclosure either north block or eastern block is added for three block houses. The courtyard house or the *nalukettu* represents a fully developed house form in Kerala. (A. Achyuthan, Balagopal T.S Prabhu)

CHAPTER 5:

It describes the physical parts of the traditional house from foundation to roof.

CHAPTER 6:

It describes in detail about the timber roofing systems. It also describes the parts of the roof for various spans, eaves, ridge, rafters etc.

CHAPTER 7:

It describes about the positioning and detailing of ancillary structures around the main house, secondary buildings such as gate houses, tanks, compound wall, house entry etc. Ground coverage and vertical proportions for the houses are also mentioned in this chapter. (A. Achyuthan, Balagopal T.S Prabhu)

2.6 THE ARCHITECTURAL CHANGE AFTER MID 20TH CENTURY

"The evolution of traditional societies and settlements over time was in such a way to provide as good a level of shelter as possible with locally available materials and crafts. These buildings evolved in tandem with a lifestyle that provided additional behavioral protection from challenging diurnal and seasonal weather extremes using clothing and various mechanisms provided by the buildings itself as part of their comfort strategies. With the introduction of mechanical cooling sharp changes took place within a relatively short time in the way we design buildings." These changes had radical impacts on the culture and led to a break with the past, in favor of international culture of air conditioned life style and buildings. (Susan Roaf, 2006)

Amos Rapoport says that, "the house is an institution, not just a structure, created for a complex set of purposes. Because building a house is a cultural phenomenon, its form and organization are greatly influenced by the cultural milieu to which it belongs." According to him, "The house form is not simply the result of the physical forces or any single causal factor, but it is the consequence of a whole range of socio-cultural factors seen in their broadest terms. Form is in turn modified by climatic conditions and by the methods of

construction, materials available and the technology." He also says that a house form would become meaningless, when the culture or way of life that was responsible for that particular form changes. (Rapoport, 1969)

In a particular cultural period, there will be change and constancy in the nature of microclimatic, social, aesthetic and structural aspects. The microclimatic conditions remain constant over a long period of time until any sort of artificial energy controls are introduced. The growth in technology spurs the field of change, thus bringing a drastic change in the structural systems.

It is understood that the environmental conditions that developed traditional architecture has changed. It is difficult for the contemporary styles and facilities to be made in traditional way. Most of the traditional houses are being transformed to accommodate the modern facilities. The houses which still survive can be preserved and maintained.

The change is a dynamic phenomena and it cannot be controlled. The traditional architecture was one which is climate driven, using local materials and construction techniques and suitable for life style, values and culture of the society. The modern architecture is one which is time adaptive with new materials and construction system, seems to be less suitable as far as the life style and culture of the society is concerned. So the desirable architecture for the region is the modification of the modern architecture by integrating the place adaptive qualities from traditional architecture so that with the contemporary style, it becomes more responsive to the character of the place around.

In Kerala, recently many architects are trying to incorporate continuity with the past in their designs, in order to bring the place adaptive qualities as well as to maintain a regional identity.

2.7 THE TRANSFORMATION FROM TRADITIONAL TO CONTEMPORARY

Traditional houses of Kerala constructed within 1900 had a form with a high pitched roof with wide overhanging and low eaves. The building materials used for the construction were laterite and wood for walls and pillars, lime mortar for plastering, wooden frames and panels for openings and timber frame for roofing. The common type of houses found were *ekasala* (single block type) and *nalukettu* (courtyard type). The other notable features were the fenestrations, thick and double panels were used for the doors, which had heavy frames also. In some houses, arch shaped openings were also used. The opening span does not go beyond

1m, because of the structural limitations. Ornamentation was high in some houses. For surface treatment, egg white mixed with lime mortar was used to get a shining effect.

Figure 15: traditional residence at Varappuzha

Figure 14: traditional residence at Tripunithura

Houses between 1900 and 1960 had the influence of colonial style in its design. Compared to the traditional houses, the height of the building was more, use of glass for openings began in this period. The span of the opening was also increased from double panel to triple panel.

Figure 17: colonial style residence at Tripunithura

Figure 16: colonial style residence at Tripunithura

The change of style of houses in Kerala from 1960 was a sudden. House as an expression of affluence started with the Gulf boom of the 1970. Rather than adaptation modernism brought replacement of the traditional design systems.

Figure 18: Contemporary house 1

Figure 19: Contemporary house 2

Concrete was the medium of construction and various shapes like linear, curvilinear, cubical etc. were used for expressing forms. The trend is derived from the modernistic style. This trend has got no difference from what is seen all over India.

Figure 20: Residence inspired by tradition at Kochi

Figure 21: Residence inspired by tradition at Edappally

From 1990's onwards, the trend which is inspired by traditional designs started to appear in the region. But the residences followed the attributes of modern architecture such as open floor plans, simplicity, function oriented, windows as design element, focus on materials etc. Most of the houses were imitating the traditional style by blindly copying the traditional characteristics without any functional use. There are some exceptional cases also, where the architects have tried to incorporate the traditional wisdom in a useful way, which are being discussed in the following chapters.

Chapter 3

CASE STUDY OF TRADITIONAL RESIDENCES & ANALYSIS

3.1 INTRODUCTION

A total of five traditional houses are studied from the study area, two double storeyed courtyard houses, one double courtyard house, one single storeyed courtyard house and a single block house. Visual survey and questionnaire survey were done.

3.2 RESIDENCE 1

Location: Cheranellur

Owner: Mr. Gopan, Atimadom,

Residential typology: Double storey residence with double courtyard for a big joint family.

Functional activities of spaces: The building entry is through a sit out or *poomukham*, where the master of the house used to sit in a long reclining chair, to a verandah and then to an open hall which is the living area.

The kitchen is located in the NE, with a well adjacent to it – water could be drawn from the kitchen area. The dining room or *uttupura*, a long room adjacent to the kitchen- where the family members used to sit on the floor in rows for having food. The central portion of the residence facing the east is the storage room and *puja/* prayer room area where there is a central space for *puja* and the rest for storage. There are basement storage also for storing grains in large quantities.

The main courtyard acts as a space where rituals are held. A square platform where Tulsi is planted can be seen in the centre. The central point of the *ara/* store, *tulsithara* /Tulsi platform and the openings in the eastern block keeps a line of axis. The courtyard on the rear side provides a private space for women. The sleeping rooms were located to the west side. The NW room which is having the air circulation in maximum is the labor room.

The attic space (in between the wooden flat ceiling and sloping roof) and the space below staircase serves as the storage rooms. Semi open verandahs acts as the most efficient living spaces where people used to gather for chatting, playing games etc.

In the first floor, there is an open hall where entertainment programs were held. Most of the rooms for sleeping are in the first floor. Each of the room has a urinal and a room for keeping dresses attached to it.

Principles and elements of design:

- The building planned in a garden plot with trees all around and a serpent grove in the eastern side, accessed through a gatehouse. The site has got other ancillary structures such as a pond, well, etc.
- The building is positioned in the NE portion of the large plot so that a large parcel of open space is left. Within the selected NE corner, nearly 14% of the land is used for the built structure. The rest is left for the trees, serpent grove, pond, toilet, etc.
- The building is organized as concentric rectangles with 147cm as the width with the central rectangle as the courtyard, the next outer rectangle as the inner verandah, then the rooms and finally the outer verandah. The building is planned in grids ultimately resulting in a well balanced built form which is aligned in the N-S axis maximizing the climatic comfort inside the house.
- The built form is a natural consequence of the various functional requirements.
- The roof which is the predominant feature in the building which is 35˚-40˚ sloping roof with deep and low overhang- influenced by the climatic aspects such as continuous precipitation and tropical sun. 1/3 rd of the wall is covered with the roof.
- The design of the spaces and their arrangements are centralized which all the rooms and halls are located around a major point which is mostly the central courtyard.
- A welcoming sense is created by the organization of *poomukham*/ sits out in front.
- Symmetry and repetition of windows and the evenly distributed columns creates a sense of balance. Continuity in the façade is created by using symmetry and the same color. Natural colors are used throughout. Balance and symmetry is quite clear.
- The roof form follows a gradated rhythm in which the upper roof is decreasing in size gradually. Gable facilitates ventilation and the element breaks the monotony of the roof.

- Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.
- A sense of lightness is created through the use of tiered roofs and multiple windows
- A cool and pleasant atmosphere is created through the relation between the built form and the nature.

Climatic aspects:

- Built form is designed to meet the climatic as well as the social needs.
- Roof and shade acts as a functional element, it helps in the easy draining off of rain water and also helps to trap wind to the inside of the house. The double roof system with wooden flat ceiling below the sloping roof helps to maintain a cool atmosphere inside the house. The wide overhanging helps in taming nature to provide for the long life of the structure.
- The verandah avoids the direct exposure of wall to sun and driving rain
- The gable helps in passive cooling by ventilating the attic space and keeps the inside temperature less and comfortable.
- The courtyard brings in nature connecting the living spaces to the sky & external atmosphere for light and ventilation. The scale of the building and the width of the court is related in such a way that there is very less sunlight falling directly into the courtyard.
- Openings: All the controlled openings are aligned in straight line for effective ventilation and lighting. More than 30% of the wall area is provided for opening.
- Permanent openings: They are provided above the lintel level or as roof top vent. Inclined Wooden louvers obstruct the direct visual contact to the inside as well as provide effective light and ventilation.
- Walls are done with laterite as it was locally available and good in thermal insulation was used in double layer. For inner partitions of the store room, wood was also used as it protects the space from dampness.

Materials & technology

- Laterite for walls with thickness 48cm for outer walls, Inner partitions are of 33cm and wood for store room.
- Timber for structural systems
- Flooring done with wood and paved with clay tiles on top, cow dung was used to polish floors. Terracotta tiles were used for ground floor.

Figure 22: Ground floor plan of Res.1

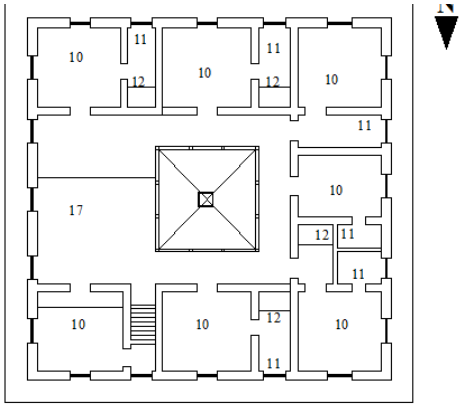


Figure 24: First floor plan of Res.2

LEGEND:

1. Living room/ Thalam
2. Central courtyard
3. Prayer room/ Puja
4. store room./ ara
5. Utility
6. Dining room
7. Kitchen
8. Sleeping room
9. Labor room
10. Sleeping room
11. Space for urinal
12. Dressing area
13. Passage
14. Verandah/ passage
15. sit out/ poomukham
16. Well
17. Upper living

Figure 23: passage around the courtyard

Figure 25: sleeping room

Figure 26: central courtyard

Figure 28:living room

Figure 27: prayer & store room/ ara

Figure 30: upper living hall

Figure 29: outer view of the residence

Figure 31: sleeping room with attached urinal

3.3 RESIDENCE 2

Location: Varappuzha

Owner: Mr. Raman Kartha

Residential typology: Double storey residence with double courtyard for a big joint family.

Functional activities of spaces: The building entry is through verandah to an open hall which is the living area where the master of the house used to sit in a long reclining chair. The kitchen is located in the NE, with a well adjacent to it – water could be drawn from the kitchen area. A permanent wooden louver in the east which is at a lower level allows the direct sunrays to enter into the cooking area. The cooking area is also at a lower level so that one can sit and prepare food. The dining room or *uttupura* is a long room on the East side, where the family members used to sit on the floor in rows for having food.

The central portion of the residence facing the east is the storage room and puja area where there is a central space for *puja* and the rest for storage. There are basement storage also for storing grains in large quantities. The main courtyard acts as a space where rituals are held. A square platform where Tulsi is planted can be seen in the centre. The centre point of the *ara*, tulsi platform and the openings in the eastern block keeps a line of axis. The courtyard on the rear side provides a private space for women. The sleeping rooms were located to the west side. The NW room which is having the air circulation in maximum is the labor room.

The attic space (in between the wooden flat ceiling and sloping roof) and the space below staircase serves as the storage rooms. Semi open verandahs acts as the most efficient living spaces where people used to gather for chatting, playing games etc.

In the first floor, there is an open hall where entertainment programs were held. It has flexible seating/ sleeping spaces called *charupadi*/ reclining seat, which is fixed to the window and when it is not needed, it can be used as a shutter for the window. Most of the rooms for sleeping are in the first floor. Each of the room has a urinal and a room for keeping dresses attached to it.

Principles and elements of design:

- The building planned in a garden plot with trees all around and a serpent grove in the eastern side, accessed through a gatehouse. The site has got other ancillary structures such as a pond, well, cattle shed.

- The building is positioned in the SW portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, **nearly 18% of the land is used for the built structure**. The rest is left for the outhouse, trees, serpent grove, pond, cattle shed, toilet, etc.
- The building is organized as concentric rectangles with 138cm as the width with the central rectangle as the courtyard, the next outer rectangle as the inner verandah, then the rooms and finally the outer verandah. The building is planned in grids ultimately resulting in a well balanced built form which is aligned in the N-S axis maximizing the climatic comfort inside the house.
- The built form is a natural consequence of the various functional requirements.
- The roof which is the predominant feature in the building which is 30˚-35˚ sloping roof with deep and low overhang- influenced by the climatic aspects such as continuous precipitation and tropical sun. 1/3 rd of the wall is covered with the roof.
- The design of the spaces and their arrangements are centralized which all the rooms and halls are located around a major point which is mostly the central courtyard. There is also a minor courtyard which is semi centralized.
- A welcoming sense is by the organization of small gardens.
- Symmetry and repetition of windows and the evenly distributed columns creates a sense of balance.
- Continuity in the façade by using symmetry and the same color. The roof form follows a gradated rhythm in which the upper roof is decreasing in size gradually.
- Gable facilitates ventilation and the element breaks the monotony of the roof.
- Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.
- A sense of lightness is created through the use of tiered roofs and multiple windows
- A cool and pleasant atmosphere is created through the relation between the built form and the nature.

Climatic aspects:

- Built form is designed to meet the climatic as well as the social needs.
- Roof and shade acts as a functional element, it helps in the easy draining off of rain water and also helps to trap wind to the inside of the house. The double roof system with

wooden flat ceiling below the sloping roof helps to maintain a cool atmosphere inside the house. The wide overhanging helps in taming nature to provide for the long life of the structure.

- The verandah avoids the direct exposure of wall to sun and driving rain
- The gable helps in passive cooling by ventilating the attic space and keeps the inside temperature less and comfortable.
- The courtyard brings in nature connecting the living spaces to the sky & external atmosphere for light and ventilation. The scale of the building and the width of the court is related in such a way that there is very less sunlight falling directly into the courtyard.
- Openings: All the controlled openings are aligned in straight line for effective ventilation and lighting. More than 30% of the wall area is provided for opening.
- Permanent openings: They are provided above the lintel level or as roof top vent. Inclined Wooden louvers obstruct the direct visual contact to the inside as well as provide effective light and ventilation.
- Cavity wall system is employed. Walls are done with laterite, which is locally available and good in thermal insulation was used in double layer. The gap in between the walls is filled with sand and utensils. For inner partitions of the store room, wood was also used as it protects the space from dampness.

Building materials and construction techniques:

Laterite is used for walls- thickness 85cm for outer walls, Inner partitions are of 50cm. Timber is used for structural systems. Flooring is done with timber and paved with terracotta tiles. For ground floor, terracotta tiles are used.

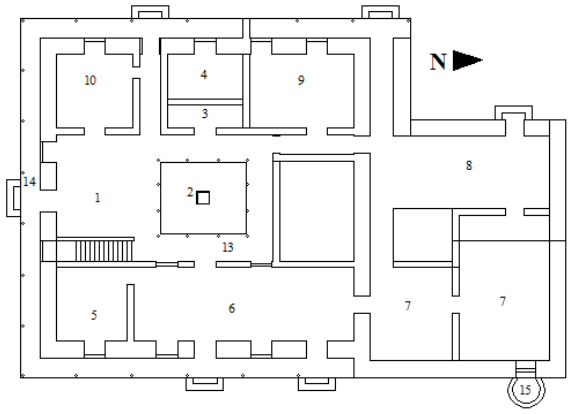


Figure 32: Ground floor plan of Res.2

LEGEND:

1. Living room/ Thalam
2. Central courtyard
3. Prayer room/ Puja
4. store room./ ara
5. Utility
6. Dining room
7. Kitchen
8. Worker's space
9. Labor room
10. Sleeping room
11. Space for urinal
12. Dressing area
13. Passage
14. Verandah/ passage
15. Well

Figure 33: staircase leading to upper floor

Figure 34: attached urinal

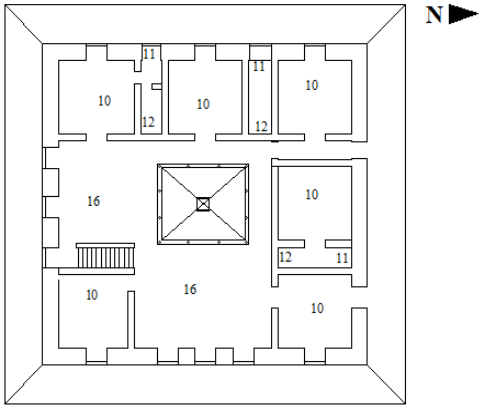


Figure 35: First floor plan of Res.2

Figure 37: living room

Figure 36: verandah and entry

Figure 38: view form the corner

Figure 39: front courtyard

Figure 41: rear courtyard

Figure 40: upper living

3.4 RESIDENCE 3

Location: Kadamakudi

Owner: Thomas

Residential typology: Double storey residence with single central courtyard for a family of approx. 6 grownups and kids.

Functional activities of spaces:

The verandah which is accessed by the long steps acts as the entry to the house. The SE room as the living room. The kitchen is in the NE, which is an extended space from the whole building, store rooms are provided to the North side of it. The verandah on the rear side of the kitchen acts as a working space as well as chatting space for the women of the family. A well is located to the back side of the kitchen. The dining room is the one next to Kitchen. People used to sit on floors while having food.

The sleeping room is located to the west side. The NW room which is having the air circulation in maximum is the labor room. The attic space (in between the wooden flat ceiling and sloping roof) and the space below staircase serves as the storage rooms. Rear verandahs are being used for drying clothes, playing games etc. The first floor rooms are used for sleeping.

Principles and elements of design

- The building planned in a garden plot with trees all around and accessed through a gate. The site has got other ancillary structures such as a pond, well, etc.
- The building is positioned in the NE portion of the large plot so that a large parcel of open space is left to the backside. Within the selected NE corner, nearly 24% of the land is used for the built structure. The rest is left open for trees, well
- The building is organized as concentric rectangles with the central rectangle as the courtyard, the next outer rectangle as the inner verandah, then the rooms and finally the outer verandah. The building is planned in grids ultimately resulting in a well balanced built form which is symmetrical along the E-W axis.
- The built form is a natural consequence of the various functional requirements.
- The roof which is the predominant feature in the building which is 35-40 degree sloping roof with deep and low overhang- influenced by the climatic aspects such

as continuous precipitation and tropical sun. 1/3 rd of the wall is covered with the roof.

- The design of the spaces and their arrangements are centralized which all the rooms and halls are located around a major point which is mostly the central courtyard.

Climatic aspects:

Hipped gable roof to facilitate weather protection- the gable facilitates air circulation. Roof eaves are1m wide, provided for protection from driving rain and sun. Verandah helps to avoid direct exposure of the structure and facilitates protection from weather. High plinth has been provided for protection from flood and dampness. Courtyard provides lighting and as well as ventilation. Double roof system with a wooden flat ceiling and the wooden framed sloping roof is provided for heat insulation. Cross ventilation is provided in all the rooms. Fenestrations are provided in such a way that a continuous line is maintained throughout. Building orientation is done as per the traditional theory and room positioning and dimensioning are also done according to the theory.

Building materials and construction techniques:

Laterite, which is locally available, is used for walls and timber for roof frames and openings. Terracotta tiles and timber are used for flooring.

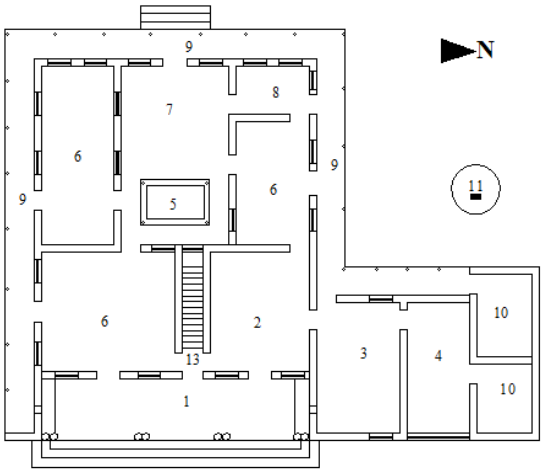


Figure 42: Ground floor plan of Res.3

LEGEND:

1. Verandah & Entry
2. Living room/ Thalam
3. Dining room
4. Kitchen
5. Central courtyard
6. Sleeping room
7. Hall
8. Labor room
9. Verandah/ passage
10. Store room
11. Well
12. Balcony
13. Stair room

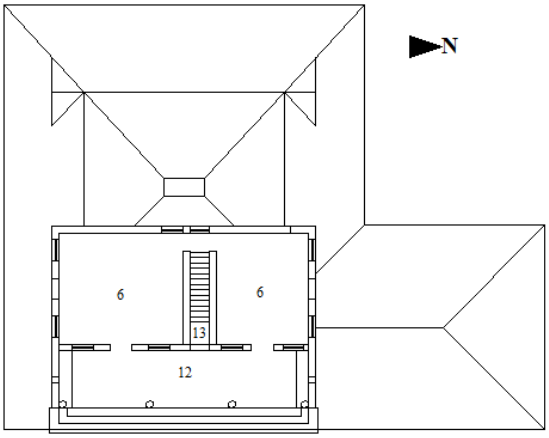


Figure 49: First floor plan of Res.3

Figure 45: Front verandah & entry to the house

Figure 43: Living room

Figure 44: sleeping room

Figure 46: central courtyard with passage around

Figure 48: hall near the courtyard

Figure 47: rear verandah and well

3.5 RESIDENCE 4

Location: Thirumuppam

Owner: Mr. Radhakrishna Warrier

Residential typology: Double storey residence without courtyard

Functional activities of spaces: Prayer & Store rooms are provided in the central area under the staircase facing east. The entry to this area is through a passage which is accessed from outside through Sit out/ *Poomukham*. The central line of axis of all these coincide with the square Tulsi platform which is positioned in front. Privacy is given importance. Bedrooms are provided with attached toilets. Kitchen is positioned in the NE with a well adjacent to it. Attic space is used for storage for old and unused utensils.

Principles of elements of design:

- The building planned in a garden plot with trees all around and accessed through a gate. The site has got other ancillary structures such as a granary, well, etc.
- The building is positioned in the SW portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, nearly 15% of the land is used for the built structure.
- The building is organized in concentric rectangles around a central passage. The building is planned in grids ultimately resulting in a well balanced built form which is aligned in the N-S axis maximizing the climatic comfort inside the house.
- The built form is a natural consequence of the various functional requirements.
- The roof which is the predominant feature in the building which is 35-40 degree sloping roof with deep and low overhang- influenced by the climatic aspects such as continuous precipitation and tropical sun. 1/3 rd of the wall is covered with the roof.
- The design of the spaces and their arrangements are centralized which all the rooms and halls are located around a common space (passage).

Climatic aspects: Sloping roof with deep overhang is provided for protection from rain and sun. The double roof system provides thermal insulation. The verandah provides protection to the superstructure from driving rain and sun. The absence of courtyard is notable because of the darkness in the interiors.

Building materials and construction techniques: Unburned clay bricks are used for walls. Wood is used for flooring. Glass and wood are used for openings.

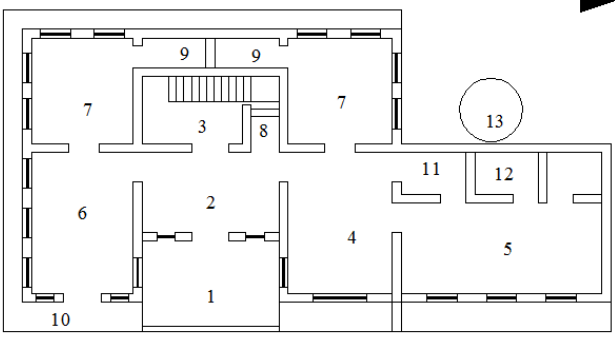


Figure 52: Ground floor plan of Res.4

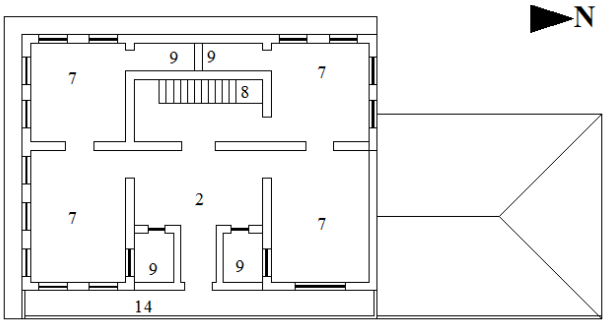


Figure 53: First floor plan of Res.4

LEGEND:

1. Verandah
2. Passage
3. Store/ prayer room
4. Dining room
5. Kitchen
6. Living room/ Thalam
7. Sleeping room
8. Stair room
9. Toilet
10. Verandah
11. Store room
12. Utility
13. Well

Figure 50: prayer & store room

Figure 51: stairs leading to attic space

Figure 55: The building & the vegetation surrounding

Figure 58: Entry to the house through sit out.

Figure 57: Living room

Figure 59: Dining room

Figure 54: Attic space used as storage & provision for ventilation is given

Figure 56: sleeping room with openings of glass and wood.

3.6 RESIDENCE 5

Location: Vadakkan paravur

Owner: Mrs. Priyamvada Thambatti

Residential typology: Single storey residence with central courtyard for small family

Functional activities of spaces: Entry to the house is through a verandah leads to an open hall with a central courtyard. A Tulsi platform is placed in the East side, which is aligned with the centre axial line of the house. The house can be accessed through all the four sides. All the rooms are arranged around the central courtyard.

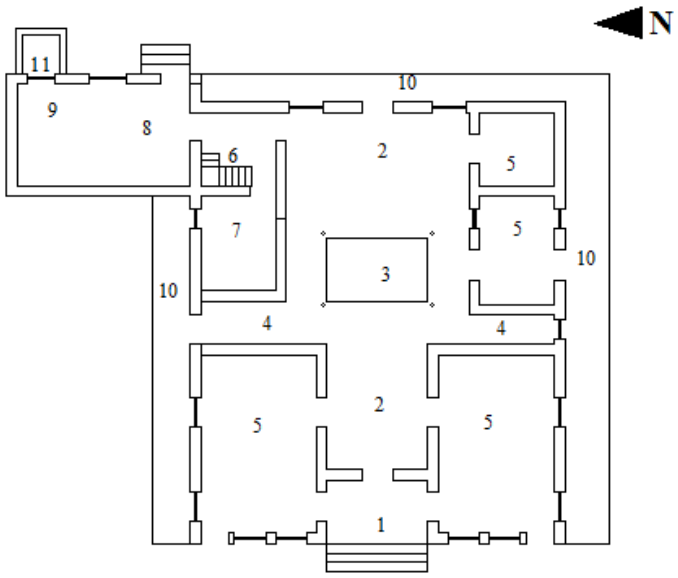
Principles of elements of design:

- The building planned in a garden plot with trees all around and a serpent grove in the eastern side, accessed through a gatehouse. The site has got other ancillary structures such as a pond, well, etc.
- The building is positioned in the NE portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, nearly 20% of the land is used for the built structure. The rest is left for the outhouse, trees, serpent grove, pond, toilet, etc.
- The building is organized as concentric rectangles with 138cm as the width with the central rectangle as the courtyard, the next outer rectangle as the inner verandah, then the rooms and finally the outer verandah. The building is planned in grids ultimately resulting in a well balanced built form which is aligned in the N-S axis maximizing the climatic comfort inside the house.
- The built form is a natural consequence of the various functional requirements.
- The roof which is the predominant feature in the building which is 35-40 degree sloping roof with deep and low overhang- influenced by the climatic aspects such as continuous precipitation and tropical sun. 1/3 rd of the wall is covered with the roof.
- The design of the spaces and their arrangements are centralized which all the rooms and halls are located around a major point which is mostly the central courtyard. There is also a minor courtyard which is semi centralized.

Climatic aspects: The sloping roof and the deep overhang provide protection from driving rain and sun. The verandah dives protection to the walls and openings. The

courtyard brings in natural light and ventilation. Minimal openings are used in the walls for permanent continuous ventilation.

Building materials and construction techniques: Laterite is used for walls, clay for flooring, timber for roof frame and columns and roof paving with clay tiles.



LEGEND:

1. Verandah
2. Living room/ Thalam
3. Central courtyard
4. Corridor
5. Sleeping room 6.
7. Store room
8. Dining room
9. Kitchen
10. Verandah/ passage
11. Well

Figure 60: Floor plan of Res.5

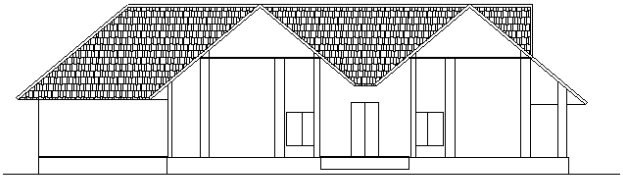


Figure 65: Section through courtyard- Res.5

Figure 61: Verandah and entry

Figure 62: long verandah on the east

Figure 64: Entry on the west

Figure 63: hall used as the living space

Figure 69: straight aligned openings

Figure 68: central courtyard

Figure 67: store room & ladder to

Figure 66: passage

3.7 PLANNING AND FUNCTIONAL ASPECTS OF A TRADITIONAL HOUSE:

Site planning: Building planned in a garden plot with trees all around, serpent grove where daily prayers were held and an excavated pond for bathing and washing. The close relation with the man and the environment is visible from the site planning.

Building layout: A linear hierarchy exists in the layout of rooms with the space accessed by the elder member (*karanavar*) towards the front (the living space, *puja*, dining, bedroom, stairs) and women to the rear side. The open plan creates a sequence which begins with the entrance and public areas, then leads into the slightly more private areas, and finally to the most private domains. Blocks are planned as per the traditional theory. Ara/ store considered as the most important space occupies the central portion of the western block and the central portion of *ara* is for prayer/ *Puja* facing East. Daily prayers are conducted in front of this space. Eastern block is for dining. Southern block is for sleeping and Northern block is for receiving guests. The SW corner is reserved for the owner (the elder member) of the family which is near to the *ara*/store. The first floor is entirely for sleeping and entertainment. Kitchen block is separated from the main house but connected. NW room in the rear side is used as the labor room, which has separate exit to outside. Privacy within the family members is least concerned.

- **Gate house/ *padippura*:** the first eye catching sight of a person who visits. Its grandness marks the economic status of the family. A pathway leads from gatehouse/ *padippura* to the sit out/ *Poomukham*.

- **Poomukham/ sit out:** Marks the entry to the house where the *Karanavar* (the elder male member) of the family used to sit in a reclining chair. The outer living space where the guests are received. Women were not allowed to this space.

- **Verandah/ *irayam*:** It acts as a passage or entry to other rooms. It is used as a chatting space by the men of the family and guests and children for playing. The entry steps will be having a brass utensil called *Kindi,* for cleaning the feet before entering the house. Rear verandah is being used by the women for chatting, for drying clothes, etc.

- ***Thalam*/ Hall/ formal living:** The central room in *Ekasala* or the open hall in courtyard building acts as the formal living space where guests are received. In *Ekasala*, sometimes it is used for sleeping also.

- **ara/ store room & prayer room/ *Puja*:** An important space in traditional residences for storing grains and valuables. This occupies the central space in western block for courtyard buildings. A small area in the centre of *Ara* is used as the *Puja* room. Daily prayers were conducted in front of *Puja* room and *Ara*

- **Courtyard:** It is a highly active space. The verandah around it provides the access to the rooms around. Considered as a sacred space by Hindu families and it may be having a square platform for Tulsi plant in front of the *Puja*/ prayer room. Sometimes ceremonial functions like marriages are conducted inside the house using the courtyard as the *mandapa* (stage).

- **Rooms for sleeping:** Southern block in the case of courtyard house and rooms in south side for single block houses are allotted for sleeping. Each room is intended for a full family of parents and kids. The rooms in *Ekasala*/ single block house are all interconnected with less privacy. The rooms of the higher caste family have attached urinal facility and a room for keeping dress.

- **Dining room:** Eastern block is provided as dining space which will be a long room where people will be sitting on the floor for food. The men of the family will be the first to have food followed by the kids and the women. The room will be having a direct outdoor access where water will be placed for cleaning before and after food. In many houses, kitchen and dining space are combined together in the form of a long room which is not partitioned physically and provided in the northern side separated from the main building.

- **Kitchen:** The extension of the main building towards North serves as the kitchen. Occupies the North- east corner of the house with a permanent opening in the East. It will be having a well either adjacent to the North or east wall or separated. The cooking platforms are at a lower level so that the person can sit on the floor and work.

- **Upper hall:** An entertainment area where cultural programs are held during some special occasions.

3.8 COMPARISON BETWEEN THE FIVE RESIDENCES

Table 1: Comparison with respect to climatic aspects

Climate	Trad.Res 1 Atimadom	Trad.Res 2 Akathuttu matapadu	Trad.Res 3 Kadamakudi	Trad.Res 4 Thirumuppam	Trad.Res 5 Vadakan Paravur
Building form & layout	Square plan with double storey blocks around a courtyard	Rectangular plan with double storey blocks around a courtyard and single storey blocks around another small courtyard	Rectangular plan with Courtyard & with double storeyed eastern block	Double storey single block type	Square plan with single storey blocks around a courtyard
orientation	Cardinal direction	Cardinal direction with longer side N-S	Cardinal direction with longer side N-S	Cardinal direction with longer side in N-S	Cardinal direction
Roof type	hipped roof with gable	hipped roof with gable	hipped roof with gable	hipped roof with gable	hipped roof with gable
shading	Wide overhang	Wide overhang	Wide overhang	Wide overhang	Wide overhang
plinth	High plinth 60cm high	High plinth 60cm high	High plinth 60cm high	High plinth 50cm high	High plinth 60cm high
opening	Windows & doors aligned in straight line, minimal openings, louvers	Windows & doors aligned in straight line, minimal openings, wooden grills or louvers	Windows & doors aligned in straight line, minimal openings	Windows & doors aligned in straight line	Windows & doors aligned in straight line
verandah	Outer verandahs around the house and inner verandahs around the courtyard	Outer verandahs around the house and inner verandahs around the courtyard	Outer verandahs around the house and inner verandahs around the courtyard	Outer verandahs around the house	Both outer and inner verandahs
landscape	Tall trees, serpent grove, other vegetation	Tall trees, serpent grove, other vegetation	Tall trees and other small vegetation	Tall trees and other small vegetation	Tall trees, serpent grove, other vegetation
wall	Laterite- double layered & cavity wall system	Laterite- double layered & cavity wall system	Laterite- single layered	Clay brick	Laterite- single layered
Roof material	Wooden structure & clay tiling	Wooden structure & clay tiling	Wooden structure & clay tiling	Wooden structure & clay tiling	Wooden structure & clay tiling
Construction techniques	Double roof system, cavity wall system	Double roof system, cavity wall system	Double roof system	Double roof system	Double roof system

Table 2: Comparison with respect to Planning aspects

Planning	Building form & layout	Privacy	Safety	Family size	Social intercourse
Atimadam	Courtyard planning with rooms arranged around courtyard	Rooms with privacy, but a single sleeping room is intended for a family.	Outer walls of 85cm thickness provision of compound wall for the plot.	-for a bigger family of more than 20 people -a single room for a family -separate labor room -store room & prayer room	front verandah and poomukham for elder person, men and children for playing & rear verandah for women
Akathuttu matapadu	Courtyard planning with rooms arranged around courtyard	Rooms with privacy, but a single sleeping room is intended for a family.	Outer walls of 85cm thickness. provision of compound wall for the plot.	-for a bigger family of more than 20 people - a room for a family -separate labor room - store room & prayer room	front verandah for elder person, men and children for playing & rear verandah and courtyard for women
Kadamakudi	Courtyard planning with rooms arranged around courtyard	Less importance to privacy within the house- rooms were interconnected	Outer wall of thickness 35cm. provision of compound wall for the plot.	-for a family of 12 people. -courtyard and the hall acts as a get together space for the family -separate labor room	front verandah for elder person, men and children for playing & rear verandah for women
Thirumuppam	Single block double storey	Interconnected rooms with less importance to privacy	Outer walls of 30cm thickness. Provision of compound wall for the plot.	For a small family of 8-10 people	front verandah and Poomukham for elder person, men and children for playing & rear verandah for women
Vadakan Paravur	Courtyard planning with rooms arranged around courtyard	Rooms with privacy	Outer walls of 35cm thickness. Provision of compound wall for the plot.	For a small family of 8-10 people	front verandah for elder person, men and children for playing & rear verandah for women

Chapter 4

CASE STUDY OF CONTEMPORARY RESIDENCES & ANALYSIS

4.1. RESIDENCE 1

Location: Piravom

Owner: Mr.Santhosh Philip

Architect: Ar. Sebastian Jose

Principles and elements of design:

- The design is based on the climatic aspects, user requirements.
- Change with a continuity, incorporating traditional elements in a modern context also keeping the identity of tradition.
- Layout : Follows a grid pattern without considering traditional dimensional system. The central space occupied by the dining and family living instead of courtyard
- Built form with an outlook of a traditional house. Roof is the predominant feature in the design. Double roof system is followed. The actual roof is concrete flat roof. The sloping roof done with steel truss and covered with Mangalore tiles.
- Constitutes large glazed openings, colonnaded verandah, *charupadi* (reclining seats)

Climatic aspects:

Site planning: The building has a front yard of 4m, East side setback of 6m. The amble open space and vegetation around the building creates a micro climate.

Orientation: Walls facing cardinal direction allows the wind to be used in maximum.

Building layout: Allows natural light and cross ventilation to all the rooms. The presence of water creates a cool atmosphere in the dining and family living area. Openings are aligned in straight lines.

Built form:

- Double roof system with flat concrete ceiling and steel trussed sloping roof helps in thermal insulation and creates a comfort environment.
- Gable acts as an aesthetic element as well as for providing light and ventilation to the attic space.
- Verandah avoids the direct exposure of wall to sun and driving rain. Sky lighting brings in light to the central portion of the house.
- Wooden louvers in the upper family living act as an aesthetic element as well as facilitate effective ventilation.
- Openings, large Glazed windows helps in maximized ventilation and lighting compared to traditional houses.
- The shading of the brick wall through verandah and overhang reduces the heat radiation through walls and glazed openings.

Materials & technology:

- Walls made of 24cm thick brick. Brick is lighter and stronger than laterite and easily workable. Thermal insulation is less compared to laterite.
- Flooring is done with cement concrete and finished with wooden tiles.
- Structural system: load bearing brick walls and wooden columns, for keeping the identity of tradition
- Roof: double roof system with concrete flat ceiling and steel trussed sloping roof covered with clay tiles. Double roof system for thermal insulation and for converting the attic space to a useful one as a store. It also keeps the identity of traditional architecture.
- Openings: glazed windows and wooden paneled doors. Single panel glazed windows from floor to lintel as a design element. Doors have a similar look of the traditional type.

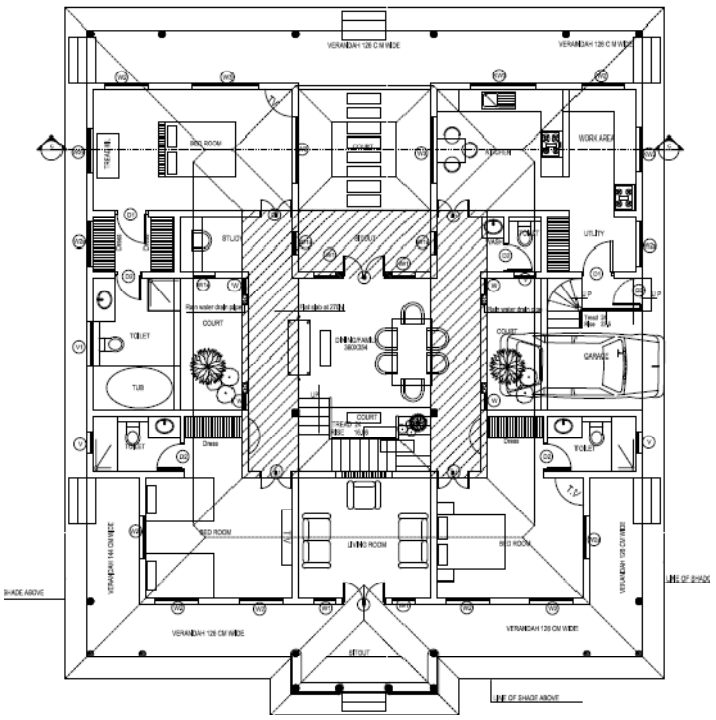


Figure 71: Ground floor plan of Contemporary Res.1

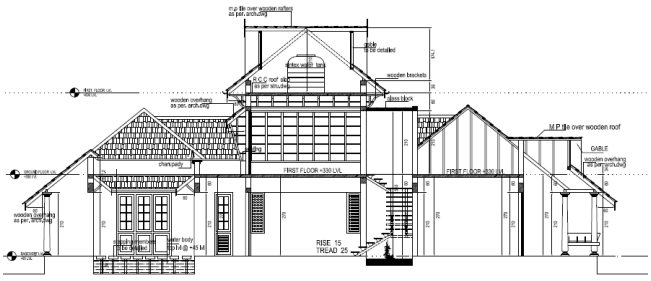


Figure 70: Section of Contemporary Res.1

Figure 82: Entry to the plot, the gatehouse

Figure 74: The sit out/ Poomukham marks the entry to the house

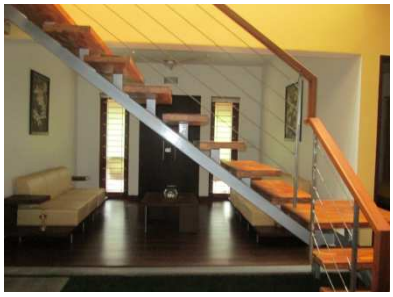


Figure 72: the living room

Figure 80: water court acts as a means for passive cooling

Figure 81: ventilated attic space used as a store

Figure 77: open dining

Figure 79: rear verandah

Figure 78: bed room with full sized glazed windows

Figure 73: inclined wooden louvers

Figure 76: kitchen with high counter tops

Figure 75: straight aligned openings

4.2 RESIDENCE 2

Location: Thrissur

Owner & Architect: Dr. Harimohan Pillai

principles and elements:

- The design has followed traditional theory of design to an extent and applied in the modern context
- Even though the plot size is 28m X 15.24 m, the building is designed in a 15.24X15.24m square selected in the western side of the plot.
- Layout: Follows a grid pattern without by considering traditional dimensional system. Open plan which minimizes the partitions.
- The central space occupied by prayer space/ puja and the sacred pit in ground floor and in the first floor, a cut-out in the slab is done.
- Built form: Contemporary with some traditional features such as the sloping shade, inclined louvers, etc. Roof is a predominant feature in the design- done with reinforced cement concrete. The roof is flat. The highlighted feature is the deep overhanging shade.

Climatic aspects:

- Site planning: The building has a front yard of 17m, side setback of 3m. The ample open space and vegetation in the plot creates a micro climate.
- Orientation: Walls facing cardinal direction allowing the wind to be used in maximum.
- Building layout: Open plan with minimum partition facilitating cross ventilation throughout. Bedrooms in SW and NW corner, kitchen in NE. Openings aligned in straight line & the presence of cut-out akin to the courtyard facilitates in effective ventilation.
- Built form: The roof is flat type done with concrete and a sloping overhanging shade is provided so as to facilitate passive cooling by trapping wind over the ceiling through the openings in the parapet. Inclined steel louvers as the openings in ground

floor and the balcony provide effective ventilation as well as lighting. Other than controlled openings permanent openings, aligned in straight line are also provided throughout the built form. Corner windows provided in the upper floor are very effective in terms of ventilation. For walls, laterite which is good for thermal insulation is used.

Materials & technology:

- 24cm thick laterite wall, which is left, exposed because of its thermal insulation properties.
- Flooring is done with ceramic tiles over concrete slab.
- Structural system with load bearing laterite walls and concrete for spanning is used. Flat cement concrete roof and sloping overhang is done because of the strength and safety of concrete. It radiates heat at night time and thus the indoor heat shoots up. So air vents are provided in order to ventilate the roof. Columns are done with laterite.
- Glazed windows inclined steel louvers and wooden paneled doors are used for openings.

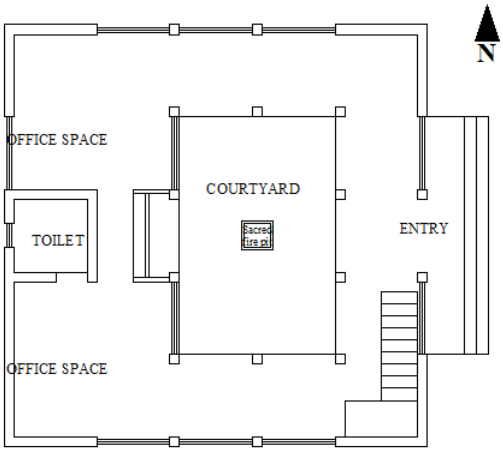


Figure 84: Ground floor plan of Contemporary Res.2

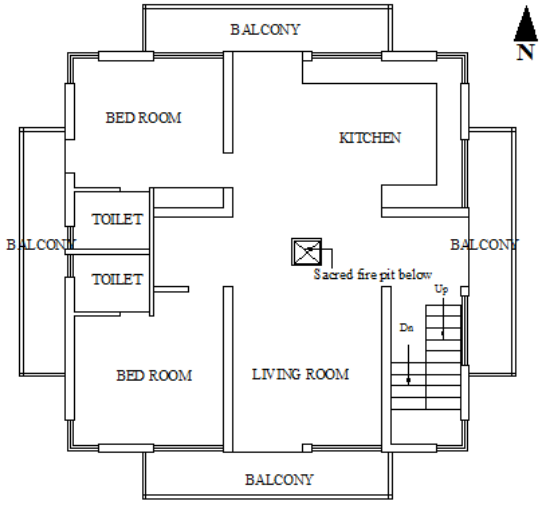


Figure 87: First floor plan of Contemporary Res.2

Figure 83: view from the main road

Figure 85: vegetation in the plot

Figure 86: air vents and wind trapping system above the roof.

Figure 90: steel louvers & reclining seats

Figure 89: minimal opening

Figure 88: roof top air vents

Figure 93: living room

Figure 92: bed room

Figure 91: open dining & kitchen

4.3 RESIDENCE 3

Location: Mavelikara

Owner & Architect: Ar. Subhash Varma

Principles and elements:

- The design has followed traditional theory of design to an extent and applied in the modern context. The plot has an old house along with a large parcel of land. The site demarcated as 16X13m in the northern side of the plot
- Layout: Follows a grid pattern by considering traditional dimensional system. The central space is a passage between the living and dining space- a linear movement similar to the *Ekasala* (single block traditional residence)
- Built form: Simplicity in form and design. Contemporary with some traditional interpretations such as the sloping shade, inclined louvers, etc. Roof is flat-done with concrete. The provision of inclined shade in the four sides break the monotony of the box like form.

Climatic aspects:

- Site planning: The building in the northern side of a large parcel of land which is a part of a traditional courtyard building. The plot has a well in the East, pond in the west and vegetation all around.
- Orientation: Walls facing cardinal direction allowing the wind to be used in maximum.
- Building layout: Open plan with minimum partitions. Plan allows cross ventilation for all the rooms. Openings are aligned in straight line. Sky lighting and roof ventilation is made to use in maximum.
- Built form: A box like structure with sloping shade in 4 sides.
- Roof and shade: The roof is flat done with concrete. Levels of the roof are adjusted so as to provide ventilation and light. A sloping shade is provided at the 4 sides as a shade to the projecting area. Inclined steel louvers as the openings as well as a seating in the living area.

- Openings: windows are less and provided at an higher level and slits with fixed glass are provided in most cases.

- Walls: hollow blocks comparatively low for thermal insulation than laterite and brick.

Materials & technology:

- Walls: 15cm thick hollow blocks which are kept as exposed. Thermal insulation and durability are more for block masonry than brick. It presents a faster construction system. Also the material is economical than brick masonry.
- Flooring is done with red oxide over cement concrete.
- Structural system with load bearing walls and concrete for spanning.
- Roof: concrete flat roof and trussed sloping shade covered with clay tiles. Concrete is strong and provides more safety. As it radiates heat at night time the indoor temperature shoots up. Air vents are provided at the roof level so as to ventilate it.
- Columns are done with steel. Openings such as fixed glass for slits, folding glass windows awning windows and wooden paneled doors are used.

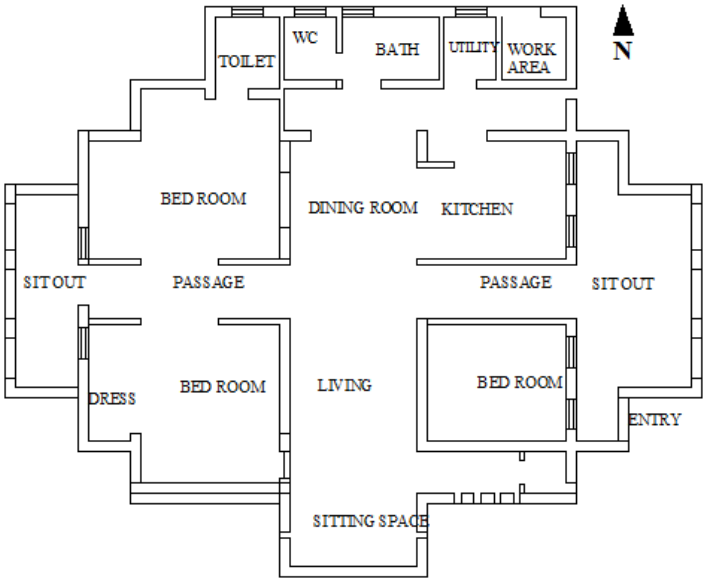


Figure 95: Floor plan of Res. 3

Figure 94: vegetation in the plot

Figure 96: pond in the west side

Figure 97: section showing roof levels

Figure 98: sit out with platforms for sitting

Figure 99: central sky lighting

Figure 105: front view

Figure 104: living space

Figure 103: bed room

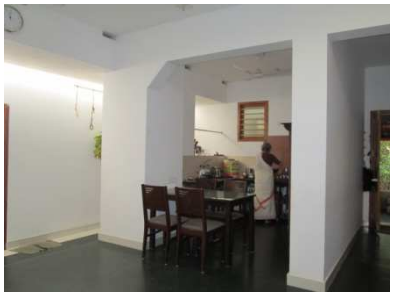


Figure 102: open dining & kitchen

Figure 100: passage inside the house

Figure 101: rear verandah

4.4 RESIDENCE 4

Owner: Dr. Sreejith

Location: Vyttila

Principles and elements:

- The design has followed traditional theory of design to an extent and applied in the modern context
- Gatehouse is provided to give an outlook of traditional style. **Less distance between the building and the gatehouse, this reduces the importance of the gatehouse.**
- Layout: Follows a grid pattern in concentric rectangles. The central space is a courtyard and rooms arranged around it.
- Built form: Contemporary with attempts to give an outlook of traditional building. Double roof system. Roof is flat, done with concrete. The sloping roof done with steel truss and covered with Mangalore tiles.

Climatic aspects:

- Site planning: The building has a front yard of 3m and minimum setback in all other sides. The open space and vegetation in the site are less.
- Orientation: Walls facing cardinal direction- the surrounding buildings block the wind.
- Building layout: Courtyard planning is done with rooms around courtyard. The courtyard brings light and ventilation to the inside rooms which is the only effective ventilation technique.
- Built form: The ceiling is flat, done with concrete and a sloping roof is provided to get an outlook of traditional style. It also helps in passive cooling. Gables are provided as an aesthetic element without having any function.
- Openings: only controlled openings are provided. Windows are glazed.
- Walls are done with 24cm thick brick, with no proper shading.

Materials & technology:

Walls are done with 24cm thick brick, which is easily available and workable. Flooring is done with red oxide over cement concrete. Load bearing walls and wooden columns, for keeping the identity of tradition are used. Flat roof with concrete and trussed sloping roof is used. The double roof system provides thermal insulation. Glazed window panels and wooden paneled doors are used for openings.

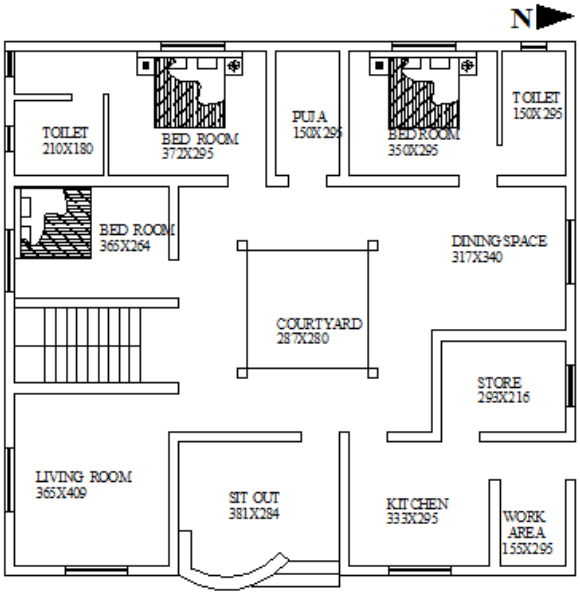


Figure 107: Ground floor plan of Res.4

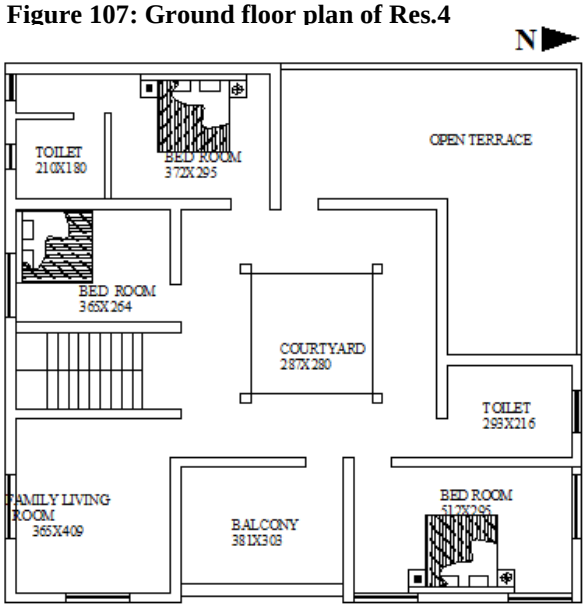


Figure 110: First floor plan of Res.4

Figure 106: front view

Figure 108: living room

Figure 109: central courtyard

Figure 112: sit out/ Poomukham

Figure 113: The gate house/ entry to the plot

Figure 111: open dining positioned to the north side of courtyard

4.5 RESIDENCE 5

Location: Tripunithura

Owner: Mr. Thomas

Architect: Ar. Rohini Prasad

Principles and elements:

- Courtyard planning in a modern context with no reference to traditional theories.
- Layout: Follows a grid pattern in concentric rectangles. The central space is a courtyard and rooms arranged around it.
- Built form: Contemporary type. Roof is flat type constructed with reinforced concrete. The sloping outer look is made with the extension of sloping shade up which makes the building look more complicated and it does not bring the elegance of a traditional residence

Climatic aspects:

Site planning: The building has a front yard of 5m and side setback of 3m. Most of the areas are paved. Ample open space and less vegetation

Orientation: Walls facing cardinal direction

Building layout: Courtyard planning is done with rooms around courtyard. It is covered with an elevated roof; with its side walls having openings allowing ventilation and minimal lighting. Also all the rooms have cross ventilation

Built form: Roof is flat type constructed with reinforced concrete. Gables are provided as an aesthetic element without having any function. Openings: only controlled openings are provided. Windows are glazed. 24cm thick brick is used for walls.

Materials & technology:

24cm thick brick, which is easily available and workable, is used for walls. Flooring is done with vitrified tiles over cement concrete. Load bearing wall system for superstructure and concrete for spanning is used. Concrete flat roof and sloping shade is used, because of the strength and safety provided by the concrete. But it radiates heat at night time and thus shoots

up the indoor temperature. Glazed window panels and wooden paneled doors are used for openings.

Figur y Res.5

Figure 114: front view

Figure 115: large verandah leading to the living space as the entry to the house

Figure 118: central courtyard as the living space

Figure 117: sit out/ poomukham

Figure 119: open dining space

Figure 120: living room with full sized glazed windows

Figure 123: gable as an aesthetic element only

Figure 121: roof of the courtyard has been covered for safety reasons

Figure 124: bed room with mechanical cooling

Figure 122: kitchen

4.6 COMPARISON BETWEEN THE FIVE RESIDENCES

Table 3: comparison of the architectural elements in contemporary residences

Connecting with tradition	Res 1 Piravom	Res 2 Thrissur	Res 3 Mavelikara	Res 4 vyttila	Res 5 Tripunithura
Building form & layout	Noncentral multiple courtyard planning with dining room as the connecting space to other rooms	Central courtyard concept interpreted to central opening	Single block type without courtyard	Central courtyard type	Central courtyard type with the roof semi covered
orientation	In cardinal directions	In cardinal directions	In cardinal directions	In cardinal directions	In cardinal directions
Roof type	Sloping roof	Flat roof with sloping shades taking the advantage of wind trapping system	Flat roof with slopping shades	Slopping roof	Flat roof with slopping shades to get an outer look of traditional style
shading	Sloping shade with wide overhang	Sloping shade with wide overhang	Sloping shade with wide overhang	Sloping shade with wide overhang	Sloping shade with wide overhang
plinth	45cm high	45cm high	45cm high	45cm high	45cm high
opening	Aligned in straight line in one direction; use of inclined louvers	Aligned in straight line; use of inclined louvers; minimal openings	Aligned in straight line; inclined louvers; opening in the roof	Large glazed openings	Large glazed openings
verandah	Wide verandah limited to the front and rear side so as to keep a connection to the outdoor	front verandah as the entry to the house	On front and rear sides keeping a connection to the outdoor	absent	Front verandah as the entry to the house
Balcony	absent	On all the four sides in the first floor	absent	With reclining seats	absent
landscape	Sufficient open space & vegetation around the building	Sufficient open space & vegetation around the building	Sufficient open space & vegetation around the building	Open spaces are not sufficient	Sufficient open space, but less vegetation
wall	brick	Laterite, which is more efficient for heat insulation	Hollow concrete blocks	brick	brick
Roof material	Concrete for flat roof; trussed sloping roof paved with clay tiles to keep the identity.	Concrete for flat roof and sloping overhang. The overhang is paved with tiles.	Concrete flat roof. Trussed sloping overhang for shading the sit out and bay window.	Concrete for flat roof; trussed sloping roof paved with clay tiles to keep the identity.	Concrete for flat roof and sloping overhang. The overhang is paved with tiles.
Construction techniques	Double roof system	Wind trapping system	Wind trapping system	Roof ventilation not effective	No provision for roof ventilation

Chapter 5

ANALYSIS ON THE TRANSFORMATION OF RESIDENTIAL ARCHITECTURE

5.1 PRINCIPLES AND ELEMENTS OF DESIGN

5.1.1 The effect of principles and elements of design on the transformation

5.1.1.1 Introduction

The traditional house design was entirely based on the traditional theory of design which had instructions from the selection of a site to the construction details. When the plot size began to reduce and people started to construct without any setbacks and considerations for neighboring buildings, building rules was introduced in 1975. The modern design attributes such as function inspired, focus to materials, linearity, transparency, simplicity, etc. has influenced in the design of contemporary houses of Kerala.

5.1.1.2 Transformation

Site planning: In traditional houses, the site planning was done as per the traditional theory of design which is based on *Vastushastra*. According to the traditional theory, the plot whether it is big or small, is divided into sectors and the sector on either the NE or SW is selected for habitation. Maximum 50% of the selected habitable land is used for the construction of house. Accordingly, the selected traditional buildings were analyzed and found that less than 50% of the habitable space is used for the building. Whereas for the contemporary buildings, the building rule itself permits for coverage of 65% and FAR of 3-4, which is problematic. From the selected case study, it can be seen that the setbacks for a residence with even 55% coverage is not sufficient. Also, the distance between the neighboring buildings is much less to allow proper wind movement in between them.

Building layout: The traditional theory of design has set some standards for the layout of the building also. The planning is done with respect to the central point, which is known as *Brahmasthanam*. No construction is favored here. A one cell width path is left around this point as vacant for the courtyard. Then the space for building is marked around the courtyard in concentric rectangles from the central point. An outer path is left for the verandah. This

way of planning helps to maintain a proportion for the building as well as minimizes the wastage of space. In the selected contemporary buildings also the similar planning strategy was found, but not with respect to traditional theory except for residence 2&3, which have followed the approach to a small extent. In contemporary houses, the width of the building is selected with respect to the spatial requirement of the user and not with respect to traditional theory, which was based on the minimum space requirement for a person.

Built form: In traditional house design, the vertical proportions of the building is compared with that of human proportions and designed accordingly. In all the selected houses, 1/3rd of the wall will be covered with the sloping roof; the plinth height will also be around 1/3rd of the height of wall. In the selected contemporary houses, res 1, 2 & 3 have followed the 1/3rd proportional system which is effective for shading. Residences 4 &5 have little variations with the proportions which has affected in the elegance of the building.

Architectural elements: Certain elements of the traditional houses such as the roof, gable, colonnaded verandah etc were the unique features of the region's architecture which were functional as well as aesthetical. Even though, the materials have changed all the selected contemporary houses have some kind of traditional element. Some are functional and some are non functional.

Space organization: The organization of a traditional building is done centrally with respect to a central point called *Brahmasthanam*. All the spaces and arrangements are done either around a central courtyard or a passage. In contemporary buildings also, similar arrangement was found.

Access design: The access to the building is made dominating through certain characteristics such as *poomukham* or sit out, long steps leading to a verandah, etc. In contemporary buildings also, the same approach was seen.

Airiness: With the use of series of openings in the form of doors and windows, gables, the open space around a sense of airiness is created by the traditional house. In contemporary houses also, the landscaping, the open space, etc. creates a sense of airiness except for res.4, which creates a feeling of congestion because of the lack of sufficient open space with respect to the size of the building.

Lightness: In traditional buildings, a sense of lightness is created through the use of multiple windows, tiered roofs supported on thin columns. In the case of contemporary houses, the

tiered roofs, long eaves and the thin columns of the res.1 creates lightness. The massiveness of res.2 is reduced by the large openings in it, the cutouts in the overhang also brings a sense of lightness. The massiveness of the box form of the res.3 is lightened with the use of vertical slits and the support of the overhang through thin steel columns adds to the lightness. Whereas, the sloping roof, the gable along with the varied height proportions create massiveness.

Cool and pleasant atmosphere: The presence of trees brings nature to the structure and provides shade. In traditional houses, a sense of cool and pleasant atmosphere has been created through the relation between the built form and the nature. This is visible in the contemporary residences also with its landscape and vegetation except in res. 4& 5, because they lack sufficient vegetation around the house.

5.1.1.3 Conclusion:

It can be seen that the byelaws itself permits wide coverage with high FAR. It shall be reduced and with increase of FAR, the coverage shall be reduced. Also the minimum distance between the buildings shall be increased. It is always better to maintain continuity with the past, so that a regional language can be followed and hence the identity of a particular place can be preserved. In the selected cases of contemporary houses, with different materials, the traditional concepts have been interpreted and applied. For example, it is expensive to build a wooden louver, but at the same time louvers are good means for ventilation and lighting, then with materials which are economical such as steel, the louvers can be made. Many such interpretations are done in the selected houses.

5.1.2 Comparison of traditional and contemporary houses

Table 4: Comparison of site planning & building layout aspects between all the residences

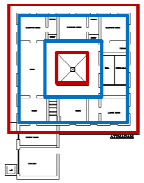
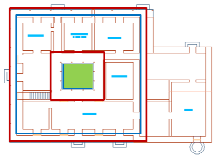
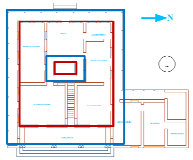
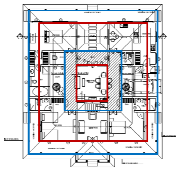
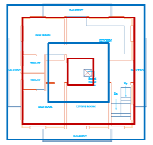
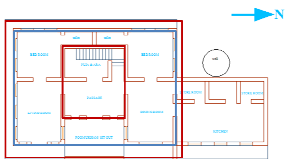
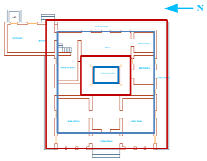
	Traditional Houses			Contemporary Houses		
Site planning	**Res.1:** The building is positioned in the NE portion of the large plot so that a large parcel of open space is left. Within the selected NE corner, nearly 14% of the land is used for the built structure. The rest is left for the trees, serpent grove, pond, toilet, etc.	**Res.2:** The building is positioned in the SW portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, nearly 18% of the land is used for the built structure. The rest is left for the outhouse, trees, serpent grove, pond, cattle shed, toilet, etc.	**Res.3:**The building is positioned in the NE portion of the large plot so that a large parcel of open space is left to the backside. Within the selected NE corner, nearly 24% of the land is used for the built structure. The rest is left open for trees, well	**Res.1:** The building planned in a landscaped plot with coverage: 35.5% accessed through 2 gates-pedestrian through gate house/ padippura and other for vehicular access.	**Res.2:** Even though the plot size is28m X 15.24 m, the building is designed in a 15.24X15.24m square selected in the western side of the plot with coverage of 21.8%.	**Res.3:** The plot has an old house along with a large parcel of land. The site demarcated as 16X13m in the northern side of the plot
	Res.4: The building is positioned in the SW portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, nearly 15% of the land is used for the built structure.	**Res.5:** The building is positioned in the NE portion of the large plot so that a large parcel of open space is left. Within the selected SW corner, nearly 20% of the land is used for the built structure.	**Site planning done as per the traditional theory of design. According to the theory, maximum 50% of the portion selected is used for construction.**	**Res.4:** Coverage: 55%, which reduces the open space around the building.	**Res.5:** The building planned in a landscaped plot with 39.1% ground coverage.	**KMBR allows to a maximum coverage of 65% and FAR of 3-4**
Building layout	**Res.1:** organized as concentric rectangles with 147cm as the width 	**Res.2:** organized as concentric rectangles with 138cm as the width 	**Res.3:** elongated concentric rectangles of varying width 	**Res.1:** concentric rectangles with varied path widths 	**Res.2:** concentric rectangles with 2m path width 	**Res.3:** elongated concentric rectangles with varied path width 
	Res.4: organized as concentric rectangles around a central passage 	**Res.5:** organized as concentric rectangles with 138cm as the width 	Planning in concentric rectangles was done to maintain a proportion as well as to minimize the wastage of space.	**Res.4:** concentric rectangles with 130cm width 	**Res.5:** concentric rectangles with 180cm width 	Even though the layout is done in concentric rectangles, space utilization is not efficient.

Table 5: Comparison of built form, spatial organization and access design among all the residences

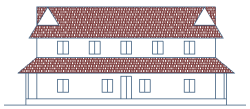
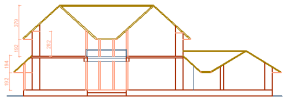
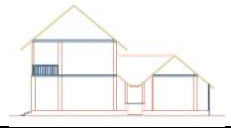
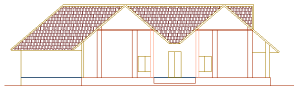
	Traditional Houses			Contemporary Houses		
Built form	**Res.1:** 35 ˚ -40 ˚ sloping roof. 1/3 rd of the wall covered with the roof. 	**Res.2:** 30 ˚ -35 ˚ sloping roof. 1/3 rd of the wall covered with the roof. 	**Res.3:**35 ˚ -40 ˚ sloping roof. 1/3 rd of the wall covered with the roof. 	**Res.1:** has an outlook of a traditional house. 30 ˚ -35 ˚ sloping roof. Constitutes large glazed openings, colonnaded verandah, charupadi	**Res.2:** Contemporary with some traditional features such as the sloping shade, inclined louvers, etc.	**Res.3:** Simplicity in form and design Contemporary with some traditional interpretations such as the sloping shade, inclined louvers, etc.
	Res.4: 35 ˚ -40 ˚ sloping roof. 1/3 rd of the wall covered with the roof.	**Res.5:**35 ˚ -40 ˚ sloping roof. 1/3 rd of the wall covered with the roof. 	According to traditional theory, for vertical proportion of the building, it is compared to a human body	**Res.4:** Contemporary with attempts to give an outlook of traditional building.	**Res.5:** Contemporary style. The sloping outer look makes the building look more complicated and does not bring the elegance of a traditional residence	Res 1&4 have similarity with traditional house. The others have kept certain characteristics of the tradition to keep its identity.
Space organization	**Res.1:** The design of the spaces and arrangements are centralized which all the rooms and halls located around a major point which is the central courtyard.	**Res.2:** The design of the spaces and arrangements are centralized which all the rooms and halls located around a major point which is the central courtyard.	**Res.3:** The design of the spaces and arrangements are centralized which all the rooms and halls located around a major point which is the central courtyard.	**Res.1:** The design of the spaces and their arrangements are centralized and located around the dining and family living space.	**Res.2:** Centralized organization and rooms around a cut out which is the interpretation of a courtyard.	**Res.3:** The design of the spaces is linear along a common passage and rooms arranged on either side of the passage.
	Res.4: The design of the spaces and arrangements are centralized which all the rooms and halls located around a major point which is the passage.	**Res.5:** The design of the spaces and arrangements are centralized which all the rooms and halls located around a major point which is the central courtyard.	**Centralized around a courtyard or a passage**	**Res.4:** The design and organization of spaces are centralized in which all the rooms are located around a courtyard.	**Res.5:** Centralized organization and rooms around a courtyard.	**Mostly centralized around a courtyard or a passage**
Access design	**Res.1:** organization of poomukham/ sit out in front.	**Res.2:** A welcoming sense through the long steps	**Res.3:** A welcoming sense through the long steps and colonnades	**Res.1:** poomukham with long steps marks the entry to the house, gatehouse marks the entry to the plot.	**Res.2:** Projecting verandah with long steps mark the entry.	**Res.3:** A welcoming sense through the projecting poomukham.
	Res.4: A welcoming sense through the verandah	**Res.5:** A welcoming sense through the long steps	**Access made dominating through certain elements. Entry to the site is marked by the gate house.**	**Res.4:** Long steps mark the entry to the house.	**Res.5:** Projecting verandah with long continuous steps.	**Greater care for the dominating characteristic of the entry**

Table 6: Comparison of airiness, lightness & cool and pleasant atmosphere between the residences

	Traditional Houses			Contemporary Houses		
Airiness	**Res.1:** Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.	**Res.2**: Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.	**Res.3:**: Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness	**Res.1:** Open space and the landscaping around the building and the verandah bring a sense of airiness.	**Res.2:** created by the open space, the vegetation and the open plan of the building	**Res.3:** created by the open space, the vegetation and the open plan of the building
	Res.4:: Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.	**Res.5:**: Use of series of openings in the form of doors and windows, gables, the open space around create a sense of airiness.	**Ensuring good ventilation and sunlight**	**Res.4:** A feeling of congestion because of the lack of sufficient open space with respect to the size of the building.	**Res.5:** created by the open space and landscaping	**Ensuring good ventilation and sunlight except for res.4**
lightness	**Res.1:** created through the use of multiple windows, tiered roofs supported on thin columns	**Res.2:** created through the use of multiple windows, tiered roofs supported on thin columns	**Res.3:** created through the use of multiple windows, tiered roofs supported on thin columns	**Res.1:** Tiered roofs and long eaves and the thin columns	**Res.2:** The massiveness of the building is reduced by the large openings in it. The cutouts in the overhang also bring a sense of lightness.	**Res.3:** The massiveness of the box form lightened with the use of vertical slits. The support of the overhang through thin steel columns add to the lightness
	Res.4: created through the use of multiple windows, tiered roofs supported on thin columns	**Res.5:** created through the use of multiple windows, tiered roofs supported on thin columns	**Lightness in the built form**	**Res.4:** The sloping roof , the gable along with the varied height proportions create massiveness.	**Res.5:** The sloping roof in a complex way adds massiveness to the structure.	The lightness is lost in some cases.
Cool and pleasant atmosphere	**Res.1:** created through the relation between the built form and the nature.	**Res.2:** created through the relation between the built form and the nature.	**Res.3:** created through the relation between the built form and the nature.	**Res.1:** through the link between landscape and the building	**Res.2:** Through large number of openings and through the vegetation in the site.	**Res.3:** through the relation between the built form and the nature
	Res.4: created through the relation between the built form and the nature.	**Res.5:** created through the relation between the built form and the nature.	**The presence of trees brings nature to the structure and provides shade**	**Res.4:** Congested outlook with lack of sufficient open space.	**Res.5:** Through the landscaping, but less effective	Cool and pleasant atmosphere is maintained in the contemporary houses also.

Table 7: comparison of entrance gate and sit out between the residences

Architectural elements	Traditional Houses			Contemporary Houses		
Padippura/ Gate house	**Res.1:** A double paneled wooden doorway which is covered with a sloping roof marks the main entry. Other entries are also provided from neighboring houses with wooden railings	**Res.2**: marks the entry. It has platforms for seating. 	**Res.3:** A double paneled wooden doorway which is covered with a sloping roof	**Res.1:** To keep the traditional identity. Separate entrance gate is provided for the cars Trussed roof is provided. Acts as the pedestrian entry. 	**Res.2:** absence of any gate house/ padippura.	**Res.3:** absence of any gate house/ padippura
	Res.4: The first built form seen while approaching a house.	**Res.5:** A double paneled wooden doorway which is covered with a sloping roof 	A double paneled wooden doorway covered with a sloping roof. single storeyed or double storeyed. Marks the entrance to the plot. The first built form seen while approaching a house. Its grandness marks the status of the family. Quite often they will be having seating facility the form of platform	**Res.4:** To keep the traditional identity. Done with concrete. Separate entry provided for vehicles. 	**Res.5:** absence of any gate house/ padippura	In res. 1, the first structure seen is the gate house. Whereas in res. 4, the importance of the gate house is lost with the background of the big house.
Poomukham/ sit out	**Res.1:** Marks the entry to the house 	**Res.2**: No structure is provided as sit out. But a verandah acts as the space. 	**Res.3:** the long front verandah acts as the sit out. 	**Res.1:** similar to that of traditional one, as projecting out. 	**Res.2:** a verandah with long steps mark the entry to the house	**Res.3:** transformed one with new materials, but projecting out. 
	Res.4: sit out 	**Res.5:**long verandah acts as the sit out 	**Either a verandah or a projecting space acts as the Poomukham. The space is an informal living space for the guests.**	**Res.4:** transformed one, within the main building. 	**Res.5:** transformed one with new materials and projecting out. 	The earlier structure with verandah transformed to a space which is either projecting or within the main building.

Table 8: comparison with respect to colonnaded verandah and reclining seats

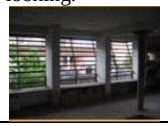
Architectural elements	Traditional Houses			Contemporary Houses		
Colonnaded verandah	**Res.1:** row of circular columns evenly spaced and supporting the roof 	**Res.2**: row of circular columns 	**Res.3:** row of double columns in the front verandah and rows of single round columns in the other sides  	**Res.1:** row of wooden columns similar to traditional 	**Res.2:** absent	**Res.3:** absent
	Res.4: Verandahs without columns are being used.	**Res.5:** row of circular columns made of laterite. 	Verandah with circular, hexagonal, or octagonal columns is an identity of traditional architecture. Columns support the roof above. Verandah avoids the direct exposure of wall to sun and driving rain. Provides as a chatting space for the guests, play area for the kids, resting place etc.	**Res.4:** row of wooden columns around the courtyard 	**Res.5:** row of brick columns 	Even though timber is expensive, it is used for columns to keep the identity of tradition.
Charupadi/ reclining seats	**Res.1:** a platform is provided, without any back rest. 	**Res.2**: provided in the upper floor, used for sitting and sleeping. 	**Res.3:** a platform is provided in the verandah. 	**Res.1:** Modern version of charupadi with less decoration. Made of wood. 	**Res.2:** provided inside as window seats with a provision of inward and outward looking. 	**Res.3:** Built in platforms made of concrete hollow blocks. 
	Res.4:  Built in seats with an ornamented back rest made of wood	**Res.5:** built in platforms with no back rest 	Built in seats of timber having inclined back rests in a raised platform usually provided in poomukham or front verandah	**Res.4:** Built in charupadi made of concrete 	**Res.5:absent**	The concept of built in seats are still followed but with new materials which are economical.

Table 9: comparison with respect to louvers, roof and gable

Architectural elements	Traditional Houses			Contemporary Houses		
louvers	**Res.1:** Wooden louvers in the kitchen which reduces sun glare and ventilates the room. A permanent opening 	**Res.2**: able to close when not in use. Used as a sitting/ sleeping space. 	**Res.3:** used in kitchen as a permanent opening 	**Res.1:** inclined wooden louvers similar to traditional one, but expensive 	**Res.2:** inclined steel louvers similar to traditional, but economical 	**Res.3:** inclined steel louvers similar to traditional, but economical 
	Res.4: permanent opening in kitchen 	**Res.5:** permanent opening in kitchen 	Inclined wooden louvers ensures controlled view as well as enough light and ventilation 	**Res.4:** no such openings	**Res.5:** no such openings	Except res.1, res.2 & 3 have interpreted the concept of wooden louvers with materials which is economical. Ensures light and ventilation with controlled view.
Roof & Gable	**Res.1:** slopping roof with functional gables 	**Res.2**: slopping roof with functional gables 	**Res.3:** slopping roof with functional gables 	**Res.1:** slopping roof with functional gables 	**Res.2:** flat roof with sloping overhang 	**Res.3:** flat roof with sloping overhang 
	Res.4: slopping roof with functional gables 	**Res.5:** slopping roof with functional gables 	**Unique feature of the houses as a functional as well as an aesthetic element.**	**Res.4:** slopping roof. Gables as aesthetic elements only 	**Res.5:** flat roof with sloping overhang. Gables as aesthetic element only 	All the residences have some kind of traditional elements, either as functional or just imitation.

5.2 CLIMATIC ASPECTS

5.2.1 The effect of climatic aspects on the transformation

5.2.1.1 Introduction

The climate is a major factor that has influenced in the evolution of the traditional architecture of Kerala. Each and every element of the built structure and the surrounding environment has equal importance in dealing with the climate. The technologies used in the building are very effective for managing the climate even today. But, with the scarcity of materials and also with the introduction of new materials which are economical, safe and aesthetically good, the locally available natural materials were replaced with new industrially produced materials and new construction technology. With the newer materials and technology, many of the contemporary buildings have successfully solved the climatic problems faced by other types of contemporary buildings.

5.2.1.2 Transformation

Ventilation:

Form & Planning: - In traditional houses, the form of the building was such that with open plan and with single row of rooms either positioned around a courtyard or surrounded with verandahs. This particular form facilitated cross ventilation for all the rooms. Also the kind of plan was spread so that ventilation is ensured. The selected contemporary houses also have the similar planning approach of providing single row of rooms around a central courtyard or a central passage, but the one around central courtyard gives the desired result. Residence-2, 4 & 5 of contemporary category have this type of planning in their design. But, residence-4&5 have covered the courtyard partially for safety reasons and hence bring a negative effect to the inside environment. The residences 1 & 3 have the approach of a single block building. The effective ventilation also depends on the open space around the building, which is lacking for residence-4.

Orientation: - Traditional buildings are oriented in the cardinal directions, thus allowing the prevailing wind from SW direction to enter the house to maximum possible. In selected contemporary buildings also the same pattern has followed knowingly or unknowingly.

Size and positioning of openings: In traditional buildings, all the openings are aligned in straight lines so as to create a tunnel effect and thus to ensure air movement in all the rooms.

Even though the opening sizes were less, more numbers were included to ensure cross ventilation. Also different varieties of openings such as roof top openings, gables, minimal openings, louvers etc. can be seen in those houses. In Contemporary residence-1, 2 & 3, the concept of straight alignment of the openings is followed and proved effective. In all the new residences, the openings were big compared to traditional ones. In the case of residence 4 and 5, the openings are helping in building up the internal heat. The interpretation of roof top air vent concept in residence-2 &3 are effective in reducing the heat inside.

Site landscaping: - The amble open space, the vegetation, the presence of water body etc. were the positive aspects of traditional building which helped in creating micro climate. In contemporary building with reduced plot size, creating micro climate is difficult. But except residence- 4 & 5, the others have managed to provide sufficient trees and green space and thus improve the micro climate. In residence 4 & 5, the water resistant tile pavement and less trees creates negative effect.

Ventilation through various other phenomena: - The courtyards, gables, roof top air vents, inclined wooden louvers, etc. were the means of ventilation other than controlled openings such as doors and windows. In modern buildings, res.1, 2 & 3 have interpreted the concept of courtyards, roof top air vents, wooden louvers etc. into their designs.

Protection from sun, rain and insects:

Shading for walls and openings: - In traditional houses, deep overhangs, verandahs and trees were the means of shading for walls and openings. The verandahs avoid the direct contact of the wall with the exterior and thus protects from the direct radiation and driving rain. The deep overhanging lowers below the eye level and avoids sun glare. In the selected contemporary building, the verandah is used only in residence 1 as an aesthetic element as well as a functional one. The concept of overhang is used in all the selected building in different styles. Residence 1&4 has used the direct way of approach in a traditional house, but with steel truss. The residence- 2 & 5 have used the overhangs only, with concrete. Res. 3 has used the overhang as an element to keep the identity of tradition as well as a shade.

Roof: Double roof system, with timber framed sloping structure paved with clay tiles and a wooden ceiling, which separates the attic space with the room below, has been followed in the traditional houses. This technique helps in creating a cool atmosphere in the rooms below. The steep slope helps in the easy drain off of rain water. In the selected contemporary

buildings, residences 1 & 4 have used the sloping roof thus facilitating the easy drainage. Both have used double roof system, but the later does not have the provision for attic ventilation. The other three residences, have the physical appearance of a sloping roof house, but not effective functionally.

Minimizing solar heating and maximizing cooling in the evening:

Built form & orientation: - In traditional buildings, the care has taken to reduce the exposure of west and southern walls either by reducing the walls facing that side or through shading by trees. In selected contemporary buildings, except res- 4& 5, the shading has been done.

Building materials: - in traditional houses, locally available and natural materials were used for construction. Double layered laterite wall of 50cm thick was used in res.1 and that of 80cm with in between space filled with soil and utensils for res.2. These two shows the best examples for the thermal insulation technique used. Unburned clay brick was one another material used in res. 3 for providing a cool atmosphere. Single layered laterite walls were used for the other two residences. In all the selected houses, flooring was done either with terracotta tiles or with timber, both are good in reducing the heat inside. The timber structural system and the clay tiling were also effective in reducing the internal heat buildup. In the selected contemporary buildings, res.1, 4 & 5 have used burned bricks for walls, glazed opening and concrete for roof. These materials directly help in the heat buildup. But in res.1, with proper shading of the walls and openings and with the use of a second roof which is sloping and with ventilated attic space, the negative effects of the materials have been avoided. Res- 4 has also used the sloping roof technology, but does not give the desired effect because of the absence of the provision for ventilation. Res.2 with the exposed laterite and shaded openings, minimize the heat buildup. The roof top air vents of res- 4 & 5 are effective in maximizing cooling in the evening compared to the unventilated simple flat roof of res.5.

Cooling techniques: The trees around the building including those in the serpent grove, which through its thick vegetation prevents the direct solar rays, the water body in the north east which humidifies the dry wind from north east during winter season, the courtyard which facilitates the ventilation through stack effect etc. were the cooling techniques used in traditional building. In the selected contemporary buildings, res.1 has included a water court in the building as a design feature as well as to help in passive cooling. Res. 2,4 and 5 have interpreted the courtyard concepts.

Maximizing day lighting:

Planning: The courtyard is an effective solution for bringing natural light into the otherwise dark interiors of a traditional house. The concept has been interpreted and used in all the selected contemporary buildings in the form of either courtyard or sky lighting.

Built form: The sizes of the openings were very less in traditional houses and the panels used were wooden, which makes the room completely dark when closed. In contemporary buildings, the use of glass panels for openings is very effective in bringing natural light even though the shutters are closed. Also the glazed panels add reflected lighting. Hence the day lighting can be used in maximum.

5.2.1.3 Conclusion

The traditional approaches were climate responsive in all senses. In the selected cases of contemporary houses, the concepts of traditional architecture have been interpreted and applied. The courtyard concept is interpreted as roof cut out, sky lighting, etc. The sloping roof system and the deep overhang of the traditional house are done with different materials. The reclining seats, wooden louvers etc are also used. The ventilation techniques such as the straight alignment of openings, the wind trapping system of the slopping roof, roof ventilating system, the concept of permanent openings, etc. are also applied in most of the residences. Contemporary buildings should also be designed as time adaptive and at the same time making it suitable for the climate of the region.

5.2.2 Comparison of traditional and contemporary houses

Table 10: comparison of residences with respect to form & planning, orientation & size and positioning of openings

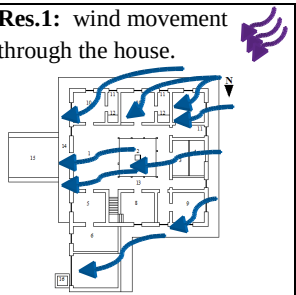
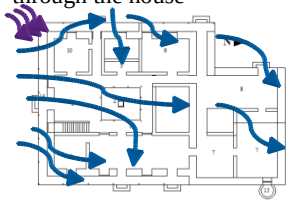
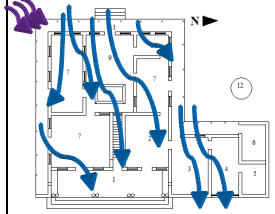
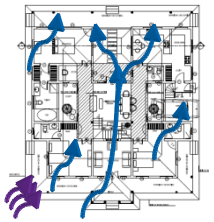
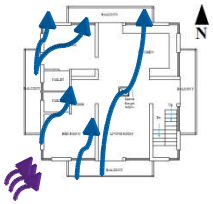
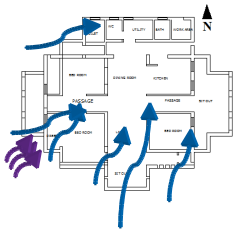
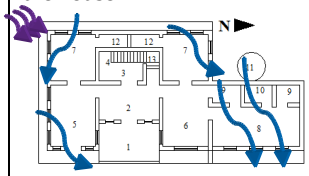
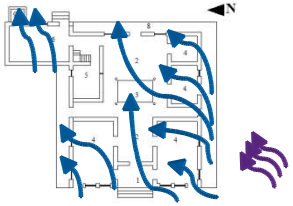
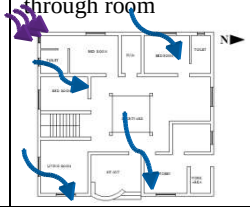
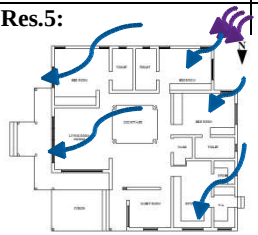
Ventilation	Traditional Houses			Contemporary Houses		
Form & Planning	**Res.1:** wind movement through the house. 	**Res.2:** wind movement through the house 	**Res.3:** wind movement through the house 	**Res.1:** wind flow through the house 	**Res.2:** wind flow through the house 	**Res.3:** wind flow through the house 
	Res.4: wind flow through the house 	**Res.5:** wind flow through room 	**Open plan with single row of rooms around the courtyard, facilitates cross ventilation**	**Res.4:** wind flow through room 	**Res.5:** 	Wind flow in res.4 is not continuous because of the inappropriate positioning of openings
Orientation	**Res.1:** along the cardinal directions with longer side in N-S, reducing south walls	**Res.2:** along the cardinal directions with longer side in N-S, reducing south walls	**Res.3:** along the cardinal directions with longer side in N-S, reducing south walls	**Res.1:** along cardinal directions with house facing south.	**Res.2:** along cardinal directions with house facing east	**Res.3:** along cardinal directions with house facing east
	Res.4: along the cardinal directions with longer side in N-S, reducing south walls	**Res.5:** along the cardinal directions with longer side in N-S, reducing south walls	**This orientation allows maximum possible SW wind**	Res.4: along cardinal directions with house facing east	**Res.5:**along cardinal directions with house facing south	Orientation allows maximum intake of wind.
Size And Positioning Of Openings	**Res.1:** openings aligned in straight line for continuous and effective ventilation	**Res.2:** openings aligned in straight line for continuous and effective ventilation	**Res.3:** openings aligned in straight line for continuous and effective ventilation	**Res.1:** openings aligned in straight line, large sized, louvers	**Res.2:** openings aligned in straight line, large sized, permanent openings	**Res.3:** openings aligned in straight line, long, permanent openings
	Res.4: openings aligned in straight line for continuous and effective ventilation	**Res.5:** openings aligned in straight line for continuous and effective ventilation	**opening less sizes, more in number, different types of openings -roof top openings, gables**	**Res.4:**openings are large in size	**Res.5:** openings of large size	**Large openings allows more ventilation**

Table 11: comparison between residences with respect to site landscaping, ventilation through various phenomena

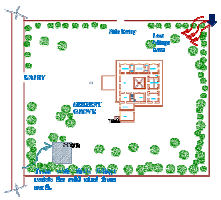
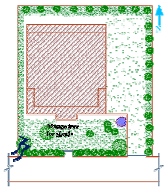
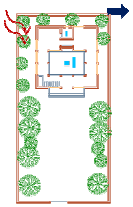
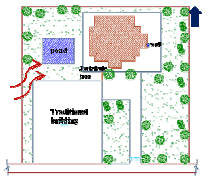
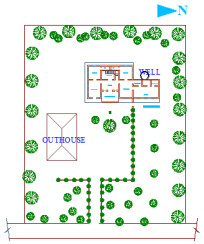
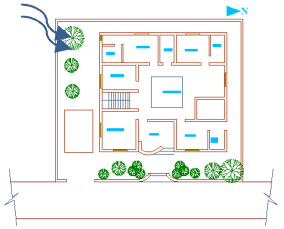
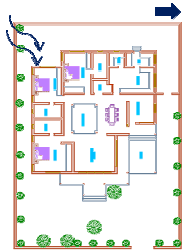
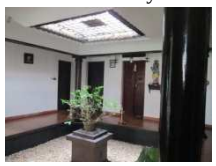
Ventilation	Traditional Houses			Contemporary Houses		
Site landscaping	**Res.1.** ample vegetation, pond, serpent grove 	**Res.2:** ample vegetation, pond, serpent grove 	**Res.3:** ample vegetation, pond 	**Res.1.** green around create microclimate 	**Res.2:** green around create microclimate 	**Res.3:** the large open space and trees favor a microclimate 
	Res.4: ample vegetation 	**Res.5:** ample vegetation, pond, serpent grove 	**Building positioned in large parcel of land with vegetation all around.- creating a micro climate**	**Res.4:** less vegetation 	**Res.5:** less vegetation 	Res.4 has very less setbacks and hence less green space; Res.5 has sufficient open space around, but less trees and ground paved with impermeable tiles.
Ventilation through various phenomena	**Res.1.** air change through gable 	**Res.2:** straight openings 	**Res.3:** wooden louvers 	**Res.1.** straight openings 	**Res.2:** air vents, permanent openings, wind trapping system with sloping overhang 	**Res.3:** roof top air vents, straight openings 
	Res.4: permanent openings above the windows and doors 	**Res.5:** small permanent openings of 1 inch square aligned in straight line 	**Opening aligned in straight line causing a tunnel effect, roof top air vents, permanent openings**	**Res.4:** air vents in the semiclosed courtyard 	**Res.5:**air vents in the semiclosed coutyard 	**Res.1,2&3 have interpreted and incorporated many techniques from traditional, 4& 5 has courtyard in their design, but later partially closed**

Table 12: comparison with respect to shading for walls and openings & roof

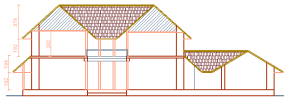
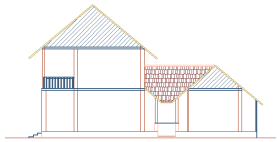
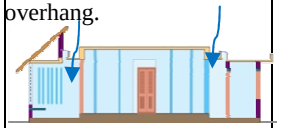
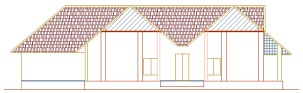
Protection from sun, rain insects	**Traditional Houses**			**Contemporary Houses**		
Shading for wall and openings	**Res.1.**deep overhang, verandah, trees 	**Res.2:** deep overhang, verandah, trees 	**Res.3:** deep overhang, verandah, trees, building 	**Res.1.** deep overhang, **verandah**, trees 	**Res.2:** deep overhang, trees 	**Res.3:** deep overhang, trees 
	Res.4: deep overhang, verandah, trees 	**Res.5:** deep overhang, verandah, trees 	Verandah avoids the direct contact of wall with sun and protects from driving rain. The deep overhang goes below the eye level and avoids sun glare.	**Res.4:**less shade with small eaves. 	**Res.5:** deep overhang 	Res.4 & 5 lacks trees as shading. The depth of overhang is much less for res.4. Walls of res.3 is overexposed to sun, due to box form but with the help of trees, its shaded.
roof	**Res.1.** ventilated double roof. Steep slope of 40˚-45˚ 	**Res.2:** double roof with attic space ventilated through gable. Steep slope of 40˚-45˚ 	**Res.3:** double roof with ventilated attic space. Steep slope of 40˚-45˚ 	**Res.1.** double roof with concrete ceiling and steel truss for frame of sloping roof paved with clay tiles. 	**Res.2:** flat concrete roof with sloped overhang for shade. The overhang traps the wind 	**Res.3:** flat concrete roof with roof top ventilation and trussed sloping overhang. 
	Res.4: double roof. Steep slope of 40˚-45˚ 	**Res.5:**double roof with attic space ventilated using gable. Steep slope of 40˚-45˚ 	**Double roof system has a wooden ceiling, which separates the roof from the room below and a sloping timber framed structure paved with clay tiles.**	**Res.4:** double roof with concrete ceiling and steel truss for frame of sloping roof paved with clay tiles. 	**Res.5:** flat concrete roof with sloped overhang 	Double roof system provides a cool effect in the rooms. Flat roof with roof top air vents are also comfortable compared to simple flat roof like res.5

Table 13: comparison with respect to built form and orientation and building materials used

Minimizing solar heating & max. cooling	**Traditional Houses**			**Contemporary Houses**		
Built form & orientation	**Res.1.** with longer walls in N-S,west walls & south wall exposure minimized and shaded with trees.	**Res.2:** west walls & south wall exposure minimized and shaded with trees.	**Res.3:** west walls & south wall exposure minimized and shaded with trees.	**Res.1.** west walls & south wall exposure minimized and shaded with trees.	**Res.2:** west walls & south wall exposure minimized and shaded with trees.	**Res.3:** west walls & south wall exposure minimized and shaded with trees.
	Res.4: west walls & south wall exposure minimized and shaded with trees.	**Res.5:** west walls & south wall exposure minimized and shaded with trees.	**Best for the region**	**Res.4:** west wall and south wall shaded by neighboring building	**Res.5:** building faces south with no secondary shading	Shading methods are not proper
Building materials	**Res.1.** double layered laterite and timber for wall, terracotta tiles and timber for flooring, timber framed roof paved with clay tiles 	**Res.2:** double layered laterite wall with space in between filled with soil and utensils, terracotta tiles and timber for flooring, timber framed roof paved with clay tiles 	**Res.3:** single layered laterite wall, terracotta tiles and timber for flooring, timber framed roof paved with clay tiles 	**Res.1.** brick, glazing and concrete adds the heat inside, but the proper shading reduces the overall effect 	**Res.2:** laterite used for walls reduces the heat, glazing, steel members and concrete add heat 	**Res.3:** concrete hollow blocks, glazing and concrete builds up the heat. Openings in the wall are positioned high so that it is strictly in shade. 
	Res.4: unburned clay brick wall, terracotta tiles &timber for flooring, timber framed roof paved with clay tiles 	**Res.5:** single layered laterite wall, terracotta tiles for flooring, timber framed roof paved with clay tiles 	The natural materials used are resistive to heat and helps to maintain a cool atmosphere and white washing the walls is also effective in reducing the heat.	**Res.4:** brick and glazing adds the heat inside	**Res.5:** brick, glazing and concrete adds the heat inside	The industrially produces materials do not suit well.

Table 14: comparison with respect to roof & shading and cooling techniques

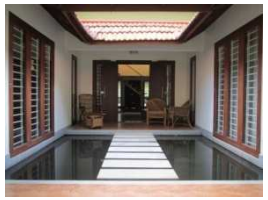
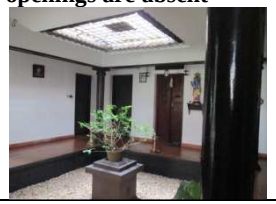
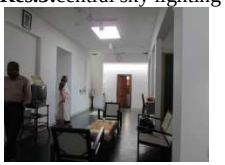
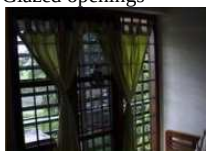
Minimizing solar heating & max. cooling	**Traditional Houses**			**Contemporary Houses**		
Roof & shading	**Res.1.** double roof system with the air gap ventilated using gable.	**Res.2:** double roof system with the air gap ventilated using gable.	**Res.3:** double roof system with the air gap ventilated using gable.	**Res.1.** double roof system with the air gap ventilated using gable.	**Res.2:** flat roof with roof top air vents. Shading by overhang, louvers	**Res.3:** flat roof with roof top air vents. Shading by overhang, louvers
	Res.4: double roof system with the air gap ventilated using gable.	**Res.5:** double roof system with the air gap ventilated using gable.	**The heat radiation from the roof is made less through the attic ventilation.**	**Res.4:** double roof system, but **no provision for ventilation of attic space- accelerates heat buildup. Shading by overhang and neighboring building**	**Res.5: simple flat roof- accelerates heat buildup. Shading by overhang**	**Roof ventilating system has been adapted in different ways.**
Cooling techniques	**Res.1.** vegetation around the building including serpent grove, pond, courtyard 	**Res.2:** vegetation around the building including serpent grove, pond, courtyard 	**Res.3:** through vegetation, courtyard 	**Res.1.** through trees, water court provided in the north side 	**Res.2:** trees, roof top openings, permanent minimal openings 	**Res.3:** trees, pond, Roof top air vents, high openings 
	Res.4: through trees and ancillary structures around the building 	**Res.5:** through vegetation around the building including serpent grove, pond, courtyard 	The ample open space with trees and a pond is a common feature; courtyard in the building is the another technique	**Res.4:** semi covered courtyard, **permanent openings are absent** 	**Res.5:** semi covered courtyard, **permanent openings are absent, mechanical cooling is used**	Except res. 4& 5, others have included different means for cooling in the built form in the form of openings.

Table 15: comparison of residences with respect to planning and built form

Maximizing day lighting	**Traditional Houses**			**Contemporary Houses**		
Planning	**Res.1.** effect of courtyard 	**Res.2:** through courtyard 	**Res.3:** through courtyard 	**Res.1.** central sky lighting 	**Res.2:** permanent openings 	**Res.3:**central sky lighting 
	Res.4: openings 	**Res.5:** through courtyard 	Courtyard provides natural light to the rooms around.	**Res.4:** central courtyard covered with polycarbonate 	**Res.5:** semi covered central courtyard 	Central courtyards and sky lighting as inspired by traditional houses facilitates more natural light in the interiors.
Built form	**Res.1.** dark interior when windows are closed  through the gap between the wall plate and roof 	**Res.2:** small double panel window  Lighting through a series of openings 	**Res.3:** dining room- small opening  Sleeping room 	**Res.1.**  Fully glazed windows and ample lighting 	**Res.2:** inclined louvers  Glazed openings 	**Res.3:** long glazed slits allowing plenty of light  
	Res.4: combination of glass and wood- allows more light 	**Res.5:** small sized opening allowing less light 	The opening sizes in the rooms are not sufficient & the wooden paneling makes it dark, when closed.	**Res.4:** long glazed openings allowing more light 	**Res.5:** large span openings, able to open fully and glazed 	Glazed openings of large size facilitates more natural lighting.

5.3 SOCIO-CULTURAL ASPECTS

5.3.1 The effect of socio-cultural aspects on the transformation

5.3.1.1 Introduction

The traditional architecture of Kerala has its soul in *Vastuvidya* and the houses are built with local building materials. Houses are usually built by local craftsmen well versed with the local technology. Both technology and tools used were simple.

Industrially produced building materials were like concrete blocks, steel members, tiles etc were used for construction of modern houses, which is a major change from tradition to modern and symbolizes a transformation. The nuclear family, the tendency of young people for living alone, high land and building cost, women working out and the fact that they do not spent much time in home have indirectly affected for not adopting traditional design strategies for new houses.

5.3.1.2 Transformation

Family structure and size:

In traditional time, extended family system prevailed and house was a symbol of the affluence. The higher classes with 15-20 members had big houses of eight blocks (double courtyard), twelve blocks (triple courtyard) etc. while the lower class people will be having a single block structure called *Ekasala*. The space requirements for these houses were limited and optimum.

At present, with the nuclear family trend, the need for separate house for young people increased and to accommodate modern facilities, the space requirements are much high and even though the family size is less, the tendency is to create big houses.

Way of living:

The means for gaining livelihood in traditional days was mainly agriculture and this brings the necessity for a safe and secure place for storing the grains. In traditional houses, the store room and the prayer room where the grains and valuables are stored, are combined together and positioned in the central part of the western block so that it faces the east, which is considered to be auspicious.

With industrialization, the dependency on agriculture reduced and thus the importance of granaries also reduced. Also, the scarcity of laterite and timber caused in the focusing of factory made products for construction. With the beginning of industries and people working in towns, their choice of land remained in the town itself and since the land value is high, the size of the plot available for construction also reduced. These resulted in concrete jungles with less trees and open space.

Religion:

The traditional house is set in harmony with the nature. The positioning of trees in auspicious locations as instructed in *Vastuvidya* and serpent grove for protecting the biodiversity, positioned in the eastern side of the large plot are examples of their worshipping of nature.

At present, the trend is towards landscaping the vacant space for improving the aesthetics rather than planting the trees according to their favorable positions.

Safety:

The houses had fencing along the site boundary with bamboos or coconut leaves and wooden gate with gate house for the access. With the availability of new materials, the fencing changed to more strong compound walls of brick, stone etc with gates of cast iron, stainless steel, etc. Since laterite, mud, palm leaves, rubble, timber etc. were the materials available, strong and easily available laterite was mostly used for walls. In some houses, double layered laterite blocks with the space in between filled with soil and utensils, measuring to a width of 80cm were used for outer walls, which were good thermal insulators. Later brick which is more strong and cheap than laterite was used for walls. The timber frame and the Mangalore tile paving used for roofing, which was highly climate responsive, was replaced with concrete because of the strength and large spanning capabilities.

Privacy:

The arrangement of rooms around the courtyard avoids the direct visual contact into the rooms. Each and every functional spaces of the traditional house were enclosed with solid walls. In houses for higher class people, a sleeping room was intended for a small family, whereas in middle class families, the rooms were all interconnected with no or less privacy within the members.

At present, with the impact of western culture and new technology, openness or transparency took the place of enclosed spaces.

Social interaction:

Verandahs were the chatting and playing spaces for the men and the children respectively. The rear verandahs and courtyards were mostly used by the women of the family. The courtyards, ponds, etc were the means for interaction at the house level.

The busy nature of the people and the various other modes of interaction may have influenced in the absence of verandahs in most of the modern houses.

Life style:

The lifestyle of the traditional people of Kerala was simple. They give much emphasis on health, hygiene and education. They are also particular in ensuring cleanliness, healthcare and physical quality of life. The brass utensil which is placed on the entry steps of the traditional house was meant for cleaning the foot of the people before entering the house. Absence of furniture was another important feature. The *poomukham* or the sit out has got a reclining chair for the elder male member to sit and a platform with inclined back rest or the *charupadi* for the guests. The long dining hall was intended for facilitating the people to sit in rows on the floor for having food. In order to meet the habit of washing hand before and after having food, water will be kept on a utensil in the outside verandah. With the development of dining table, the size of the dining room reduced. The transparent nature of the modern culture eliminated the enclosures of the traditional culture and the concept of open dining came.

The concept of separate kitchen and rear verandah were meant to avoid the smoke and heat from the kitchen and also to provide a working space for the women of the family. With the development of technologies, the kitchens are smokeless and also the women do not want to be separated from the family, which led to the concept of open kitchen as a part of the house itself. In traditional houses, instead of cot, mat was used to spread on the floor for sleeping. The room size was also small to accommodate a small cot and a table. The combined dressing area and space for urinal near the sleeping room of the traditional house is similar to the current toilet cum dressing space. Toilets were placed far away from the house because of hygienic reasons and due to the lack of proper drainage system. With the development of

technology, plumbing lines and sewage lines could easily be installed through the walls and floors and this made an end to the detached toilet concept.

5.3.1.3 Conclusion:

The influence of socio-cultural aspects in the transformation is much greater. Even though the inside of the house is of entirely international style, the outer design follows that of tradition. This shows the attachment to the traditional outlook and to keep a regional identity.

5.3.2 Comparison between traditional and contemporary houses

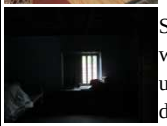
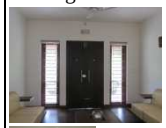
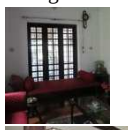
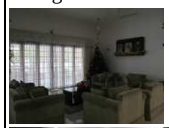
Table 16: comparison of residences with respect to family structure, size and way of living

	Traditional Houses			Contemporary Houses		
Family structure & size	**Res.1:** extended family with 15-20 members 	**Res.2:** extended family with 20-25 members 	**Res.3:** extended family with 12-14 members 	**Res.1:** nuclear family of 4 members 	**Res.2:** nuclear family of 4 members 	**Res.3:** nuclear family of 4 members 
	Res.4: extended family with 10-12 members 	**Res.5:** extended family with 8-10 members 	**The space requirements were optimum.**	**Res.4:** nuclear family of 4 members 	**Res.5:** nuclear family of 4-6 members 	**The space requirements are more to accommodate the modern facilities.**
Way of living	**Res.1:** grain store and prayer as the central space 	**Res.2:** grain store and underground store 	**Res.3:**wooden ladder to the attic space, used as store. 	**Res.1:**house set in 530m^2 plot near the highway	**Res.2:** house set in a residential area 1/2km from the highway. Plot area- 430m^2.	**Res.3:** house set in a residential area concentrated around a temple, and the plot size is large.
	Res.4: prayer room and store as the central space 	**Res.5:** store room facing east. 	Agriculture based, the need for granary, house set in large plot (approx. 1 acre) and used natural materials	**Res.4:** house set in a 340m^2 plot in a residential area, ½ km from the NH-bye pass	**Res.5:** House set in a 640m^2 plot in a residential area, ½ km from the NH-bye pass	**Big mansions in small plots with less open space and vegetation**

Table 17: comparison with respect to safety and privacy

	Traditional Houses			Contemporary Houses		
Safety	**Res.1:** fencing with bamboo or coconut leaves and wooden gate with gate house for the site. The outer wall is constructed with double layered laterite.	**Res.2:** fencing with bamboo or coconut leaves and wooden gate with gate house for the site. The outer wall is constructed with double layered laterite, with the in between space filled with sand and utensils.	**Res.3:** fencing with bamboo or coconut leaves and wooden gate with gate house for the site. The outer wall is constructed with single layered laterite wall.	**Res.1:** compound wall with brick, wooden gate house with steel trussed sloping roof paved with Mangalore tiles to get the look of a traditional house 	**Res.2:** compound wall with concrete blocks which is economical and easily available. 	**Res.3:** compound wall with concrete blocks which is economical and easily available.
	Res.4: fencing with bamboo or coconut leaves and wooden gate with gate house for the site. The outer wall is constructed with clay bricks.	**Res.5:** fencing with bamboo or coconut leaves and wooden gate with gate house for the site. The outer wall is constructed with single layered laterite wall.	**The roof system followed in traditional houses is not that safe as one can remove the tiles and do burglary.**	**Res.4:** compound wall with concrete blocks which is economical and easily available.	**Res.5:** compound wall with concrete blocks which is economical and easily available.	**The roof is done with concrete because of its strength and less maintenance.**
Privacy	**Res.1:** introvert nature of the courtyard house avoids the direct visual contact into the rooms. All the rooms are separated with walls.	**Res.2:** introvert nature of the courtyard house avoids the direct visual contact into the rooms. All the rooms are separated with walls.	**Res.3:** introvert nature of the courtyard house avoids the direct visual contact into the rooms. All the rooms are separated with walls.	**Res.1:** open dining and the other rooms opening to the family living/ dining space.	**Res.2:** open dining and open kitchen visible from the living room. Along with the living, the whole space acts as a hall.	**Res.3:** open dining and open kitchen. The layout of the furniture separates the spaces for living and dining.
	Res.4: introvert nature of the courtyard house avoids the direct visual contact into the rooms. All the rooms are separated with walls.	**Res.5:** introvert nature of the courtyard house avoids the direct visual contact into the rooms. All the rooms are separated with walls.	**All the functional spaces were separated with walls**	**Res.4:** open dining visible from the entry to the house	**Res.5:** open dining visible from the living room	**Less partition walls.**

Table 18: comparison between residences with respect to social interaction and life style

	Traditional Houses			Contemporary Houses		
Social interaction	**Res.1:** verandahs, courtyards	**Res.2:** verandahs, courtyards	**Res.3:** verandahs, courtyards	**Res.1:** verandahs, courtyard as elements to keep the identity of tradition	**Res.2:** reclining seats.	**Res.3:** long platform in the sit out and the sitting space near the window.
	Res.4: verandahs, courtyards	**Res.5:**. verandahs, courtyards	**As it was a joint family, more common spaces required.**	**Res.4:** Reclining seats in the verandah and balcony.	**Res.5:** front verandah	**Space requirements increased. Instead of verandahs, courtyards and family living as common space**
Life style	**Res.1:** sit out/ poomukham  Dining room- long enclosed room adjacent to kitchen. A kitchen is an extended room from the main house. Living room  Sleeping room- with attached urinal and dressing room 	**Res.2:** entry  Living room  Sleeping room- with attached urinal and dressing room 	**Res.3:**long verandah  **Living room**  Sleeping room- which is connected to other rooms 	**Res.1:** sit out/ poomukham  Living room  Sleeping room- with attached toilet & dressing room 	**Res.2:** reclining seats  Living room   Open kitchen & dining	**Res.3: sit out**  Living room   Open kitchen & dining
	Res.4: entry to the house  **Living room**   Sleeping room- with attached toilet	**Res.5:** entry to the house  **Living room**   Sleeping room- separated	**Separate rooms for various functions- optimum sizes to accommodate the minimum things. An entire family used to sleep in a single room. Sleeping room with dress room and urinal facility. Separated kitchen and dining room adjacent to it.**	**Res.4:** sit out  Living room   Open dining	**Res.5:** sit out  Living room   Open dining	**Spaces with less partitions. Separate rooms for the members. Room sizes are big so as to accommodate modern facilities. Bed rooms with attached toilet facilities and dressing spaces. Concept of open kitchen and open dining space.**

5.4 MATERIALS AND CONSTRUCTION TECHNIQUES

5.4.1 The effect of materials and construction techniques on the transformation

5.4.1.1 Introduction

The traditional houses are built with local building materials. Houses are usually built by local craftsmen well versed with the local technology. Both technology and tools used were simple.

Industrially produced building materials were like concrete blocks, steel members, tiles etc were used for construction of modern houses, which is a major change from tradition to modern and symbolizes a transformation.

5.4.1.2 Transformation

Walls: The space used by the walls of the traditional house was much more. This was mainly because of the less choice of materials and the need for double storeyed houses. In res.1 & 2, tapering walls with base thickness of 48 and 80 respectively were used. About 23.6% and 26.5% respectively of the total floor area were used for walls. In the other residences also nearly 20% of the floor area is used. In the new residences, with the new materials, this trend has changed. The percentage of wall in res.1 comes to 13% with the use of 24cm brick and open planning, 13.7% for res.2 with the use of 25cm thick laterite and open planning, 9% for res.3 with the use of 15cm hollow blocks and open planning, 14% for res.4 and 13.5% for res.5 with the use of 24cm brick. Reducing the thickness of the wall has helped in reducing the floor area and thus the cost of construction.

Considering the place adaptive qualities of the materials, the traditional materials were natural and hence suitable for the region. The materials used in the selected contemporary buildings were brick, laterite and hollow blocks, out of which laterite is the best one, but it is scarce. Brick is easily available and strong & hollow brick is economical and good thermal insulator than brick, but both are not suitable for the region.

Foundation: In traditional houses, rubble or laterite was used for the foundation works. In contemporary houses also the same material use is followed. Concrete is also used.

Flooring: The choice of materials for flooring was limited to clay, terracotta tiles, timber etc. They all were good in providing a cool atmosphere in the interiors. In the selected case study, terracotta tiles and timber was used as the flooring material. In the case of contemporary

residences, material choice is more. Wooden flooring is good for the climate, but expensive as it is scarce.

Structural system: In traditional houses load bearing walls were used for supporting the roof and timber, which was easily available used as the structural member for spanning. Wooden members and arches were used for spanning openings, which limited the size of openings to 1m. In contemporary houses, instead of timber, concrete which is more strong, durable and economical is used. Concrete lintels were used for spanning openings, which affected in the large size openings.

Roof: Double roof system with timber framing paved with either palm leaves or clay tiles is the roof style of traditional houses of Kerala. The roof is a dominant feature in the design and it gives a unique appearance to the built form. In the selected case study of contemporary houses, res.1& 2 have used the same type of roof with different material. The material used for sloping roof is steel truss paved with Mangalore tiles. The ceiling is done with concrete. The advantage of this kind of roof system is that, the heat radiation from roof can be reduced and at the same time, whenever an expansion has to be done, the lightweight roof structure can be easily removed. The res. 2& 3 have employed, flat roof system with air vents in the ceiling, which helps to ventilate the ceiling, thereby reducing the heat radiation from roof. Res.5 has used the simple flat roof with concrete, which builds up the heat with the radiation.

Openings: Wooden paneled doors (double door) and windows are a common feature of the traditional houses. Wood reduces the heat radiation and the amount of reflected light will also be less. Teakwood is commonly used. Whereas in contemporary houses, glazed openings maximize day lighting through direct as well as reflection light. Such openings build up the heat through radiation through glass even if windows are closed.

Columns: Wood and laterite were the common materials used in traditional houses. In contemporary houses, res.1 & 4 have used wooden columns, so as to get the appearance of a traditional house. Res. 3 has used steel columns and laterite and brick for res.2 & 5 respectively.

Exterior finishes: Lime mortar with admixtures of vegetable juices is used as the wall finish in traditional houses. The white color reflects the heat and hence keeps the interior temperature less. Red/Black oxide with a local mix of egg white batter and lime is most commonly used for flooring, which gives a rich shine on polishing. The selected

contemporary houses had followed the trend of either white finishing or exposed walls. The wall is painted with white exterior emulsion which is a characteristic feature of traditional house and reflects the heat.

5.4.1.3 Conclusion:

The influence of materials and construction technology on the transformation is being discussed here. The elements of traditional design systems are used in the cases of the contemporary buildings with new technology and materials. With the introduction of the new system, the place adaptive qualities shall also be considered.

5.4.2 Comparison of traditional and modern houses

Table 19: comparison with respect to materials used for walls and flooring

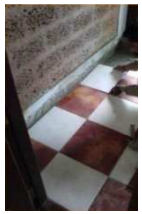
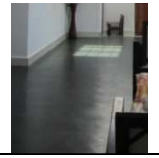
	Traditional Houses			Contemporary Houses		
walls	**Res.1:** Laterite used in double layer. Wall thickness: outer-48cm & inner- 33cm. 23.6% of the total floor area left for walls. 	**Res.2: cavity wall system**-double layered laterite wall with the gap filled with sand and utensils. Wall thickness: outer-80cm,inner-40cm  Safety & thermal insulation were the major factors. 26.5% of the total floor area for walls.	**Res.3:**laterite wall- 35cm thick, cheap, easy available, good thermal insulator. 18.5% of the floor area for walls.	**Res.1:** brick, which is easily available, economical, safer used. 23cm thick. Thermal insulation less than laterite. 13% of the floor area for walls.	**Res.2:** laterite wall 25cm thick & not plastered. Good thermal insulator. 13.7% of the floor area for walls. 	**Res.3:** hollow concrete blocks of 15cm thick-unplastered. Economical than brick. Thermal conduction better than brick, more economical & durable, provides faster construction. Only 9% of the floor area for walls.
	Res.4: unburned clay bricks of 30cm thick. Clay was locally available. Good thermal insulator. 18% of the floor area for walls	**Res.5:** laterite wall- 35cm thick, easily available, good thermal insulator. 17% of the floor area for walls.	**Laterite gets stronger and durable with exposure at atmospheric air. The space used by the wall is much more.**	**Res.4:** brick, which is easily available, economical, safer used. 23cm thick. Thermal insulation less than laterite. 14% of the floor area for walls.	**Res.5:** brick, which is easily available, economical, safer used. 23cm thick. Thermal insulation less than laterite. 13.5% of the floor area for walls.	**As the thickness of the wall is reduced, the usable space in the building is increased**
flooring	**Res.1:** terracotta tiles for ground floor. Wood for upper floor paved with terracotta tiles.	**Res.2:** terracotta tiles for ground floor. cow dung for finishing the rammed earth floor. Wood for upper floor paved with terracotta tiles	**Res.3:**terracotta tiles for ground floor. Wood for upper floor. 	**Res.1:** Cement concrete and paved with wooden panels gives coolness & the elegance of traditional flooring, but expensive. 	**Res.2:** ceramic tiles over concrete floor slab. 	**Res.3:** red oxide over cement concrete. Less expensive, low maintenance and durable. Provides a cool effect. 
	Res.4: terracotta tiles for ground floor. Wood for upper floor paved with terracotta tiles.	**Res.5:** Terracotta tiles for ground floor.	**The choice of materials were less, Natural material used provides a cool atmosphere.**	**Res.4:** red oxide over cement concrete. Less expensive, low maintenance and durable. Provides a cool effect. 	**Res.5:** vitrified tiles over cement concrete, expensive, builds up inside heat. Gives good finishing. 	Material choice is more, wooden flooring is good for the climate. Clay tile flooring which suits well for the climate, has not been used in any of the houses.

Table 20: comparison with respect to structural system and roof technique

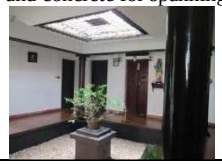
	Traditional Houses			Contemporary Houses		
Structural system	**Res.1:** load bearing tapering walls and timber for spanning 	**Res.2:** load bearing tapering walls and timber for spanning. 	**Res.3:** load bearing laterite walls of even thickness and timber for spanning 	**Res.1:** Load bearing walls and concrete for spanning. 	**Res.2:** load bearing walls and concrete for spanning. 	**Res.3:** load bearing walls and concrete for spanning. 
	Res.4: load bearing wall and timber for spanning. 	**Res.5:**. load bearing wall and timber for spanning 	Timber, which was easily available used as the structural member.	**Res.4:** load bearing walls and concrete for spanning. 	**Res.5:** load bearing walls and concrete for spanning. 	Scarcity of timber resulted in the use of industrially produced materials. Concrete which provides safety, economical and easily available is used.
Roof	**Res.1:** timber for the ceiling and the frame work and covered with clay tiles. Double roof system for thermal insulation.	**Res.2:** timber for the ceiling and the frame work and covered with clay tiles. Double roof system for thermal insulation.	**Res.3:** timber for the ceiling and the frame work and covered with clay tiles. Double roof system for thermal insulation.	**Res.1:** double roof system with concrete flat roof, for safety reasons and steel trussed sloping roof paved with Mangalore tiles for keeping the identity of tradition. The whole system reduces the heat radiation from roof.	**Res.2:** concrete flat roof, for safety reasons. Provision for air vent is provided to minimize the heat radiation from roof.	**Res.3:** concrete flat roof, for safety reasons. Provision for air vent is provided to minimize the heat radiation from roof.
	Res.4: timber for the ceiling and the frame work and covered with clay tiles. Double roof system for thermal insulation.	**Res.5:**. timber for the ceiling and the frame work and covered with clay tiles. Double roof system for thermal insulation.	**Teak wood is commonly used. More maintenance, not safe**	**Res.4:** double roof system with concrete flat roof, for safety reasons and steel trussed sloping roof paved with Mangalore tiles for keeping the identity of tradition. The whole system reduces the heat radiation from roof.	**Res.5:** concrete flat roof, for safety reasons. Absence of roof ventilation builds up the internal heat due to the radiation.	**Less maintenance, safer, durable**

Table 21: comparison with respect to exterior finishes and foundation

	Traditional Houses			Contemporary Houses		
Exterior finishes	**Res.1:** wall finished with lime plaster. Black oxide with a local mix of egg white batter and lime for polishing 	**Res.2:** wall finished with lime plaster. Black oxide with a local mix of egg white batter and lime for polishing 	**Res.3:** wall finished with lime plaster. Floor not polished. Column finished with egg white and lime to get a shiny appearance. 	**Res.1:** Painted with white exterior emulsion which is a characteristic feature of traditional house and reflects the heat 	**Res.2:** Absence of any finish for the exposed wall. The rest is painted. The texture of the material helps to scatters the incident heat and reduces the radiation to the interiors. 	**Res.3:** Absence of any finish. The texture of the material helps to scatters the incident heat and reduces the radiation to the interiors. 
	Res.4: wall finished with lime plaster. 	**Res.5:** wall finished with lime plaster. 	Lime mortar with admixtures of vegetable juices. The white color reflects the heat and hence keeps the interior temperature less. Red/Black oxide with a local mix of egg white batter and lime most commonly used, gives a rich shine on polishing.	**Res.4:** Painted with white exterior emulsion which is a characteristic feature of traditional house and reflects the heat**.** 	**Res.5:** Painted white exterior emulsion which is a characteristic feature of traditional house and reflects the heat 	The same color choice with the tradition shows the need for a continuity in one sense and also the advantage of the white.
foundations	**Res.1:** rubble used for the plinth and basement.	**Res.2:** rubble used for the plinth and basement	**Res.3:** rubble used for the plinth and basement	**Res.1:** rubble used for the plinth and basement	**Res.2:** rubble used for the plinth and basement	**Res.3:** rubble used for the plinth and basement
	Res.4: rubble used for the plinth and basement	**Res.5:** laterite used for the plinth and basement	**Rubble and laterite were the only choice of materials for the foundation. Usually laterite plinth is plastered with lime mortar. Laterite mostly used for single storeys and rubble for double storeyed constructions.**	**Res.4:** rubble used for the plinth and basement	**Res.5:**. rubble used for the plinth and basement	**The choice of materials is more. Other than laterite and rubble, reinforced concrete is also used.**

Table 22: comparison with respect to materials used for columns and openings

	Traditional Houses			Contemporary Houses		
openings	**Res.1:** wooden paneled doors and windows; Wooden louvers 	**Res.2:** wooden paneled doors and windows; Wooden louvers. 	**Res.3:** wooden paneled doors and windows; Wooden louvers 	**Res.1:** glazed windows and wooden paneled doors. Full size windows allow natural light to maximum, at the same time builds up the temperature inside through radiation through glass. The presence of verandah and deep overhang prevents the direct exposure of the windows to sun. 	**Res.2:** glazed windows and wooden paneled doors; & steel louvers, which is economical and at the same time establishes continuity with the past. The deep overhang prevents the direct exposure of glazed windows. 	**Res.3:** fixed glass for slits, folding glass windows awning windows, wooden paneled doors. Fixed glasses and less opening seems to build up the heat inside but it is less felt. 
	Res.4: wooden paneled doors and windows. Colored glasses were also used for windows. 	**Res.5:**. wooden paneled doors and windows; Wooden louvers 	**Teak wood is commonly used. Wood reduces the heat radiation and the amount of reflected light will also be less.**	**Res.4:** glazed window panels, wooden paneled doors. No measures for avoiding the direct exposure of the windows. Hence it builds up the heat inside.	**Res.5:**. glazed window panels, wooden paneled doors. No measures for avoiding the direct exposure of the windows. Hence it builds up the heat inside.	Glazed openings maximize day lighting through direct as well as reflection light. Builds up the heat through radiation through glass even if windows are closed.
columns	**Res.1:** Wooden columns 	**Res.2:** Wooden columns 	**Res.3:** wooden and laterite columns  	**Res.1:** wooden columns, establishing a continuity with the past 	**Res.2:** laterite columns 	**Res.3:** steel columns which are economical and less space consuming. 
	Res.4: Brick columns	**Res.5:**. wooden columns	Wood and laterite were used because of the easy availability as well as the structural capacity.	**Res.4:** wooden columns, establishing a continuity with the past 	**Res.5:**. brick columns 	**In res.1 & 4, the intention behind the provision of wooden columns, which is expensive, similar to tradition is to keep the identity of tradition. In other cases other economical methods are opted.**

Chapter 6

SUMMARY & CONCLUSION

6.1 Summary of the study

Throughout the study, the transformations of the stand-alone residences based on various aspects influencing the house form were analyzed. The study identifies and analyses certain characteristics of the traditional architecture which is continued in the contemporary designs as well as those which are imitated.

While analyzing the effect of principles and elements, it was found that some of the strategies of the traditional houses are blindly followed in the contemporary buildings without considering the reason behind it. In some cases, the traditional wisdom is being completely neglected.

The analysis based on climatic aspects, shows that the traditional houses had better solutions for most of the problems arise by the climate. The contemporary houses have interpreted many of the concepts of tradition in a useful way. For example, the straight alignment of openings, double roof system, air vents at roof level, use of permanent openings, courtyards, deep overhang for shading, the wind drawing technology of the sloping roof etc. are some of the concepts of tradition which are being interpreted and used in the new residences. The use of climate responsive elements is comparatively less in the contemporary residences which have to be considered seriously.

The introduction of new materials and technology has revolutionized the trend followed for thousands of years. The sloping roof construction with timber which is a unique style of the architecture of Kerala is now being done with steel truss which is less time consuming and economical. The integration of place adaptive qualities along with the usage of new materials has been seen in some cases of the selected studies which is relevant.

The socio-cultural aspects are the major ones in the transformation. The way of life of the people had great influence because the large granaries, which were a necessity is no longer exists. With the breakup of joint family system, the concepts of big mansions were avoided. The change in life style has a direct impact on the transformation as we can see that the need

for incorporating modern facilities has affected in the increased space requirements and the concept of enclosed dining and separated kitchen changed to open dining and open kitchen.

6.2 Conclusion

It can be seen that there have been a strong transformation in the physical characteristics of the house. The arrangement of spaces in the houses, which once followed the geometrical rules and regulations are now following the geometry of plots available. The multi-functional spaces are entirely replaced with single-function spaces.

The physical changes happened along with the transformations in the socio-cultural aspects. The extended families were replaced by nuclear families. The way of living and the life style of the people have changed a lot.

As time passes, and with change of life style, the needs of the person also changes even though many physical and physiological needs such as the need for openness, airiness, privacy etc. remain unchanged. Even though some aspects of the traditional architecture were valuable and rich, the same system cannot be followed today because the conditions under which traditional architecture evolved have changed and no longer exist today. People always have the tendency to come back to their base culture which is visible in their adaptation of the traditional characteristics. The integration of time adaptive qualities such as new building materials, construction methods and structural systems along with traditional design systems can be done without affecting the place adaptive qualities of the design. So it is important that the architects and designers should try to incorporate the traditional wisdom into the modern houses, rather than adopting the new technologies as such.

6.3 Utility of the study

The present study has analyzed the relevance of continuity of traditional systems for adaptation in contemporary design practices. The study identifies certain built forms and the features which integrates the traditional wisdom with contemporary building materials and construction methods without disturbing the place adaptive qualities of the design.

6.4 Scope for future research

The kind of analysis done in the study is purely architectural. There is scope for further improvements in the methodology.

The comfort level in terms of wind, temperature and illumination can be analyzed and compared with the traditional houses so as to understand how efficiently the contemporary houses have used the traditional wisdom.

In conclusion, the present research will create awareness among the designers to include the traditional wisdom to the contemporary design so as to integrate the time adaptive qualities such as the advanced materials and construction technology with the place adaptive qualities of the design.

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ANNEXURES

ANNEXURE 1

Questionnaire for the interview with architects:

1. What style has been followed during the design of the residence?
2. Is there any traditional characteristic feature in the building? If yes, what are they?

   a. Are all the above mentioned features appropriate? If yes, how?

   b. What are the outstanding components that reflect the characteristic traditional features in the building?

   c. What is the ambiance brought about by the traditional features in the building?

3. How the transformation is done?
4. Have you used traditional building materials?
5. Traditional features are used for its functional utility/use or they are used to satisfy the traditional identity or both?
6. How do you compare the spatial configuration in your building and the traditional ones?
7. While designing a building, what do you prefer- traditional style or contemporary? Why?
8. What are the other potential aspects of traditional architecture that can be adapted to new buildings?

ANNEXURE 2

Questionnaire for the interview with occupants:

1. What do you like from traditional Kerala architecture?
2. Is there any traditional characteristic feature in the building?
3. Are all the above mentioned features appropriate? If yes, how?
4. What are the outstanding components that reflect the characteristic traditional features in the building?
5. What is the ambiance brought about by the traditional features in the building?
6. Are you satisfied with the spaces inside- in terms of function and comfort?