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Construction Practices in Traditional Dwellings of Kerala, *India*

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The Faculty of Graduate Studies and Research
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the degree of Master of Architecture

Construction Practices in Traditional Dwellings of Kerala, *India*

Abstract

This thesis examines the construction practices in the traditional domestic architecture of Kerala in India. In doing so, it identifies two vital aspects of the architecture, namely the *Vedic* planning principles of the *Vasthushasthra* and the indigenous craft practices. The thesis pays tribute to both: the theories of *Vasthushasthra* in the construction of houses are examined in detail; the craft practices are documented and analyzed through a field study of 24 houses in Kerala selected across the caste, class and religious structures of the society. The thesis arrives at the proposition that the construction practices in the domestic architecture of Kerala, as evident in the case studies, are the result of a simultaneous presence of both these aspects. The *Vedic* principles were adapted to the contingencies of the context. The craft and techniques prevalent in Kerala at that time are part of a larger picture of cross-cultural transfer of techniques that occurred in the early historic times. Thus in Kerala, practice and theory worked together towards making a traditional domestic architecture that was meaningful and relevant in the socio-cultural, political and religious context at that time.

Les pratiques de construction des maisons traditionnelles de Kérala, en Inde

Résumé

La présente thèse étudie les pratiques de construction dans l'architecture domestique traditionnelle de Kérala, en Inde. En ce faisant, elle identifie deux aspects vitaux de l'architecture; notamment les principes *védiques* de planification du *Vasthushastra* et les pratiques traditionnelles de l'artisanat de construction. La thèse rend hommage aux deux aspects: les théories du *Vasthushastra* dans la construction des maisons sont examinées en détail; les pratiques de l'artisanat de construction sont documentées et analysées à l'aide de l'étude de vingt-quatre maisons à Kérala, sélectionnées parmi les différentes structures de castes, de classes et de religions de la société. A travers l'observation de ces cas, la thèse en arrive à proposer que les pratiques de construction dans l'architecture domestique de Kérala proviennent de la présence simultanée de ces deux aspects. Traditionnellement, les principes *védiques* étaient adaptés aux éventualités du contexte. Les métiers et les techniques de construction prédominants faisaient partie d'un plus vaste phénomène: celui d'un échange inter-culturel s'étant produit durant les premières périodes historiques. A Kérala, pratique et théorie travaillaient de pair pour créer une architecture traditionnelle domestique significative dans le climat socio-culturel, politique et religieux à cette époque.

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I thank Professors Ashalatha Thampuran, Mariamma K. and Narayanan K., who were my former teachers in architecture; Mr. M. G. Sashibhooshan; Mr. Ananda Bose, director of Nirmithi Kendra; Mr. Cyriac T. M, colleague and lecturer; N. M. Mohan, chief editor to Balarama Publications; George Punnoose, colleague and critic; all in Kerala, for their encouragement and support lent to me during my field visit. I am greatly indebted to my colleague Jayakrishnan K. B. for helping me during the time when my whole thesis literature and field work documents got lost on my return flight to Montreal, creating a 'thesis void' for the whole month of December 1995 until its miraculous retrieval.

I wish to thank my close friends who have, in one way or another, guided me all along.
- Roula, who was a source of unconditional support and inspiration without which this thesis would have never been.
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I am indebted to my cousins Tony, John and Jacob and their families for their support and love. I am indebted to my brother Antony for his assurance and help which were free and most generous.

My true mentor throughout this effort has been my mother. To her I dedicate this thesis.

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[1] In this list and in the plates, figures adapted from the original with modifications are denoted using the term *After*; and those reproduced as such, using the term *Source*; to acknowledge the original sources.

2. Pictures

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Introduction

This thesis examines the construction practices within traditional domestic architecture of Kerala. By "traditional" domestic architecture, I mean houses built during a specific historic period -- from 14th to mid 20th century.[1] The thesis involves a detailed survey and documentation of select samples of these houses which incorporate common construction techniques. The prime objective of this study is to attain an understanding of such construction techniques pertaining to materials and structure, as applied in traditional house building in the region.

Background

The region of Kerala is located on the southwestern coast of the Indian subcontinent, having its own distinct topographical, cultural and linguistic identity. It is bounded by the Arabian Sea in the West and the Western Ghats in the East (Refer Figure: I.1 and Figure: I.2). Kerala receives the full brunt of the monsoon winds that bring heavy rains for three and a half months to the entire region. The rest of the year, the region experiences a warm, humid climate intercepted by seasonal rains in between. Kerala hence has extensive rainforests which provided an abundant supply of high quality timber. The specific climatic conditions, the abundance of wood, and the unique community structure resulted in the development of distinct features that characterize the traditional architecture of Kerala.

The traditional architecture of Kerala comprises temples, palaces and houses built until 1947[2] which characteristically reflect the unique wood construction system in this region (Refer Figure: I.3). The ridge roof pitched at angles between 30 to 45 degrees forms the

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[1] This period delineated based on the evidence of domestic architecture that I encountered in my field research: the maximum age of the houses still existing in Kerala is about 500 years. To the detriment of this thesis, there is no existing physical evidence of domestic architecture built prior to this period, which leads to the assumption that earlier houses were of semi-permenant construction.

[2] This, also being the year of India's Independence mark the start of a epoch in the history of the region in which traditional societal and family structures start to break down and new social order begins to emerge. The influence of this transition on architecture is vital in traditional construction materials (such as wood) and practices begin to be replaced by modern construction technology.

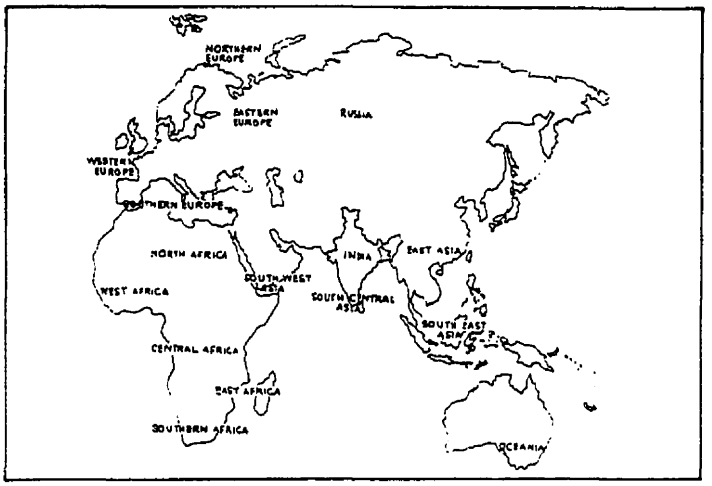

Figure I.1: *India located as part of South Central Asia and the surrounding major cultural region (Source: Debenham, The Reader's Digest Great World Atlas, 1982).*

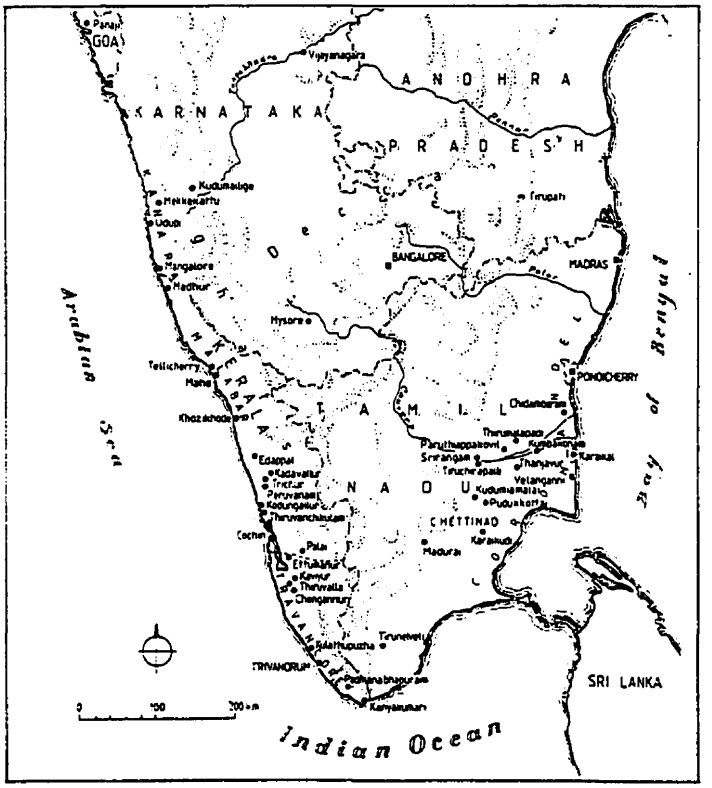

Figure I.2: *Map of Southern India, now divided among the four states of Karnataka, Andhra Pradesh, Tamil Nadu and Kerala. Also shown are the 3 historical regions in the West coast of South India such as Canara, Malabar and Travancore.*

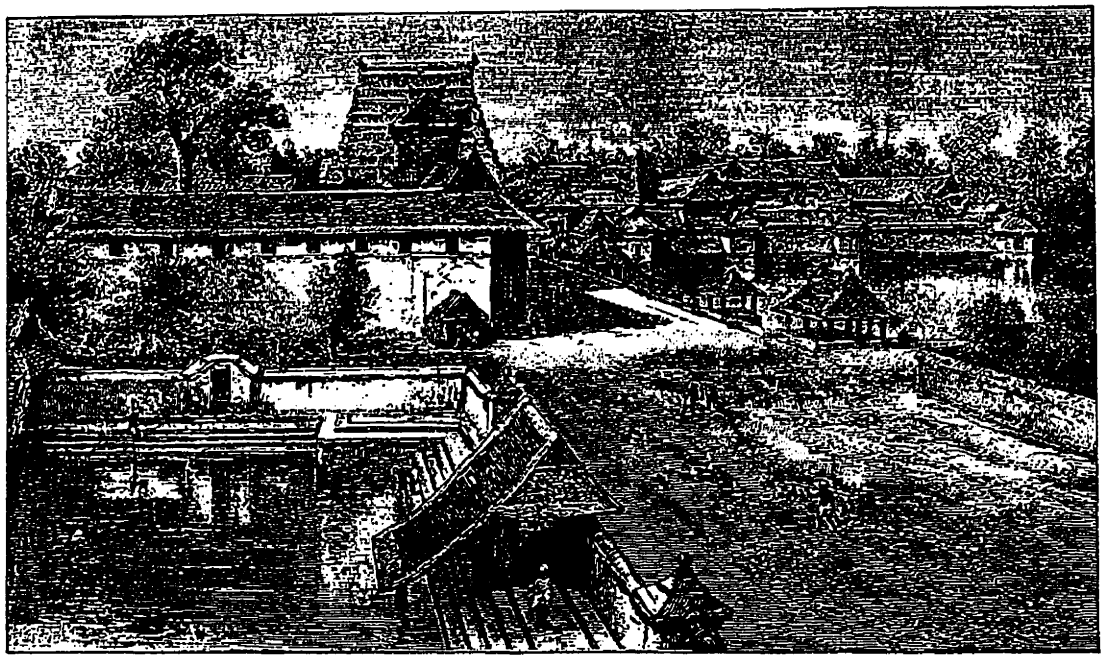

Figure I.3: *A view of the main axial street of the temple city --Thiruvananthapuram-- in Travancore (Source: Matteer, Native life of Travancore, 1871).*

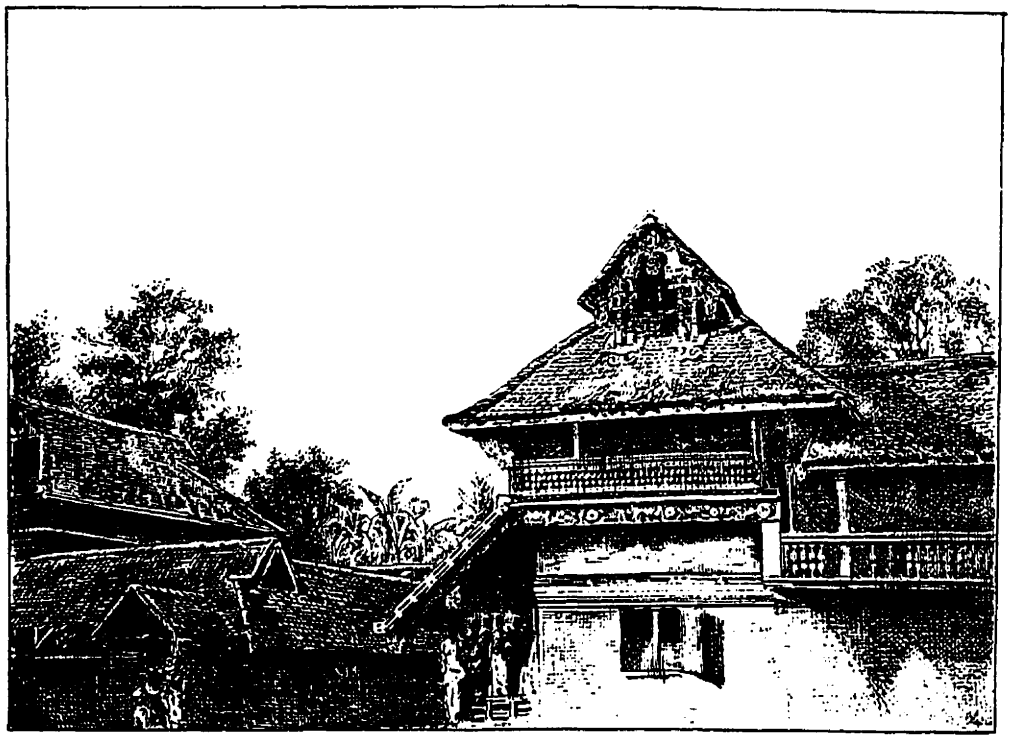

Figure I.4: *View of a traditional palatial complex --kottaram-- in Travancore region (Source: Matteer, Native life of Travancore, 1871).*

main visual and functional element that renders a distinct identity to the region's architecture. The roof was embellished with intricately carved gables protruding from the roof, and had generous overhangs sometimes supported by wooden brackets (Refer Figure: I.4).

This form and features are believed to have evolved through a history of tradition dating back as early as the *Vedic* period.[3] During this period, the Dravidians who followed the Jain and Buddhist religions, incorporated into their thought and practices, some of the *Vedic* principles that they adopted through interaction with the Brahmins. Later, in the wake of the teachings of Adi Shankaracharya,[4] there occurred a revival of Hindu thought from the *Vedic* past, resulting in the domination of the Hindu religion and culture over Jainism and Buddhism. This tradition continued to grow more stable and organized in the later centuries, a productive period in the indigenous architecture of Kerala. In this millennium (8th to 18th century), Kerala architecture attained refined standards following the *Vedic* principles of the science of architecture. This period also witnessed the distillation of architectural theory: treatises such as *Manushyalayachandrika, Thantrasamuchaya* and *Shilparathna* were written during 15th and 16th century.

The "colonial style" in Kerala emerged during the period of colonization (16th to 20th century) when the Portuguese, the Dutch, the French and the English adapted European modes of construction to the local practices. By mid 20th century, after India attained independence, new developmental policies resulted in rapid urbanization and industrialization. This effected drastic changes in the social, political and economic structures prevalent in the country, which occurred also in Kerala. The transformation in dwelling pattern following the change in familial structure from joint to nuclear gave rise to an acute demand in housing. The popularity of reinforced cement concrete technology changed the mode of construction and the form of architecture. The use of wood as the

[3] 500 BC-200 AD.

[4] lived during 788 AD-820 AD, led to renaissance of Hinduism.

primary construction material was discarded when its prices went up following the invasion of concrete technology. The long tradition of wood construction practice had produced in Kerala craftsmen who were skilled in their craft at the same time well versed in theoretical principles. Remnants of this practice is seen even today, but the number of skilled and knowledged craftsmen has dwindled.

The construction practices and the development and refinement of the traditional architecture of this region have been mostly unrecorded, and rarely become a subject of study. During the past 30 years, numerous old buildings from the mediaeval to the colonial periods have been demolished. The annihilation of these buildings threaten the loss of valuable physical evidence on the thoughts, customs and practices of the past society. This concern over the disappearance of traditional architecture motivates this project: to study the construction practices of traditional wooden houses of Kerala, focusing on Travancore, its southern district (Refer Figure: I.2).

Research problem

The primary research question that this thesis addresses is formulated as follows:

> **Kerala's traditional domestic construction practices: derived from the *Vedic* theories of the *Vasthushasthra* or developed from craft practices?**

Definitions of key words

Traditional- means or practices transferred through generations which reveal the attainment of a certain refinement over this process of transfer.

Domestic- pertaining to the home environment.

Construction practices- the wisdom derived from techniques, art and craft prevalent in the region.

Vasthushasthra- The science of architecture as stipulated in *Vedic* scriptures.

The scholarly context of the study

The study of traditional architecture has assumed a distinct dimension recently. Scholars of diverse backgrounds and interests have been attracted to the study of traditional architecture all over the world. Buildings and artifacts were the principal surviving evidence for many of these scholars, especially in the contexts where written documents were non-existant. Scholars from as diverse fields as history, anthropology, archaeology, folklore, geography, architects and so on have embraced this approach through artifacts as an authentic and effective method of study.[5]

In the West, the Arts and Crafts Movement's interest in hand craftsmanship inspired many of the earliest scholars in traditional architecture. They gave considerable attention to the study of materials and structural systems. For them, a technical understanding formed the pre-requisite to understand broader issues of form and meaning in architecture. Construction has only recently become a subject of historical study, the first volume of *Construction History* appearing in 1985. Recently, construction practices in specific regions are being taken up as a common area for research. This thesis is located within such a context of studies.

In *Early Carpenter's Manual 1592-1820,* David.T.Yeomans examines English carpentry from the 18th to 19th century as an indicator of the evolution of building form simultaneous with change in architectural style. Yeomans traces the particular field of roof construction practices and presents with a few publications on his explorations on roof structures. In his later book *Trussed Roof: its History and Development* he traces the origin of new structural ideas of the time and the way they were adopted and used by architects and by carpenters.[6] The book discusses how the knowledge spread rapidly into the construction practice and considers whether this happened through the agency of

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[5] Dell Upton, "The Power of Things: Recent Studies in American Vernacular Architecture," American Quarterly , March 1983, 262-279.

[6] David Yeomans, The Trussed Roof: Its History and Development (England: Scholar Press, 1992), 221.

architects or carpenters who built the roofs. The third in series on 18th century timber construction in Britain was published in *Architect's Journal*, 1991 July issue.[7] Heinrich Engel in his book, *The Japanese House A Tradition for Contemporary Architecture* brings a holistic dimension in studying construction practices, which in many ways and for many reasons form a model for this study of the similar context to that of Kerala.[8]

The study of traditional architecture has branched out into various lateral fields recently. Sybil-Mohaly-Nagy's *Native Genius in Anonymous Architecture* and Bernard Rudofsky's *Architecture without Architects: An Introduction to Non-pedigreed Architecture*[9] characterize traditional buildings as drawing their beauty from blending with the environment at the same time, serving the basic necessities of people. Later on Amos Rapoport in his book *House Form and Culture* rebutted functional, environmental, economic and other forms of determinism, to lay the emphasis on culture as primarily influencing house form.[10] Construction practices, one can easily see, also develops within this milieu.

IASTE (International Association for the Study of Traditional Environments), established at the First International Symposium on Traditional Dwelling and Settlements held at Berkely in April 1988, conducts biennial conferences on select themes in traditional building environmental research. IASTE has published 55 volumes of *Traditional Dwellings Working Paper Series* which are a compilation of the papers presented at the International Symposium in the years 1988, 1990 and 1992.[11] This covers a wide range of studies in traditional dwellings and settlements throughout the world. The studies

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[7] David Yeomans, "18th Century Timber Construction 3: Roof Structures," Architects' Journal, July 1991, v.194, 45-50.

[8] Heinrich Engel, The Japanese House - A Tradition for Contemporary Architecture (Tokyo: Charles E. Tuttle Company, 1964), 101-220.

[9] Bernard Rudofsky, Architecture without Architects: A Short Introduction to Non pedigreed Architecture (New York: Doubleday, 1964).

[10] Amos Rapoport, House, Form and Culture (New Jersey: Prentice-Hall Inc: Englewood Cliffs, 1968), 25.

[11] Traditional Dwellings and Settlements-Working Paper Series, Vol. 1 to 55, Centre for Environmental Design Research (Berkeley: University of California, 1988, 1990 and 1992).

include documentation and analysis of aspects of culture, craftsmanship, construction, evolution, environment, form, theory, technology, myth and symbolism in traditional settlements. The 17th volume of this series titled, *Traditional Construction Practices* has 6 articles, all of which deal with timber construction in different parts of the world. The first article is *The Evolution of French Colonial Architecture in the Mississippi River Valley* by Edward. J. Cazayoux. It is about a distinct Louisiana Creole style of architecture developed from adapting to the coastal climate with locally available materials, within the context of French colonial culture. The French colonists produced a distinctive style of timber framed architecture unique to this continent. The lean-to double-pitch-hip roof was later on replaced by a steep-hip roof in order to adapt to the problem of rain water runoff. It studies the evolution of form and construction details of this architecture. The second article *The Gable End* by Michael Robert Austin is a formal description and analysis of the treatment of gable ears in Oceana. This article elaborates on the different treatments from hip and rounded forms to peaked and cantilevered projections, extensions and additions of the gable ears. *The Wood Framework of Traditional Dwellings in South-East Asia* deals with the system of wood frame work characterizing the dwellings of South-East Asia. *Traditional Wood Architecture of Cameroon* by Wolfgang Lauber and *The Pitches of the Timber Roof Construction in Eastern Europe* by Kunio Ohta, study traditional timber dwellings in Eastern Europe and the still developing techniques of roof-building in ethno-cultural backgrounds. *Traditional Construction Practices Utilizing Unreinforced Masonry in Seismic Areas,* focuses on the composite wood and masonry construction in Kashmir, Greece, Yugoslavia, El Salvador and Nicaragua, which incorporate elements in their design that are intended to improve the performance of the structures during earthquakes.

Studies of dwelling construction in Kerala have their basic information contained in the manuals on traditional construction and planning theories such as the *Thantrasamuchaya*,

Manushyalayachandrika and *Mayamatha*[12] of the 15th century and *Shilparathna* by Sri Kumara of the 16th century. The *Malabar Manual,* written by Sir William Logan, a British administrator during the late 19th century describes in detail the climate, construction and architecture, history, physical features, vegetation, demography, social customs, trade and commerce on the Malabar coast.[13] Dr. Stella Kramrisch and Dr. J. H. Cousins write about the exquisite craft, techniques and symbolism in the traditional temple and domestic architecture of Kerala in their book *The Arts and Crafts of Kerala.*[14] Unpublished documents preserved in the National and State Archives, *District Gazetteers* and Government *State Manuals* are potential sources of information on records and historical facts in general with considerable amount of detail. K. P. P. Menon in his *History of Kerala Written in Form of Notes on Visscher's Letters from Malabar* discusses critically the practice of house construction based on the Hindu canons; and conducts a spatial analysis of houses of different castes.[15] Documentation of the traditional roof artifacts, techniques and skills of the carpenters also exists. Professor Mariamma K. in her Masters thesis supplies a detailed list of all the Hindu treatises on architecture in India and of many publications in this field.[16] Articles published in local journals by scholars in this field are widely available locally.[17] Apart from these are many unpublished studies and documentation done by the students of schools of architecture in Thiruvananthapuram and Kollam and those in other states of India, which when compiled, serve as an important resource for the study.

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[12] Bruno Dagens, Architecture in the Ajitagama and the Rauravagama- An Indian Treatise on Housing, Architecture and Iconography. (New Delhi: Sitharam Bharatia Institute of Scientific Research, 1985), 9-10,89-106, [English transalation].

[13] William Logan, Malabar. (Thiruvananthapuram: Chaithram Publication, 1981).

[14] Dr. Stella Kramrisch, and Dr. J. H. Cousins, Arts and Crafts of Kerala, (Ernakulam: Paico Publishers, 1973), 24-50.

[15] K.P.P. Menon, History of Kerala Written in Form of Notes on Visscher's Letters from Malabar, Vol. 4 (New Delhi: Asian Educational Services, 1986), 147-183.

[16] Mariamma K., "Analytical Study of Manasara Vasthushasthra and its relevence to Modern Architecture," Master's thesis, University of Roorke, India, 1981.

[17] Refer publications of Vasthuvidhyaprathishtanam, International congress on Kerala Studies and Architecture + Design Journals etc.

Objectives

The ultimate aim of this study is to record, compile and synthesize information on construction practices employed in the traditional wooden houses of Travancore which would serve as a foundation for further study in the field. In the course of this study an understanding of the following aspects of traditional domestic architecture in Kerala is sought to be attained:

- The ways of house planning, forms and typologies as prescribed in the Hindu canons on planning and architectural construction.
- Wood construction practices employed in traditional house building in Kerala, by an analysis of case studies carried out in the Travancore region.
- The traditional timber roof construction practices of Kerala.

I will finally weigh the understanding gained thus in a critical light, to address the research question.

Research methodology

The research starts with a literature survey which gives a clear understanding of the larger picture of Kerala's socio-cultural setting. The first 3 chapters will discuss the key factors that influenced Kerala's traditional architecture. Following this, a case study of a few traditional houses is conducted in the Travancore region to analyze the craft and material technology in traditional house construction (Refer Figure: I.2). The data, its analysis and findings will form the fourth chapter. Speculations and references on potential research and further studies will be accounted for in an additional section. The extent of the study is limited to compiling and analyzing data and identifying directions for further study in the field.

Chapter 1: Social History of Kerala and the Evolution of Traditional Settlements and Dwellings

1.1. Introduction

An account of the socio-cultural setting of Kerala will be necessary to understand the settlement pattern, domestic architecture and its construction practices of the different castes and classes. Kerala's socio-cultural history is vague and controversial even to this date. However, here I will attempt to streamline a history based on available evidence, on the setting and influences that eventually reflect in the traditional domestic environments and construction techniques.

1.2. Kerala's social history in brief

Archaeologists have broadly classified 3 major periods of ancient Indian history as follows:

1. The period of First Urbanization, referred to as the Dravidian or Indus valley civilization which reached its peak of glory roughly around 1750 BC.
2. The intervening Dark Age[1], considered to be a period of a "reverting to preliterate peasant communities."
3. The period of Second Urbanization roughly starting from 700 or 600 BC -- the Aryan or *Vedic* civilization, in which urban life flourished once again.[2]

Dravidians, the original inhabitants of northern India are believed to be driven south by the Aryan settlers from central Europe. They became the first migrants to settle in Kerala, which was already inhabited by various tribes. Later, during the *Vedic* period, the *Vedic rishi* Agasthya introduced the Aryan institution of Brahmanism in the Dravidian south. In the post-*Vedic* period, the religious orders of Jainism and Buddhism developed in the north as offshoots of *Vedic* Hinduism and at a stage, challenged Hinduism through extensive missionary activities. Jain and Buddhist missionaries found their way to the south too. Jain missionaries who penetrated into this region through the territories of Mysore and Tamil Nadu founded centers all over Kerala. Buddhism reached Kerala not over-land straight from the north, but in a circuitous way via land and sea through China

[1] thousand years of obscurity.

[2] Debiprasad Chattopadhyaya, History of Science and Technology In Ancient India (Calcutta: Firma KLM Pvt.Ltd., 1991), 3-10.

and Sri Lanka. During this time (around the beginning of the Christian era), Buddhism was the dominant religion in Kerala. This is attested by the names of places ending with *pally* meaning Buddhist *vihara*,[3] which were quite common then (and still exist).

Politically, Kerala was ruled during this time by the Chera Kings who established their kingdom on the western seaboard of the Western Ghats. There were periods of prosperity and decline of the Chera kingdom in their frequent wars with the neighboring Chola kingdom. The Chera kings maintained trade links with the Arabs, Chinese, Jews, Greeks and Romans. The main port of the kingdom at that time was Muziris (Refer Figure 1.1), a flourishing town in the trade of spices, peacock, muslin, and various forest products. The volume of this trade grew immensely after the discovery of the sail route aided by the monsoon winds[4] (Refer Figure 1.2). These trade links were instrumental in bringing the Semitic religions such as Judaism, Christianity and Islam to Kerala. There existed early Jewish settlements in Muziris (now Kodungalloor). The one in the town of Mattancherry with its two synagogues still exist.

Christianity came to Kerala in the first century. The apostle Thomas is believed to have reached Kerala in 52 A. D. and propagated the teachings of Christ among the natives. Around this time there were also migrations of Christians to Kerala from Syria and the Arabian peninsula. Later, Islam took root in Kerala through contact with the Arabs. These communities prospered by their gaining special privileges from the kings, and the flourishing of their trade. Thus, in the early Christian era, the society of Kerala was a milieu of these communities and religions coexisting in peace and prosperity.

A major wave of Aryanization occurs in the 7th and 10th centuries A. D., when a large group of Brahmins move into Kerala from Kohlapur. This also corresponded with a massive revival of *Vedic* thought which started in Kerala with the teachings of Adi Sankaracharya. With this development, Hinduism regained stature as the major religion

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[3] Following etimological references. Examples: Karthigapally, Kanjirapally, Edapally etc.
[4] Ibid. 83.

all across India, and also in Kerala. A rejuvenated Hinduism under the leadership and power of the Brahmins implemented with full force in Kerala the caste hierarchies, thus stratifying the society. Such a caste hierachy was the hallmark of the Kerala society, which was prevalent even upto mid 20th century.

Around the 12th century, Kerala disintegrated into smaller principalities after the decline of the second Chera empire following long wars with the Cholas. The prominent local kingdoms during this period were Venadu,[5] predecessors of the Maharaja of Travancore, the Zamorins of Calicut,[6] the Cochin royal house[7] and the Kolathiris[8] in north Kerala. In 1498, the Portuguese, the first colonists to arrive in the Indian subcontinent, landed in Kerala. They established trade with the local kingdoms and later seized their territory to establish the colonial rule. They were followed by the Dutch, the French and the English who followed the same strategy. The English emerged as the most powerful in this struggle among the colonists for supremacy. In Kerala, the northern district of Malabar came directly under British rule, while the kingdoms of Travancore and Cochin were ruled by native kings who acknowledged British sovereignty. In Kerala, the colonial rule brought about a revival in the Christian faith, with the Christians acquiring a new-found privileged status in the society. The activities of Christian missionaries brought education (in the Western tradition) to the masses; this countering the esoteric *Vedic* education of the Brahmins.

After India's independence from colonial rule in 1947, the state of Kerala was formed merging the three districts of Travancore, Cochin and Malabar. Many of the caste practices were put to an end by government ordinances. Land reforms bills effected a breakdown of the feudal system of land ownership. Thus during this age, the traditional social structures broke down, and the society assumed the nature of a modern democratic one.

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[5] 12th century AD.

[6] 13th century AD.

[7] which rose to prominence in the16th century AD.

[8] 14th century AD.

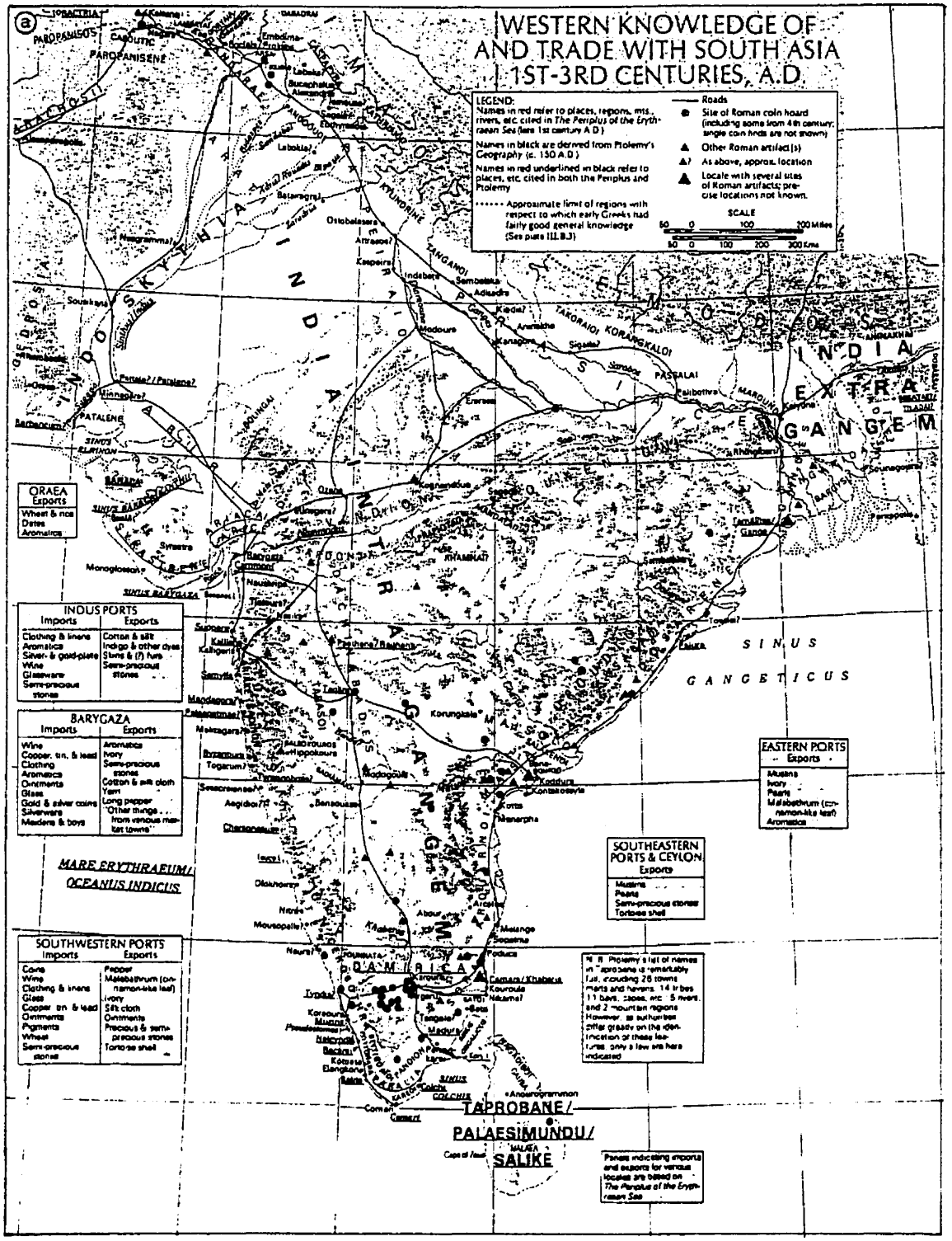

Figure 1.1: *Map showing Western knowledge of trade with India during 1st to 3rd centuries, AD (Source: Schwartzberg, A Historical Atlas of South East Asia, 1978).*

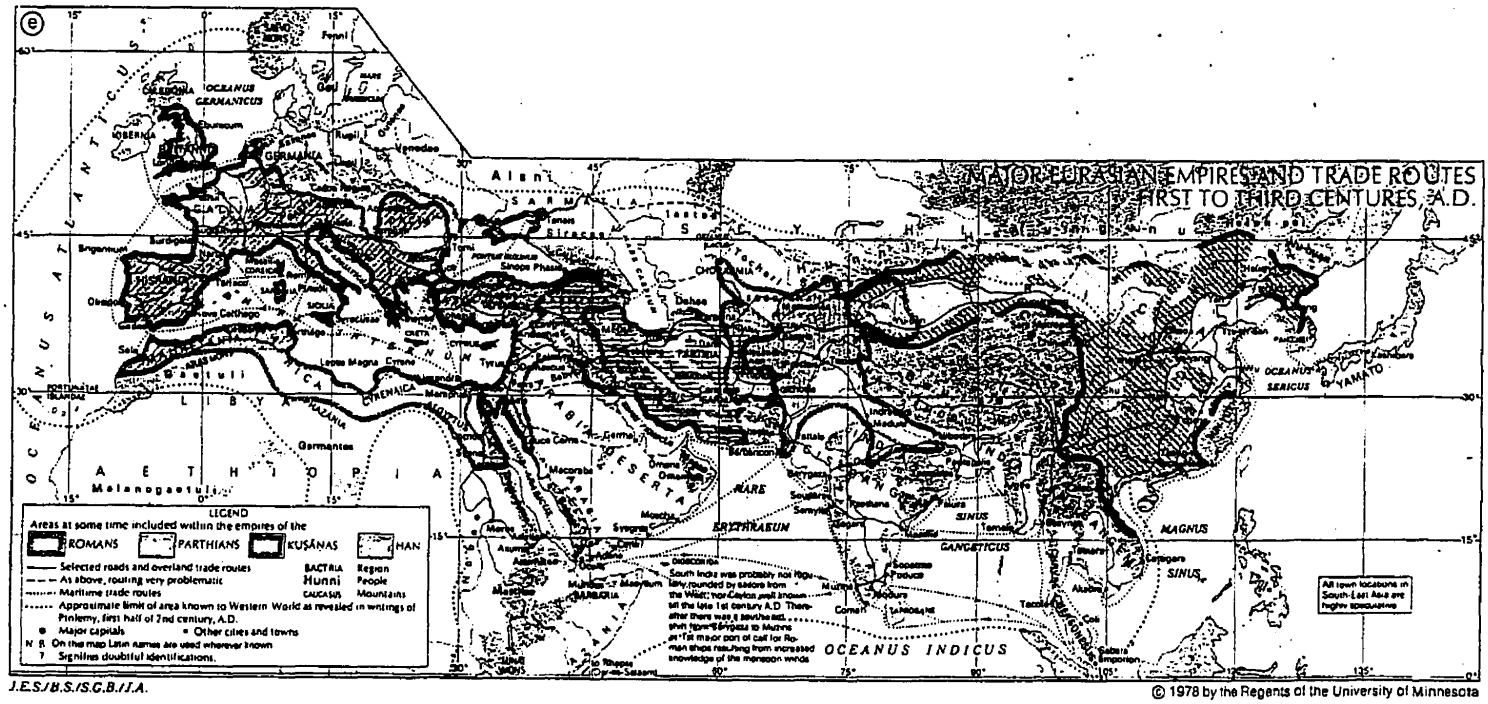

Figure 1.2: *Major Eurasian empires and trade routes - 1st to 3rd centuries, AD*
(Source: Schwartzberg, A Historical Atlas of South East Asia, 1978).

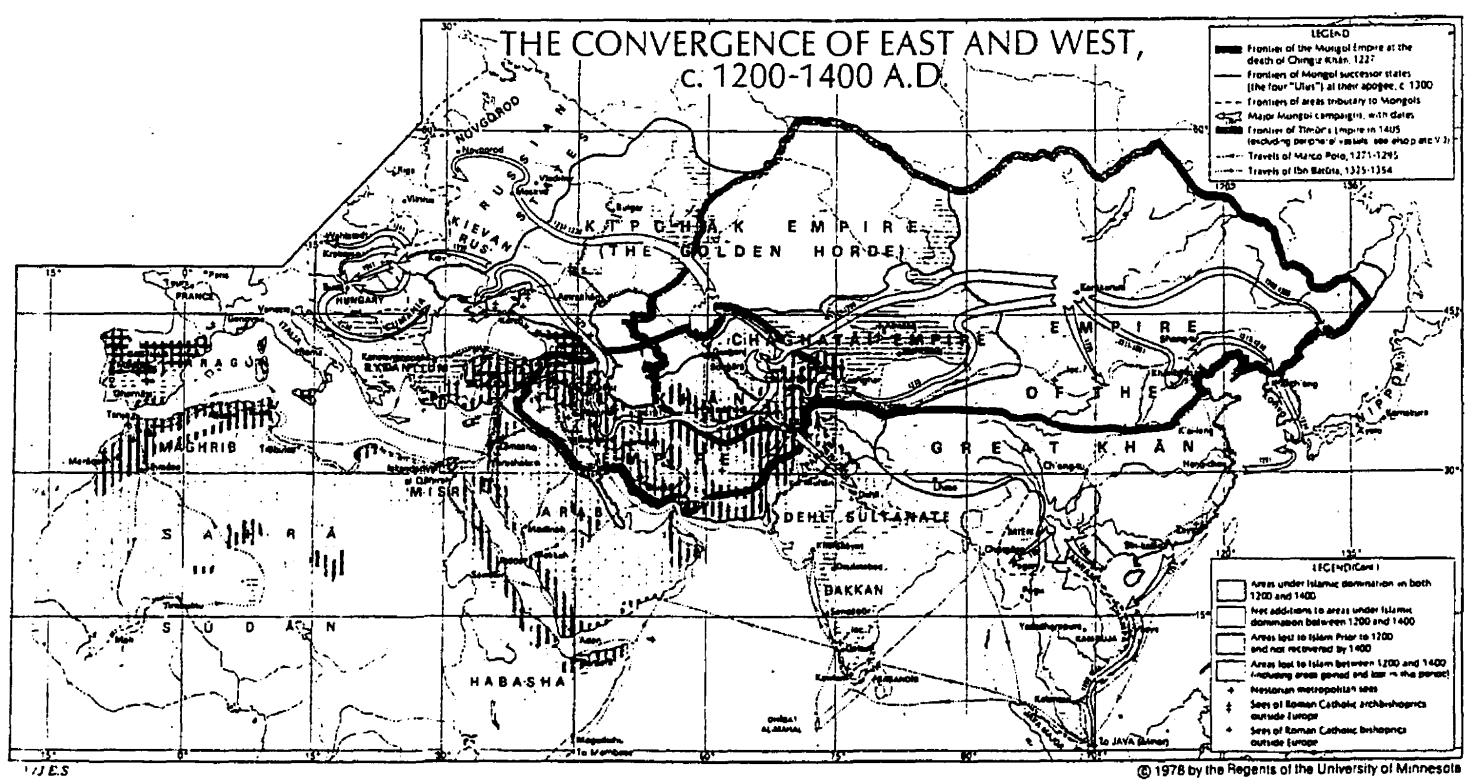

Figure 1.3: *The convergence of East and West (Source: Schwartzberg, A Historical Atlas of South East Asia, 1978).*

1.3. Transfer of Construction Techniques and Architecture

The syncretism of cultures and religions that occurred in Kerala over the centuries that was brought about by waves of migration and trade relations had profound influences in the development of construction practices in Kerala. Techniques that came to Kerala from foreign nations and peoples were adapted to suit the local conditions of climate, social structure and cultural practices. The new settlers themselves initiated this process of adaptation so as to blend themselves and their architecture into the socio-cultural milieu and the existing built environment of Kerala.

The tribal populace who were the original inhabitants of Kerala lived in settlements comprised of hutments clustered together. They had developed techniques with the materials available from the immediate locality such as bamboo reeds, grass, mud, stone and so on. The Dravidians, the first migrants to settle in Kerala brought with them their own construction techniques which also had traces of the Aryan *Vedic* construction practices. Using this knowledge and techniques, they generated in Kerala a distinct indigenous architectural form of pitched roof using bamboo and wood rafters and thatch for cover. Later, during Jain and Buddhist periods[9] the practice and skills in wood and bamboo construction were translated to composite construction techniques in wood and stone. This translation enabled the craftsman to refine his skills by imparting artistic expression into these materials.

The Jews, Syrian Christians and Arabs who arrived around the 1st century A. D., adapted their own ways of construction to local modes and practices. St.Thomas, who propagated Christianity in Kerala was himself a craftsman. In his travels in the subcontinent, he is recorded to be introduced to king Gondophares in Gandhara as an architect. *Acta Thomae*, referred to in *The Encyclopaedia of St. Thomas Christians in India*, cites St. Thomas declaring to the king:

> "In wood I know how to make yokes and ploughs and ox-goods, and oars for barges and ferry boats and mats for ships; and in hewn stone, tombstones and monuments

[9] 2nd to 3rd century AD.

> and palaces of kings. . . I will build you a palace and furnish it, for I had come from working at buildings and carpentry."[10]

The fact that Apostle Thomas brought with him and used his technical know-how for building religious structures[11] supports the hypothesis of cultural and technological transfer from distant lands. Many of the early Muslim mosques (a totally new concept of worship that came with Islam) in the northern region of Malabar were built adapting to the style specific to Jain temples as seen in Mudabidri and other places in South Kanara.[12]

Another evidence that strengthens this thesis of transfer of ideas and techniques is that of the presence of monolithic structures in front of religious buildings. James Fergusson argues that the idea of and the techniques in erecting the *deepasthambha* or lamp bearing pillars in front of Jain and Hindu temples and the monolithic granite crosses with beautifully carved bases at the bottom[13] in front of the Syrian Christian churches have their origins in the practice of erecting the obelisks in front of temples in Egypt. However, Fergusson admits that there is a great difference in the design of the plain, straight lined forms of obelisks and the complicated and airy forms of *sthambha* of Buddhists, Jains and Hindus.

The working tools, agricultural implements and utensils used by the agrarian society of Kerala are yet another evidence. The wooden wheels used to pump water for irrigating paddy fields are an example for this. The details with which the spokes were joined and the mechanics of the working of the wheel resembled similar machines in use at the time in Europe. The craft by which sewn boats of Kerala were built owes its origin in

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[10] George Menachery, "Thomas Christian Architecture", The St.Thomas Christian Encyclopedia of India, vol. 2, (Trichur:), 135-152.

[11] St.Thomas is believed to have built seven churches in Kerala. The last of these is recorded to have been demolished by the Portuguese. In K.P.P. Menon, History of Kerala Written in Form of Notes on Visscher's Letters from Malabar, Vol. 4 (New Delhi: Asian Educational Services, 1986), 147-183.

[12] K.K.N. Kurup, "The legacy of Jainism in Kerala." Aspects of Kerala History and culture, (Thiruvananthapuram: College Book House, 1977).

[13] Menachery, "Thomas Christian Architecture," 135-152.

Arabia.[14] The giant fishing nets hooked onto a maneuverable crane is another example of a similar borrowing of technology from China.[15]

During the golden era of the Hindu religion and culture in Kerala, construction activity flourished with the building of temples and houses. Traditional architecture, now firmly grounded in the *Vedic* principles, attained a refinement in its theory as well as construction and craft. This was concomitant with the writing of treatises on architecture such as the *Manushyalayachandrika*, *Thantrasamuchaya* and *Shilparathna.*[16]

During the period of colonization, the Europeans brought to Kerala principles of spatial planning that were based on their own social and familial structure, and adapted this to the climatic conditions of Kerala. A marriage of the traditional visual elements (such as the hip roof with the gable ear) and the European spatial planning occurred, resulting in what is called "colonial architecture." Colonial architecture was hallmarked by new building types such as schools and colleges, administrative buildings, libraries, museums and so on. The colonists integrated their planning and construction practices with the local ones, using locally available materials.

However, the presence of colonial powers and ideas did not influence the traditional architecture of Kerala, in the building of the temples and houses for the upper caste Hindus. Traditional architecture, rooted in the *Vedic* principles withstood the onslaught of the ideas from the West. This can be attributed mainly to the conservatism of the upper caste Hindus who strictly followed the tenets of their religion. Traditional architecture in Kerala survived the colonial period into the 20th century owing to such a concern in preserving the traditional building principles by the Brahmins.

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[14] Tim Severin, "In the Wake of Sindbad," National Geographic, July 1982, 2-41.

[15] Working on counter weight principle, made of wooden poles seen along the coastal areas of Cochin and northern Travancore.

[16] during 15th and 16th century as refered by Stella Kramrisch in "The Arts and Crafts of Kerala."

1.4. *Gramam* or village as the settlement prototype

Influences from the rest of the subcontinent also mingled with those from far-off nations in forming the local social milieu. The Dravidian and the tribal communities passed through Jain and Buddhist phases before they were wiped off by Aryanization, which ushered in the Hindu era of *Vedic* ideas. The Buddhist *pallys* were open houses centrally located in urbanized neighborhoods. With the decline of Jainism and Buddhism, both unable to match the aggression of the Hindu revivalist movement, most of these *pallys* were transformed into Hindu temples. The caste system which the Brahmins practiced and imposed on the rest of the society changed the whole social structure of Kerala. Also the planning principle that the Brahmins developed to suit their supreme position in the social stratum were instrumental in transforming the settlement pattern of the entire region. The unique settlement pattern we see now in Kerala -- the scattered village -- developed through the *grama* concept.

> "The primitive sense of the word *gramam*, which occurs frequently from the *Rigveda* onwards, appears to have been 'village'. The *Vedic* Indians dwelt in villages, scattered all over the country, some close together, some far apart and were connected by roads. The village consisted of detached houses with enclosures."[17]

The *Manasara*, the ancient *Vedic* treatise on architecture describes eight classes of villages according to the shape and layout of houses, measurements and the ceremonial openings of buildings.[18] The *Manushyalayachandrika*, written later in Kerala, classifies *gramam* as appropriate, moderate and inappropriate according to the measurements, scale and wealth of the Brahmin houses located in each of them. The *gramam* having 1000x2000 square *dhand* area was generally called *nagaram* and the same if consisting of a port was termed *pattanam*. The political and commercial capital, where the King resided and trade flourished was termed *puram*.[19] The peripheral settlements surrounding a *puram* formed the *nagarams*. The basic unit of the *gramam* consisted of a single Brahmin family surrounded by the settlements of the servant community. Such a *gramam* was called *eka kutumba gramam*. According to Herman Gundert in

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[17] Prasanna Kumar Acharya, A Dictionary of Hindu Architecture, 181.

[18] Prasanna Kumar Acharya, Manasara, 1-538.

[19] Example-Thiruvananthapuram

Keralolpathi, the Nambuthiri Brahmins established themselves in Kerala in 32 *gramams*.[20] William Logan refers to 32 *gramams* but gives the names of only ten.[21] In epigraphic evidences from the 8th century AD, eighteen of them have been traced. Kanipayyur Sankaran Nambuthiripad[22] has identified 30 of them while Velutattu Kesavan had traced 31 of them.[23] The 32 *gramams* enlisted in *Keralolpathi* were considered to have been established by Parasurama,[24] as follows:

> Between rivers *Perumpula* and *Karumanpula* in northern Kerala.
> 1. *Payyannur* 2. *Perumcellur* 3. *Alathur* 4. *Karantola* 5. *Cokiram*
> 6. *Panniyur* 7. *Karikkatu* 8. *Isanamangalam* 9. *Trissivaperur* 10. *Peruvanam.*
> Between rivers *Karumanpula* and *Curni* in central Kerala.
> 11. *Camunda* 12. *Irungatikkutal* 13. *Avattiputtur* 14. *Paravur*
> 15. *Airanikkalam* 16. *Mulikkalam* 17. *Kulavur* 18. *Atavur* 19. *Ceganatu*
> 20. *Ilibhyam* 21. *Uliyannur* 22. *Kalutanatu.*
> Between river *Curni* and *Kanyakumari* southern Kerala.
> 23. *Errumanur* 24. *Kumaranellur* 25. *Katamaruku* 26. *Aranmula*
> 27. *Tiruvalla* 28. *Kitangur* 29. *Cengannur* 30. *Kaviyur* 31. *Venmani*
> 32. *Nirmanna*[25]

These *gramams* were founded around the 4th or 5th century AD, perhaps not all, but at least a few. The earliest of them were *Payyannur, Perincellur, Alattur, Panniyur* and *Sukapuram.* By the beginning of the 9th century, the Brahmin settlements of Kerala were so well established and prosperous, that they had *upagramams*, satellite village settlements around them.[26] There might have been a few more *gramams* and *upagramams* apart from the above mentioned 32 *gramams*; for example, the original *gramams* in Suchindram, Varkala, Quilon and Kuttanad.[27] The center of the *gramam* organization was the *grama kshethra* or the village Temple. Each *gramam* consisted of several *upagramams.* Being an agro-based community, the whole setting was located in

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[20] Herman Gundert, Keralolpathi (Thiruvananthapuram: -, 1961), 5,27.

[21] William Logan, Malabar. (Thiruvananthapuram: Chaitram Publication , 1981),120.

[22] Kanipayyur Sankaran Nambuthiripad, Aryanmarute Kutiyettom. (Kunnankulam: Kunnankulam Publishers, 1965), 284-295.

[23] Kesavan Velutattu gives a critical identification of these settlements constituting the *gramams* in "Brahman Settlements in Kerala-historical studies," 21-32.

[24] one of the 10 incarnations of Lord Vishnu

[25] Ibid., 23.

[26] subsidiary village settlements

[27] P. P. Narayanan Nambuthiri, Aryans in South India (New Delhi: Inter India Publication, 1992), 243.

close proximity to agricultural fields. The inhabitants of these *gramams* transacted with the Nambuthiris in their social and religious affairs. In course of time Nayar and other castes next in the hierarchy to the Nambuthiris also consulted them in such matters. The organization of such communal administration was feudal in character.[28] Beside the strict *varna* or caste classification, there existed stratification into different classes according to division of labor and economic status. The untouchable classes were located away from the houses of the higher classes. The special social institutions like caste-class hierarchy, joint family system, matrilineal kinship and high religious affiliations formed the basis for the layout and texture of the traditional settlement pattern of Kerala.

1.5. The caste-class community structure and the house genre

The social system of Kerala after Aryanization was based on principles of organization of caste and kinship. The society was stratified and arranged in a hierarchical order from the priestly to the lowly. The principle of treating each group following a certain occupation as a separate caste and of prohibiting their intermingling gave rise to 72 principal castes comprising 8 classes of Brahmins, 2 *Nana Jathi*, 12 *Anantharala Jathi*, 18 Shudra, 6 Artisans, *Pathitha Jathi*, 8 *Nicha Jathi* and 8 miscellaneous *Jathis*.[29] At the top of the hierarchy were the Brahmins or Nambuthiris who were landed aristocrats, priests and scholars. The rituals and offerings in the Brahminical temples were performed by them . They enjoyed the proprietary and supervisory rights to the temple, along with the rulers. A Tamil Brahmin wrote about the Nambuthiri during late 19th century as follows: "his person is holy; his directions command; his movements are a procession; his meals nectar; he is the holiest of human beings; he is the representative of god on earth."[30]

The system of kinship among the Brahmins was based on the *illom*. Only the eldest son of the Brahmin family was required by law to marry a Brahmin woman. All others maintained relations with Nayar women and those from the subcastes of Nayar. This

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[28] Ibid, 242.

[29] L. A. Krishna Iyer, Social History of Kerala-The Dravidians , Vol. 2, (Madras: Book Center publications, 1970), 45.

[30] Christopher J. Fuller, The Nayars Today (Cambridge: Cambridge University Press, 1976), 11.

practice was known popularly as *sambandham.* In such cases the issues had no right over the property of the Brahmin father. The Nambuthiri women were not permitted to marry lower caste men like the Nayars. Next to the Nambuthiri in the strata there were other Brahmins named after the place of origin, such as "Pattar" from Tamilnadu and "Embranthiri" from Tulunadu. They engaged themselves as royal cooks, messengers of the rulers and as inferior priests in temples. The main reason of their inferior status was that they had no high connections by marriage or possession of land.

The native rulers claimed a separate status as Kshatriya and used the title as 'Varma'. This ruling group established relations with the Nambuthiri and other ruling families. However, Kshatriya men were not allowed to marry Brahmin women. Many of these rulers wore the sacred thread like the Brahmins and observed strict vegetarianism. The greatest ideal and ultimate aim of these Kshatriya rulers were the protection of cows and the welfare of the Brahmin.[31]

The next in hierarchy were the Nayars. They had a dominant position in the society on account of their women's *sambandham* with the Nambuthiris. This caste consisted of several sub-castes like Kurup, Nambiar, Adiyodi, Pillai, Kartha etc. Traditionally, the Nayar was a warrior and a non-cultivating tenant. There were many sub-castes among the Nayars who were forbidden to marry from the upper classes within the Nayar caste itself. C.J. Fuller observes about 18 to 20 subdivisions within the Nayar caste engaged in different occupations like herding, temple drumming, copper smithy, tile-making, palanquin-bearing, serving Brahmins and Ambalavasis, pottery, oil mongery, funeral priesthood, trading, weaving, laundering, barbering, masonry and minor temple priesthood.[32] The *tharavad* corresponds to the *illom* of the Nambuthiri. A *tharavad* had several branches called *thavazhi* and each of them had common possession of properties. The entire family affairs in a *tharavad* or *thavazhi* were managed by its *karanavan* or the male head. The issues of the male members of a *tharavad* were not members of that

[31] Kurup, The Malabar Society, 41.
[32] Fuller, The Nayars Today, 40.

kinship unit. They belonged to the *tharavad* of their mothers. Traditionally, husbands did not live with their wives. The line of succession among the Nayars was matrilineal, called *marumakkathayam.* The native rulers also followed the same custom of inheritance regarding succession to the throne. The crown went but to his sister's son not to the son of a ruler.

Another major caste lower in the hierarchy was that of the Thiyya. They engaged in agriculture, toddy tapping and animal husbandry. Some of them were well known warriors who used the title *chekavan.* Thiyya was a polluting caste for a Brahmin and had to keep a distance of at least 32 feet from a Brahmin. As a polluting caste, the Thiyyas were not allowed to enter or worship in the temples of Nayars or Brahmins.[33] Hence they maintained several folk gods and goddesses in their own *kavu* or shrines for worship. 'They have there own idols," stated Barbosa, "in whom they put their faith."[34]

Artisan's groups like Kammalar and the untouchable caste of Pulaya or Cheruman constituted the lower stratum of the caste hierarchy. A Pulaya had to keep at least a distance of 64 feet from a Brahmin. The pulayas led a life of acute poverty and servitude. They toiled day and night in the soil and its fruits were exploited by the privileged classes of the society. They were sold and exchanged like cattle, along with the land. This oppressed and "polluting" caste were denied all privileges enjoyed by the other castes of Kerala. In rainy seasons, the Pulayas were feared by women folk of higher caste due to a strange custom called *pulappedi*[35] that prevailed till the end of the 17th century in Kerala.

Amongst the Dravidian communities, the Nayars who came to Kerala from the north possibly belonged to the Naga[36] race. A grove is found in the southwest corner of each

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[33] Ibid., 35.

[34] Kurup, The Malabar Society in 17th Century, 43.

[35] P.N.Kunjan Pillai wrote, "According to this custom if a slave like Pulaya, Paraya or Mannan happened to see a high-caste woman alone after dusk, she would lose her caste and would have to go with him. It was enough if the Mannan or Pulaya threw a stone or a stick at her or called out that he had seen her.

[36] literally meaning snake

Nayar homestead in Kerala.[37] The Vellala, Kammalar and Velar communities came from Madurai and Tirunelveli, Vaniyan and Pattaryar from the Chola kingdom, Ezhavas from Ceylon and Paravars from Ayodya.

Apart from the hierarchical divisions of the Hindu community, another group that existed in Kerala were the Mappilahs who followed the Islamic religion. Their ancestors were the descendants of the Arab traders. A good number of them were converts from the Hindu community, who even followed several Hindu rituals like the worship of the dead heroes and spirits which were against Islamic principles. Many Mappilah families followed matriliny as a custom. The Mappilahs were not treated as a polluting caste.

Christianity also influenced the society of Kerala. Many natives were converted to that religion following its propagation by the apostle St.Thomas. Later, the advent of the Portuguese and the Dutch was a fillip to the growth of the Christian community in Kerala. The natives were converted in large numbers to Christianity and given several privileges in the settlements of the Portuguese and the Dutch. The Christian community was known as the Nazranis, after their religious connections with Nazareth.[38] There were also Jewish settlements in Cranganore and Cochin.

The houses in Kerala belonging to the different classes and castes were popularly known by specific generic names. These names follows the family name which forms the address of the household. Apart from this, these houses rarely have typological characteristics that describe such a generic classification. The spatial morphology and size of the houses varied corresponding to the different familial and cultural habits of each caste. These houses formed the unitary block of houses or *shala* laid out as single; or a cluster of multiple blocks varying with the size of the family, its affluence and the caste of the dweller (Refer Figure I.4). House form and layout of all these communities irrespective of their religious beliefs held a coherent order adhering to the *Vedic* planning

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[37] Krishna Iyer, Social History of Kerala , 117.

[38] Kurup, The Malabar Society in 17th Century, 43.

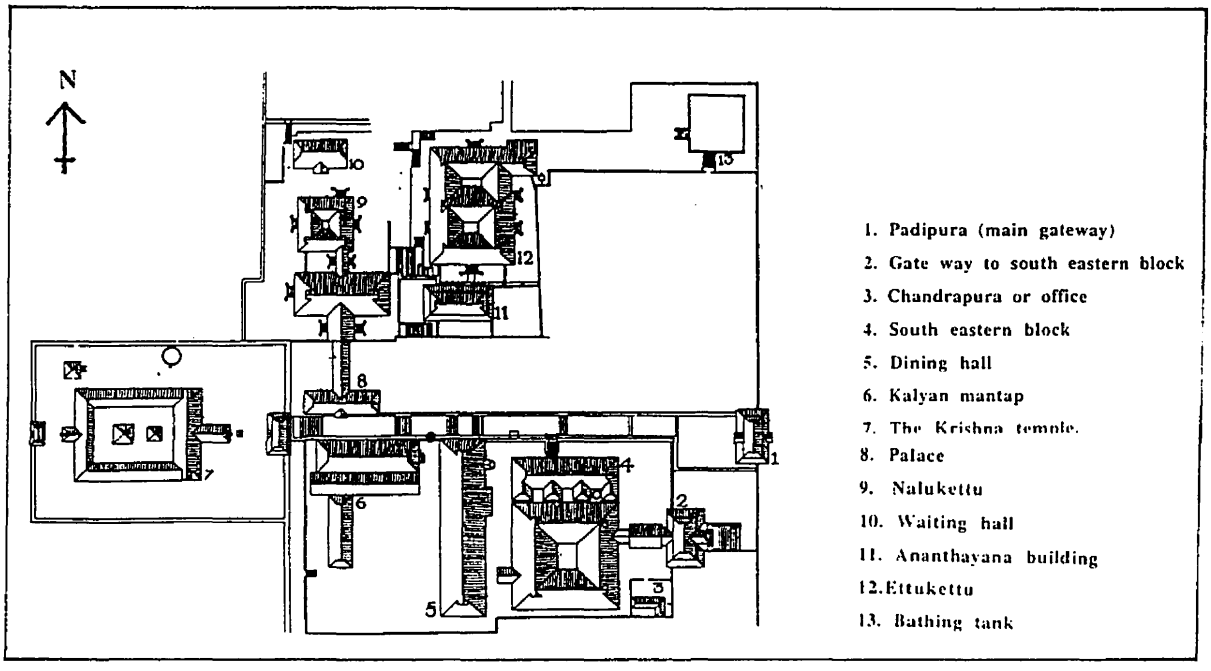

Figure 1.4: *A palace complex in Travancore (Source: Joseph, M Arch. Thesis-Lessons from the Past -The Domestic Architecture of Kerala, 1991).*

system, even though variations had occurred from the original while adapting to the locale. According to K. P. P. Menon the households can be typified as follows:[39]

Generic house names	Caste or class title of the dweller
mana	Nambuthiripad
illom	Nambuthiri
kovilakam	Kshathriyar
kottaram	kings or former rulers
idom, kuttala or *bhavanam*	local chieftain or *naduvazhi*
veedu	Nayar
poomatham, pushpak pisharam, variam	Ambalavasi or Temple servants
matham	Chakkiar, Nambiar, Thampan
kudi	Chaliar or weaver, the artisans
pidika	Mappilah and Nazrani
pura	Ezhavar or Chogan or Thiyya
chala	Pulayar
pura or *chala*	blacksmith, goldsmith

Chart 1.1: *Generic names for houses traditionally used indicating the caste and class.*

1.6. Conclusions

The social structure and cultural diversity prevalent in Kerala invariably molded the house type and form. Houses of the upper classes sprawled over large premises represent the feudal profile of those families. The lower classes lived in small mud or wooden dwellings in the village outskirts. The *shasthras* or treatises specified separate units of measurements, features for site allocations, materials and construction methods to clearly distinguish this social hierarchy. Even though the early construction practices in the domestic architecture of Kerala absorbed influences from other cultures in their process of evolution, they were finally codified and canonized only with the domination of *Vedic* thought in architecture. It thus becomes imperative to first understand these principles of *Vasthushasthra* as applied in domestic architecture for a better and effective analysis of the case studies.

[39] Tony Joseph, "Lessons from the Past -The Domestic Architecture of Kerala," Master's Thesis, (Austin: University of Texas at Austin,1991), 91-92.

Chapter 2: The House: A Modular Assemblage

2.1. Introduction

Vasthushasthra or the science of architecture according to *Vedic* principles was widely accepted all over the Hindu world in regional versions, such as *Thatchushasthram* which was exclusively applied in Kerala. Standardization of design is an important feature of *Vasthushasthra.* This standardization made to effect through canonization resulted in a modular geometry; dimensions and proportions ascertaining uniformity and physical wholeness to the buildings. Canonization of building systems in India created a unique vocabulary out of a common language of building practices which is identified today as Indian architecture. The general spatial pattern of houses throughout the region remained the same while the size and number of rooms varied according to the economic and social status of the occupants. The standard modules, dimensions and joinery details made it possible to provide extensions where required, at the same time control the form and spread of the building. Even though factors that influenced the evolution and practice of this particular building method are varied, it successfully attained a refinement drawing from the essence of the region. The basic configuration of blocks in courtyard format was used as a module and perfected as a unified spatial and structural system adapted to climatic and socio-cultural conditions. The architecture of Kerala, though rooted in *Vedic* canonical practices, was altered to fit the local conditions. This chapter elaborates the patterns of this adaptation and lists the vocabulary of the regional version of *Vasthushasthra -- Thatchushasthram* which is practiced even today in house building.

The chapter starts with discussing the basic dimensional system based on which the entire spatial order was articulated and constructed. This is followed by a discussion the primary stage of site selection, location of habitable and ancillary spaces of the house with respect to geo-climatical features as prescribed by the rules. Finally, it explains the possible multiple configuration of the block layouts corresponding to a system of computation which enabled an envisioning of space and form of the building in the absence of a graphical method.

2.2. Measurement system

The etymological meaning of the word *Manasara* is "the essence of measurement", *sara* meaning "essence" and *mana,* "measurement." It may however be rendered 'the standard measurement' or 'the system of proportions.[1] This implies that the traditional science of architecture is grounded in principles of measurements and proportions. From the ancient times, *acharyas* or master craftsmen found and organized simple and convenient dimensional systems to accurately measure all sizes. These systems made it possible to work out details of prefabricated units to perfection, and simplified the task of assemblage of these prefabricated units. The system of dimensioning can be broadly classified into two -- *anupadhikam* or proportional and *kevalam* or absolute dimensional system.[2]

2.2.a. *Anupadhikam* or proportional dimensional system

Anupadhikam or proportional dimensional system is based on proportional theories which can be again classified into two major measuring systems. The system derived from the proportions of human body is called *thalamanam* and that derived from mathematical tables, as *dhandumanam.*

2.2.a.a. *Thalamanam*

One *thalam* is the length of a palm which is equal to the length of the face. In this theory of proportions, the dimensions of a healthy adult male or female figures are contained in *ashtathalam* (8 divisions), *navathalam* (9 divisions) or *dashathalam* (10 divisions); youth figures in *shadthalam* (6 divisions) or *sapthathalam* (7 divisions); and child figures in *panchathalam* (5 divisions). The unit *thalam* is divided into 12 *angulams.* An *astathalam* is thus 96 *angulams* and *dashathalam,* 120 *angulams.* Depending on the choice, the artifact, a sculpture for example, of any size is divide into 8, 9 or 10 units, each division being one *thalam. Thalam* here is fixed as the length of a face. In *navathalam,* the proportions are as follows :

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[1] Ram Raz in his "An Essay on the Architecture of the Hindus," written in reference to the first few chapters of the "Manasara."

[2] Balagopal T.S. Prabhu, Vasthuvidhyadharshanam (Calicut: Vasthuvidhyaprathishtanam, 1994), 15-26.

Body = 3 *thalam* (from shoulder to *naabhi* or solar plexus).
Thighs = 3 *thalam* (from solar plexus to knee calf).
Hind legs = 2 *thalam* (from knee to ankle).[3]

Navathalam is generally adopted for sculpting deities. To sculpt humans, only *ashtathalam* is considered in which the length of right the palm of the male till the tip of the middle finger is adopted as the unit *thalangulam. Dashathalam* is adopted for carving goddess images. The child figure of the god Ganapathi is proportionate with *panchathalam*[4] (Refer Figure 2.1).

2.2.a.b. *Dhandumanam*

In this system, the dimension of a significant building part is taken as the unit *dhand.* The dimensions of other parts of the building are taken in relation to this dimension. For example the dimensions of different parts of a house structure are arrived at in proportion to the diameter of the top end of a pillar of the house (Refer Figure 2.2).

2.2.b. *Kevalam* or absolute dimensional system

Kevalam or absolute dimensional system is further classified into *angulamanam* and *yavamanam.* The former is based on the dimensions of the human body and the latter on the dimensions of a grain.

2.2.b.a. *Angulamanam*

This absolute dimensional system is based on the human body. The horizontal width of an adult male with hands stretched forms the unit *vyamam.* This *vyamam* is equal to this persons height called *kayam.* One eighth of *vyamam* or *kayam* forms *padam* and one eighth of *padam* is called *angulam* or finger. The dimension of *angulam* corresponds to the length of middle fold of the fore finger which is called *mathrangulam* (Refer Figure 2.3). Proportionately, *mathrangulam* is equal to 1/120 of the height of the human body with its hands in folded position above the head, this posture known as *purushanjali*

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[3] Ashalatha Thampuran, and Balagopal T.S. Prabhu, "Scale and proportion used in Traditional Architecture," Readings in Vasthushasthra Traditional Architecture, Book 1, November 1995.

[4] Prabhu, Vasthuvidhyadharshanam, 15-26.

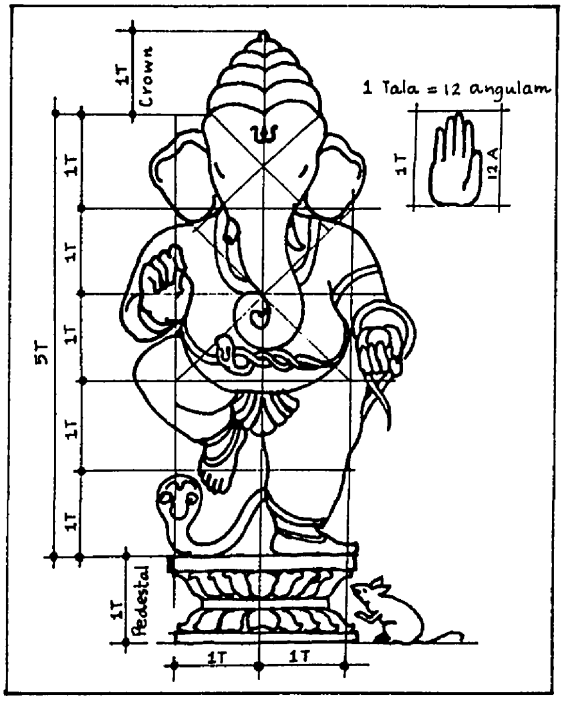

Figure 2.1: *Example for 'panchathalam' proportion applied in a Ganapathi image (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

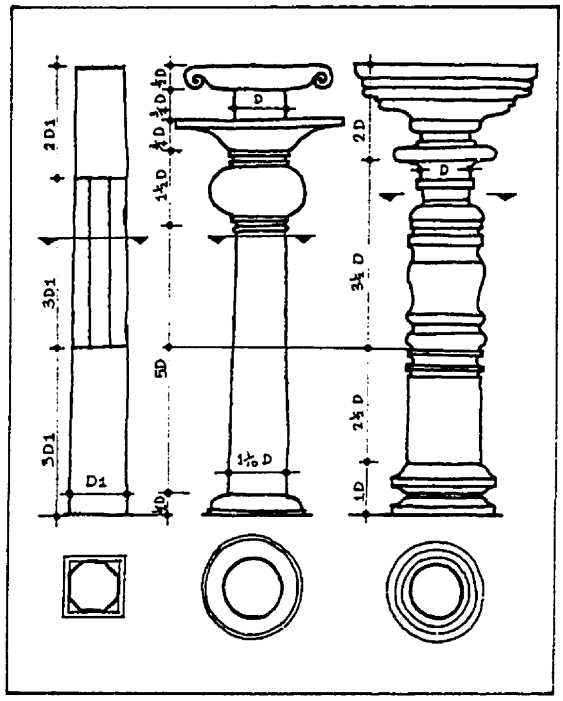

Figure 2.2: *Example for 'dhandumanam' where width of the base (D1) or top (D2) is considered as the unit measurement in proportioning these pillars (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

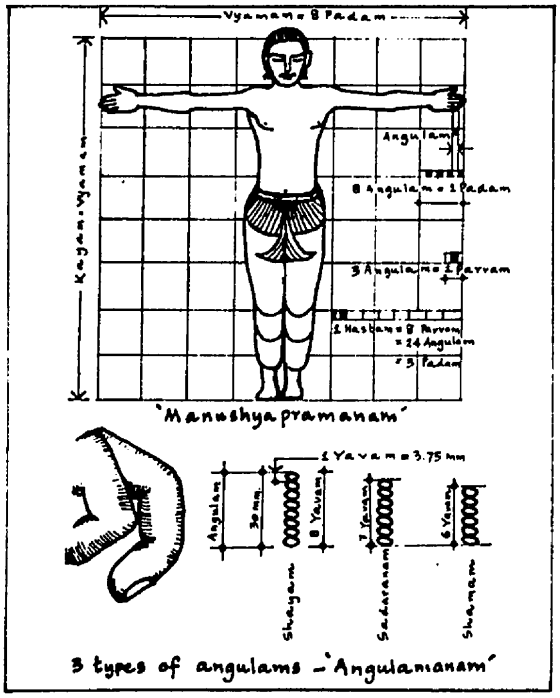

Figure 2.3: *'Purushanjali' or 'manushyapramanam' and the measurement system 'angulamanam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

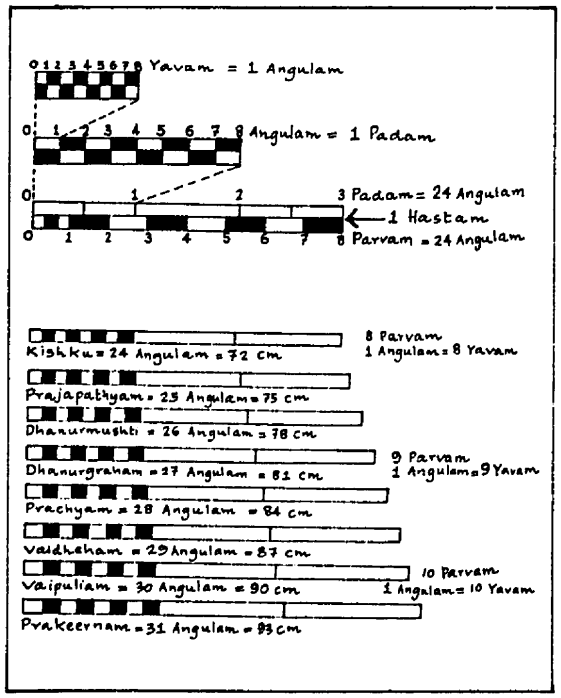

Figure 2.4: *Different scales and units used in traditional Kerala architecture (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

(Refer Figure 2.3).[5] One *purushanjali* is divided into 10 portions each of which is 12 *angulams*. This unit of 12 *angulams* is known a *pradhesha* or *vithasthi*. All the vital dimensions of the human body can be related to *pradhesham* as given below.

8 *pradhesham* = *keshantham* or height or stretch of the *yajamana*.
1 *pradhesham* = *thalam*, length of face.
2 *pradhesham* = shoulder width.
3 *pradhesham* = length of hand from shoulder joint to the tip of the finger.
7 *pradhesham* = *greevantham* or height till shoulder from foot.[6]

2.2.b.b. *Yavamanam*

The human scales differ with different individuals and so do the dimensions of the respective *angulam*. *Yavam* is a barley grain. *Yavamanam* evolved to resolve the differences in *angulamanam* by introducing a standardized dimension to the *angulam*. The short, medium and long *angulam* dimensions fall in divisions of 6, 7 and 8 when the width of *yavam* is applied. These are called as *shyamam*, *sadharanam* and *shayam* respectively. The auspicious *angulam* with 8 *yavam* is 3 centimeters in the metric system. One *yavam* in this *angulam* measures 3.75 millimeters. The minutest unit called *thilam* or *yookam* forms one eighth of a *yavam*, measuring 0.47 millimeter.

It is seen that the anthropomorphic dimensional module of 1 *vyamam*[7] is divided to obtain a *padam*, almost equal to the length of the foot. The octal division of *padam* yields the digit *angulam* and further octal division gives *yavam*. This octal system of dimensioning forms the basic matrix for proportioning form and space characteristic of Kerala architecture. This traditional octal system approximated to the metric system is tabled as follows.[8]

8^0 *paramanu* = 1 *paramanu*
8^1 *paramanu* = 1 *thrasarenu*
8^2 *paramanu* = 1 *valaghra*

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[5] In all cases the dimensions of the male head person of the family, refered to as *yajamana* becomes the standard for adopting these human proportions.

[6] A*shala*tha, "Scale and proportion.... ," 51-62.

[7] literally meaning 'span'.

[8] A*shala*tha, "Scale and proportion.... ," 55,56.

8^3 *paramanu*	= 1 *liksha*	= 0.059 mm
8^4 *paramanu*	= 1 *yuka/thila*	= 0.47 mm
8^5 *paramanu*	= 1 *yavam*	= 3.75 mm
8^6 *paramanu*	= 1 *angulam*	= 30 mm
8^7 *paramanu*	= 1 *padam*	= 240 m
8^8 *paramanu*	= 1 *vyamam*	= 1920 mm

2.2.b.c. Different *kol* and measurement tables

24 *angulams* formed 1 *hastham* which formed length of the typical measuring scale or *kol*. The length from shoulder edge to the tip of fore finger forms measurement of 1 *hastham*. The following table shows the derived units.

8 *thilam*	= 1 *yavam*	= 3.75 mm
8 *yavam*	= 1 *angulam*	= 30 mm
3 *angulam*	= 1 *parvam*	= 90 mm
8 *angulam*	= 1 *padam*	= 240 mm
8 *parvam*	= 1 *hastham*	= 720 mm
3 *padam*	= 1 *hastham*	= 720 mm
8 *padam*	= 1 *vyayam/kayam*	= 1920 mm
4 *hastham*	= 1 *dhandu*	= 2880 mm
8 *dhandu*	= 1 *rajju*	= 23 m
1000 *rajju*	= 1 *yojana*	= 23.04 km

There were 8 different kinds of *kol* used in Kerala. The *kol* with 24 *angulam* is *kishku* which was commonly used by all classes for residential buildings. *Dhanurmushti* having 26 *angulam* used for measuring land was prescribed commonly for all the 4 castes. *Dhanurgraham* having 27 *angulams* and *prakeernam* with 31 *angulams* were used for measuring cities, towns, villages, and for residences of Brahmins. *Vaipuliam* having 30 *angulams* was used for Kshathriya residences; *prachapathyam* having 25 *angulam* and *vaidheham* with 29 *angulam* for *Vaishya* and *prachyam* having 28 *angulam* for Shudra residences. Thus the scales used for building houses for the lower castes were not used for the upper castes and vice versa[9] (Refer Figure 2.4).

[9] Kanipayoor Shankaran Namboothiripad, Manushyalayachandrika, (Kunnankulam: Panchangam Book Stall, 1994), 54-55, [In Malayalam].

2.3. Planning with energy grids and nodes

The concept of the *vasthupurushamandala* (Refer Figure 2.7), the cosmic diagram and related geomantic ways of spatial planning in relation with time and nature based on astrology and mathematical computation formed the primary resource of Hindu architecture. This energy field called *mandala* comprising grids, diagonals and nodes formed the building code for spatial planning, proportions, door and window positions and the functional layout in traditional domestic architecture. The regional version of such planning practices applied in Kerala is discussed in succession.

2.3.a. Selection, orientation and location of house and the energy field concept

The plot that bears the dwelling is selected considering many auspicious characteristics. The site should be plain preferably with a slight, even slope towards the east, with the sound of foot-steps on the site audible to those inside the house, and enriched with trees bearing fruits, flowers and milk. After clearing and leveling the site, an approximately square area is demarcated. The approximate center of the plot is located, and the north-south and east-west direction lines are marked through the center.[10] The east-west direction line is called the *brahmasuthram* and the north-south line is called *yamasuthram* (Refer Figure 2.8). If the size of the site is between 16h. x 16h.[11] and 32h. x 32h., the entire site is taken as house-plot which is called *grihamandala.* If the size is greater than 64h. x 64h., the N-E and S-W quarters are again subdivided into 4 *upakhandas* or quadrants and the S-W *upakhanda* or sub quadrant *(manushyakhanda)* and N-E *upakhanda (devakhanda)* are taken as *grihamandala*[12] (Refer Figure 2.5).

For larger sites, the entire site is divided into 9 *veedhis* or paths by concentric squares and the four inner *veedhis* of the N-E quarter are taken as *grihamandala.* The 7th and 8th *veedhis* are reserved for ancillary structures (Refer Figure 2.6). This process of site division is called *veedhivinyasam.* The location of the house position is based on

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[10] Vazhapilli Krishnan Achari, Vishwakarmavin Proktham-Thatchushasthram (Guruvayoor: Shantha Book Stall, 1993), ---.

[11] *'h.'*is abbreviation of unit *hastham.*

[12] Prabhu, Vasthuvidhyadharshanam, 44-45.

defining the *grihamandala* by dividing it into different grids called *padam* and assigning specific functions for each *padam*. The division into grids or *padhavinyasam* is generally by 8x8 (*ashtavarga vasthumandalam*), 9x9 (*navavarga vasthumandalam*) or 10x10 grids (*dashavarga vasthumandalam*) for residential buildings. For this the entire *mandala* is conceived as a microcosm of the universe with the divine region in the center surrounded by solar and stellar regions, the outer space forming the space outside the *mandala*.[13] This is symbolically represented by the concept of *vasthupurusha* according to which the whole site is sanctified by a retinue of gods seated on the body of *vasthupurusha*, a demon confined within the boundary of the plot (Refer Figure 2.7). The *vasthupurushamandala* may also be viewed as a set of enveloping regions around the central point of the plot which is the *brahmanabhi*. The squares lying on the outermost envelope are designated as the path of demons or *pishachaveedhi*, wherein no construction, other than gate houses on each side are permitted. The envelope next to *pishachaveedhi* is called *manushyaveedhi* and the immediate next one is called *devaveedhi*. The squares falling in these regions are the only areas prescribed for residential construction. The remaining inner region called *brahmaveedhi* is considered holy and only construction of spiritual shrines is allowed here. The energy paths running in horizontal and vertical directions are called *naadi*. The main diagonals are called *suthrams* and the minor ones, *rejju*. The nodal points of the rectangular grid lines and the diagonals are called *sandhi*. These nodes are named according to the number of lines meeting at the node as *mahamarma*, *marma*, *rajjumarma* and *mannantha* (Refer Figure 2.8).[14] It is stipulated that the major *marma* where several lines meet should be left free. Construction is allowed on either side of the nodal points leaving half the width of a thread on either side. If these nodes are marked distinctly, the different parts of the building such as pillars, walls, doors and windows can be checked at every stage of construction, thus facilitate flexibility in case of extensions and revisions. A detailed

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[13] Sashikala Ananth, "The Institutions of the Vishwakarma," Architecture + Design Journal, September 1991, 77-84.

[14] Prabhu, Vasthuvidhyadharshanam, 54-59.

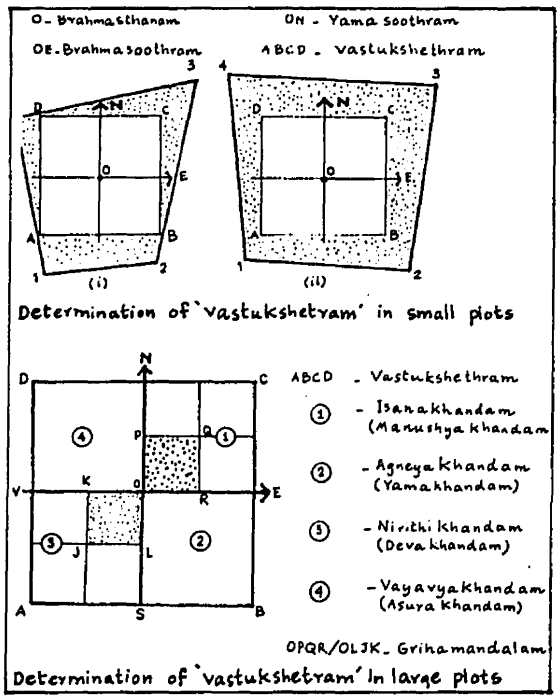

Figure 2.5: *Determination of 'vasthukshethram' in small and large plots (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

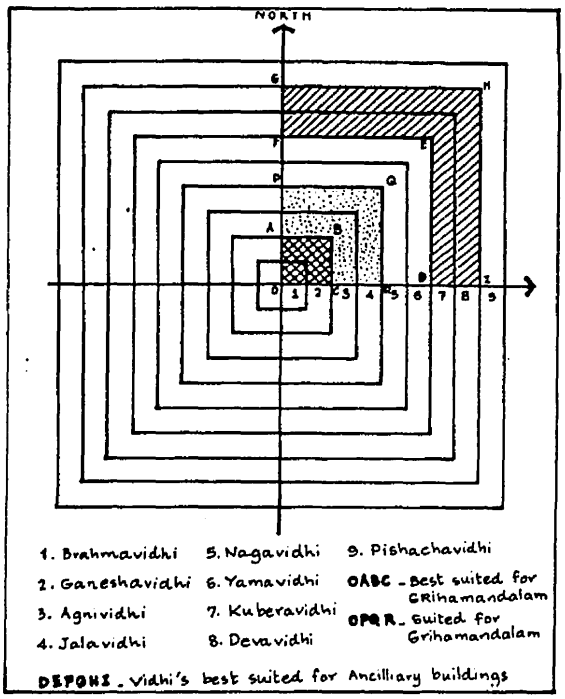

Figure 2.6: *'Veedhivinyasam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

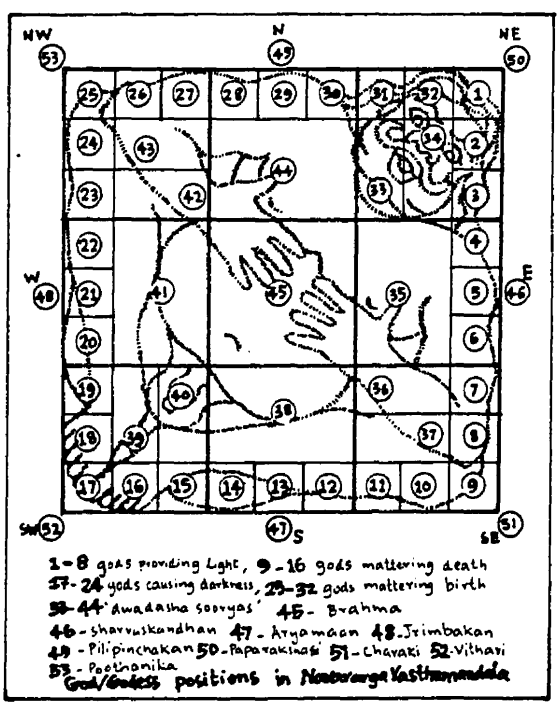

Figure 2.7: *'Vasthupurushamandala' applied in Kerala (After:* Namboothiripad, *Manushyalayachandrika,* 1994).

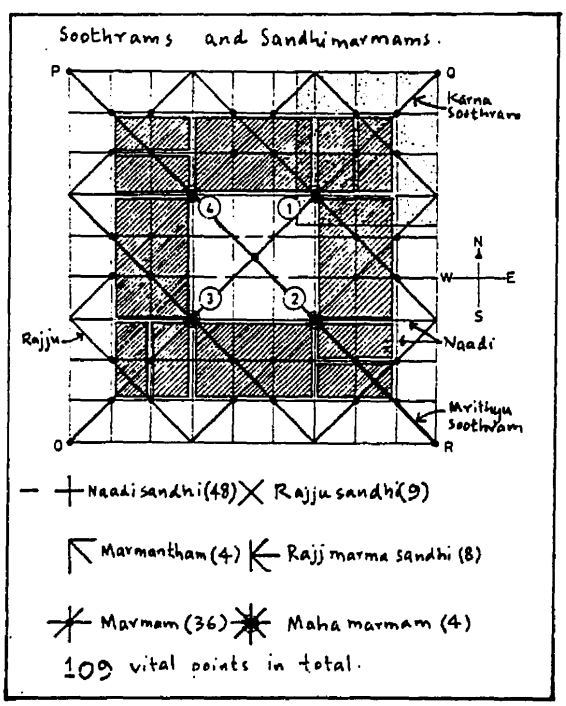

Figure 2.8: *The various energy nodes depicted in a 'navavarga vasthumandalam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

description of various types of these energy grids, diagonals and nodes are provided herein (Refer Figure 2.9).[15]

2.4. Proportions and configurations of the house pertaining to astro-numerical theories

Astrology played a major role in Kerala's domestic architecture.

> "The house for instance is compared to the bride-groom and the building-site to the bride, about to be united together in holy wedlock; the perimeter of the structure playing the same part as the horoscopes of human beings."[16]

The dimensions are selected by complex computational formulas of *ayadishadvarga*, the six astrological canons of traditional architecture. With different ratios of width to length, it defines the plan; and by the proportionate system, it becomes the basis of vertical dimensions. In a sense, once the perimeter is specified, one can know whether the building is small or big, secular or religious, which direction it faces, and so on. Such a form description must have been highly useful in the absence of graphical record.

After selecting the appropriate measuring system, the next step is to make sure that the different dimensions of the house are in accordance with a system of proportions that takes into consideration, among other matters, the horoscope and caste of the owner of the house. The calculations are based on the perimeter of the structure to be constructed. The dimensions of houses constructed on orthodox lines are based on the *sadvarga* formulae by means of which the *yoni*, *aya*, *vyaya*, *thithi*, *nakshathra* and means of a house are calculated from its perimeter.[17] The first one --*yoni*--has a purely scientific basis and deals with orientation. The others are based on astrology.

2.4.a. *Yoni*

To obtain the *yoni* of a house, the perimeter is multiplied by 3 and then divided by 8; the remainder gives the value of the *yoni*, which is used to find the orientation of the house.

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[15] Ibid, 35-59.

[16] K. P. Padmanabha Menon, History of Kerala written in form of notes on Visscher's letters from Malabar, Vol. 4, (New Delhi: Asian Educational Services, 1986), 148-149.

[17] Sarvavigjnanakosam- (Encyclopaedia), 1987 ed. S.v. "vasthuvidhya," [In Malayalam].

The values of the *yoni* from 0 to 7 relate to directions. 1 corresponds to the east and is called *dwajam* or *ekayoni*; 2 is south-east and is called *dhoomam*; 3 is south and is called *simham* or *thriyoni*; 4 is south-west and is called *kukkaram;* 5 is west and called *vrishabham* or *panchayoni*; 6 is north-west and is called *kharam*; 7 is called *gajam* or *sapthayoni* and 0 is north and is called *vayasam.* The odd *yoni* is considered to be auspicious; the even *yoni*, inauspicious.[18] Because there are 8 directions, multiples of 8 *angulams* are taken for measurement. The perimeters for the different *yonis* are given below in *hastham* and *angulam.*

Yoni	1	2	3	4	5	6	7	8
Perimeter	0h. 8a.	0h. 16a.	1h. 0a.	1h. 8a.	1h. 16a.	2h. 0a.	2h. 8a.	2h. 16a.
Perimeter	3h. 0a.	3h. 8a.	3h. 16a.	4h. 0a.	4h. 8a.	4h. 16a.	5h. 0a.	5h. 8a.
Perimeter	5h. 16a.	6h. 0a.	6h. 8a.	6h. 16a.	7h. 0a.	7h. 8a.	7h. 16a.	8h. 0a.

Graphically the *yoni* formula may be represented by an Archimedian spiral starting from an initial radius vector of 9 *padam* moving in a clockwise rotation (Refer Figure 2.10).
The *yoni* concept is used not only to indicate the location of the building in relation to the courtyard but also to standardize its dimensions and to classify the building according to a set of perimeters incremented by *purushapramana* or the human scale. The different *shala* coming on the 4 sides of the central courtyard should have the designated *yoni* number, but the *yoni* number of the central courtyard itself should be 1. Similarly, auspicious constructions like sacrificial altar, platform around banyan trees and so on. should be of *dwajayoni.* Specific *yoni* numbers are also prescribed for wells, tanks, stables, furniture and vehicles.[19]

2.4.b. *Aya-vyaya*

The remainder obtained when the perimeter is multiplied by 3 and then divided by 10 gives the value of *vyayam* or loss. When the perimeter is multiplied by 8 and divided by

[18] Kanipayoor Shankaran Namboothiripad, "Introduction to Vasthushasthra," Readings in Vasthushasthra Traditional Architecture, Book 1, November, 1995, 9-17.

[19] A. Achyuthan, "Principles of Vasthushasthra," Readings in Vasthushasthra Traditional Architecture, Book 1, November, 1995, 18-27.

12, the remainder gives the value of *ayam* or gain. It is very important in the measurement of a structure that *ayam* be always greater than *vyayam*.

2.4.c. *Nakshathram-ayursthithi*

When the perimeter is multiplied by 8 and divided by 27, the remainder gives *nakshathram*, the star. This value relates to the twenty-seven constellations and has to match the asterisms of the owner. The auspicious and inauspicious nature of each asterism must be considered. In the above calculation, the quotient gives the *vayas* or age, which is one of five types: (1) *balyam* (childhood), (2) *kaumaram* (youth), (3) *yuovanam* (manhood), (4) *vardhakyam* (old age), and (5) *maranam* (death). All of these ages except *maranam* are considered auspicious for the house. These various stages of age were generally termed as *ayursthithi*.[20]

2.4.d. *Thidhi-vaaram-raasi*

Thidhi or *pakkam* is the remainder obtained when the perimeter is multiplied by 8 or 9 and then divided by 30. In some cases, the perimeter itself is divided by 30. The resulting value relates to the number of days from the first day of the full moon. *Vaaram* or *Aazhcha* is obtained from the remainder, when the perimeter is multiplied by 3 or 8; in some cases, the perimeter itself is divided by 7. This value gives *raasi* or the day of the week, starting from Sunday. The values corresponding to Monday, Thursday and Friday are considered to be auspicious.

The above calculations are to be performed using the perimeter of the building or the room which is to be built. For best results, one must use them also when calculating the length, breadth, and height of the basement, the height of the columns, and other dimensions in the building. There are many variations in the above calculations. For example, *vyayam* can also be calculated when the remainder of the perimeter is multiplied by 9 and divided by 8 or multiplied by 8 and divided by 27, with the remainder divided again by 8. In addition to the above calculations, there are other aspects which must be

[20] Menon, K. P. Padmanabha, History of Kerala, 148-149.

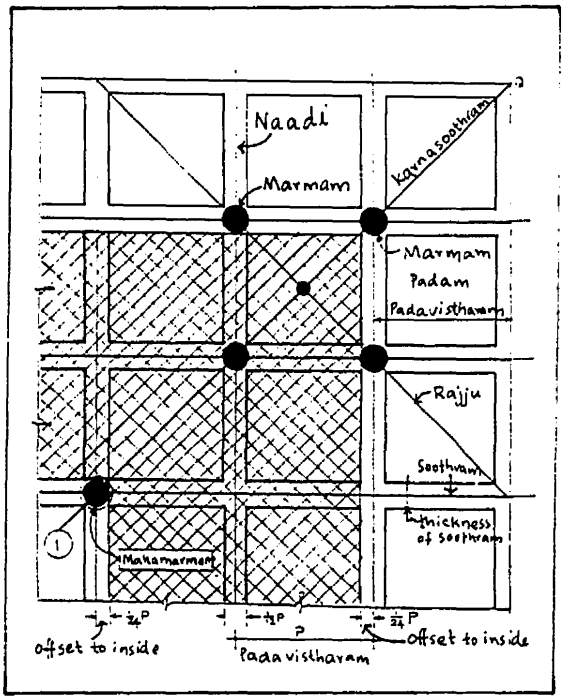

Figure 2.9: *Detail showing method of offsetting the walls to avoid crossing the energy nodes (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

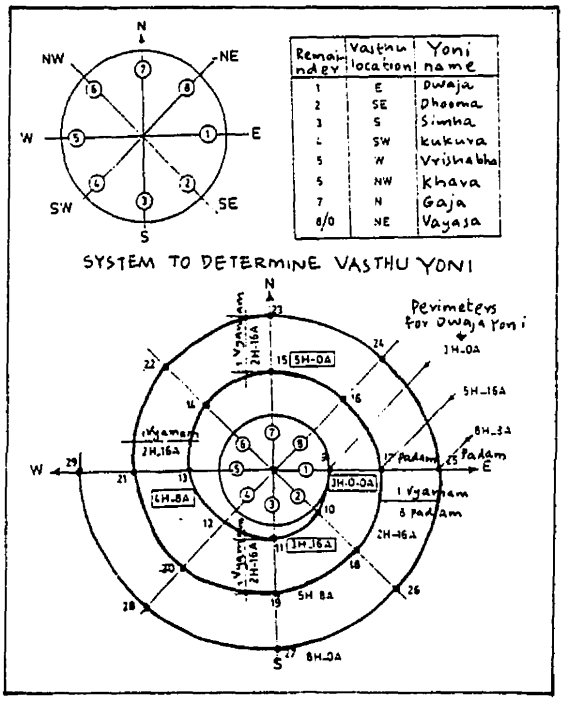

Figure 2.10: *Determination of 'yoni' spiral (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

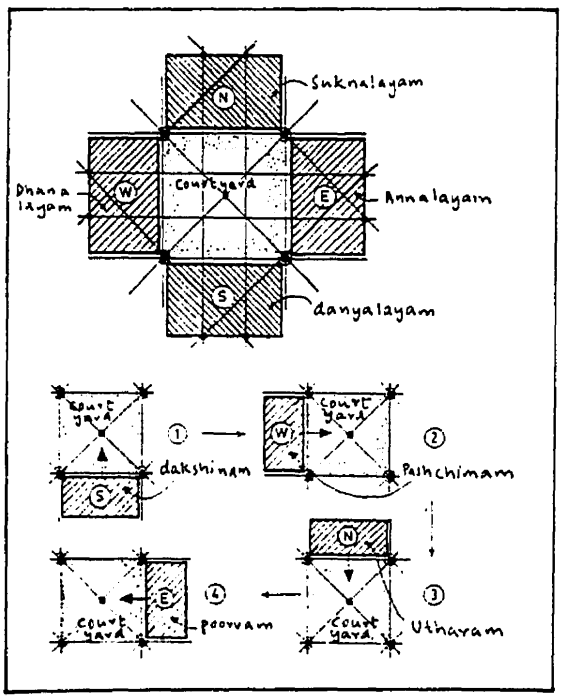

Figure 2.11: *Various 'ekashalas' and their hierarchies (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

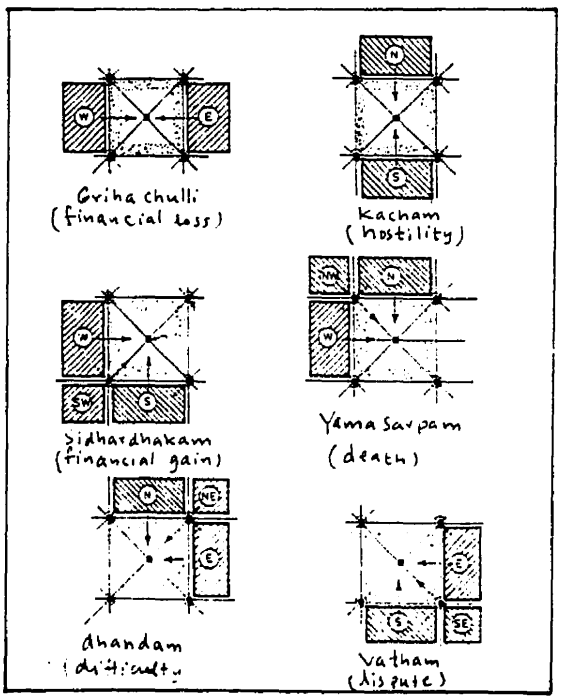

Figure 2.12: *Six models of 'dwishalas' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

considered while determining the dimensions of a structure. These include the *jathi* or the caste, which is obtained when the perimeter is multiplied by 3 or 9 and divided by 4. This value, which corresponds to the 4 castes, should match the caste of the owner. The perimeter is multiplied by 4 or 8 and then divided by 12, the remainder gives the *mashadi raasi*, or the months. Again, when the perimeter is multiplied by 2 or 3 and divided by 16, the remainder gives the value of the *dhruvadhi*, which are 16 in number, of which 10 are considered auspicious. *Dhruvadhi* is also determined from the remainder obtained when *kshethraphalam* or the area[21] is added to *vyayam* and the sum is divided by 16.

2.5. Configuration of *shala* corresponding to position and dimension of building components

The smallest and basic dwelling unit is termed *shala* which in progressive articulation around courtyards evolve into larger complexes. With regard to the orientation of the *shala* in reference to the *ankanam* or courtyard and cardinal directions, houses are broadly classified as *dikshala* and *vidikshala*. The *shala* facing any cardinal direction is a *dikshala*, and one which is in an off-cardinal position is called a *vidikshala*. In the pattern of combination of multiple *shala* or *slishtashala*, 2 units form a *dwishala*, 3 units a *thrishala*, and 4 units form a *chathurshala*.[22]

2.5.a. *Ekashala* system

The single isolated *shala* facing any cardinal direction is called an *ekashala* or the basic unit of a dwelling cluster. These units are rectangular in plan and have a horizontal or annular support called *aaroodam* on which the roof rests. These are the widely adopted forms of dwelling in Kerala. The order of preference and the names of the four different *ekashalas* with reference to the cardinal orientation as prescribed in the text *Mayamatha* (Refer Figure 2.11), are as follows:

1. *Thekkini* (facing south) - *Dhanalayam* or house for wealth - storage.
2. *Padinjattini* (facing west) - *Dhanyalayam* or house for grains - entertaining guests.

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[21] length x breadth

[22] Achyuthan, "Principles of Vasthushasthra," 25.

3. *Vadakkini* (facing north) - *Sukalayam* or house for pleasures - living space for ladies and children.

4. *Kizhakkini* (facing east) - *Annalayam* or house for food - prayer and religious rituals.[23]

Some books allow *padinjattini* to be given priority along with the *thekkini* even though the *padinjattini* is the popular type used by all the communities.

2.5.b. *Dwishala* system

A *dwishala* consists of 2 *ekashalas* which can be configured in six different ways each adhering to typical characteristics. Of these the *dwishala* consisting of *thekkini* and *padinjattini* is considered the best and is called *sidharthakam.* One of the *shalas,* normally the *padinjattini* is given a relative importance over the other by providing extra length, width and height. The 6 variations in *dwishala* configuration are shown (Refer Figure 2.12).

2.5.c. *Thrishala* system

A combination of 3 *ekashalas* is termed *thrishala.* There are 4 types of *thrishala* out of which *hiranyanabham* and *sukshethram* are the best suited for tropical regions and hence popular in Kerala. Due to the better qualities of these combinations, they are also called *sidharthakam.* The other 2 types are *tchulli* and *pakshankanam* which are considered inferior to *hiranyanabham* and *sukshethram.* These 4 types of *thrishala* are shown (Refer Figure 2.13).[24]

2.5.d. *Chathurshala* system[25]

Four *ekashalas* are grouped together around the *ankanam* to form a *chathurshala.* According to *Mayamatha, chathurshalas* are of two models with respect to open and covered courtyards. The former is termed *samvrithankana* and the latter, *vivrithankana chathurshala.* All the *chathurshalas* in Kerala are of the *vivrithankana* model

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[23] Kanipayoor Shankaran Namboothiripad, "Vasthuvidhya, A Living Heritage," National Convention on Vasthuvidhya, November, 1995, 9-12.

[24] Prabhu, Vasthuvidhyadharshanam, 67-69.

[25] Ibid. 69,133-150.

comprising open courtyards. The *chathurshala* is basically divided into 2 types (Refer Figure 2.14): *bhinnashala* or separated halls and *abhinnashala* or combined units. If the *vidikshala* or corner units are not included, the *chathurshala* is called a *bhinnashala* and otherwise as *samslishtachathurshala* or a *nalukettu.* When the *shalas* are partially joined, the *chathurshala* is called *slistabhinnashala. Samslishtachathurshalas* are of 2 types. When the four *shalas* are alike and have a square *ankanam* it is called an *ekakashala* or *sammishrakabhinnashala,* When consecutive *dikshala* and *vidikshala* within a *samslishtashala* are united, they form *mishrakachathurshala* (Refer Figure 2.15). *Mishrakachathurshala* is more complex compared to *ekakashala.* The aspects followed in devising *mishrakachathurshala* are as follows:

1. Courtyard and peripheral shape of the building should be perfect squares and the internal and external perimeters be of *dwajayoni* value.

2. *Dikshala* should be comprised in the respective *yoni* perimeters prescribed for each, and *vidikshala* in *dwajayoni* values (Refer Figure 2.16 for a sample scheme of *mishrakachathurshala* devised according to these rules).

Usually *chathurshalas* comprise rectilinear courtyards in the north-south direction. There are three models accepted for devising *chathurshala* in this manner namely *samshlishtabhinnashala, shlishtabhinnashtashala* and *mishrabhinnachathurshala.* In the case of *samslishtabhinnashala* each *vidikshala* and the related *dikshala* merges together to form a single unit. The resulting east, west, south and north units are separated by *antharalam* or a corridor passage. A model *samslishtabhinnashala* devised according to the prescribed *yoni* rules and *shala* configuration is described in Figure 2.17. *Shlishtabhinnashtashalas* are formed when the related *vidikshala* and *dikshala* are separated spatially but connected by the roof, as the name indicates. A sample model of *shlishtabhinnashtashala* is described in Figure 2.18. In the third model *mishrabhinnachathurshala,* the dimensional computation of the four *dikshalas* are more important which are to be devised with respect to the prescribed *yoni* perimeters for each type of *chathurshala.* The courtyard as well as the external perimeters should be of *dwajayoni* value. The computation of *vidikshalas* are unimportant. The *chathurshala*

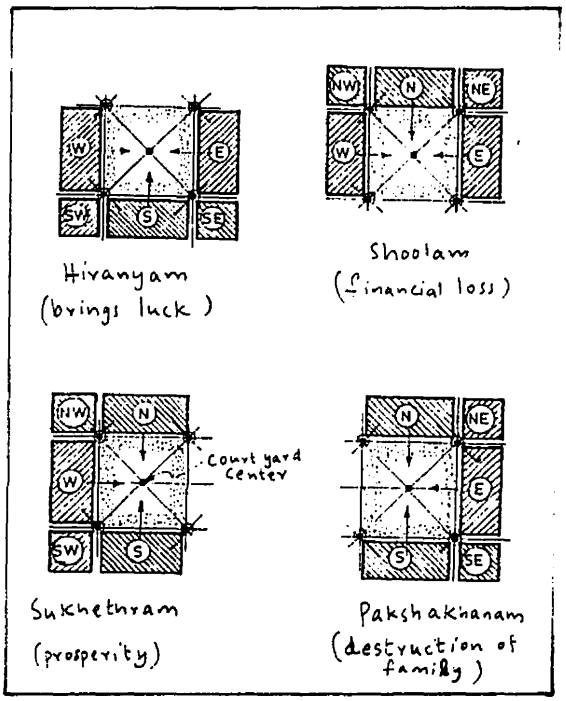

Figure 2.13: *Four basic models of 'thrishalas' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

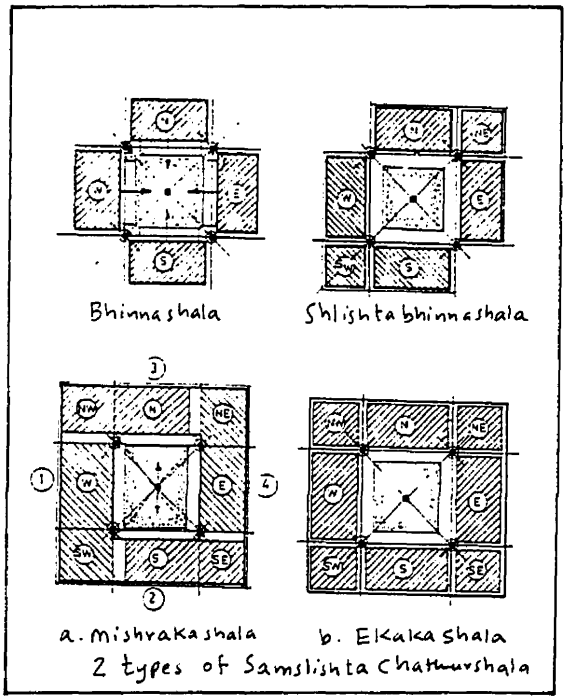

Figure 2.14: *Basic models of 'chathurshalas' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

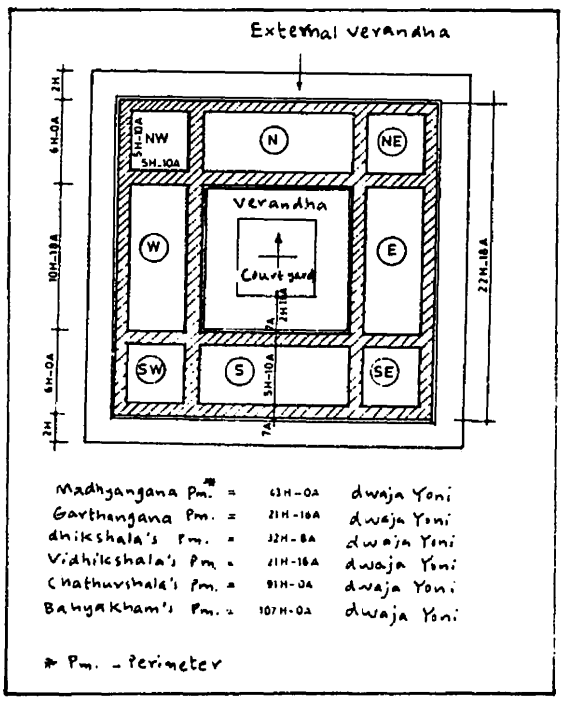

Figure 2.15: *'Ekakashala' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

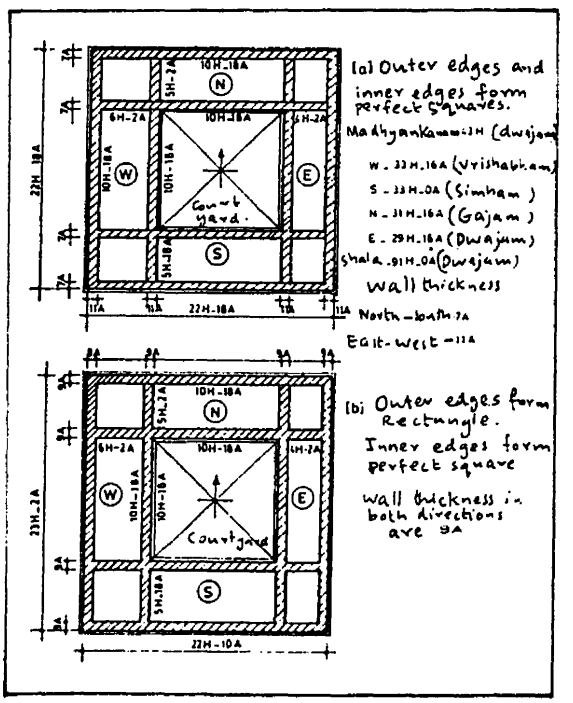

Figure 2.16: *'Mishrakachathurshalas' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

may be further divided into *sarvathobhadram*, *nandhyavartham*, *vardhamanam*, *swasthikam* and *ruchakam* based on the position of porch, gable, major doors and verandahs (Refer Figure 2.19). There are 9 specific forms of *chathurshala* with the characteristics of how the halls are connected by means of *alindha* or passages and how the roof frames are joined, as described in the text *Vasthuvidhya*.

2.6. Vertical proportioning

The total height of the building from the ground level to the level of the wall plate is termed *padamana* which also forms its width. The plinth of the house is fixed as a fraction of the *padamana* between 1/10 and 1/3 depending on the width and ground condition. For the smallest building, this gives inside a headroom equal to the reach of the man and will suggest only single story construction. For larger buildings, the *padamanam* may be taken as a maximum of one and half times the width of the building making provision for two storied construction. The thickness of the walls is taken as 1/2 to 1/6 of the *padamanam* by which the slenderness ratio is controlled to about 1/8 or 1/9 of the wall height.[26] The wall is topped with *utharam* or the wall plate, *upatula* or the floor joists and *tulopathula* or the bressumer supporting the rafter ends. The upper ends of the rafters rest on the ridge and get tied with each other by collars and collar pins, forming a strong space frame. For rooms with larger span, additional props from wall plates are provided which support secondary bressumers. The pitch of the roof is generally 45^0 with eaves projecting from the walls to suit the climatic needs. *Vasthuvidhya* give the sizes of all structural members in a proportionate system based on the building width, as well as elaborate details of joinery.

The following chart gives the ratios for the horizontal and vertical proportions stipulated by the traditional rules.

HORIZONTAL

The ratios of length to width of a house must not be between 1 3/4 and 2, 2 3/4 and 3, 4 3/4 and 4 and so on.

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[26] Balagopal T.S. Prabhu, "The Traditional Approach to Residential Architecture," Vasthu Science and Technology in Buildings, March, 1994.

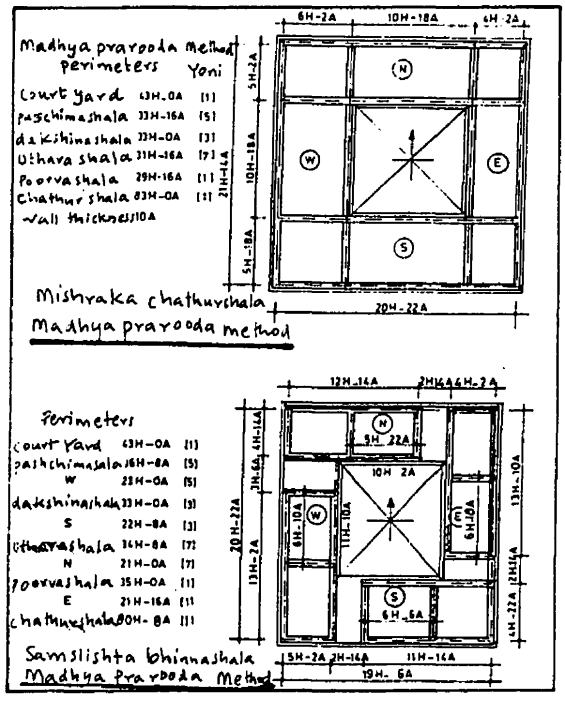

Figure 2.17: *'Samslishtabhinnashala' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

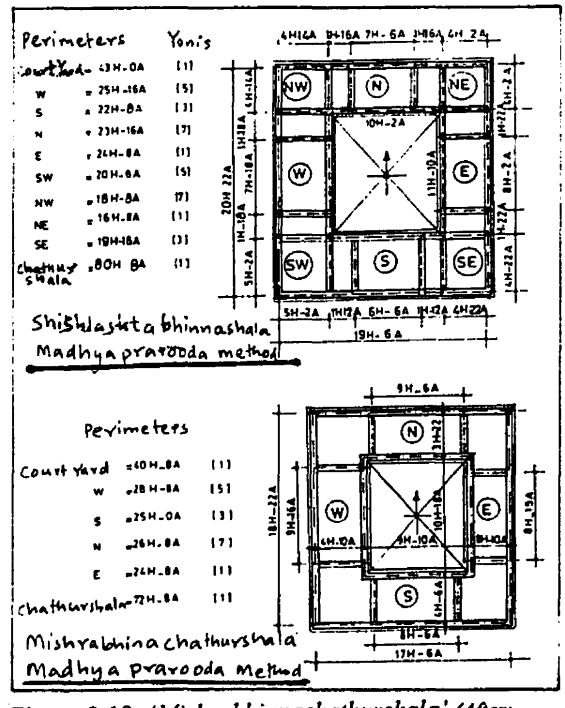

Figure 2.18: *'Mishrabhinnachathurshala' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

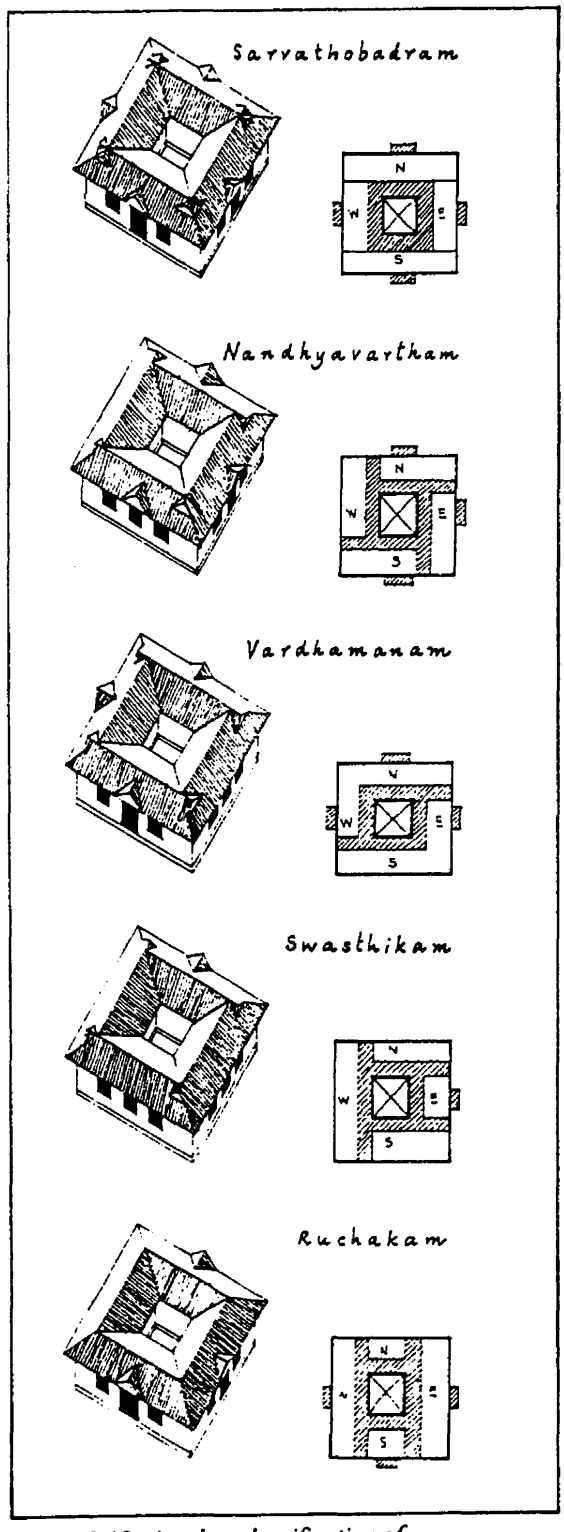

Figure 2.19: *Another classification of 'chathurshalas' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

1 and up to 1 1/4 is called *samathadhayika* which means a square.

1 1/4 and 1 1/2 is called *padadhika*

1 1/2 and 1 3/4 is called *ardhadhika*

1 3/4 and 2 called *padhona,* is not advisable.

The length of a room should be 1 to 1 3/4 times its width; that is or 1:1 1/4, 1:1 5/4 to avoid *padhona.*

VERTICAL

The heights or the vertical dimensions of the building are derived from the horizontal dimensions. The total height should be a minimum of 3/2 times, 5/4, 6/5, 7/6, 8/7, 9/8, 10/9, 11/10, 3/4, 5/6, 6/7, 7/8, 8/9 times or a maximum of 9/10 times the width.

The height of the plinth should be 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9 or 1/10 of the total height of the building.

The height of walls in the upper floors should be reduced by 1/8 or 1/10 of the total height.

The foundation should be excavated to a man's height if a rocky bottom is not reached in between or to water table depth. Otherwise it is taken as 1/4, 1/5 1/6 of the height of the building.

The bottom of pillar should be 1/4, 1/5, 1/6, 1/7, 1/8, 1/9, 1/10, 1/11 of the width of the bottom.

Considering a rectangular or square shape, the base of the pillar footing should be equal to the diagonal of the section at the top.

Width of the pillar capital is half the width of the pillar added to thickness of the wall plate, length 3, 4 or 5 times that of the middle piece.

The depth of the eaves board is 2/5, 4/9, 3/7, 3/8, 1/4 or 1/2 part of the height of the wall. This could be reduced or added by 1/6, 1/7, 1/8, 1/9, 1/10, 1/11 parts.

The maximum is 1/2+(1/2x1/6) = 7/12

The minimum is 1/3+(1/3x1/6) = 5/18

2.7. Conclusion

The traditional theory of residential architecture has many characteristics such as its holistic concept, rational dimensional basis, convenient proportionate systems, proper use of indigenous materials and customized hierarchy of building skill. The standard *angulam* is approximately equal to 3 cm acts as the basic unit in the scale. Other units of measurements like *mushti*, *vithasthi*, *kharam* or *kol* are proportionate to human proportions whose height is considered as 64 *angulam*. In the modern times, the SI unit is universally accepted and replace the traditional system even though they do not refer to any human proportions. The decimal system of SI units makes manual computation easy whereas the traditional system based on the octal system is perhaps more complex for multiplication and division. Still, courtyard houses incorporating traditional system of measurements were widely built and lived in originally over the last 400 years.

Political and cultural changes influenced the dwelling and construction methods in the later stages when *ekashala* became popular. Correspondingly, the mandates of *alpakshethra* concepts became more popular.[27] Even though changes occurred in the style and scale of buildings over time, the basic rules of determining orientation of the house, computing dimensions with respect to the perimeter values and so on, were strictly followed.

[27] Sarvavigjnanakosam, 352.

Chapter 3: Canonical Practices of Construction in Domestic Architecture

3.1. Introduction

Vasthushasthra is the theory of the traditional building science of India which was formulated and developed through centuries of observation and practice. In the process it adapted to regional influences, and these regional versions had a great degree of autonomy. *Vasthushasthra* is derived from the root *'vas'* meaning 'to dwell' or 'to occupy'.[1] All dwellings of both mortals and immortals are called *vasthu*. The science of designing and building *vasthu*, -- *Vasthushasthra* -- originated in the *Vedic* period. *Vasthushasthra* covers the 4 main aspects of *vasthu* such as *bhumi* (land), *prasada* (building), *yana* (vehicles) and *sayana* (furniture). *Shilpa* (sculpture) and *chitra* (graphics) are also considered as the two other limbs forming the *shadanga* (6 limbs) of *vasthu*. Thus the scope of *Vasthushasthra* ranges from planning of settlements to making small furniture and graphics. *Prasada* are classified into 5 types such as *prapa*, *mandapa*, *shala*, *sabha* and *mandira*. Of these *mandira* includes *manushyalaya* (human dwelling) as well as *devalaya* (temples). *Prasada* are also classified according to the type of construction into *shuddha* (built of 1 material), *mishra* (2 or 3 materials) and *sankirna* (more than 3 materials). Most of the buildings of Kerala belong to the *mishra* type, commonly found to be using stone, mortar and timber construction.[2]

A variety of materials available in different regions of Kerala was used in *vasthu* construction, making use of their structural properties. Materials like bamboo, mud, brick, stone, timber and metals together with many binding materials were found to be used in the construction. *Vasthushasthra* was never material-specific. Rather it incorporated new materials and techniques in its theories in the course of its development. The primitive bamboo construction formed the basis for later timber work. The skill in making mud walls developed into more complex masonry skills. Thatching was replaced

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[1] A. Achyuthan, "Principles of Vasthushasthra," Readings in Vasthushasthra Traditional Architecture, Book 1, November, 1995, 18-27.

[2] Balagopal T. S. Prabhu, Vasthuvidhyadharshanam (Calicut: Vasthuvidhyaprathishtanam, 1994), 168.

by tiles and later by metal cladding.[3] As newer materials were discovered and used, refinement of skill was also achieved by consistent practice. In any building construction, foundation and basement required only semi-skilled laborers. The ultimate test of the craftsman's skill lay in assembling the roof frame. Naturally, the highest skills were that of the carpenter or *thatchan* and, consequently the science of *vasthu* was called *Thatchushasthram* in Kerala.[4] This chapter discusses in sequence, the system of the craftsmen, various building parts, their construction methods and different materials and their applications as prescribed by the regional and local codes of practice.

3.2. Craftsmen

Ancient Indian artisans were organized into guilds, which were extensions of family units. Their traditions were handed down orally from one generation to the next. The title *shilpi* was applied to a craftsman when he become an expert in his line. The term *shilpa* means an art, fine or mechanical, classified into sixty-four types.[5] According to Dravidian folklore, Maya and Manu, the progenitors of the crafts together with *shilpa*, *twasthra* and *vishwajna*[6] have all descended from Vishwakarma, the lord of creation.

3.2.a. Canonical reference and the *shilpa parampara*

The community of *shilpi* all over India is commonly named as *vishwakarma*. The *Mansara* speaks of four *shilpis* who came from Brahma: *vishwa-bhu*, *vishwa-stha*, *vishwa-vidh* and *vishva-sristhta*. The next generation comprised Vishwakarma, Maya, Twashta and Manu. From these four descended *sthapathi*, *suthragrahi*, *vardhaki* and *thakshaka* (Refer Appendix 3.1). The ancient canons specify the qualities and duties of these four classes which form a guild of craftsmen, each an expert in his own department at the same time possessing an overall knowledge of the science of architecture. The

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[3] Metal cladding was used only in religious buildings, mainly for the roof of the sanctum sanctorum of temples.

[4] Ashalatha Thampuran, and Balagopal T.S. Prabhu, "Timber Walled Houses of Malabar Coast," Readings in Vasthushasthra Traditional Architecture, Book 1, November, 1995, 77-87.

[5] M.S. Sreedharan, explains 'kalakal' meaning 'arts' in Bharathiya Shasthra Manjusha elaborately list out these 64 types of arts, Volume 3, Pages 193-196.

[6] representing masonry, metal craft and goldsmithy.

code of ethics and practice in the *Manasara* is elaborate and in many ways resembled the Ten Books by Vitruvius, the first treatise on architecture in the Western tradition.[7] The craftsmen not only mastered these treatises but also were scholars in the *Vedas* and religious ceremonies thus earning the title *acharyas*. The *sthapathi* was the chief architect. He had faithful disciples in craftsmen and artisans from varied backgrounds. The *sthapathi* was always a member of the Brahmin caste; the *suthragrahin* of the Kshathriya caste; the *vardhaki* of the Vaisya caste and the *thakshaka* of the Sudra caste.[8]

In such a craft oriented society, the master craftsman was also an important figure in the community, because craftsmanship was considered to be a high function of the human being endowed with talents. Kerala had fine craftsmen in other crafts too such as weaving, pottery, sculpture, painting and so on. Socially, each group formed a caste or sub-caste with a hereditary craft specialization which fixed their role in the society.

3.2.b. *Thatchan, kallan* and *kollan*

The *Vedas* and *Puranas* identify 5 separate groups of craftsmen based on their particular skills and training:

Thatchan or *ashari*, the wood craftsman or carpenter who built furniture, wooden images, temple utensils, boats and chariots.

Twashta or *mooshari*, the maker of designed copperware, bells, metal vessels, oil lamps and metal mirrors.

Viswagya or *thattan*, the jeweler or goldsmith.

Manu or *kollan*, the blacksmith-- a maker of weapons as well as metal tools for agriculture and sculpture.

Shilpi or *kallan* the builder of religious and domestic buildings and sculptor, basically on stone.

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[7] Prasanna Kumar Acharya in Chapter 4 of Indian architecture according to Manasara-Shilpashasthra discusses in detail, similarities between Manasara and the treatises of Vitruvius. He finds the similarities so striking as to propose a hypothesis that the two works were written under each other's influence.

[8] M.A Ananthalwar, and Alexander Rea, eds., Indian Architecture, (Delhi: Indian Book Gallery, 1980), 42-43.

Since most of the dwelling structures in Kerala were *mishra*[9] type, 3 major craftsguilds conducted the construction practices: *thatchan*, *kallan* and *kollan*, the executors of all types of buildings. In Kerala, the *thatchans* or the carpenters (Refer Picture 3.1) formed the dominant craftsguild under whom woodcrafts found full expression in the making of temples and domestic buildings. The science of timber craft in Kerala known as *Thatchushasthram* is synonymous with the traditional science of architecture. In the early period, timber was the chief material used in house building. Timber walled houses represent the earliest tradition in residential architecture over the entire region of Kerala.[10] Among the carpenters, there were 6 sub-divisions specializing in temple construction, house building, cart making, boat making, cabinet making and shaping implements and gadgets.

The guild of workshops or *shilpashalas* formed schools of craft-training and education based on the *gurusishya parampara* (the master-disciple lineage).[11] The craftsmanship was hereditary and was passed on generations. The apprentice lived in the masters house. The young *thatchan* or *kallan* started his schooling at the work yard at about 10-12 years of age when he was old enough to handle implements. In the early stages, he learned by watching the elders at work, familiarizing himself with the rituals, ceremonies, different tools, materials and terminology. In this stage, he was allowed to participate in the work only nominally: sharpening and cleaning the tools and preparing the *kavi* mixture for marking. The young *thatchan* was initiated by a formal ceremony marking the holding and wielding of implements on a special day when the stars were auspicious. There was equal emphasis on proper education and the right environment for the growing youth under hereditary craftsmanship. Usually, the young craftsman was brought up and educated in the family workshop under the discipleship of his father, uncle or elder brother, whoever happened to be the head of the family. In the bosom of the family workshop, the techniques were taught in their entirety in direct relation, by constant

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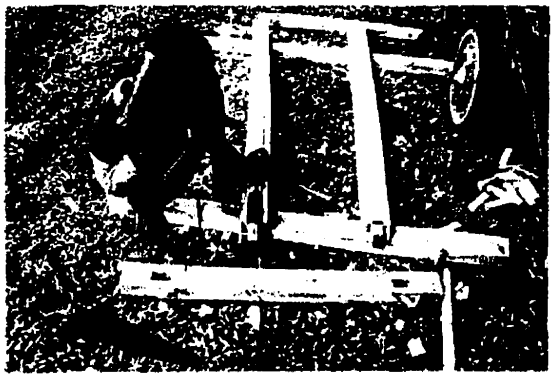
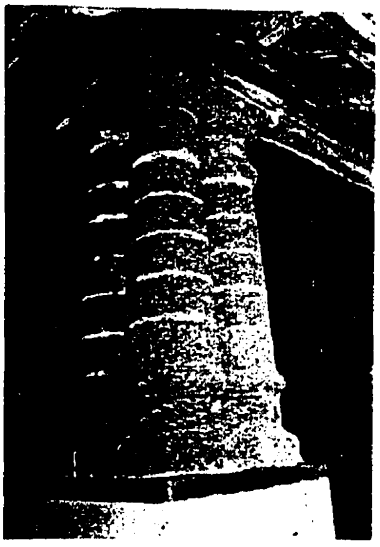
[9] made using 3 materials.

[10] Ashalatha Thampuran, and Balagopal T.S. Prabhu, "Timber walled houses of Malabar coast," Readings in Vasthushasthra Traditional Architecture, Book 1, November 1995, 77-88.

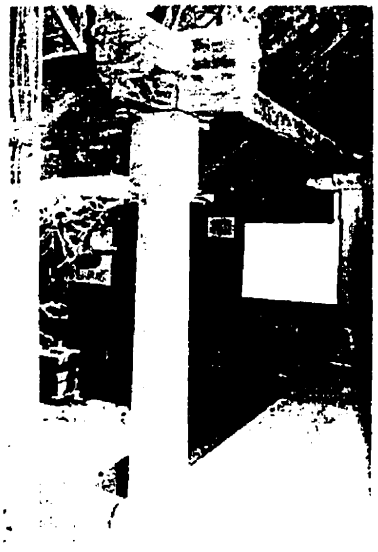
[11] Sashikala Ananth, "The Institution of the Vishwakarma," Architecture + Design Journal, September 1991, 77-84.



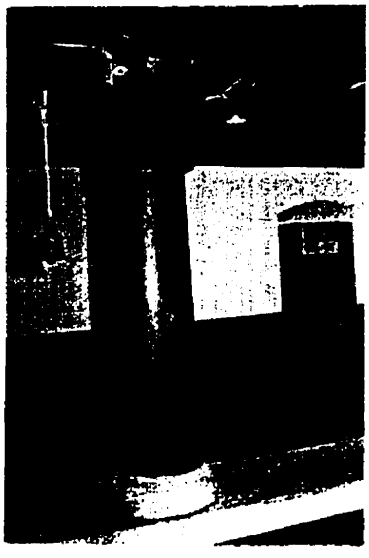
Picture 3.1: *A local 'thatchan' making a door frame.*



Picture 3.2: *A group of laterite pillars in a house in Malabar.*



Picture 3.3: *A granite pillar.*



Picture 3.4: *A wooden pillar with a granite base.*

Picture 3.5: *Typical door with wooden hinge and locking device.*

practice. With practical training, the knowledge comprised in the traditional treatises such as *Thantrasamuchaya* and *Manushyalayachandrika* was imparted to the young *thatchan.*

3.3. Construction of six limbs of a dwelling structure

Considering the house as a male human being standing erect on a firm ground, the scriptures describe the six physical organs forming its body above ground level, excluding the plinth. For small buildings or *alpakshethram* these six limbs are *adisthanam* foundation, *padam*, *prastharam*, *greevam*, *shikharam* and *sthupi* (Refer Figure 3.1). Even though the plinth was not included as visible body organ of the building it was considered an important invisible organ. In to mythology a building is the progeny resulting from the fertilization of the seed planted by the male force *vasthupurusha* in the female force *bhoomi* or mother earth, thus emerging out of her body. The seed ought to be planted as deep as the height of a human being or above water table if not met with a hard rocky strata, as specified by the ancient architect Mayamuni in the section *bhoomilambham.*[12] In common practice, the plinth depth is 1/3rd the width of the *shala* or block and is not less than 1 *hastham*[13] and 8 *angulam* in width.[14] This plinth is built of laterite, stone or brick masonry from a depth of 8*a.* to the ground level after excavating the loose earth and ramming the earth below in many layers of sand, gravel and pebbles. This plinth surface is evenly leveled to the ground floor by means of water levels to make the seating for the lower most limb, *adisthanam.*[15]

3.3.a. *Adisthanam* or foundation

Adisthanam forms the foundation of the building, which is also known by names such as *masoorakam*, *vasthuadharam* and *dharathalam.* There were basically 3 types of designs for *adisthanam* in residential buildings named as *manchakam*, *prathimanchakam* and *galamanchakam* (Refer Figure 3.2). The simplest form of the *manchakam* type had two

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[12] In Mayamatha.

[13] *Hastham* is referred as also *kol* in Chapter 4 both of which are same.

[14] *angulam* is abbreviated as '*a.*' and *hastham* as '*h.*'

[15] Prabhu, Vasthuvidhyadharshanam, 151.

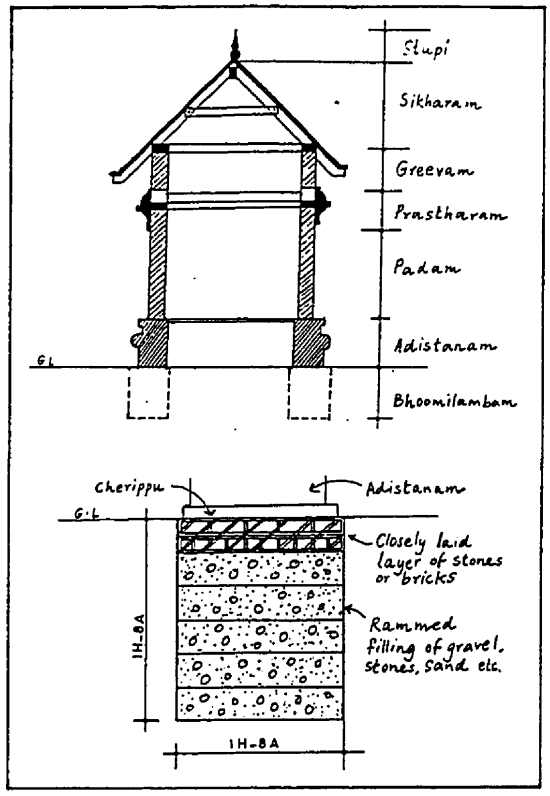

Figure 3.1: *The six limbs of a building and details of the basement (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

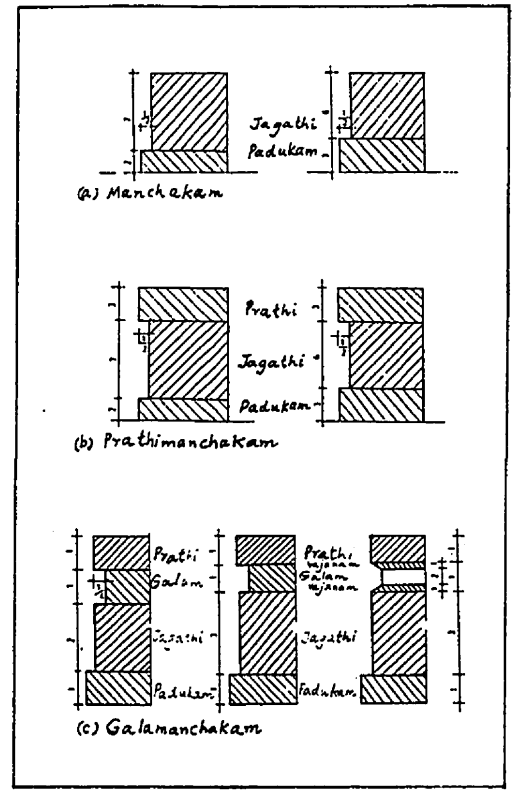

Figure 3.2: *Different types of 'adhisthanams' used in residential buildings (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

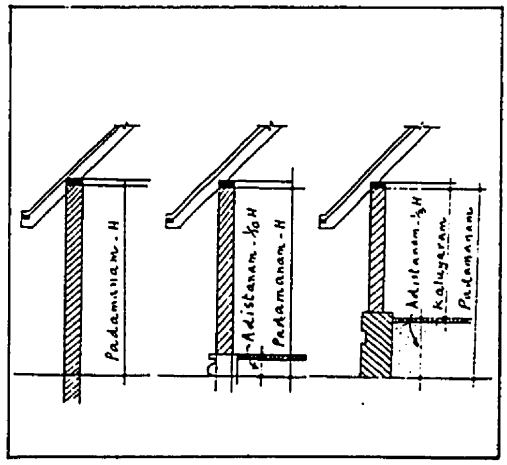

Figure 3.3: *'Padhamanam' and the height of 'adhisthanam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

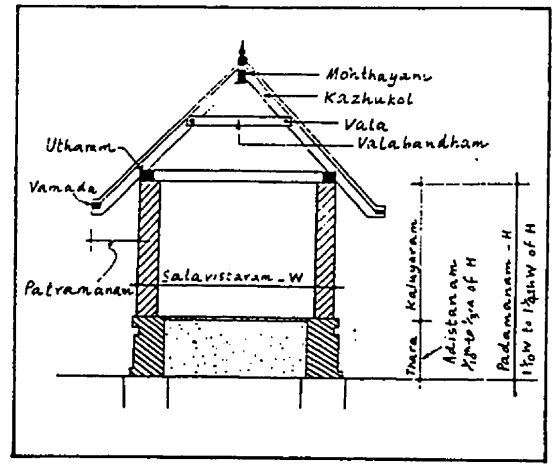

Figure 3.4: *Evolution of 'padhamanam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

main steps called *padhukam* which is the lower part and *jagathi* the upper part. These two parts were proportioned as 2:7 or 1:2. This form of *manchakam* turned into a *prathimanchakam* with a third extra step on the top forming a proportion of 2:7:3, such that the middle portion is recessed while the other portions are leveled to the same plane. In the third type a fourth step appeared as a groove called *galam* between the second and third parts known as *galamanchakam.*

The height of *adisthanam* is depended on *padamanam* or the height of the building from the ground level to the bottom of the wall plate (Refer Figure 3.3). Usually *padamanam* is equal to the span of the block and the lowest permitted height is 3 *h.* and 6 *a.*. The length of *padamanam* is also calculated by adding or subtracting values from 1/10th to 1/4th of the span from the span of the block. The height of *adisthanam* is part within and forms 1/10th to 1/3rd of the *padamanam.* In single storied residential buildings these heights ranged from 8*a.* to 1*h.* 2*a.* (Refer Figure 3.4). In two storied buildings it was 1*h.* 6*a.*. It increased further by 6*a.* for each additional floor.

3.3.b. *Padam* or lower walls and pillars

This limb built above the *adisthanam* was compiled of walls or *bhithi* and pillars or *sthambham* (Refer Figure 3.5). In courtyard houses the *shalas* were composed of walls except the inner face of the north and south *shalas* facing the courtyard, which had pillars. The walls were always pillared on the outer edges of the inner and outer verandahs in these houses. The method of building *yagashala* or sacrificial altars even today resemble the building of residential *shalas*: by erecting pillars over the raised *adisthanam* and tying them together at the top by wall plates. Over the wall plate, the pitched roof with prefabricated timber frames was erected. Thus the total structure comprised frames which later got partitioned by wooden panels, threshed or knitted bamboo mats or plated palm leaves. The inscribed relation contained in the term *padamanam* even though indicates the height of *padam* added to *adisthanam*, points to a possible practice of the earlier form when *adisthanam* did not exist at all. The height of *padam* which is the difference of *padamanam* and the height of *adisthanam* was called *kalpokkam.*

3.3.b.a. *Bhithi* or wall

When *Brihathsamhitha* stipulates wall thickness as 1/16th of span of the hall, *Manushyalayachandrika*, a later text asks for a minimum equal to that of the width of wall plate. The top width of a pillar is same as width of the wall plate, making it possible to have values ranging from 1/12th to 1/6th of the height *kaluyaram* which is 2/3rd of the height *padamanam*. *Padamanam* and hall width used to be equal, thus *Brihathsamhitha* and *Manushyalayachandrika* asked for more or less the same results. Accordingly, for a hall span of 4*h*.8*a*. the required wall thickness was more than 6*a*.. Considering wall thickness as 1/12th of *padamanam* which has to be equal to the hall span also leads to the value 8*a*. for wall thickness. In small houses, load bearing walls were of 8*a*. thickness and partition walls of 6*a*. thickness. An increase of 2*a*. was made to these wall thickness, as the span of the hall increased. *Shilparathna* stipulates 5 types of walls with respect to the materials used for their construction such as *shilamayam*, *ishtikamayam*, *jalakamayam*, *phalakamayam* and *mrinmayam* (Refer Figure 3.7). *Shilamayam*, *ishtikamayam* and *mrinmayam* correspond to walls built of stone, brick and mud respectively. *Jalakamayam* corresponds to perforated or jalied screen wall in stone and *phalakamayam* to timber walls comprising frames and panels.[16]

3.3.b.b. *Sthambham* or pillar

The name *sthambham* has derived from the Sanskrit word *'sthambh'* meaning 'still'. The width of the pillar varies from 1/6th to 1/12th portion of its height with regard to the material used. For pillars made of wood, bottom width was either 1/11 or 1/12 of its height, for hard stone pillars such as granite, it 1/8,1/9,1/10 of height. For brick or mud pillars it was either 1/6 or 1/7 parts of their height. A reduction of about 1/8 to 1/16 parts in the width of the pillar was used to effect a taper from base of the pillar to its top. These pillars were circular, square or octagonal, and in some cases, all three combined in the same pillar. The span between two pillars ranged from 3 to 10 times their diameter. A pillar comprised of 3 parts: the base or footing called *oma*; the mast, the central portion; and the topmost part which is the bracket called *bhodhika* (Refer Figure 3.6).

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[16] Ibid, 151.

The *bhodhika* was pinned on to the bottom of the wall plate. *Oma* and *bhodhika* were joined to the mast by a dove-tailed joint in stone and wooden pillars. The upper tail of the mast pierced all the way through *bhodhika* and entered the wall plate. In some cases stone bases were used to protect the wooden mast from termite attack and decay due to dampness in the floor. Depending on the economic and social status of inhabitants, the degree of ornamentation in pillars varied. Refer Pictures 3.2, 3.3, 3.4 and Picture 3.5 for pillars made of 3 materials in traditional houses in Kerala.

3.3.b.c. *Vathil* or doors and *jalakam* or windows

The main doors and windows were located in the middle of the quadrant or in the central axis of the *shala* and that of the courtyard. The inner perimeter of door and window frames corresponded to the *yoni* values prescribed for the respective *shala*. In many cases, an inner width of 22*a*. to 1*h*.6*a*. (66cm to 90 cm) was applied to doors (Refer Figure 3.12). Their heights equaled a deduction of 1/7th or 1/8th value from the *kaluyaram*.[17] Even though detailed descriptions on making doors are present in the traditional texts, they do not elaborate on windows as much.

3.3.b.d. Timber joinery

The assembling of vertical pieces was done according to different principles mentioned originally in the *Mayamatha*. In pillars, the assemblage was below the middle and any assembling done in the upper half was a source of failure. The *Mayamatha* specifies 5 types of vertical joints for lengthening structural members in timber as follows (Refer Figure 3.8):[18]

1. *mesayuddha* - This is a mortises and tenon assembly, the width of the tenon being 1/3rd of the pillar and its length normally twice or two-and-half times its width.
2. *trikhandaka* - There are 3 mortises and 3 tenons arranged as a *swasthika* configuration.
3. *saubhadhra* - Comprises of 4 peripheral tenons.

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[17] Ibid, 151.

[18] Dagens, Architecture in the Ajitagama and the Rauravagama, 89-106.

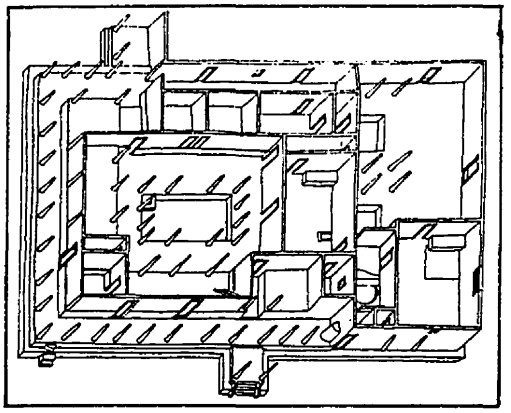


Figure 3.5: *The walls and pillars in a Nayar house in Travancore region.*

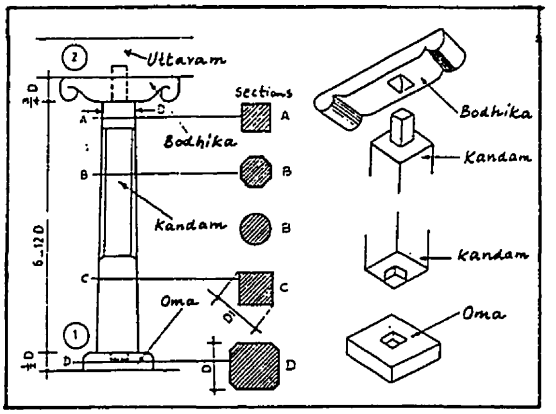


Figure 3.6: *Details of a 'sthambham' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

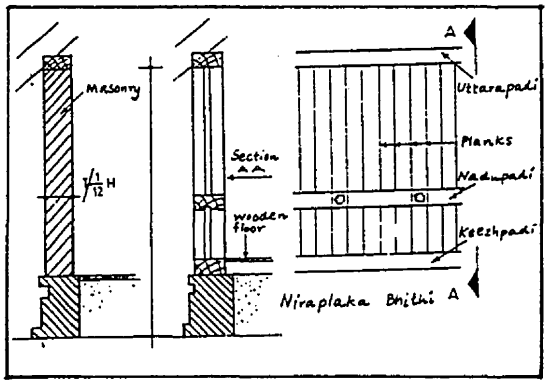


Figure 3.7: *Details of 'bhithi' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

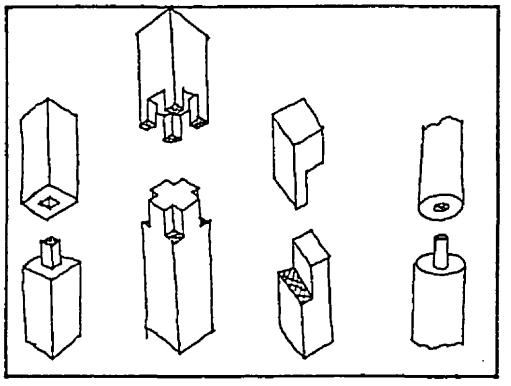


Figure 3.8: *Various vertical timber joining (B.R.Balachandran, Monograph on Traditional Building Materials in Kerala, 1993).*

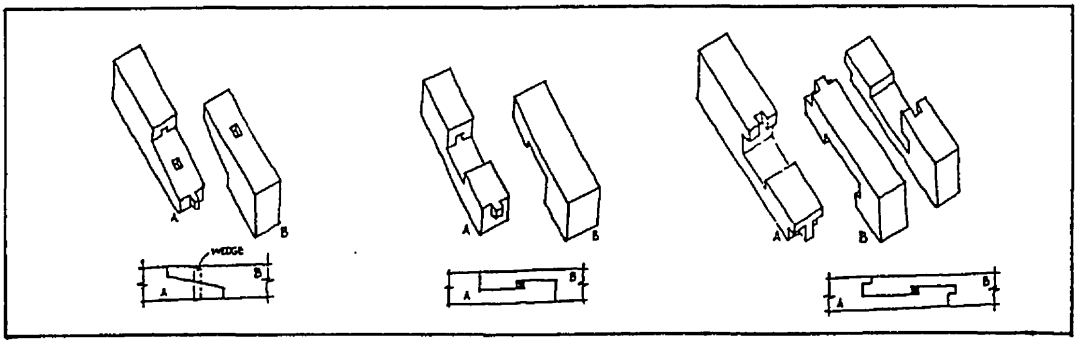


Figure 3.9: *Various horizontal timber joining (B.R.Balachandran, Monograph on Traditional Building Materials in Kerala, 1993)*

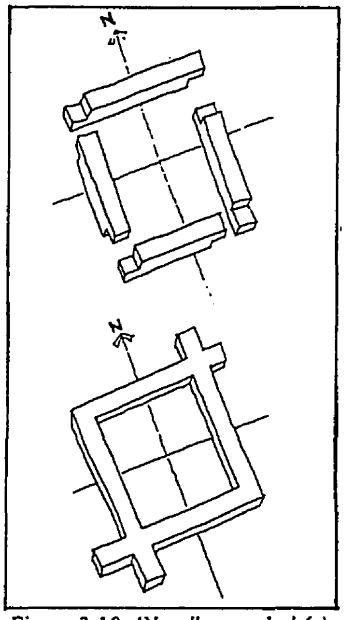


Figure 3.10: *'Nandhyavartha' (a) and 'sarvathobhadhra' (b) assembly (B.R.Balachandran, Monograph on Traditional Building Materials in Kerala, 1993).*

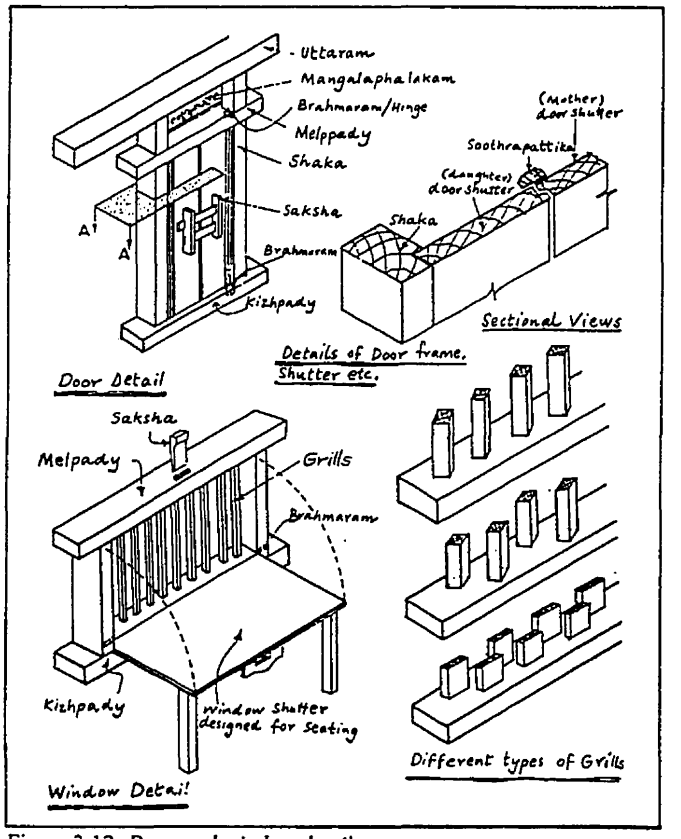


Figure 3.12: *Door and window details (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

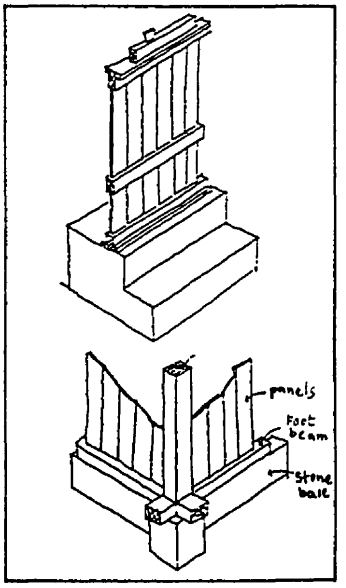


Figure 3.11: *Details of wooden frames and 'nira' panels (B.R.Balachandran, Monograph on Traditional Building Materials in Kerala, 1993).*

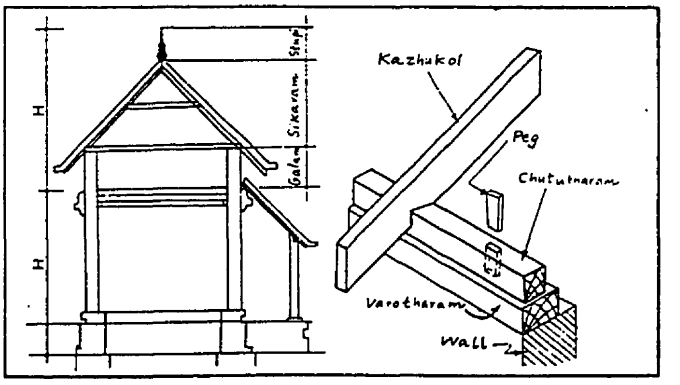


Figure 3.13: *Details of upper part of the building and 'chuttutharam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

4. *ardhapani* - This is a scarf joint where half the lower and half the upper pieces are cut to size according to the thickness chosen for the pillar.

5. *mahavritha* - This is also a mortise and tenon assembly, the tenon being semi-circular in section.

According to the *Mayamatha* horizontal joining of timber are as follows:

1. *shathsikha* - 6 ploughshare shaped tenons arranged in both sides of an *ardhapani* assembly, with a pin in the middle of its thickness.

2. *sukaraghrana* - This assembly comprises tenons of various sizes according to the required firmness, and shaped as the snout of a boar.

3. *vajrasannibha* - This is the dove-tail assembly with the tenon in the form of a diamond.

4. *nandhyavartha* - One long piece stretching from north to south having a projection at its southern end; another long piece, stretching from east to west having a projection in the west; a third long piece, stretching from south to north, having a projection in the north and a long west-east piece having a projection in the east (Refer Figure 3.10).

5. *sarvathobhadhra* - In this assembly, the bottom of the first piece is in the south-east corner and its top in the north-east. The first supporting piece is on the eastern side and its bottoms are cut on its upper face and the piece in the west, the top and bottom of are cut on its lower face and is supported (Refer Figure 3.10).

Other few assemblies mentioned in *Mayamatha* are

1. *mallalila* - single assembly uniting 2 pieces

2. *brahmaraja* - double assembly uniting 3 pieces

3. *venuparva* - 3 or 4 assemblies uniting 4 or 5 pieces

4. *pukaparva* - 5 or 6 assemblies uniting 6 or 7 pieces

A few of the joinery details used in joining horizontal members are illustrated in Figure 3.9.

3.3.b.e. *Nira* or timber framed/paneled wall

The timber houses in Kerala especially in the southern region were composed of walls built of frames and panels called *nira* (Refer Figure 3.11). These buildings were constructed almost entirely of timber from plinth level upwards consisting of wooden

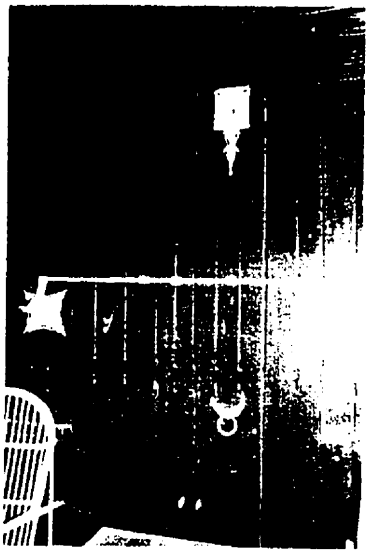
posts, beams, rafters, collars and panels (Refer Picture 3.7). The beams at plinth level were supported on granite pillars about 50cm x 50cm x 150cm embedded in the ground.[19] These granite supports were provided at all wall junctions and at 1.5 to 2m intervals along the length of the walls where required. The space in between was built up to the plinth level with bricks or laterite. Above the wooden plinth beam were wooden pillars at all wall junctions and at intervals along the walls (Refer Picture 3.8). Between these pillars were wooden planks joined to each other by tongue and groove joints. Usually these planks were vertically divided by an ornate horizontal member called *aranjganam* which ran around the exterior walls (Refer Picture 3.9, Picture 3.10).

3.3.c. *Prastharam* or cornice beam

Prastharam was the beam running around the building which is detailed for damp-proofing and holding the upper floor, forming a decorated cornice above the *bhithi* (Refer Figure 3.14). There were four parts constituting the *prastharam* such as *chumarutharam*, *vallabhi*, *kapotham* and finally *prathi*. (Refer to Figure 3.14 along with the following description for a detailed understanding of *prastharam*.) The wooden beam or *utharam* was laid on top of *chumar* or *bhithi* level, tying the pillars and forming the *chumarutharam*. Across, on top of these were arrayed a series of cross beams called *sheelanthi*, also called *thatuthulaam* which literally means floor beams, over which was fixed a wooden floor with planks neatly joined on edges (Refer Picture 3.11 and Picture 3.12). These joints were concealed by reapers called *bhahalathulam* running below, arrayed in equal spacing across the *sheelanthi* forming a chequered pattern to be seen from below. The projecting ends of *sheelanthi* outside the wall were covered with a wooden decorative edge board forming the second part of *prastharam* called *vallabhi*. Above the wooden floors were laid clay tiles in lime or *surki* mortar. This layer over the wall was lined with edge stones detailed with a protective projection curving down to the outside designed for prevention of dampness. It ran around the entire length of the exterior wall and was called *kapotham* (Refer Picture 3.13). These stones being

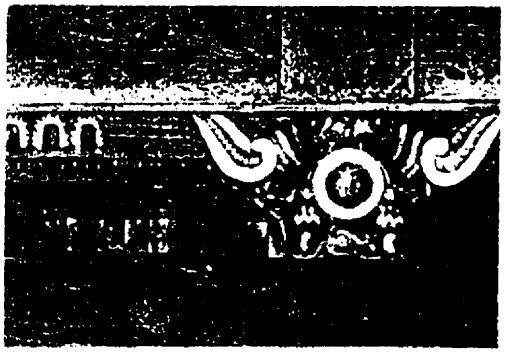
[19] B. R. Balachandran, and Subhash Mohan S., Monograph on Traditional Building Materials in Kerala, (Bombay: Indian Institute of Technology, 1993), 23-34.

Picture 3.6: *Entrance door of a Syrian Christian house in Kuttanad.*

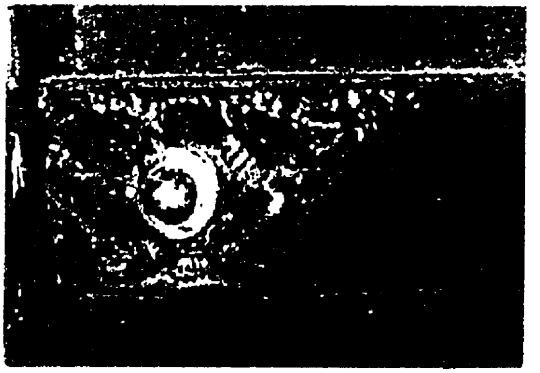


Picture 3.7: *A view of method of locking the 'ara' and 'nira' in a Syrian Christian house in Thazhathangadi.*

Picture 3.8: *Shows the corner detail of plinth level beam over which 'nira' is erected.*



Picture 3.9: *'Aranjanam' depicting two parrots pecking cashew fruits.*



Picture 3.10: *'Aranjanam' depicting 'vyali' images.*

cantilevers, were kept in place by another layer of stone or brick working as counter weight. This top layer which prevented the toppling of *kapotham* formed the fourth part called *prathi.*

3.3.d. *Greevam* or upper wall

In a house structure divided into two vertical sections, the *adisthanam, padam* and *prastharam* formed the lower and *greevam, shikharam* and *sthupi* the upper sections. *Greevam* also called as *galam* formed the lower part of the upper section (Refer Figure 3.1 and 3.13). The total height of the house was arrived at by adding 12/28, 14/28, 21/28 part or full part of the *shala* width to the same full width.[20] This total when divided equally into two gave the above mentioned upper and lower halves. The continuation of *bhithi* or wall above the half line over *prastharam* was called *greevam.* Usually the height of *adisthanam* was repeated for *greevam.*[21]

3.3.e. *Shikharam* or roof

The pitched roof resting on top of the *greevam* formed the *shikharam* (Refer Figure 3.16). It was the wall plate or *varotharam* that attached the entire roof onto *greevam* (Refer Picture 3.14). On top of the wall plate was fixed by means of wooden pegs, a secondary plate called *chuttutharam* (Refer Figure 3.13). It was onto this *chuttutharam* that the rafters called as *kazhukol* sloped down from the ridge and were seated (Refer Picture 3.15, Picture 3.16, Picture 3.17). At the ridge, the rafters from either side of the slope met. To this joint was hooked a hanging beam called *monthayam.* As the rafters reached the end of *monthayam* they were arranged radially to be fixed together on to the *koodam,* an apex pinnacle. There were even number of rafters on all four sides. Horizontal tie members called *valabentham* were fixed onto these rafters below the ridge and a square sectioned rod called *vala* or collar pin was driven through holes in all these members (Refer Picture 3.18, Picture 3.19). This *vala* which sewed together all the rafters as well as tie beams, ensured the firmness and rigidity of a triangular frame and held the members

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[20] H=13/7, 11/2, 13/4 Or 2W, where H refer to height and W to width.

[21] Prabhu, Vasthuvidhyadharshanam, 151.

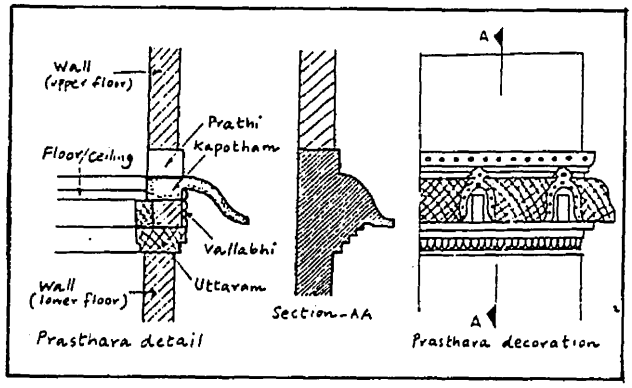


Figure 3.14: *Details of 'prastharam' (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

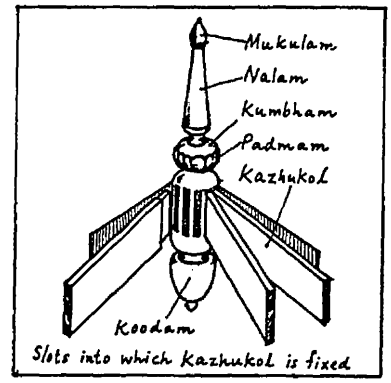


Figure 3.15:*Details of Stupi and Koodam.*

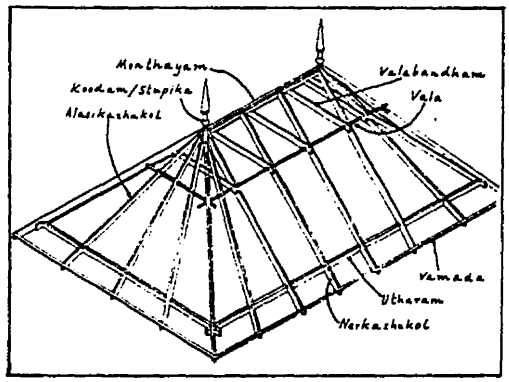


Figure 3.16: *Different parts of 'shikharam'.*

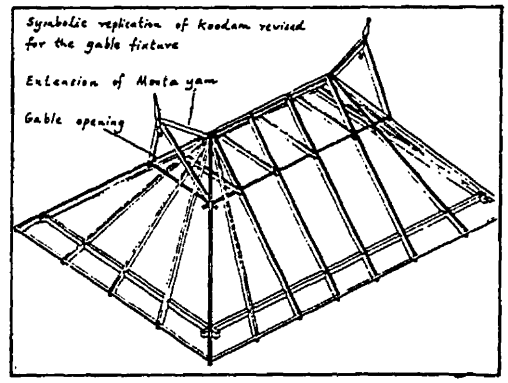


Figure 3.17: *'Shikharam' with addition of a gable ear.*

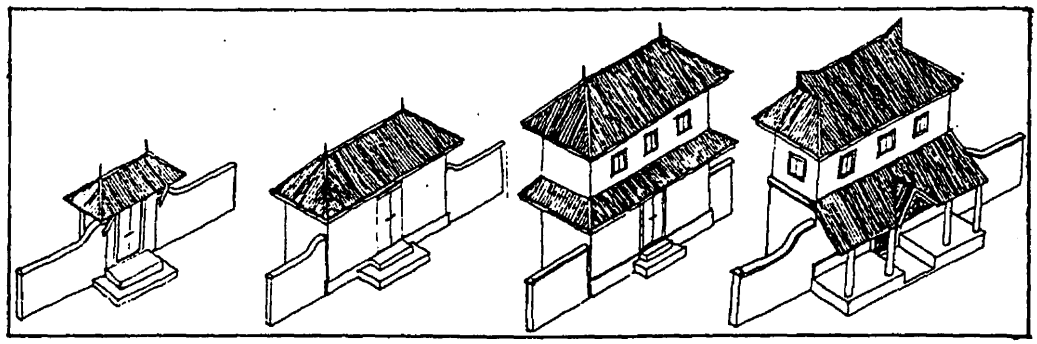
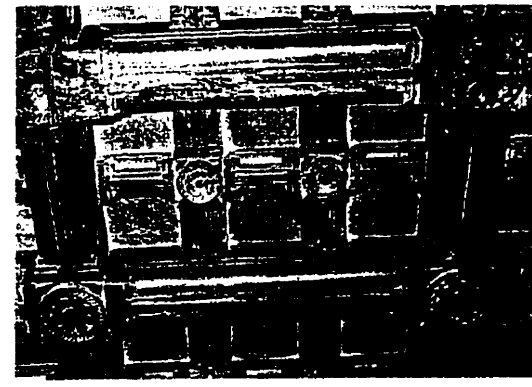


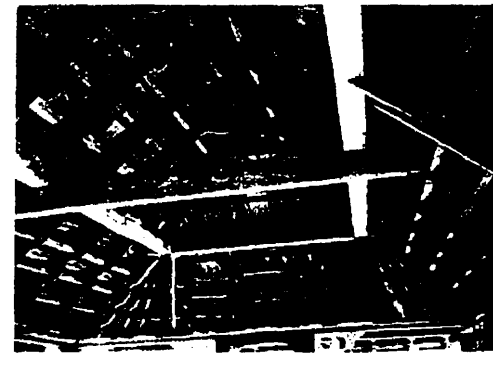
Figure 3.18: *Different types of gate houses (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

Picture 3.11: *Decorated ceiling showing 'sheelanthi' and 'thatuthulam'.*



Picture 3.12: *Detail veiw of the decorated ceiling.*

Picture 3.13: *Shows the projecting line of 'kapotham' at the upper edge of the wall.*



Picture 3.15: *Roof frame as seen from inside.*

Picture 3.14: *Typical roof profile of a traditional house in Kerala.*

Picture 3.16: *Wall plate supported on pillars around the courtyard.*

from sliding. Similar to *vala* at the lower end of the rafters also there were pinning members called *vamada* that tied them tight (Refer Picture 3.20).

3.3.f. *Sthupi* or pinnacle

Sthupi were the finials crowning the apex of the roof. In temple structures there was one *sthupi* for roofs corresponding to square and circular shaped plans and 3 *sthupis* for rectangular and absidal forms. *Sthupis* which were structural extensions of *koodam* (Refer Figure 3.15), were made on roofs of houses also, to evoke resemblance to the temple roof. This practice of fixing *sthupi* was replaced lately by the development of the gable ear opening (Refer Picture 3.21 and Picture 3.22). This triangular shaped gable ear consisted of many layers of decorative boards pinned together by wooden nails with carved dragon heads,[22] the whole of which was fixed to the end of extension from *monthayam.* The image of the entire three dimensional form of *sthupi* with *koodam* was reproduced two dimensionally to form part of the decorated gable (Refer Figure 3.17). This element of the roof which developed in the process of technical improvisation became a strong visual element in Kerala's domestic architecture.

3.4. Construction of ancillary structures and horticulture

As part of ensuring security and facilitating the customary practices, dwelling structures were adjoined with ancillary structures built according to specific description and details stipulated in the traditional texts. This description includes measurements and specific position for each of these structures.

3.4.a. *Padipura* or gate houses

When planning a house according to the *navavarga* system, certain *padams* in the peripheral layer were chosen for locating these gates and gate houses. According to rule, the *padipura* or gate house could be located in any of the 36 *padams* in this layer but the imagined effect was prescribed different in each case. *Indrapadam* in the east, *grihakshethrapadam* in the south, *pushpadhanthapadam* in the west and *bhallatapadam*

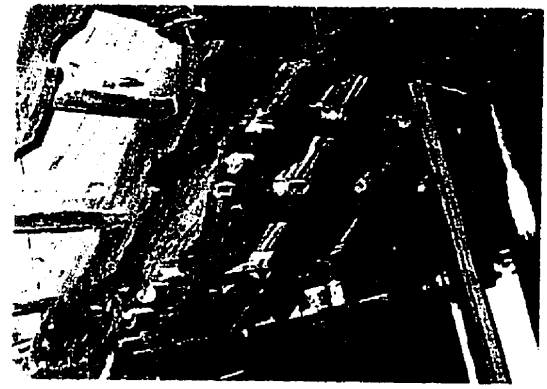
[22] locally referred as *vyali* figures.

in the north were the most auspicious among them which also indicate that locations of these gates had to deflected to the left from the central axis lines in the cosmic field defined by *navavarga* system. The eastern gates led to the northern *shala* or *vadakkini*, southern gate to eastern *shala* or *kizhakkini*, western gate to southern house of *thekkini* and northern gate to western *shala* or *padinjattini*. This layout defined a sense of orientation: the building was always to the right side of a person passing through any of these gates. Usually in the upper class houses there were two gates on each of the sides which were meant for the use for different classes of people and cattle. There existed different types of gates and gate houses attached to Kerala's traditional house compounds (Refer Figure 3.18). In some cases there was just a door in the compound wall with a pitched roof (Refer Picture 3.23). This gateway developed into a single or multiple storied *shala* or house, in special cases, for the use of guests, gate watchman and additional male members of the family.

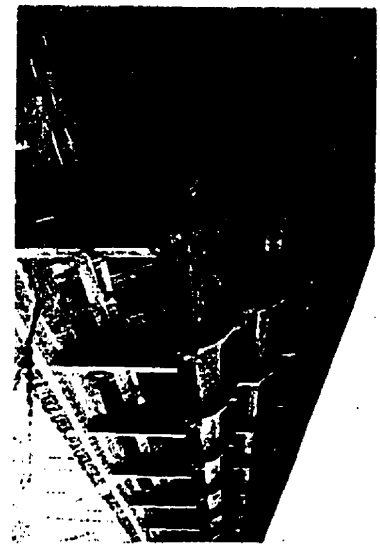
3.4.b. *Kayyala* or compound wall

According to *Vasthushasthra* the boundaries of human habitation should be made in 3 ways (Refer Figure 3.19). The best method is to build a masonry wall. Another method is to make a trench around the boundary. A third method is to make fences with twigs, thorns etc. The masonry walls, common among upper class houses, were found to have wall thickness corresponding to the span width of the main house. The country method of stacking stones on either sides and filling mud in between so that the outer surfaces are level and tapered to the top developed and evolved into the classical form using masonry. Such walls are called *kayyala*. The thatched roof over the *kayyala*, a protective device against rain was also copied onto the timber palisade or masonry walls of temples and houses. The timber fences or palisades were made by fixing horizontal wooden reapers at intervals sewn through vertical masts erected at equal spacing and built to have a roof on top. Later on, they were modified with an array of oil lamps fixed onto the joints, these were usually seen in temple walls.

Picture 3.17: *Rafters that slope down are seated on the wallplate.*



Picture 3.18: *Lower side of the rafters used to be decorated by cuved edge patterns.*



Picture 3.20: *Rafters are tied by 'valas' passing through them in between and 'vamadas' at the lower end.*

Picture 3.19: *Rafter overhangs many times used to be extensions.*

Picture 3.21: *Gabled roof of a Syrian Christian house in Thazhathangadi.*

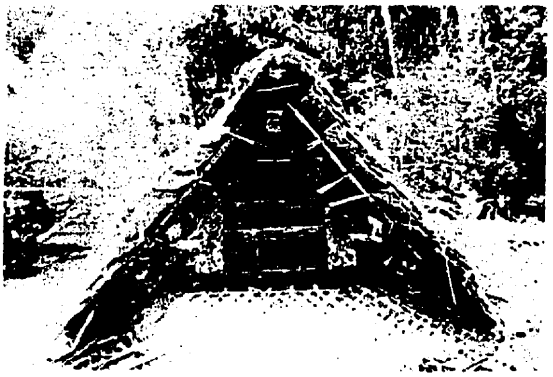
3.4.c. *Kinar* or wells/*kulam* or ponds

The scriptures insist on having separate water sources for drinking, bathing, laundry and irrigation purposes in a domestic environment. *Ishanakon*, *mahendradhisha* in the east, *varunadhisha* in the west and *somapadam* in the north are all reliable positions for seeking water sources. According to the *rashi* cycle, the directions such as *makaram*, *kumbham*, *meenam*, *medam* and *idavam* are ideal locations for digging ponds and wells (Refer Figure 3.20). Since the most auspicious location is in *meenamrashi* or *ishanakon*, and the ideal location for the kitchen is also in *ishanakon*, the main well is always seen attached to the kitchen in Kerala (Refer Picture 3.24). Usually ponds of rectangular or square shapes with stepped banks called *kulam* were used for bathing purposes. They were attached with a bathing house or *kulipura* (Refer Picture 3.25). These ghats were built of granite or laterite slabs, similar to the *surajkund* in Northern India.

3.4.d. *Adukkala* or kitchen

The *adukkala* (kitchen) was usually located in the north-east quarter of the house. In older houses made of timber, the kitchen was built detached from the house. According to instructions in *Brihathsamhitha* and *Manushyalayachandrika*, positions such as *shikhipadam* or *parjanyapadam* which fall in the *pishachaveedhi* are best suited for erecting these detached kitchens. Since the main house could not cross into the *pishachaveedhi*, the kitchen was built as an ancillary structure (Refer Figure 3.23). But later, when fire resistant masonry walls replaced timber walls, kitchens were attached to the main house.

In Kerala, a contradiction exits in the position of the kitchen within the house, from positions prescribed in other parts of India. Elsewhere else in India, the kitchen was located in the south east corner which forms the *agnikon* or fire corner where a fire was allowed to be made. Whereas in Kerala, since the main wind current was from the south west, kitchens were relocated to the north east corner, ensuring smoke free interiors. This



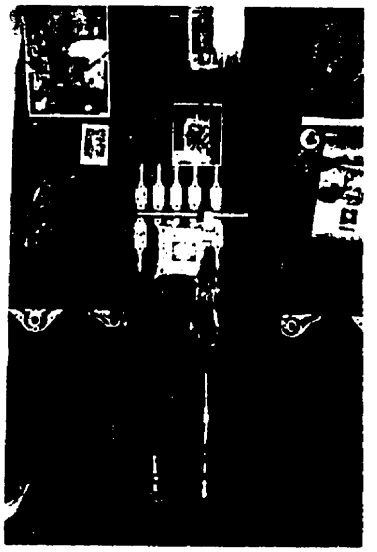
Picture 3.22: *A decorative gable end in a thatched roof.*

Picture 3.25: *A 'kulipura' and the stepped banks leading to a 'kulam'.*

Picture 3.23: *A canopied entrance gateway in Moncompu.*

Picture 3.26: *A snake grove.*

Picture 3.24: *An attached well showing the typical wooden pulley for drawing water.*



Picture 3.27: *Door entrance of a 'thevaramuri'.*

position formed the *ishanakon*, where the head of the *vasthupurusha* lay. Lighting a fire on it was considered auspicious.[23]

3.4.e. *Kalapura* or yard house

These ancillary houses located to the east side of the house were used to store harvested paddy and for activities such as threshing and separating grains. They were adjacent to open yards where the grain was dried, and granaries where dry grain was stored. These granaries, due to this particular position, received maximum solar radiation, thus were always warm, ensuring protection of the stored grain inside. Granaries were made of hard wood panels joined together with a special detail to withstand contraction and expansion because of exposure to sunlight.

3.4.f. *Uralpura* or threshing house

Ural is the wooden bin in which the paddy is threshed into rice. Apparently *uralpura* is the rice mill within the house where the paddy will be processed into rice by laborers. They were located in the eastern end of *kalapura* in the *agnipadam.* They could also be located in *vayukon* as well as in the *varunapadam.* The kitchen, the food hall and the grain processing/storing house were all located adjacently, completing the picture of the typical agriculture based domestic environment in traditional Kerala dwellings.

3.4.g. *Thozhuthu* or cattle shelter

The cattle shelter was located in the north or west side of the main house. For its construction, *vrishabhayoni* or *gajayoni* was used for the inner perimeter. There were also other parameters applied in fixing dimensions and location of cattle shed or *thozhuthu* ensuring protection of cattle and other animals. The animals could not be walked along *karnasuthra* determined for the house compound while leading them in and out of the shelters. *Thozhuthu* is a good example for studying wooden wall and screen forms adopted in the earlier versions where the entire house was constructed of timber.

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[23] Ibid, 177.

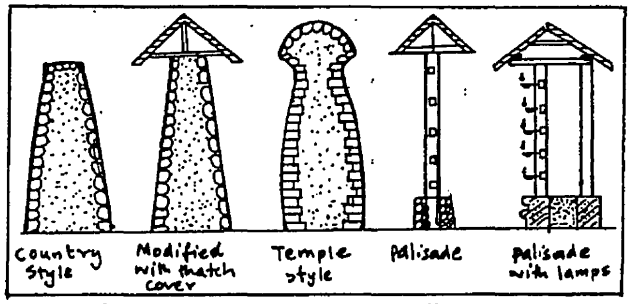

Figure 3.19: *Different types of compound walls (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

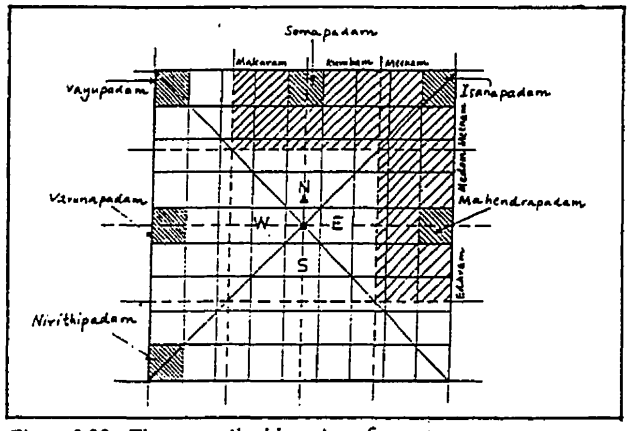

Figure 3.20: *The prescribed locations for water sources with in the site (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

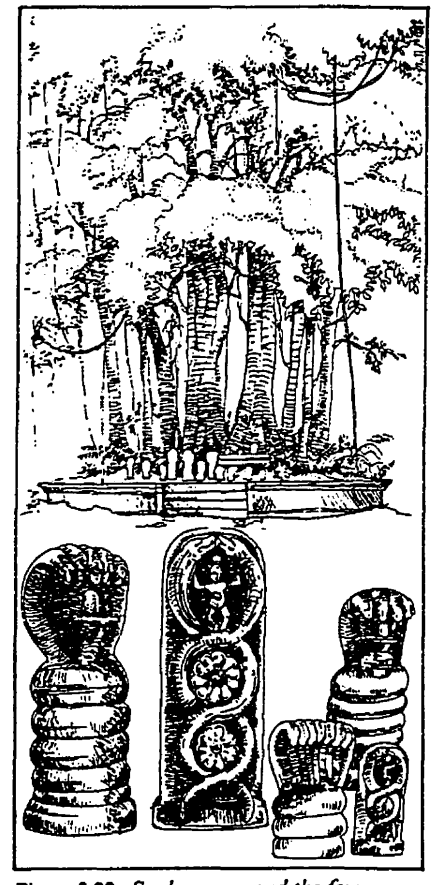

Figure 3.22: *Snake grove and the few types of stone images commonly found.*

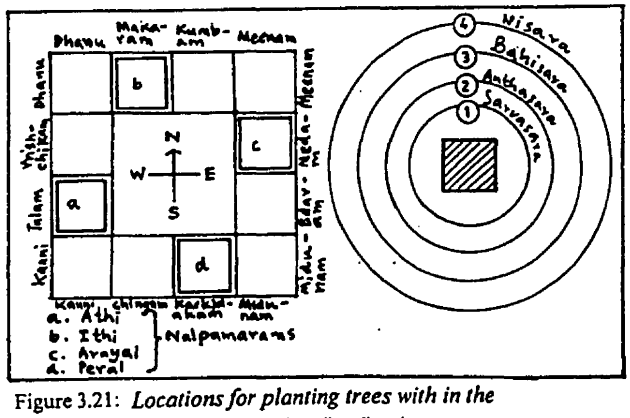

Figure 3.21: *Locations for planting trees with in the house plots (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

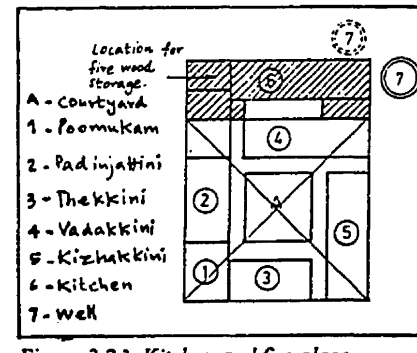

Figure 3.23: *Kitchen and fire place location (After: Prabhu, Vasthuvidhyadharshanam, 1994).*

3.4.h. *Kavu* or shrines and snake groves

Shrines were usually located in the corners of the *grihavasthu.* The family goddesses were located in *ishana/nirithikon* and snake groves in *agni/vayukon* (Refer Figure 3.22 and Picture 3.26). There used to be shrines enclosed within wooden chambers called *thevaramuri* located in the *padinjattini* or *kizhakkini shala* in a house (Refer Picture 3.27). Objects worshipped in these chambers were *charabhimbham* which were either inscriptions made on metal plates or stones called *salagramam.* Shrines housing permanent idols or *sthirabhimbham* were built detached to the main house (Refer Picture 3.28). Sufficient space clearance was given so as to build the essential organs of a small temple around it. This clearance space around the *kavu* was double the width of the sanctum sanctorum. The inner courtyards are considered sacred and usually contains a pedestal in which is grown jasmine or *thulasi* (Refer Picture 3.29).

3.4.i. Planted vegetation

Trees are classified into 4 kinds according to their cross sectional features. They are *anthasara vriksha*, which have a hard inner core and a soft cork cover, *bahisara vriksha* with hard outer cover and soft inner core, *nisara vriksha*, made up of light cork and fiber and *sarvasara vriksha* consisting of a hard inner core. A few examples of these 4 kinds of trees are given below.

anthasara vriksha -jack, *anjili.*
bahisara vriksha -coconut palm, arecanut.
sarvasara vriksha -*puli*, teak.
nisara vriksha -*muringa, ezhilampala, murikke.*

All 4 types of trees were grown separately in a concentric layout around the house. The *anthasara* trees could be grown more closer to the home (Refer Figure 3.21).[24] Next were the *sarvasara* trees, then *bahisara* and finally *nisara* trees near the boundary of the compound.[25]

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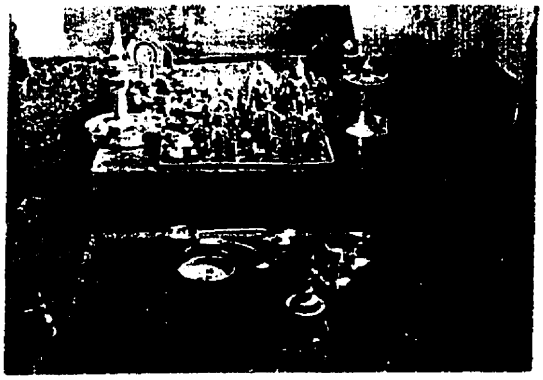
[24] Should be double its height distance away from the house.

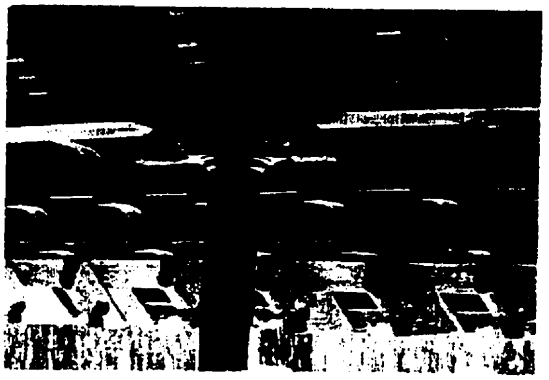
[25] Kanipayoor Shankaran Namboothiripad, Manushyalayachandhrika (Kunnankulam: Panchangam Book Stall, 1994). [in Malayalam].



Picture 3.28: *A family shrine and its appurtenances.*

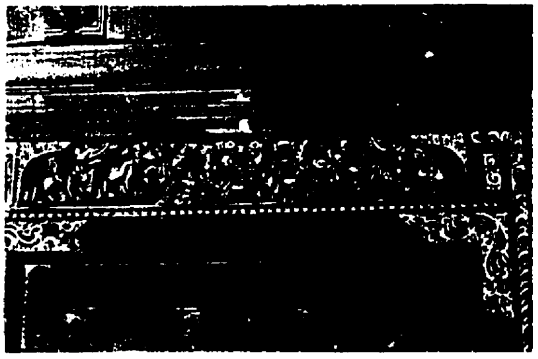
Picture 3.31: *Masonry pillar built of cut laterite.*

Picture 3.29: *Jasmine or 'thulasi' are planted in the courtyards considered as sacred.*



Picture 3.32: *An elaborate wood construction in a house at Thalakulam.*

Picture 3.30: *Monolith granite washing sink found in kitchen premises.*



Picture 3.33: *The head board of main doors are carved with icons.*

3.5. Materials

Vasthushasthra describes on the availability, processing and utility of 7 types of materials. These 7 materials were *shila* or stone, *ishtika* or brick, *dharu* or wood, *mrithsna* or mud, *mrilloshtam* or ceramics, *sudha* or mortar and *lohakam* or metals. Factors such as availability, workability, strength and durability decided the ideal materials suited for the respective region or locality. The quality and uniqueness of traditional construction was brought about by the expertise attained in the application of these materials by trial and error. The selection of the appropriate material for the right application was another aspect of this process. Hence classification of materials was made into 7 general types, within which came the multitude of varieties found in various places.

3.5.a. *Shila* or stone

Vasthushasthra considers *shila* as the best building material. Any construction is initiated by the laying of the 'stone' in the most auspicious corner. All construction ends by the placement of *uurdhwashila* or upper stone over the roof and fixing the finial on top. Stones are classified as male, female and hermaphrodite types according to hardness, and as *swetha* or white, *raktha* or red, *peetha* or yellow and *krishna* or black in terms of color.[26] *Purushashila* or male stones are hard stones used for carving sculptures. *Sthrishila* or female stones are less hard and tender and are ideal for construction. *Napumsaka* or hermaphrodite stones are flat stones having mixed qualities, and were used for making pillars, footings and brackets (Refer to Picture 3.30 showing a washing sink made of granite).

Laterite or *vettukallu* was the most popular stone used for building in Kerala.[27] These are soft but sturdy stones found below the top soil and are red in color due to the presence of iron oxides in them. These iron oxides, when exposed, undergo chemical change and become hard and durable in due course of time. Hence laterite was left exposed without

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[26] B. R. Balachandran, Monograph , 23-34.

[27] Term laterite derived from latin word lateritis meaning brick-stone, was christened in 1800 by Dr. Francis Hamilton Buchanan from Scotland in Kerala.

plaster finish. Usually laterite stones used for residential buildings were cut to a size of volume 12 *angulam* x 8 *angulam* x 6 *angulam* or of a square shape of volume 12 *angulam* x 12 *angulam* x 6 *angulam.* In special cases the size became 10 *angulam* x 12 *angulam* x 14 *angulam.* The walls were usually of thickness 8 *angulam* but sometimes extended to a maximum of 24 *angulam* (Refer Picture 3.31 which shows a group of 3 pillars built of laterite).

3.5.b. *Ishtika* or brick

Ishtika or burnt brick was prevalent in India from the Indus valley civilization onwards. Specifications on the process of making brick is described in *Shilparatna.* Even today it is made following these specifications in many parts of India. The size of *ishtika* was 8*a.* x 4*a.*x 3*a.* or some times 8*a.* x 4*a.* x 1.5*a.*. Six types of soil were identified to be ideal for making burnt bricks. The soil was soaked with water and *nelli* fruit juices, and seasoned before it was cast in wooden molds and dried. Dried bricks were stacked with gap in between filled with paddy husk. The outer gaps were sealed using clay after the pile grew to a comfortable size to fire. It took 10 to 11 days for the whole thing to burn to form *ishtika.* The bricks were then soaked in water to a period of 6 months to one year before using. *Padmasamhitha* stipulates that an evenly burned *ishtika* should not break if dropped to the ground, and should give a ringing sound when tapped.[28]

3.5.c. *Daru* or wood

Wood as a building material stood first in terms of availability, workability and durability. The structural properties of wood were well studied and were made use of more than any other material, in construction. The structural forces working on different elements of the building such as pillars, rafters, beams, nails etc. were very well understood, and the appropriate timber was chosen to make each element (Refer Picture 3.32). All the joints were made by means of wooden nails and pegs. The joinery details were developed to such refinement that the joints could be assembled firmly and

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[28] M.S. Sridharan, Shasthramanjusha (Thiruvananthapuram: Bharathiya Shasthra Manjusha Publications, 1987), 72-74,210-229, 153-172.

disassembled easily. Trees were considered to be inhabited by natural forces in addition to birds, insects and animals and hence given due respect (Refer Picture 3.33). Wood suited for construction underwent strict selection that trees affected by lightning, wind turbulence, and those dried up, containing sap, bearing flowers and fruits etc. were avoided. The common trees used for construction in Kerala and their properties are mentioned in Appendix 3.2.[29] Houses in northern Travancore represents a high order of wooden craft in architecture (Refer Picture 3.34).

3.5.d. *Mrithsna* or mud

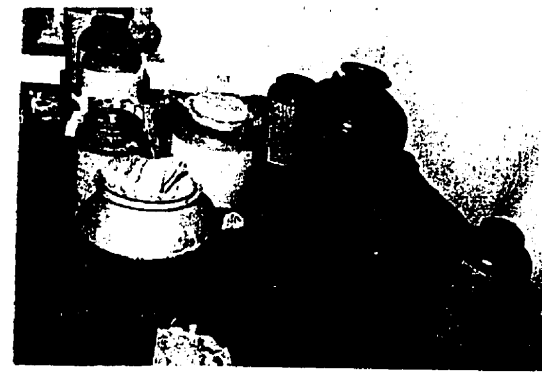
Even though the term *mrithsna* depicts mud as a building material, it is not elaborately discussed in the traditional texts. Still, this does not deny the fact that it formed the most common building material in the villages, which is true even today. There were mainly 3 types of mud walls used commonly in Kerala: masonry walls with adobe or sun dried bricks, cobble walls, and wattle and daub walls made by plastering mud over thin panels of woven bamboo or reed fixed to a palisade. Mud was mixed with coarse sand, paddy husk or grated hay as reinforcement and mixed with vegetable juices, lime, molasses etc. to ensure cohesiveness. Originally for floor and wall finishes, fine mud mixed with cow dung was applied neatly by the sweeping of the palm of the hand (Refer Picture 3.35).

3.5.e. *Mrilloshtam* or terra-cotta

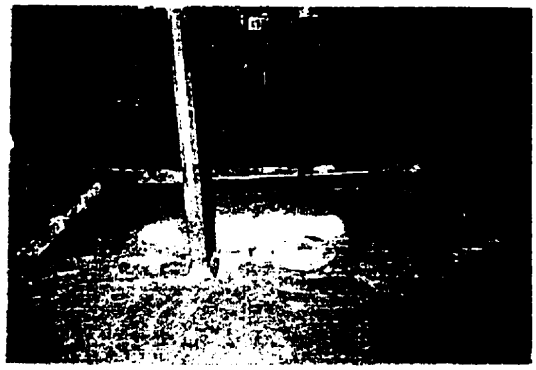
The making of terra-cotta tiles for laying the floor and thatching the roof (Refer Picture 3.36) is elaborately described in *Vasthuvidhya*. This could have been a development contemporaneous with the writing of the text in the 15th century. Using these tiles for floors was rare, and found only in the houses of the elite upper class. Fine, coarse mud, clear of decayed or organic matter was used to make these tiles. The mud underwent a series of treatments with different vegetable juices before it was cast in molds and baked in kilns. *Vasthuvidhya* describes 11 different patterns of shapes and dimensions

[29] B. R. Balachandran, Monograph , 23-34.

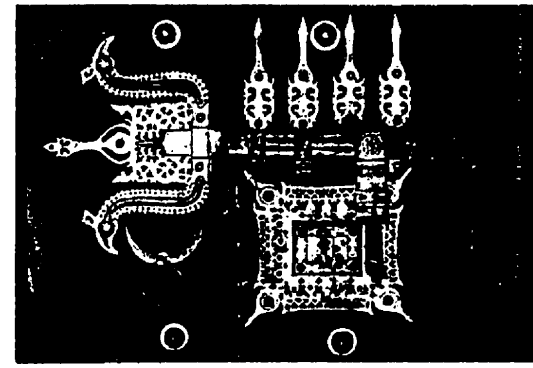
Picture 3.34: *Travancore houses are noted for versatility of its built in wooden fixtures.*



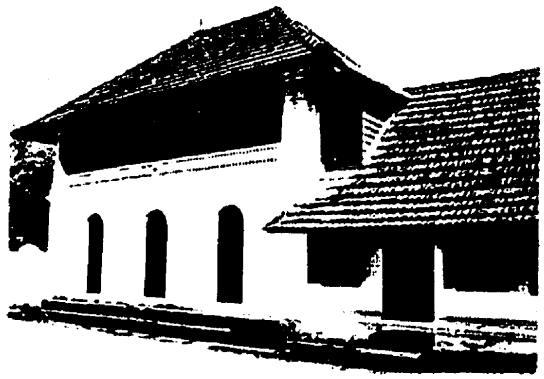
Picture 3.37: *A kitchen cellar showing ceramic jars.*



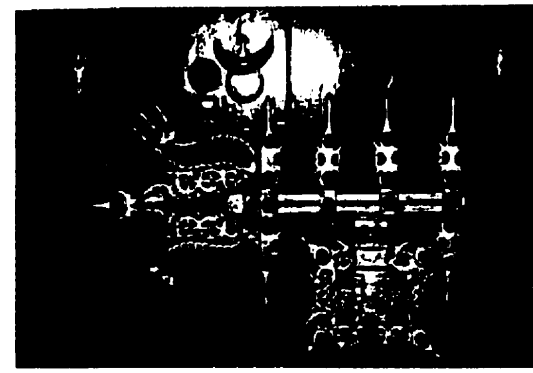
Picture 3.35: *A cowdung plastered floor.*



Picture 3.38: *A 'chithrapootu' in a Hindu house.*



Picture 3.36: *A Syrian Christian house showing its terra-cotta roof tiles.*



Picture 3.39: *A 'chithrapootu' in a Syrian Christian house.*

standardized for the floor tiles, their dyes and specifications for firing methods.[30] Ceramics were used for making huge jars and other kitchen wares (Refer Picture 3.37).

3.5.f. *Sudha* or mortar

Various admixtures such as shells, coarse or fine sand, molasses, vegetable juices etc. were mixed and seasoned for a few weeks before being used as mortar for rubble and brick masonry. Fine paste was applied to form a polished finish over plastered surfaces called as *chaanthu*. Complexly mixed *chanthu* called *vajralepam*[31] were prepared in 5 methods as described in *Brihathsamhitha*. These plaster finishes constituted proportions of finely ground and soaked charcoal, slaked lime, egg white, palm toddy, fine paste of ground seed of *kunnikuru*. This mixture was palpitated with syrup of molasses, or water in which slimy fish, called varal were put for a few days, or water thickened with *kadukkai* or gall nut seed to form a paste. The mixture was then applied and polished to glaze when dried. Rammed earth floor was laid out first, over which lime mortar was plastered and finished with a sweep of paste made of powdered mixtures of charcoal, cowdung and herbal juices such as juice of balloon wine or *uzhinjavalli*. This was then dried and rubbed to glaze by polished stones. Traditional wall murals of Kerala, a part of fine crafts in its residential architecture, is known for its color pigments prepared carefully from vegetable mixtures and natural elements and applied onto lime plastered walls. These mural wall preparations and application techniques of color pigments are mentioned in *Shilparathna* and other architecture treatises as well.

3.5.g. *Lohakam* or metals

If wood was the major material for building walls, doors etc., metals were used as decorative embedding aiding protection from tear and wear, in decorative icons and in braidings depicting religious images and symbols. The major parts of the house usually detailed with metal work are shown in Figure.3.. Locking and mechanically crude but elaborately ornamental devices called *mayilpootu*, *chithrapootu* and *naazhipootu* made of

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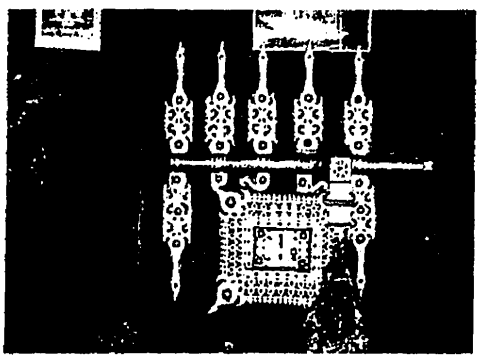
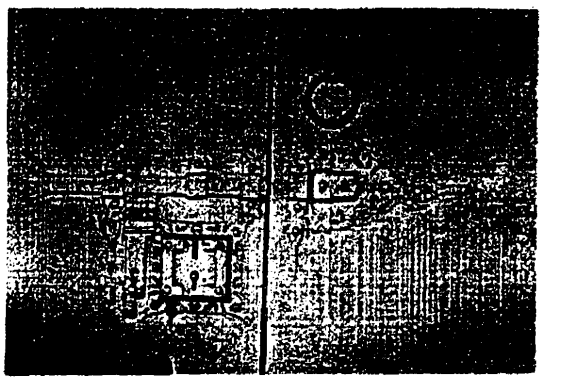
[30] M. S. Sridharan, Shasthramanjusha , 193.

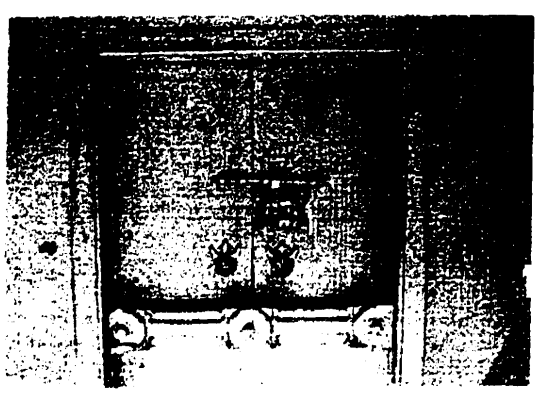
[31] literally meaning diamond paste.



Picture 3.40: *'Chithrapootu'.*



Picture 3.41: *Lower version of 'chithrapootu'.*



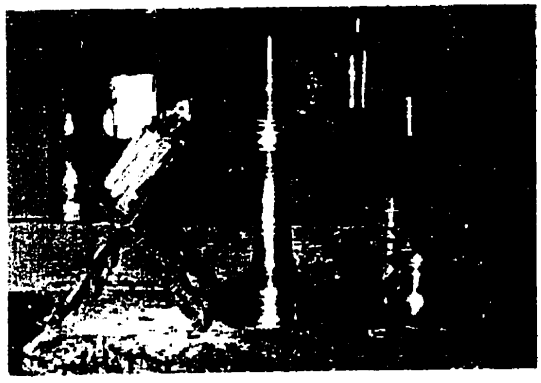
Picture 3.42: *Another decorated metalic door lock.*

Picture 3.45: *A 'nazhipootu'.*

Picture 3.43: *'Mayilpootu' in a Syrian Christian house.*

Picture 3.44: *An elaborately decorated 'mayilpootu' and 'nazhipootu' in a Brahmin house at Moncompu.*

Picture 3.46: *A typical brass lamp in Kerala.*



Picture 3.47: *Metal lamps and kitchen wares.*

iron or brass, decorated the doors (Refer Pictures 3.38, 3.39, 3.40, 3.41, 3.42, 3.43, 3.44 and Picture 3.45 for various types of decorative locks). These were an interesting feature that stood out visually from the rustic shade of the wooden facade. Moreover, metal crafts excelled in household cooking as well as ritualistic wares and utensils (Refer Picture 3.46 and Picture 3.47). Metal mirrors of Aranmula in Travancore, and lamps and miniatures made of *panchalohakam* or five metals comprising or copper, iron, brass, silver and bronze explain the skill of the *kollan* or metal crafts person of Kerala. Usually peacocks, parrots, herbs, tortoises, cows, reptiles, dragon and other mythical Hindu characters were portrayed in iconographic metal works.

3.6. Conclusion

The construction practices described in this chapter face the threat of extinction. Rather than attempting to preserve them as such, they need to be adapted to the modern conditions and methods of construction. This documentation helps a better understanding of these practices, so that they could be adapted to the modern context without severing their traditional links. Building technology has to develop locally to achieve the continual process found to have consistently occurred in history, thereby adapting to innovations in materials and changing cultural aspirations, at the same time achieving or maintaining a unique regional identity. A better or scientific understanding of the old practices tested in time and adapted locally is undoubtedly essential to find the threshold to position modern or the living tradition of the normal locale. The resulting state of the art building culture could ensure to conserve or even help to retrieve and strengthen links of a deteriorating tradition manifest in the regions building craft.

Chapter 4: Traditional Timber Houses of Travancore

4.1. Introduction

Although the traditional houses in Kerala were built according to rules laid down by the *Vasthushasthra*, the *thatchan* deserves credit for his innovations in creating magnificent forms and spaces while working within the severe constraints laid out by these treatises.[1] It is a fact that the traditional domestic architecture of Kerala never attained the dazzling brilliance of the palaces and pavilions of Ayodhya or Lanka or the lithic grandeur of Mughal or Vijayanagara structures. Perhaps Kerala's craftsmen had aberrant objectives. K.P.P. Menon explains the unpretentious nature of Keralite structures by saying that luxury and ostentatious display go hand in hand with despotism and monarchy.[2] Even though the principles were rooted on Hindu treatises, the cultural symbiosis contributed by a multi-religious social environment has undoubtedly shaped the traditional domestic architecture of Kerala. To a great extend these set rules helped exemplify craftsmanship and local diversity. A close observation of motifs and symbols reveals their origins in the culture dating back to 2000 years or more. The hues and shades of Buddhist, Jain, Hindu, Muslim and Christian ways and practices are seen in superimposition, on the artifacts and iconography. Moreover, the trade and religious transactions from China, Persia, Syria and so on had a greater bearing on the earlier stages of development of these crafts.

4.2. Regional characteristics and cultural identity

Every society generates a built environment which is unique to its culture and place, an environment that is a physical expression of all the beliefs central to the life of the people and which conveys a sense of their particular identity.[3] A palette of variations of the archetypal architecture is found in Kerala in response to the geographical and cultural changes from the north to the southern part of the state. The two major schools of

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[1] Satish Grover, The Architecture of India-Buddhist and Hindu (New Delhi: Vikas Publishing House, 1980) 172-175.

[2] K. P. Padmanabha Menon, History of Kerala written in form of notes on Visscher's letters from Malabar, Vol. 4, (New Delhi: Asian Educational Services, 1986), 147-183.

[3] Amos Rappoport, "Cultural Origins of Architecture," Introduction to Architecture. (New York: McGraw Hill, 1979), 2-19.

architecture seen in Kerala are the Malabar style in the northern and the Travancore style in the southern geographical districts. In Malabar, the significant presence of Muslims also contributed to the development of the Malabar style. The Malabar style is characterized by the abundant use of excellent quality cut-laterite. Whereas in Travancore, the dominance of the Hindus reflects in its architecture. The Travancore style is characterized by high quality timber construction. Even the Malayalam translations of the treatises followed the two different schools of practice pertaining to Malabar and Travancore regions. The central part of Kerala which may be referred to as Cochin region reflects a distinct colonial character since the European colonies were concentrated in that area. The traditional core groups of high caste Hindus all over Kerala remained conservative as a result of which the European colonial influences on the domestic architecture were very minimal. Most of the houses built 75 to 100 years ago mostly among the upper-class orthodox Hindus were free of colonial influences except in a few cases. Due to political and social affinity of the Cochin region to Travancore, its traditional architecture also showed more resemblance to the southern style. Within the Travancore region towards its southern borders, it is influenced by the stone culture of the neighboring Tamilnadu state (Refer Picture C.11).

The case studies of this thesis were conducted in the Travancore region so as to analyze timber construction practices pertaining to the southern regional style. The activities of this early period are shrouded in obscurity. Due to lack of historical evidence it is not possible to trace the chronological development in this study even though an attempt is made. The characteristics of built structures dating approximately between 75 and 600 years of age are documented and analyzed. These cases are explained in the inventory and study (Refer Figure 4.1, Chart 4.1, Chart 4.2 and Chart 4.3). The study observes the process and extent of adaptation which took place in the traditional domestic architecture of Kerala. It looks at the local influences on building techniques and materials, with reference to the respective social and religious situation. In the field research, a study of 24 houses within the Travancore region was done. Out of these 24 houses, 4 samples were selected for a detailed explanation of the construction systems applied in this region.

In the overall observation it was identified that the system of timber roof construction forms the single major characteristic of Kerala traditional domestic architecture. It is crucial to document the building process of the roof as seen and discussed with local carpenters in the Travancore region. Moreover, an attempt is also made to compare the regional variations in roof form, pattern of building components and iconography used in the houses.

4.3. Inventory of selected traditional houses in Travancore

This checklist and inventory were prepared as a result of fieldwork conducted in Travancore region during second half of the year 1995. It is an inference based on the compilation of published and unpublished documentations. During the site survey, this information is verified and analyzed. Sometimes the information is formulated upon assumption over the discussions conducted with experts and learned people have also been helpful in the process.

4.3.a. Selection criterion

In order to meet the objectives set by the research question, the field survey was limited within the Travancore region during the pre independence period of India. Travancore forms the southern region of Kerala. The selection of houses were made at random according to directions given by people already knowing the locations and corresponding to the information already existing. 24 houses are cited, whose locations are scattered over this region. Among them, 18 belong to different sects of Hindus (Refer Picture 4.4 to Picture 4.12), 5 to the Syrian Christian community (Refer Picture 4.1 and Picture 4.2) and one to a Muslim family (Refer Picture 4.3).

The criteria for selection of the building depended mainly on formal judgment: most buildings that exhibited higher qualities of timber construction were selected. Secondly an attempt was made to include houses of different caste classes in the Hindu religion to make the checklist cover the diversity in the social structure. Geographically, the samples were chosen from culturally live regions of historic Kerala and spread out evenly in the

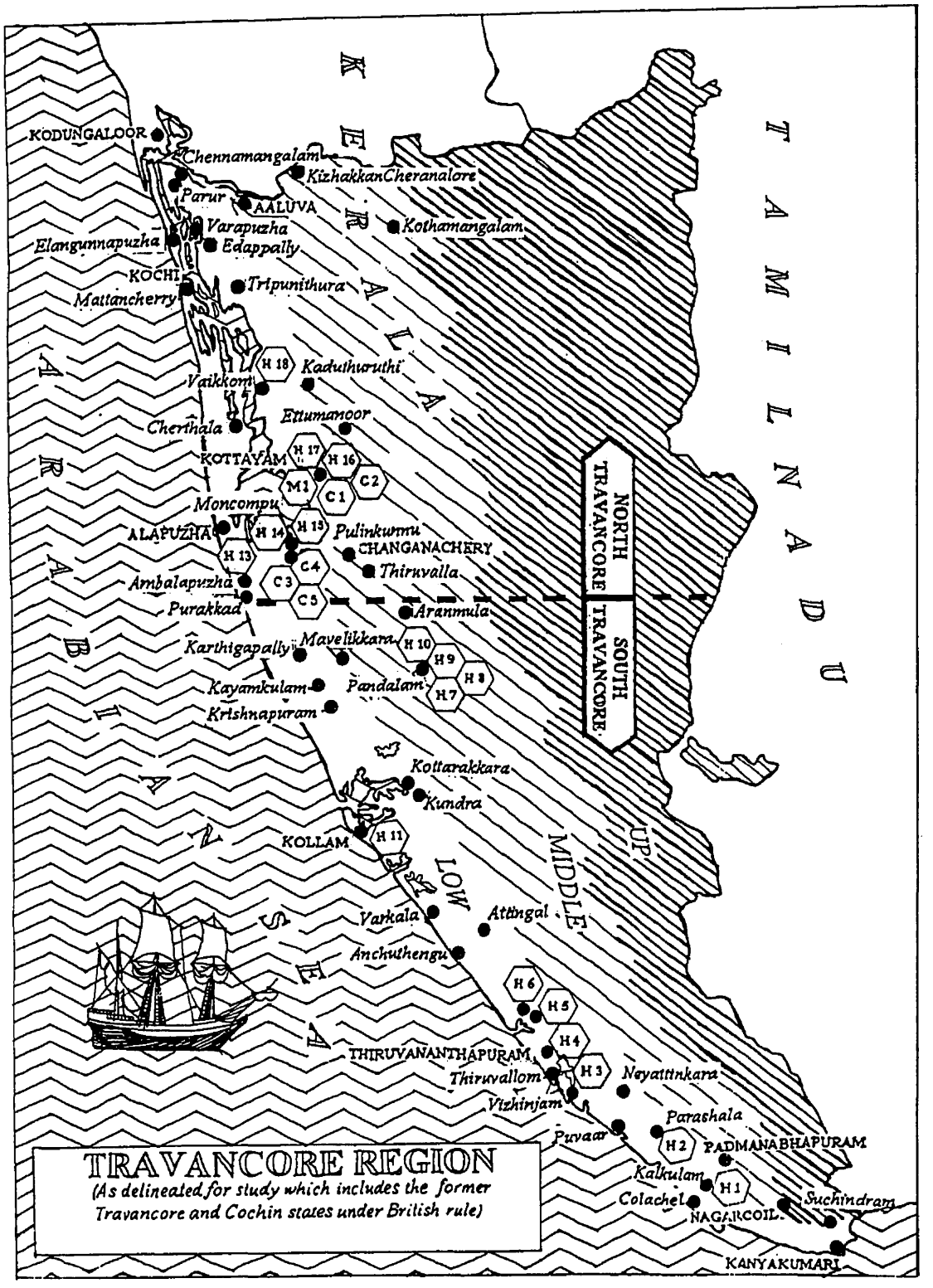


Figure 4.1: *The 24 sample houses spotted in the delineated Travancore region with geographical demarcation of up land, mid land, low land, south and north matrixes.*

Travancore region (Refer Figure 4.1). Buildings built before 1947 were fixed as the lower age limit, while there was not any upper age limit. Yet all the selected house samples ranged between approximately 75 to 600 years of age.

4.3.b. List of case samples

The check list of houses surveyed are presented in Chart 4.1. The following checklist gives code characters denoting each sample and their whereabouts (Refer Figure 4.1).

Serial No:	Sample Code	House Name	Location	Region
1	**H-1**	*Valiya veedu*	Talakulam, Kalkulam	SM
2	**H-2**	*Kalpazha madom*	Choozhal, Para*shala*	SL
3	**H-3**	*Narakathara veedu*	Edayar, Thiruvallom	SL
4	**H-4**	*Ammachi veedu*	Kizhakekotta,Thiruvananthapuram	SL
5	**H-5**	*Mangalavil veedu*	Ulloor, Thiruvananthapuram	SM
6	**H-6**	*Sreekariyathu madom*	Sreekariyam, Thiruvananthapuram	SM
7	**H-7**	*Nalukettu kottaram*	Panthalam	SM
8	**H-8**	*Vadakke kottaram*	Panthalam	SM
9	**H-9**	*Vadakkedam kottaram*	Panthalam	SM
10	**H-10**	*Puthenkoikkal kottaram*	Panthalam	SM
11	**H-11**	*Vadakkottu veedu*	Chavadi, Kollam	SL
12	**H-12**	*Padinjaredath mana*	Cherpu	NL
13	**H-13**	*Umbakkattu veedu*	Vaikkom	NL
14	**H-14**	*Mantra madom*	Ambalapuzha	NL
15	**H-15**	*Kottaram veedu*	Moncompu, Kuttanad	NL
16	**H-16**	*Kullangara illom*	Moncompu, Kuttanad	NL
17	**H-17**	*Vakkassery veedu*	Kottayam	NL
18	**H-18**	*Therettu Lakshmi bhavanam*	Kottayam	NL
19	**C-1**	*Pazhayaparambil veedu*	Pulinkunnu, Kuttanad	NL
20	**C-2**	*Puthenpurackal veedu*	Pulinkunnu, Kuttanad	NL
21	**C-3**	*Wachaparambil veedu*	Pulinkunnu, Kuttanad	NL
22	**C-4**	*Thazhathangadi - House 1*	Kottayam	NL
23	**C-5**	*Thazhathangadi - House 2*	Kottayam	NL
24	**M-1**	*Valiyakaruthora veedu*	Kummanam, Kottayam	NL

Chart 4.1: *Check list of the 24 house samples.*

These code characters generally indicate the religious background of the original occupant of the sample house. H corresponds to Hindu houses, C to Christian houses and M to Muslim houses. The survey is legended onto a map of Travancore[4] showing

[4] The delineated Travancore area for study includes the administrative boundaries of Travancore-Cochin states under British rule considering political as well as cultural influence and dependands of these states.

selected places of traditional as well as contemporary significance (Refer Figure 4.1). It demarcates the three geographic zones *up land* indicated as U, *mid land* indicated as M and lowlands as L, which also refers to the availability of materials, these geographical distinctions had an important role in the regional style variations. If in the east-west direction the region is divided into these three zones, in the north south direction it is divided into two zones, thus making a matrix of 6 zones. The northern zone is indicated as N and southern zone as S.

4.3.c. Inventory

The inventory of the 24 houses are briefly worked out in Chart 4.2 and Chart 4.3 (Refer Appendix 4.1 to Appendix 4.18 for the measured drawings of the house samples other than the ones described in this chapter). It explains the social as well as the physical status of the sample houses. In the 'House genre' are *veedu*, *madom*, *kottaram*, *mana*, *illom*, *bhavanam*. House types are represented as *ekashala*, *dwishala*, *thrishala*, single courtyard or *nalukettu*, double courtyard, triple courtyard, four courtyard and six courtyard houses. The caste classes represented are Brahmin, Kshathriya, Nayar, Ezhava, Devadasi, Syrian Christian and Muslim. The age of the house is approximated to range from 50 to 100 years, 100 to 150 years, 150 to 200 years, 200 to 300 years, 300 to 400 years, 400 to 500 years and 500 to 600 years. The quality of craftsmanship is referred to as excellent, good and moderate. The physical status refers to the structural situation as moderate and good. The materials are indicated as wood, laterite, granite, terra-cotta (represents tile and brick), cement, mud and thatch.

4.4. Case analysis of construction system

From the inventory chart, four houses were chosen for detailed study on construction techniques. It is intended to examine each of these houses in detail for special construction techniques, material use, the overall layout and building features. Samples **H-4**, **H-6**, **H-7** and **C-4** were selected since these buildings represent the archetype, and still having the characteristic of regional variations within Travancore. Even though it is acknowledged that four samples cannot explain the wide variations existing in different

Sample code	H1	H2	H3	H4	H5	H6	H7	H8	H9
House genre	Veedu	Madom	Veedu	Veedu	Veedu	Madom	Kottaram	Kottaram	Kottaram
House type	4Courtyards	1Courtyard/ Malika	2Courtyards	4Courtyards	Ekashala	1Courtyard	1Courtyard/ Malika	1Courtyard	1Courtyard/ Malika
Caste class	Nayar	Brahmin	Ezhava	Devadasi	Ezhava	Brahmin	Kshethriya	Kshethriya	Kshethriya
Approximate age	200-300	150-200	150-200	200-300	100-150	500-600	150-200	50-100	150-200
Craftsmanship	excellent	good	excellent	excellent	moderate	excellent	excellent	good	moderate
Physical status	good	good	good	moderate	good	good	good	good	moderate
Roof material	terra-cotta	terra-cotta	thatch	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta
Wall material	wood/granite/ mud	wood/laterite	wood/mud	wood/ laterite	laterite	wood	wood/laterite	wood/ laterite	wood/ laterite
Pillar material	wood	wood	wood	wood	wood/ laterite	wood	wood/laterite	wood/ laterite	wood/ granite
Floor material	cement/granite/ wood/terra-cotta	cement	cement/ wood	terra-cotta	cement	cement/ wood	wood/granite/ cement	cement/ granite	granite/mud -cow dung
Base material	granite	laterite	laterite	laterite/ granite	laterite	laterite	laterite/ granite	laterite/ granite	laterite

Chart 4.2: *Inventory No.1.*

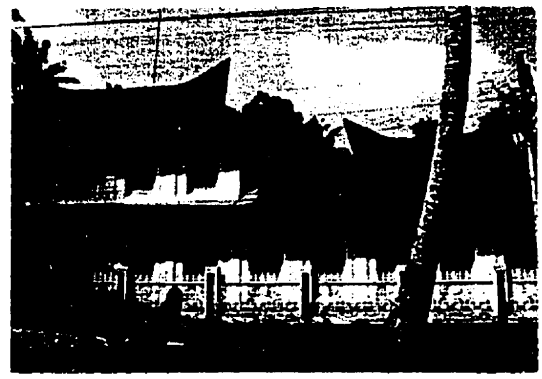
Sample code	H13	H14	H15	H16	H17	H18	C1	C2	C3	C4
House genre	Veedu	Madom	Veedu	Illom	Veedu	Bavanam	Veedu	Veedu	Veedu	Ve
House type	Dwishala	1Courtyard	1Courtyard	6Courtyards	3Courtyards	Dwishala	Thrishala	1Courtyard	Thrishala	Ek Ma
Caste class	Nayar	Brahmin	Nayar	Brahmin	Nayar	Nayar	Syrian Christian	Syrian Christian	Syrian Christian	Syr Chr
Approximate age	100-150	150-200	150-200	300-400	50-100	100-150	100-150	50-100	100-150	100
Craftsmanship	good	good	good	excellent	good	good	good	good	good	goo
Physical status	good	good	good	good	good	good	good	good	good	goo
Roof material	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	ter
Wall material	wood/ laterite	wood	wood/ laterite	wood/ laterite	wood/ laterite	wood/ laterite	laterite	laterite/ terra-cotta	laterite/ terra-cotta	late ter
Pillar material	wood	wood	wood	wood	wood	wood	wood/ laterite	wood/ laterite	wood/ laterite	wo late
Floor material	cement	cement	cement	cement/ granite	cement	cement	cement	cement	cement	cem
Base material	laterite	laterite	laterite	laterite	laterite	laterite	laterite	laterite	laterite	late

Chart 4.3: *Inventory No.2.*

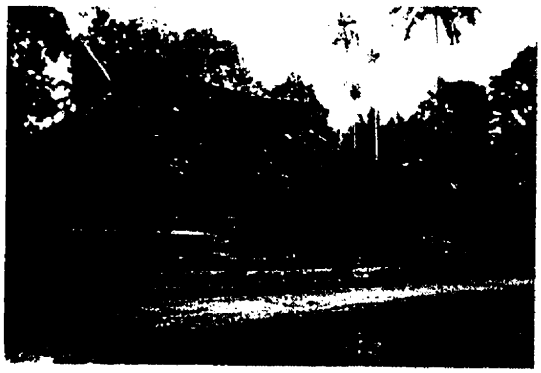
	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
	Madom	Veedu	Veedu	Veedu	Madom	Kottaram	Kottaram	Kottaram	Kottaram	Veedu	Mana
	1Courtyard/ Malika	2Courtyards	4Courtyards	Ekashala	1Courtyard	1Courtyard/ Malika	1Courtyard	1Courtyard/ Malika	2Courtyards	2Courtyards	1Courtyard/ Malika
	Brahmin	Ezhava	Devadasi	Ezhava	Brahmin	Kshethriya	Kshethriya	Kshethriya	Kshethriya	Nayar	Brahmin
	150-200	150-200	200-300	100-150	500-600	150-200	50-100	150-200	100-150	150-200	150-200
	good	excellent	excellent	moderate	excellent	excellent	good	moderate	moderate	excellent	excellent
	good	good	moderate	good	good	good	good	moderate	good	good	good
	terra-cotta	thatch	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta
	wood/laterite	wood/mud	wood/ laterite	laterite	wood	wood/laterite	wood/ laterite	wood/ laterite	laterite	wood/ laterite	laterite
	wood	wood	wood	wood/ laterite	wood	wood/laterite	wood/ laterite	wood/ granite	wood/ laterite	wood	wood/ laterite
/	cement	cement/ wood	terra-cotta	cement	cement/ wood	wood/granite/ cement	cement/ granite	granite/mud -cow dung	cement	cement/ wood	cement
	laterite	laterite	laterite/ granite	laterite	laterite	laterite/ granite	laterite/ granite	laterite	laterite	laterite	laterite

14	H15	H16	H17	H18	C1	C2	C3	C4	C5	M1
adom	Veedu	Illom	Veedu	Bavanam	Veedu	Veedu	Veedu	Veedu	Veedu	Veedu
ourtyard	1Courtyard	6Courtyards	3Courtyards	Dwishala	Thrishala	1Courtyard	Thrishala	Ekashala/ Malika	Thrishala	1Courtyard
ahmin	Nayar	Brahmin	Nayar	Nayar	Syrian Christian	Syrian Christian	Syrian Christian	Syrian Christian	Syrian Christian	Muslim
0-200	150-200	300-400	50-100	100-150	100-150	50-100	100-150	100-150	100-150	100-150
od	good	excellent	good	good	good	good	good	good	good	good
od	good	good	good	good	good	good	good	good	good	good
ra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta	terra-cotta
od	wood/ laterite	wood/ laterite	wood/ laterite	wood/ laterite	laterite	laterite/ terra-cotta	laterite/ terra-cotta	laterite/ terra-cotta	laterite/ terra-cotta	laterite/ terra-cotta
od	wood	wood	wood	wood	wood/ laterite	wood/ laterite	wood/ laterite	wood/ laterite	wood/ laterite	wood/ laterite
nent	cement	cement/ granite	cement	cement	cement	cement	cement	cement	cement	cement
rite	laterite	laterite	laterite	laterite	laterite	laterite	laterite	laterite	laterite	laterite

Picture 4.1: *A Syrian Christian house at Thazhathangadi, Sample C-4.*



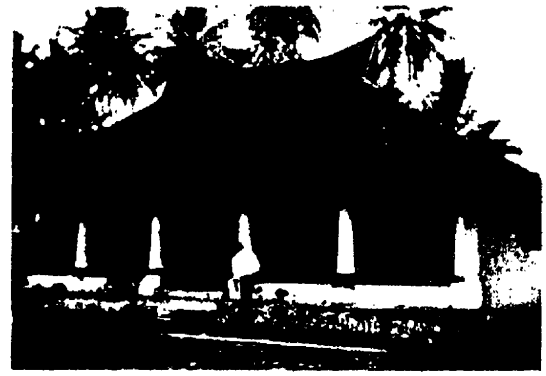
Picture 4.2: *A Syrian Christian house at Pulinkunnu, Sample C-3.*



Picture 4.3: *A Muslim house at Kummanam, Sample M-1.*

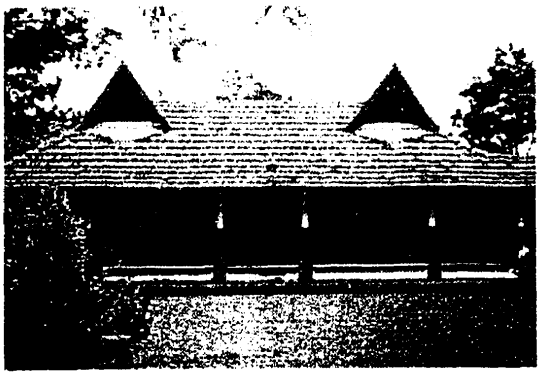
Picture 4.4: *A Shudra house at Parashala.*

Picture 4.5: *A Ezhava house at Thiruvallam, Sample H-3.*



Picture 4.6: *An Ezhava house at Ulloor, Sample H-5.*

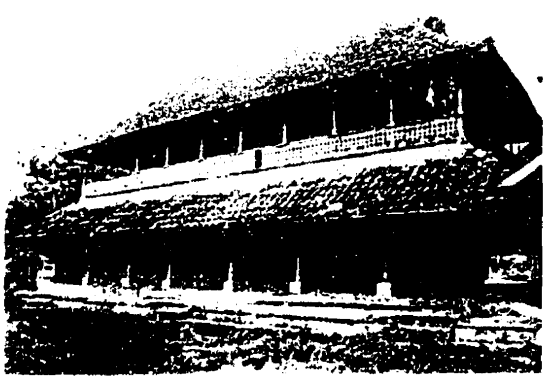
Picture 4.7: *A Nayar house at Thalakulam, Sample H-1.*



Picture 4.8: *A Nayar house at Kaviyoor, Thiruvalla.*

Picture 4.9: *A Kshethriya house at Panthalam, Sample H-9.*

Picture 4.10: *A palatial Kshethriya house complex at Pathmanabhapuram.*



Picture 4.11: *Grain store of a Brahmin house at Moncompu, Sample H-16.*

Picture 4.12: *A Brahmin house at Sreekariyam, Sample H-6.*

chosen samples are still expected to perform their functions in representing and explaining the Travancore style within the scope of this project. The general features pertaining to geographical and regional characteristics are discussed particularly with reference to the 24 cases.

4.4.a. Sample H-4 or *Ammachi veedu*, Kizekkekotta, Thiruvananthapuram

This dwelling is located within the fortified district of Thiruvananthapuram city. This region known as East Fort is a historic zone where one finds an urban fabric rich with typical Keralite, Tamilnadu, British Colonial and trendy Post-Colonial architecture.

Originally called *Ammachi veedu*, the house is now owned and named after the charity trust *Mithranikethan*. The house is unoccupied and needs repair of its floors and roof purlins. It is square in shape with originally three courtyards. The linear courtyard was recently divided, which makes it now four altogether (Refer Figure 4.2). Excepting the kitchen walls in the north eastern corner, the house is entirely built of wooden panels or *nira*. Both the square courtyards have circular sectioned pillars and ornate capitals arranged in two concentric split levels. The third courtyard has four sided pillars. The floor of the courtyard has granite slab edging on which are fixed the wooden pillars. The house has a continuos *nira* wall on its periphery but rarely any interior partitions, leaving the interior a continuous space with four bright courtyards puncturing the expanse. The *nira* walls are fixed on vertical frames erected on a solid wooden timber floor beam and tied by a horizontal beam at the top (Refer Figure 3.11). The roof frame resumes from another timber beam above this beam. It has a well worked out ceiling as detailed in Figure 4.3. The roof frame forms the specialty of this house. It has 10 fans of angle rafters in its roof frame as detailed in Figure 4.4. Moreover the common rafter edges have cuttings of a wave pattern and extra collar pins meant for decoration. The joinery of the *nira* and ceiling is exquisite even though decorative iconography are minimal (Refer Figure. 4.5). On the under side of the hip rafters there are images of parrot and monkey figures sculpted with great attention. The floor is laid with terra-cotta tiles and the roof clad with Mangalore tiles.

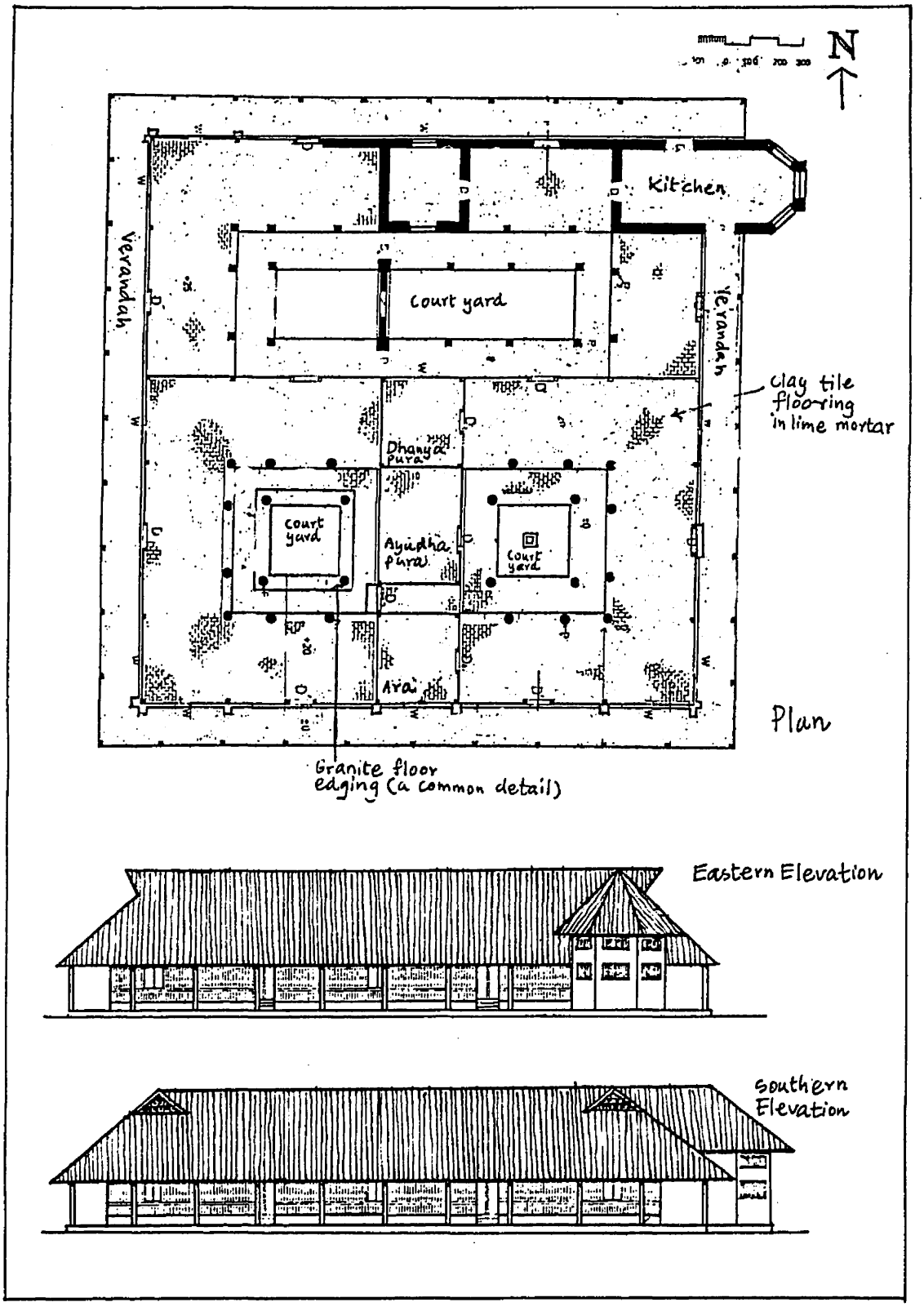


Figure 4.2: *Sample H4 showing plan and elevations (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

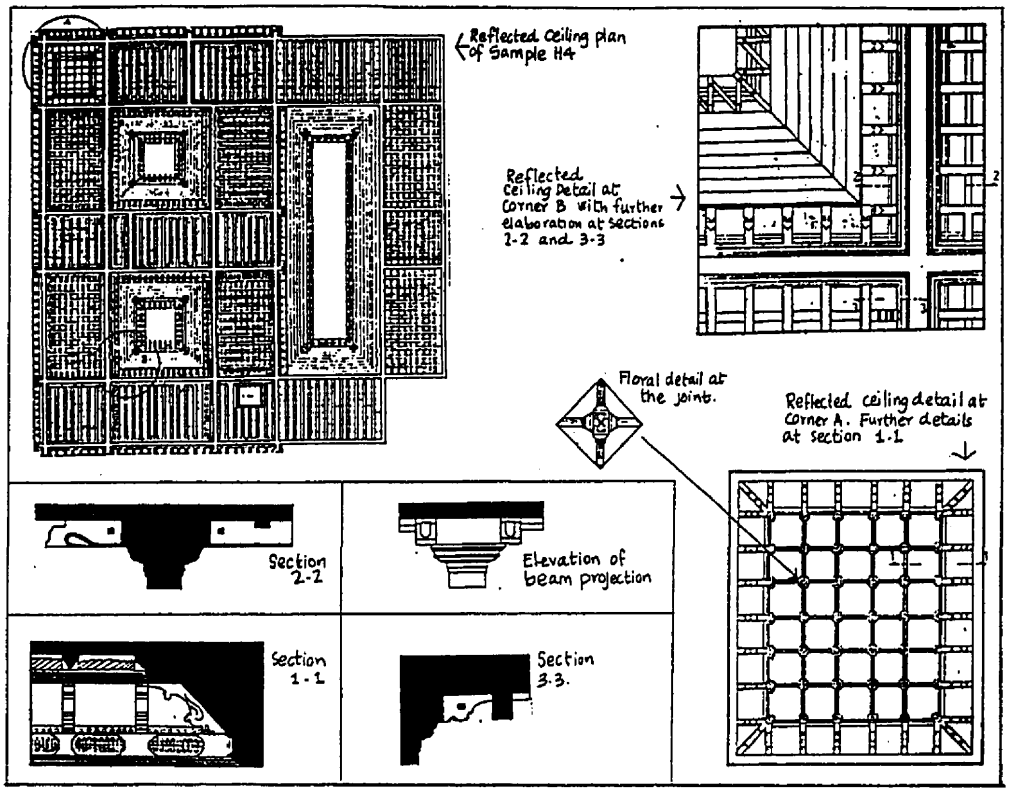


Figure 4.3: *Ceiling details and beam sections of sample H4 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

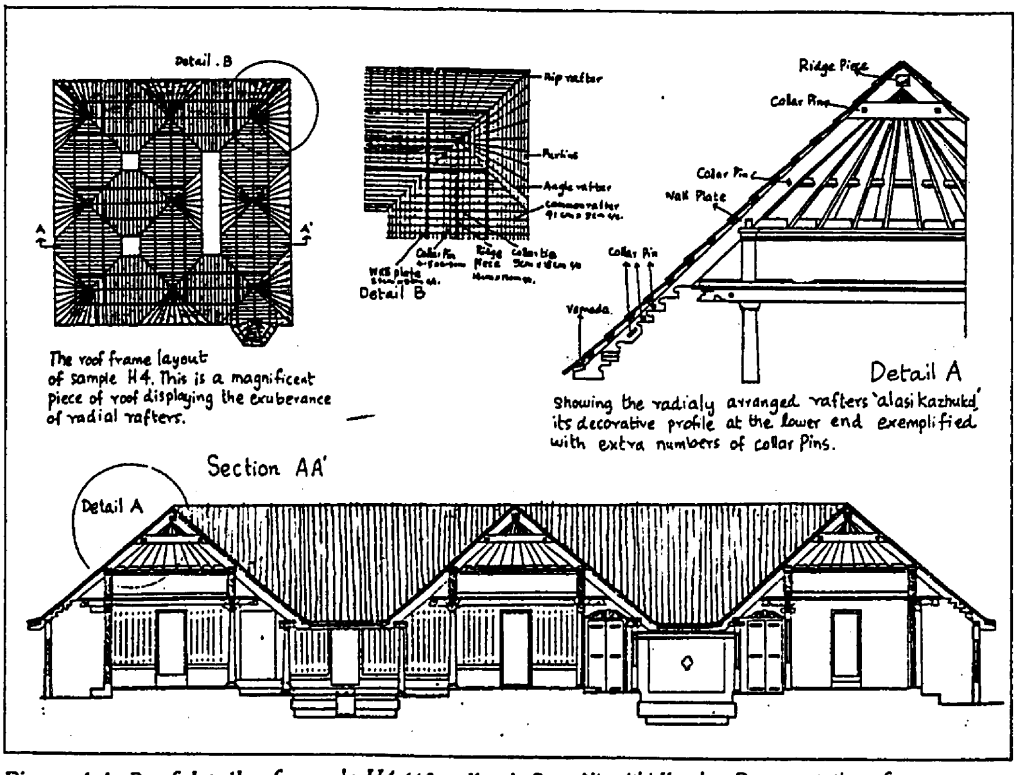


Figure 4.4: *Roof details of sample H4 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

4.4.b. Sample H-6 or *Sreekariyathu madom*, Sreekariyam, Thiruvananthapuram

Sreekariyathu madom located in the outskirts of Thiruvananthapuram city in the small town of Sreekariyam is presumed to be over 500 years old. This is a Kerala Brahmin house and presently Mr. Narayanan Potti lives here with his family (Refer Picture 4.12). It has all its walls built of wooden panels. It consists of two courtyards, an attached well, a *poomukham*,[5] a *thevaram*,[6] and other household spaces (Refer Figure 4.6). It has a magnificent roof with radiating rafters. Originally it was a *nalukettu* which later was extended northward with the second courtyard in between. The roof was originally thatched which was later on replaced, a hundred years ago by Mangalore tiles. It has both circular and square sectioned pillars (Refer to Figure 4.7). The wooden craft exhibits classic finesse in its decorative details of the *nira*, the entrance door, gable ears, shape and proportions of pillars and roof. The entrance door is representative of the Chinese influence on wood technology in the old houses of Kerala. The door spins on wooden pivots projecting to the inside, and has wooden latches. Figure 4.8 explains the door details. *Nira* panels here consist of finely worked out floral decorative patterns (Refer Figure 4.9).

4.4.c. Sample H-7 or *Nalukettu kottaram*, Thonaloor, Panthalam

Panthalam is a historic place known after the local royal family's devotion to Lord Ayyappa. Scattered around the town are palaces located on either bank of the sacred river Pamba that flows through the vicinity. The *Nalukettu kottaram* is located in Thonaloor township, besides other palaces in the vicinity such as *Shrambical kottaram*, *Vadakkedam kottaram*[7] and *Vadakku kottaram*. The *Nalukettu kottaram* consists of an elegantly proportioned, delicately crafted *nalukettu* behind its later addition of a double storied hall or *malikapura* facing the street. The *Nalukettu* is entirely built of wood whereas the *malikapura* is built of thick exposed laterite, abundant in the mid lands of Travancore. The *nalukettu* is simple in layout and has a minimal number of cabins. The basic space

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[5] Entrance patio.
[6] Prayer room.
[7] Refer Picture 4.9.

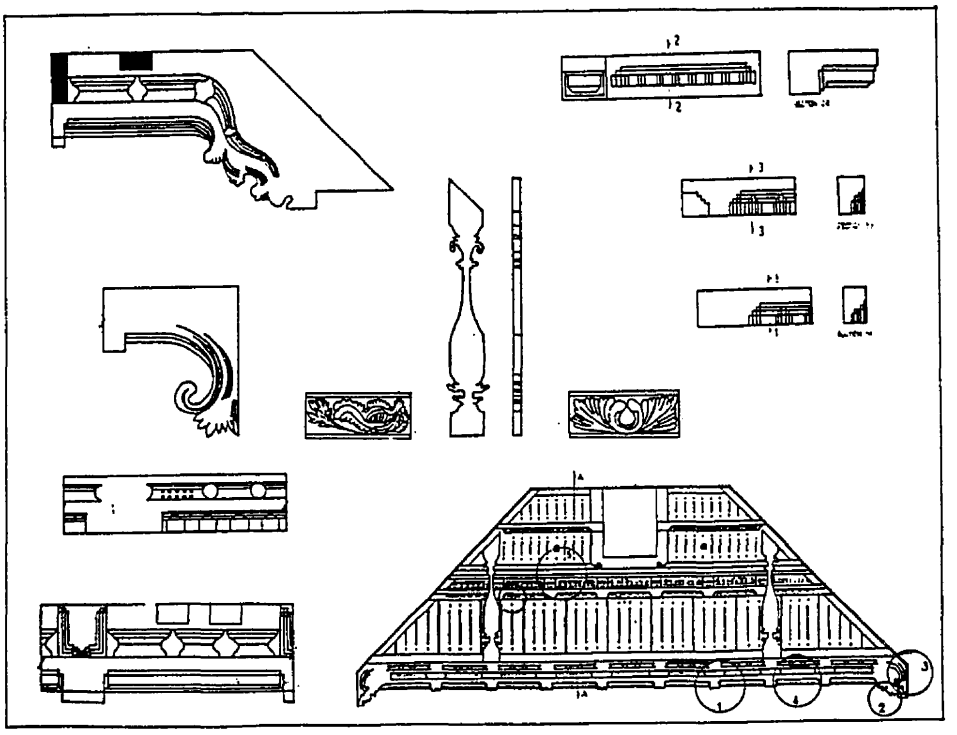

Figure 4.5: *Ceiling decorative details and iconography of sample H4 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

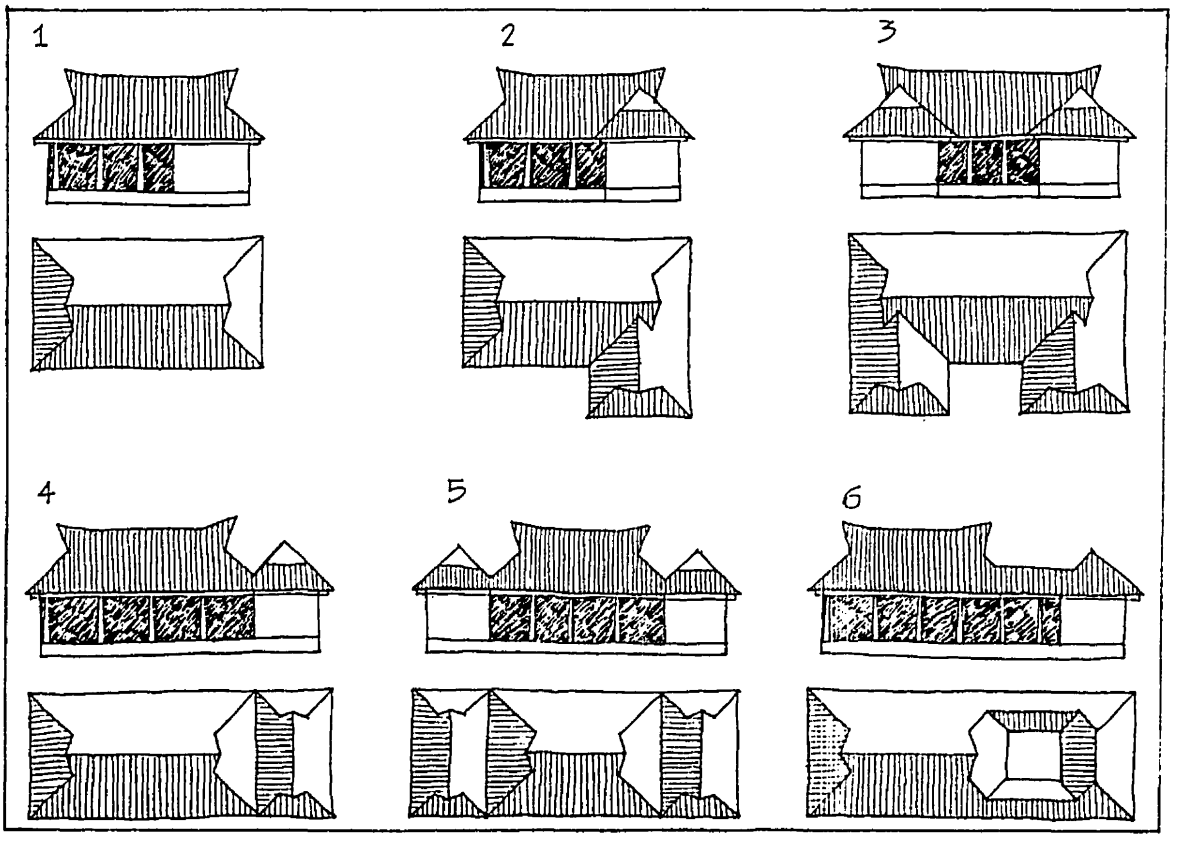

Figure 4.14: *Six of the various roof profiles of small houses in Kerala.*

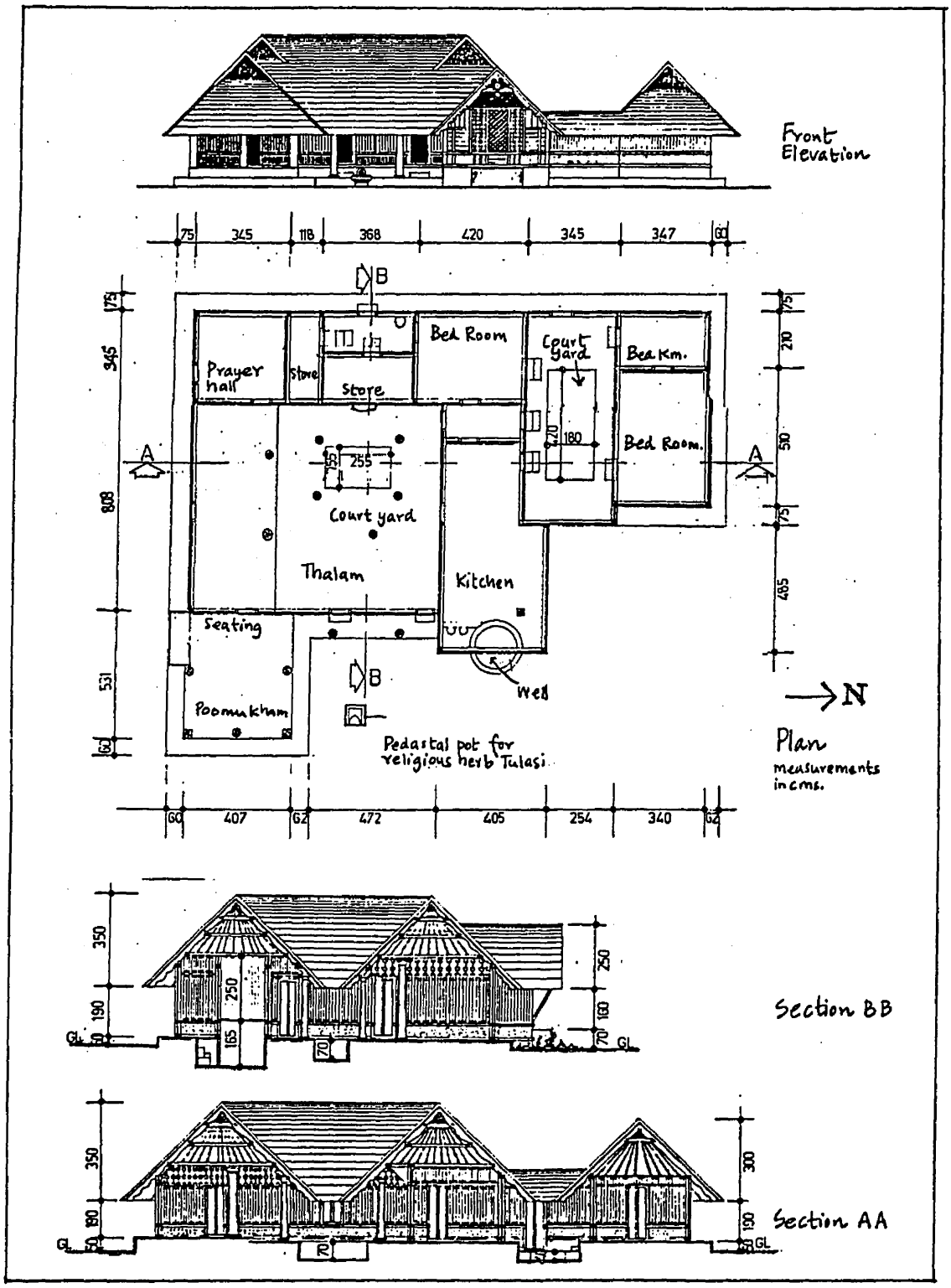

Figure 4.6: *Elevation, plan and sections of sample H6 (After: Department of Architecture, COE Thiruvananthapuram, Documentation of Sreekariyathumadom, 1993).*

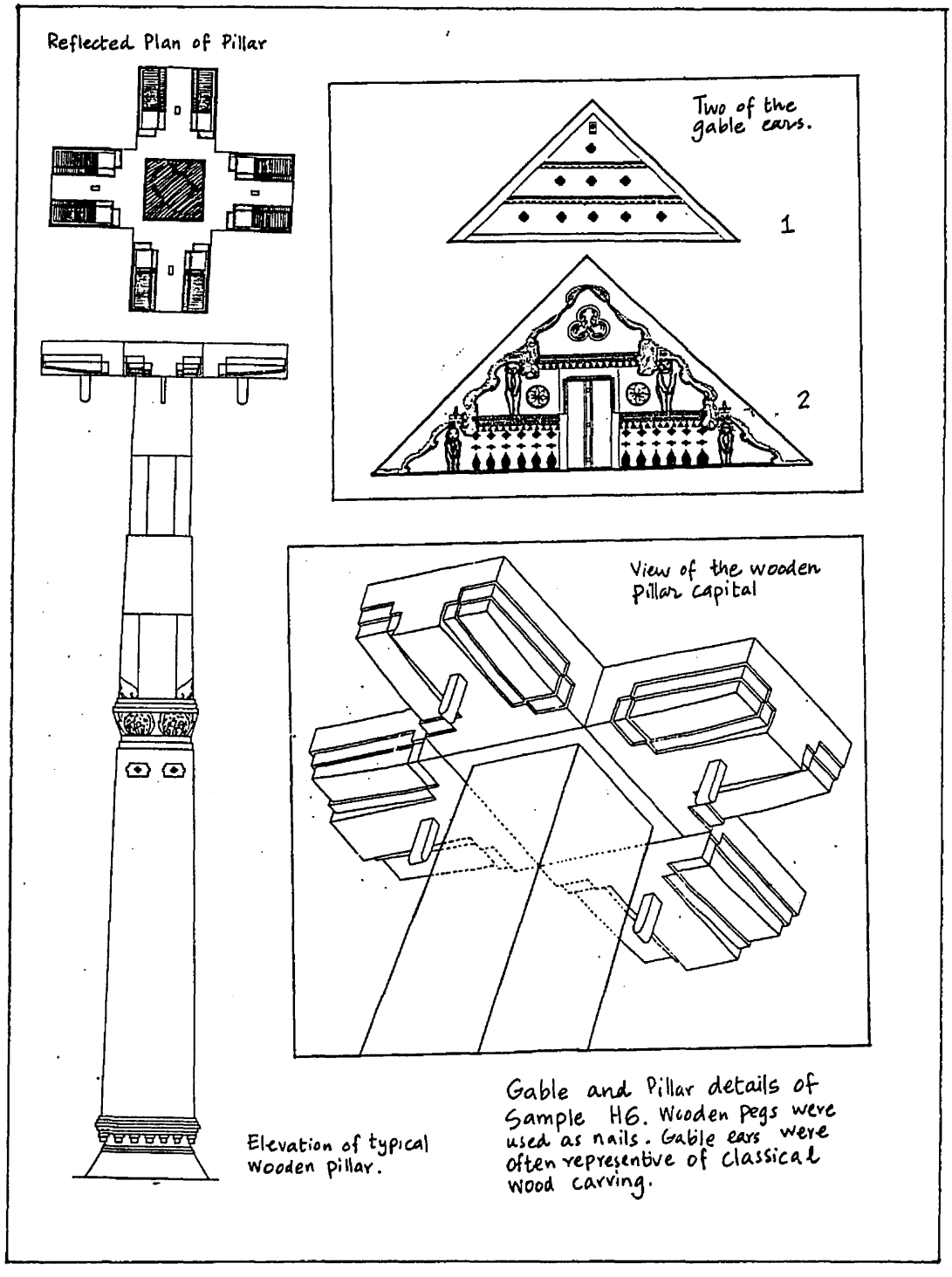

Figure 4.7: *Gable and pillar details of sample H6 (After: Department of Architecture, COE Thiruvananthapuram, Documentation of Sreekariyathumadom, 1993).*

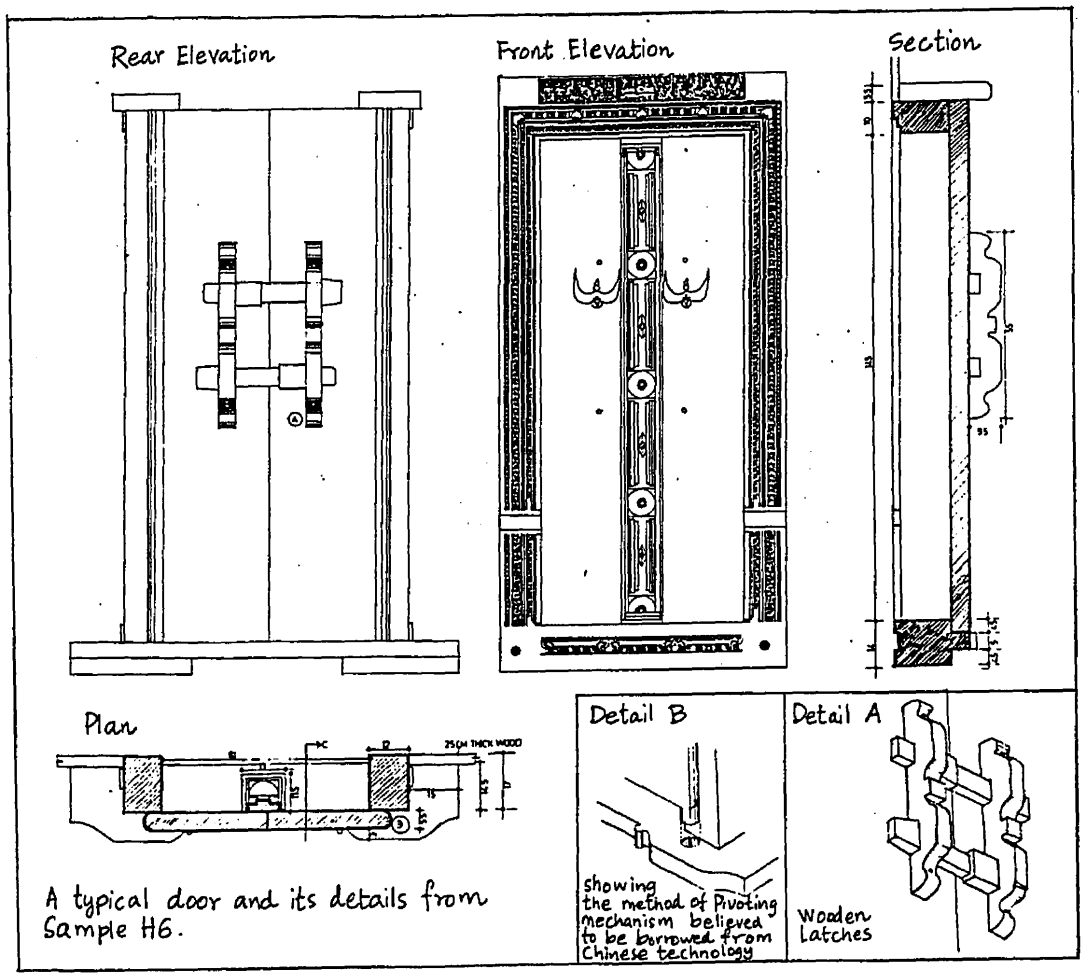

Figure 4.8: *Door details of sample H6 (After: Department of Architecture, COE Thiruvananthapuram, Documentation of Sreekariyathumadom, 1993).*

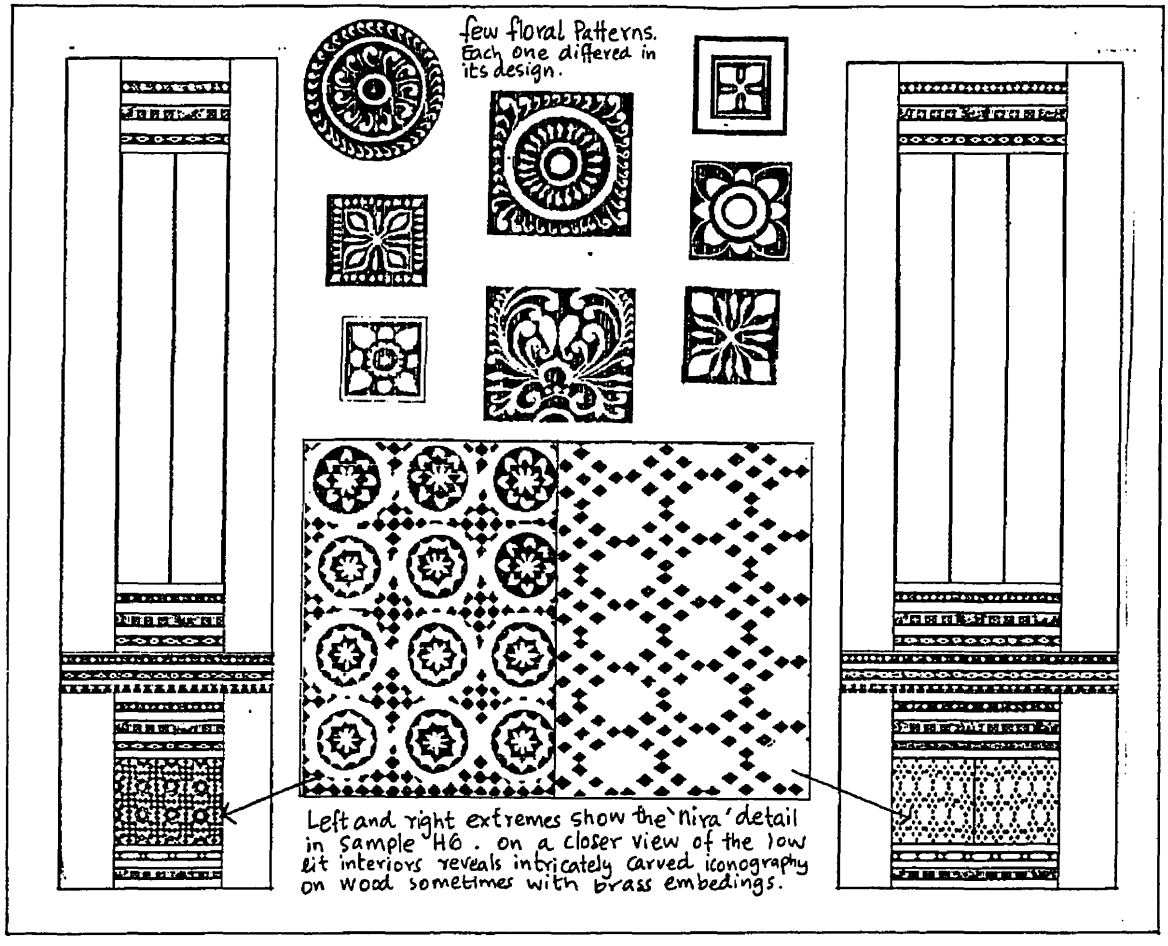

Figure 4.9: *Wooden decorative pattern of 'nira' in sample H6 (After: Department of ArchiteCture, COE Thiruvananthapuram, Documentation of Sreekariyathumadom, 1993).*

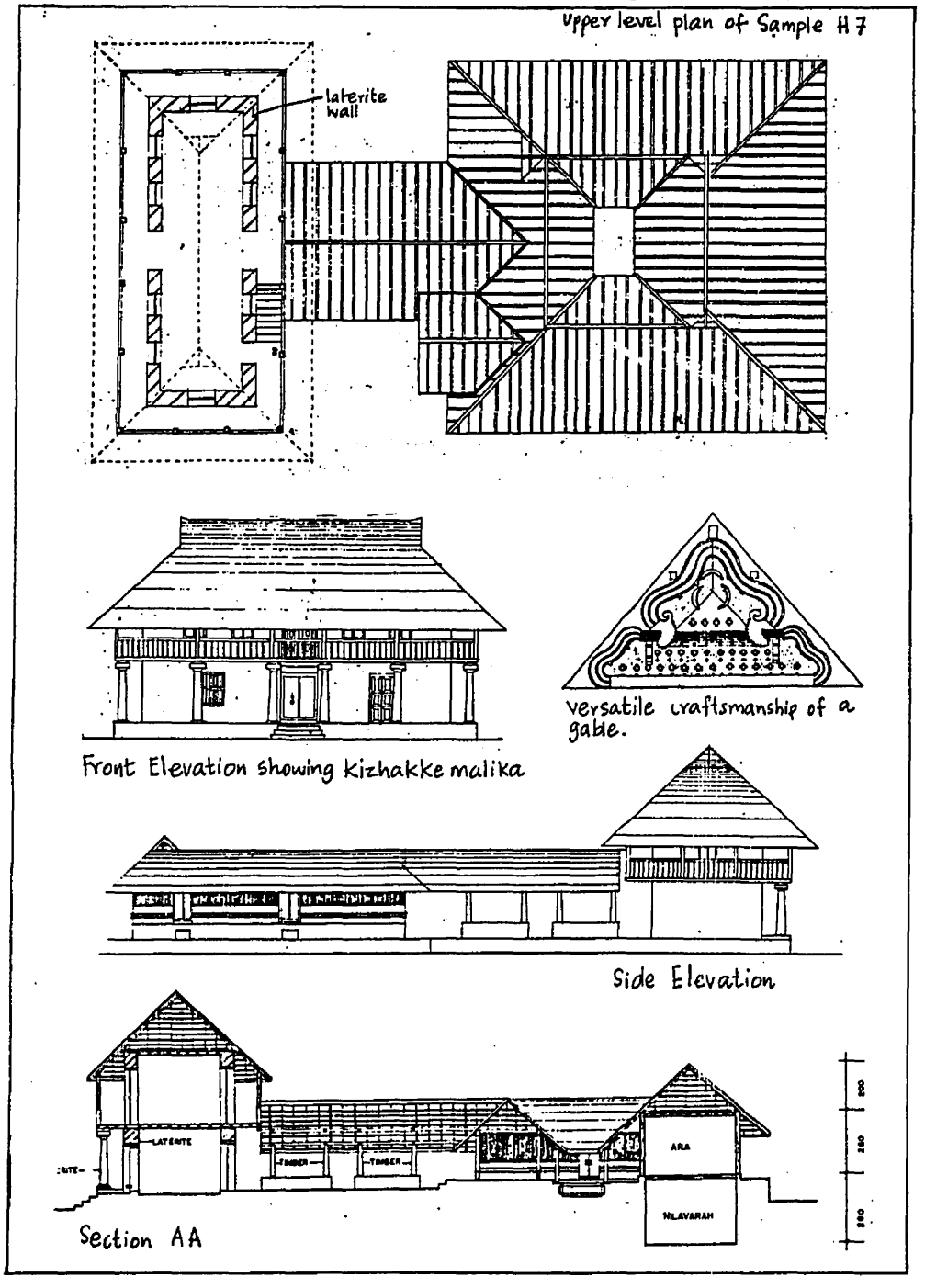

Figure 4.10: *Plan, gable ear and door details of sample H7 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

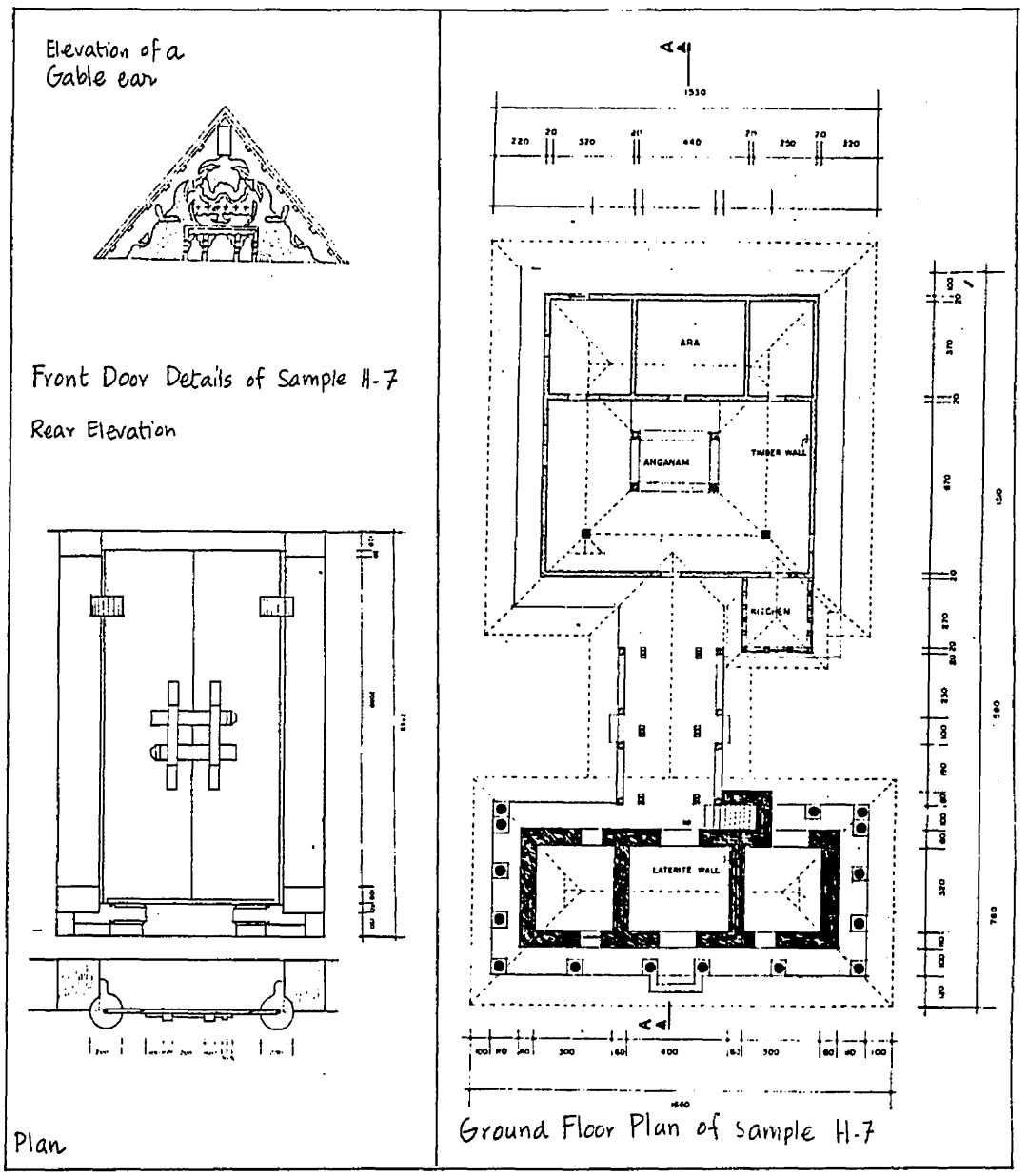

Figure 4.11: *Plan, elevations, section and gable details of sample H7(After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

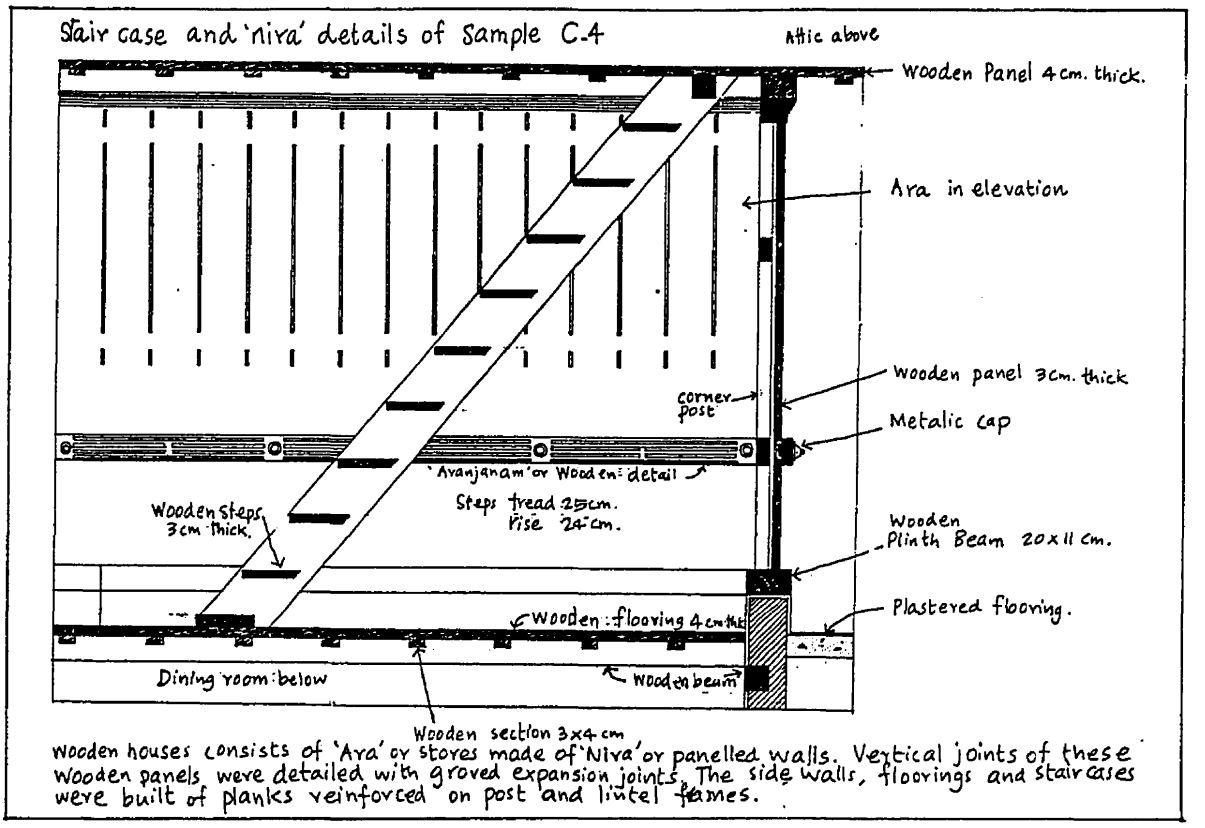

Figure 4.12: *'Nira' and staircase detail of sample C4 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

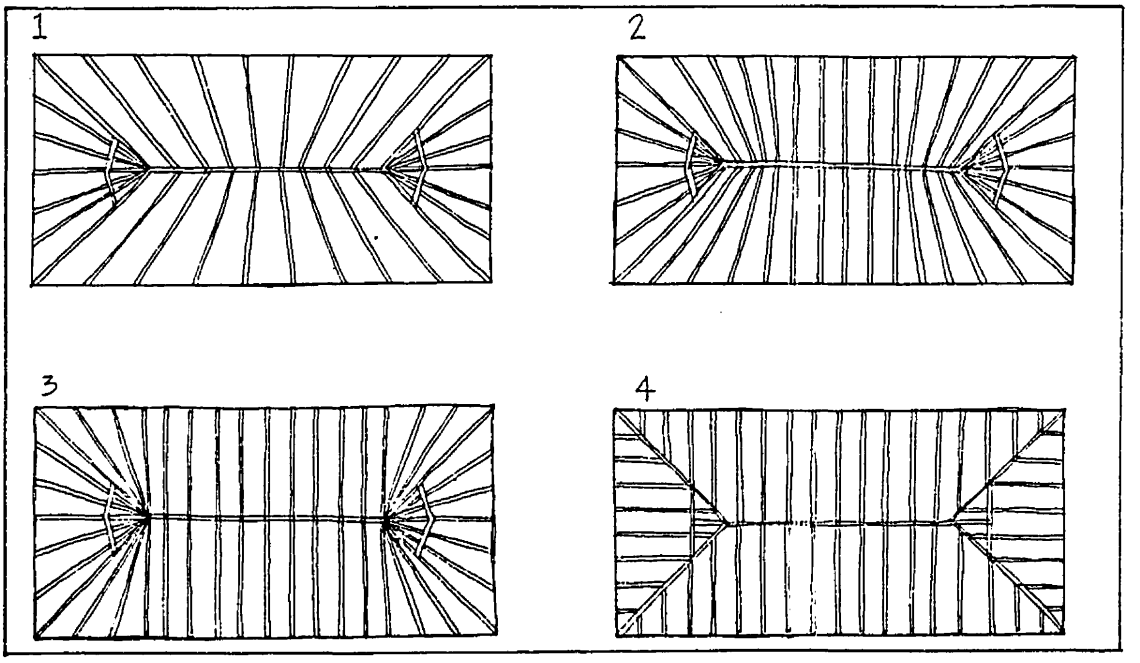

Figure 4.15: *Four types of roof rafter pattern identified in the case study.*

structure consists of a *thevaram*, *ara* and a bed room besides a small kitchen and the spacious hall around the courtyard. The front and rear wings are connected by a pillared corridor open on either side. Its roof is supported by four rows of wooden pillars (Refer Figure 4.10). The *malikapura* has a narrow verandah running all around having pillars built of exposed laterite. The upper floor, reached by a wooden ladder, is built of wooden planks on beams called *machu*. The doors and gables are detailed as in Figure 4.11. The roof is clad by Mangalore tiles over rows of rafters.

4.4.d. Sample C-4 or House 1, Thazhathangadi, Kottayam

Thazathangadi is an old settlement of houses belonging to the traders along the shores of river Meenachil flowing past the town of Kottayam. In this location there are about 25 houses of similar character out of which 2 are selected. One is described in detail here (Refer Picture 4.1). Even though this building consists of three floors, including the attic space, due to the stepped and raised plinth till the middle level, it appears single storied from the front with the attic balcony projecting out of the steep and prominent roof. Refer Figure 4.13 for details of mezzanine floor and balcony floor lay out and the ground floor and the raised plinth in the front. The front facade has jali screen with star patterns. Its projecting balcony and front gable ear are adaptations that characterize the Christian version of the Kerala style. Pattern details and profile of jali screens, door shutters, wooden window grills and gables reflect its propinquity with the European style. The mezzanine and attic floors are comprised of wooden planks on beams called *machu* which are vertically connected by wooden stairs as in Figure 4.12. The balcony has screens on sides and a wooden seating as detailed in Figure 4.13.

4.5. The way of the roof

Visually, a traditional house with its steeply sloping roof makes a dramatic vertical statement and presents an active, staccato silhouette.[8] Rich decorative detail is subordinate to the impression of pure geometry. Even though the height of the roof may

[8] Ronald M Bernier, Temple Art of Kerala, (New Delhi: S.Chand and Co. Ltd., 1982), 511-516.

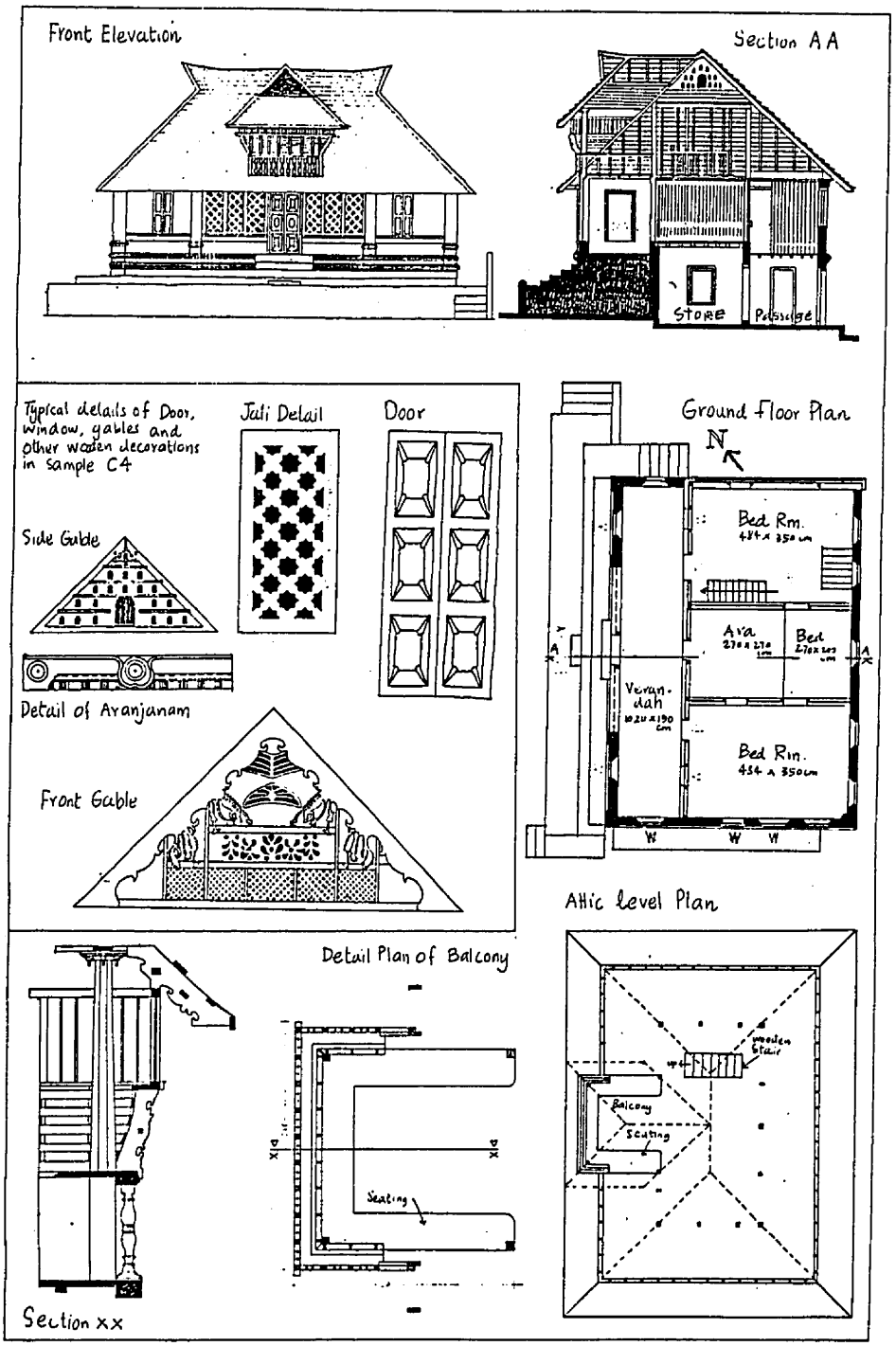

Figure 4.13: *Elevation, section, plans and details of balcony, gable, jali and door shutter of sample C4 (After: Kerala State Nirmithi Kendra, Documentation of traditional houses in Kerala, 1993).*

be twice or more than that of the wall that supports it, such a structure rarely tops the trees around it. Even though the roofs are huge and quite high, the overall emphasis of the built form is horizontal rather than vertical. The roof, above its overall aesthetic prominence, is also an abode of the *sthapathi's* wisdom and mastery in carpentry skills and mathematical computation. From the attic space beneath the roof, one can view a pyramidal wood frame system forming the roof skeleton. The assemblage of the roof skeleton forms the important aspect in the overall construction process of the traditional architecture. The study hence focuses on this wooden construction.

4.5.a. Sophistication in wooden construction technique

Transformation of the roof and wall structures with respect to technological and cultural developments took place over thousands of years of history. Yet we have visible examples that depict the evolution in the period of 500-600 years dating back from the present. The older forms were lost in time and any pertinent information remains shrouded in obscurity. During the field work, an exact documentation of the practice of the more recent version of this old system of roof as applied in residential architecture was attempted. The version of the current roof frame is different from that of the previous one mainly with respect to the absence of radiating rafters or *alasikazhukol.* The technical process of the framing system was thus much simplified. Absence of radial rafters resulted in the introduction of hip rafters to hold metallic nails. A graphical comparison of these two stages of the roof and its subsidiary components is done in Figure 4.15. The earlier form reveals the highest state of sophistication achieved in the area of wooden techniques in Kerala architecture. In certain palatial houses, the magnified size and decoration had produced higher classical orders of roof forms. In these buildings massive wooden members were joined with the finest precision, incorporating complex joinery details. The rafters were heavily ornate with iconic images and symbols engraved on them. The collar pins were sometimes provided in surplus and used to be in spiral form bearing ornamental details. Even though the radiating rafters were replaced by the hip rafters, the method of assembly of common rafters and hip rafters onto the ridge piece and wall plate, and the method of driving the collar pin

remained more or less the same. This simplification of wood technology happened during the colonial periods.

4.5.b. Methods and practices

It is found that in northern and southern regions of Kerala, the practices were more or less similar in an overall sense. However the practices described here refers to the Travancore region. Within the Travancore region itself there are minor variations in roof form, type of wood used, decoration detail, style etc. Hence in this study a general method of fabricating and assembling the roof frame takes an objective focus.

Generally, good quality hard wood such as teak, anjili, jack etc. was preferred for building purposes and was commonly used in the highlands and midlands. However in the lowlands, well seasoned and aged coconut palm and pamyra palm wood were used more commonly. The head carpenter with his team of assistants chose the wood from the timber yard. The wood was sawed to required sizes after ensuring its proper seasoning. The seasoning was generally done by dipping the wood in water and drying it in the shade. The master carpenter made the major design decisions. He would make a diagram on a wooden palanquin by the mark of a chisel as in Figure 4.16. This diagram gave the proportionate unit measurements of each part of the roof frame, which then was cut out of the sawed wood using chisel, by his assistants. The craftsmanship ensured a high degree of precision or else the piece would not fit while assembling. The different parts of the roof and details on its sizes and joinery are discussed in the following sections.

All measurements were taken with the local scale of the *kol*. 1 *kol* (*k.*) is taken as 24 *angulam* (*a.*) and one *angulam* as 8 *yavam* (*y.*). In conversion 1 *kol* is 72 centimeters, 1 *angulam* is 3 centimeters and 1 *yavam* is 3.75 millimeters.

4.5.b.a. Wall plate or *uttaram*

The first step was to choose the permissible perimeter value for the wall plate. This was strictly followed according to the treatises. From the perimeter, the effective length and breadth of the wall plate was obtained. For example: the perimeter length 40*k*.8*a*. is an

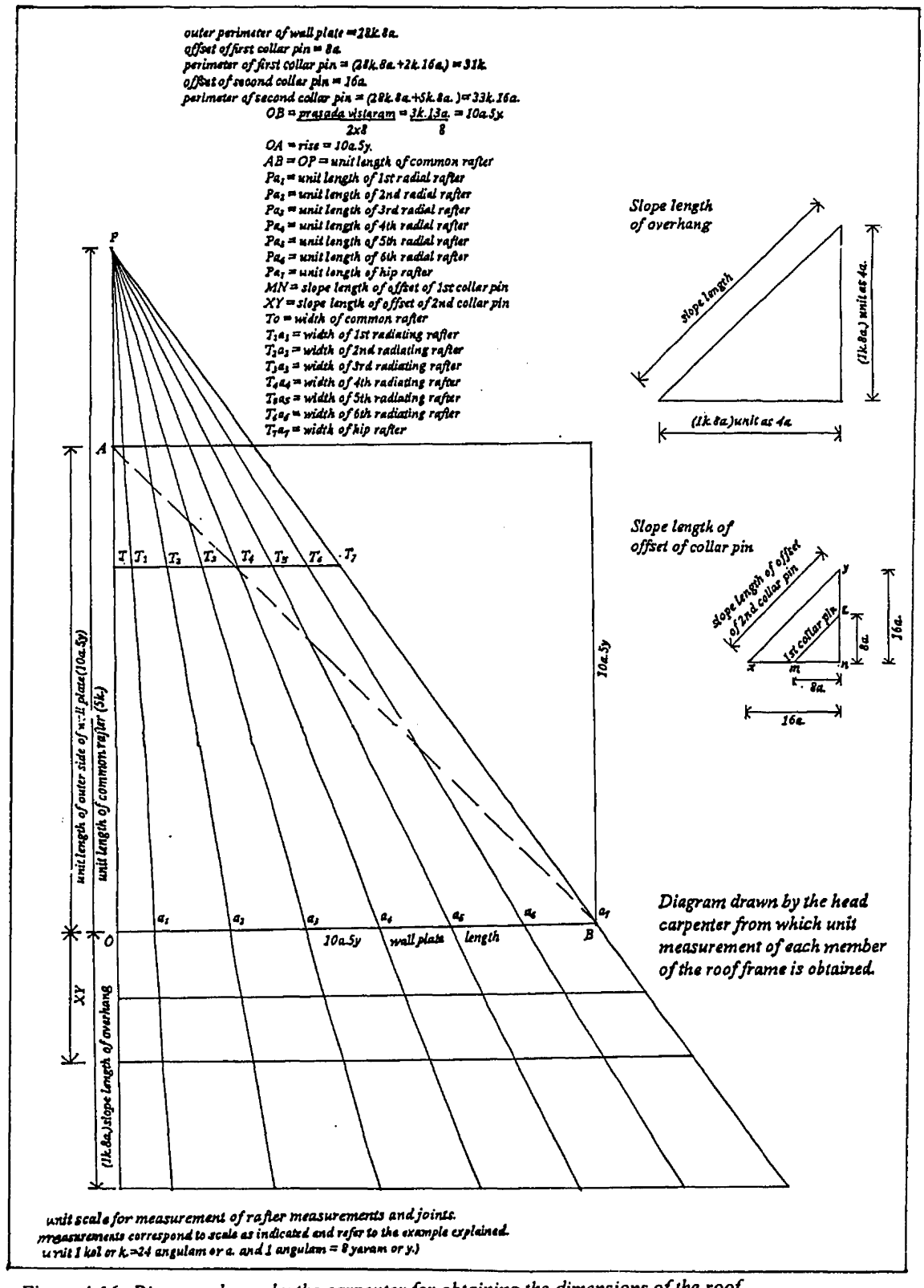

Figure 4.16: *Diagram drawn by the carpenter for obtaining the dimensions of the roof members (After: K.S.Suresh Kumar, Lecture notes on 'thatchushasthram' at Vasthuvidya Gurukulam, 1995).*

auspicious length[9] from which the sides are worked out as 13*k*.23*a*. and 6*k*.5*a*. and the wooden pieces are cut and joined following the specifications. The members in the north-south direction are laid such that foot of timber as in the tree points south. Similarly the foot points west in the east-west direction. In section, the thickness of the wall plate is half its height or vise versa. While joining, the shorter member is laid and fixed on top of the longer piece by the simple joinery (Refer in Figure 4.18). The offset length for wall plate is usually taken as 5*a*. to both sides. In the above example, the total length of the wall plate is 14*k*.9*a*. for the longer piece and 6*k*.15*a*. for the shorter piece.

4.5.b.b. Ridge piece or *monthayam* and rafters or *kazhukol*

The common and hip rafters culminate at the ridge piece. The hip rafter is the diagonal common rafter, hence having a greater length. All the dimensions of these various members are proportionate to unit measurements deduced with the help of the geometric diagram drawn by the head carpenter as in Figure 4.16 (Refer Figure 4.17 for details of the rafters). In all cases this method starts from drawing a square of side 6*a*. (Refer Figure 4.16).

The width and breadth of the ridge piece or *monthayam* in section is the same as the wall plate. i.e. 5*a*. x 2*a*. The effective length of the ridge piece is found as the difference between the length of longer and shorter wall plate member to which the offset of 6*a*. on both sides are added to get the full length. Following the previous example the effective length of the ridge piece is thus 13*k*.23*a* - 6*k*.5*a*. = 7*k*.18*a*., to which when the offset of 6*a*. is added to both sides, gives the full length as 8*k*.6*a*.. For common rafters, the following proportions are worked out from the diagram. For 1 *k*. base the diagonal length is 1*k*.5*a*. and hence for 3*k*.2*a*.4*y*. base,[10] the diagonal length is 3*k*.18*a*.1*y*. This is the length of common rafter till the wall plate, to which the overhang is to be added so as to get its full length. The overhang is usually taken as 2/5th, ½, 3/7th or 4/9th of *kaluyaram*.

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[9] These measurements are adopted from the table prescribed as slogans in the traditional treatises Manusyalayachandrika.

[10] In the example the effective span is 6k. 5a. and hence the base length of the triangle makes 3k. 2a. 4y.

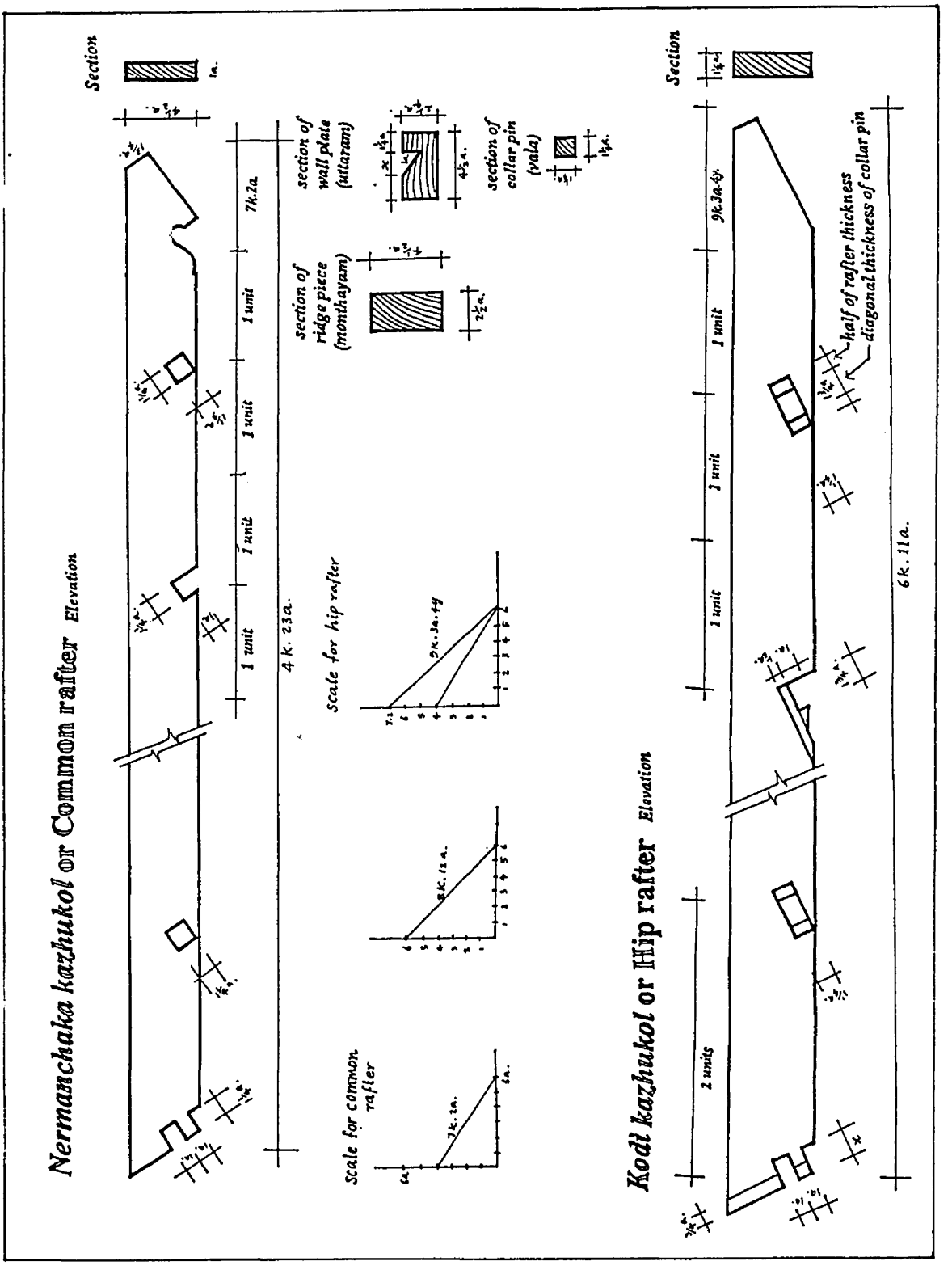

Figure 4.17: *The detail of common rafter and hip rafter (After: K.S.Suresh Kumar, Lecture notes on 'thatchushasthram' at Vasthuvidya Gurukulam, 1995).*

It is also deduced simply as in the case: for 1*k.* offset the slope length as 1*k.*5*a.* For hip rafters the proportion is, for 6*a.* base the diagonal is 8*k.*7*a.*. Therefore, for 1*k.* base it is 1*k.*12*a.* and similarly for 3*k.*2*a.*4*y.* it is 4*k.*16*a.*, which is the length of the hip rafter till the wall plate. The full length of the hip rafter after adding the overhang slope of 1*k.*12*a.* gives 6*k.*4*a.* The common rafters at the hip edge are of varying lengths reducing in a progression. These rafters are locally called as *chedira kazhukol* (Refer Figure 4.18). These varying lengths of *chedira* are found as follows. Taking the overhang as 1*k.* on both sides, the total width of the roof will be 8*k.*5*a.* The spacing between rafters are called *panthiyakalam*, which is usually taken as 18*a.* and is always less than 1*k.*. Assuming rafter thickness as 1*a.* and providing 4 *chedira* for one hip rafter, we get 8 *chedira* and 9 *panthiyakalam* in total. In correction 1 *panthiyakalam* becomes 21*a.*[11] Now the length of common rafter is divided by the number of *panthiyakalam* which gives 13*a.*4*y.* The consecutive subtraction of each unit in progression gives the varying lengths of different *chedira* rafters as 4*k.*12*a.*4*y.*, 3*k.*9*a.*4*y.*, and so on.

4.5.b.c. Collar tie and collar pin

Normally collar pins are driven at two levels so as to tighten and pin all the members in place. The first one is usually located at 12*a.* depth from the level of wall plate, which forms the lower collar pin or *keezhvala.* In this case the length of *keezhvala* as in the referred example is 45*k.*16*a.*.[12] The upper collar pin or *maelvala* passes through the joints of collar tie and rafters. *Maelvala* consist of *benthavala,* the main one, and its subsidiaries on the either ends.

The length of *maelvala* is deduced as = length of ridge piece + 1k. + offset

= 8*k.*18*a.* + 8*a.* = 9*k.*2*a.* = 7*k.*18*a.* + 1*k.* + (2 x 4*a.*)

The *vala* has a square section of width 1*a.* 2*y.* (Refer Figure. 4.19).

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[11] Total roof width of 8k. 5a. subtracted with 8 times the rafter thickness, the value when divided 9 times gives 21a.

[12] (13k. 23a.) + (6k. 5a. + 1k.) + (8 x 4a.) = 45k. 16a.

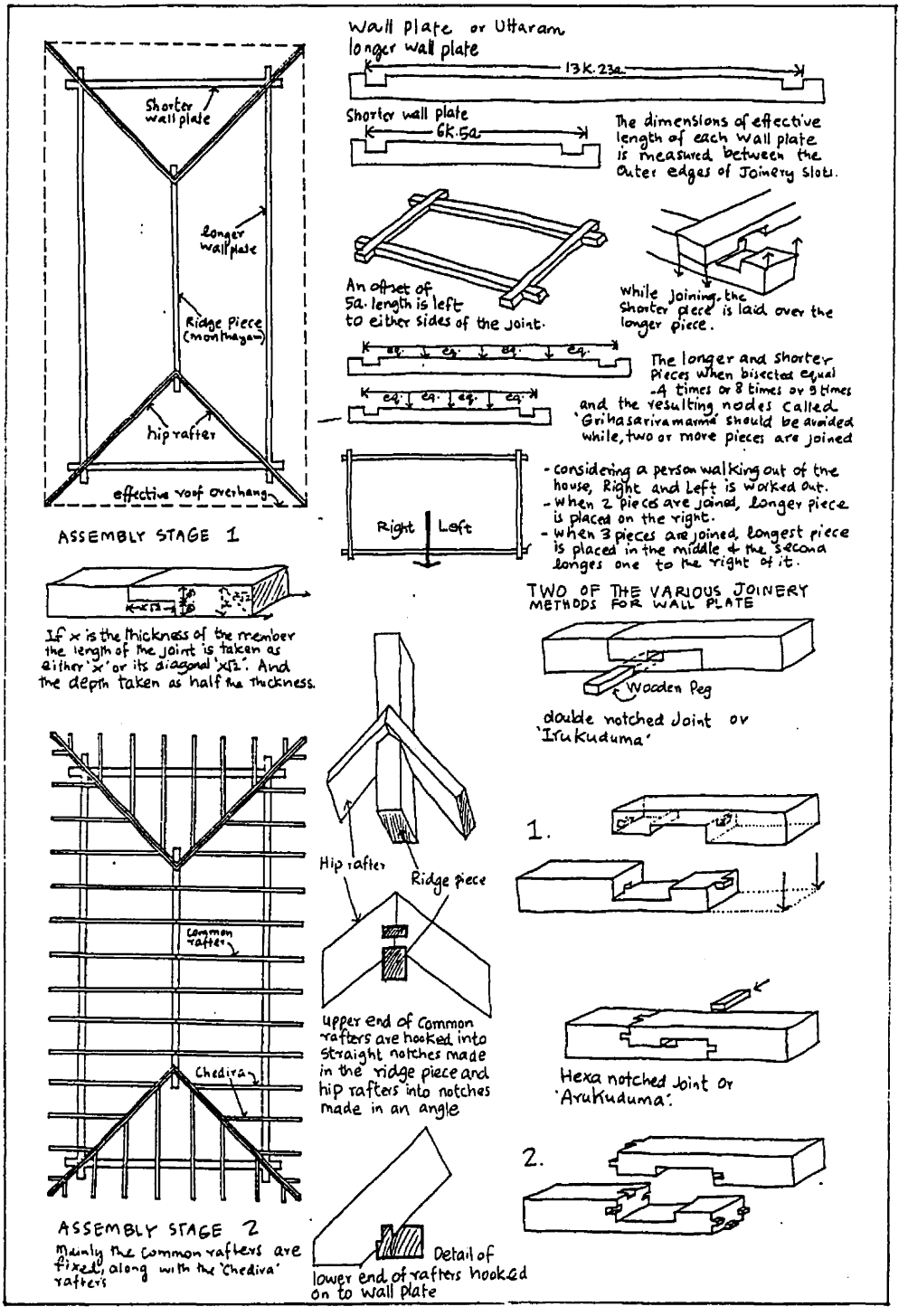

Figure 4.18: *Details of wall plates, rafters and ridge piece.*

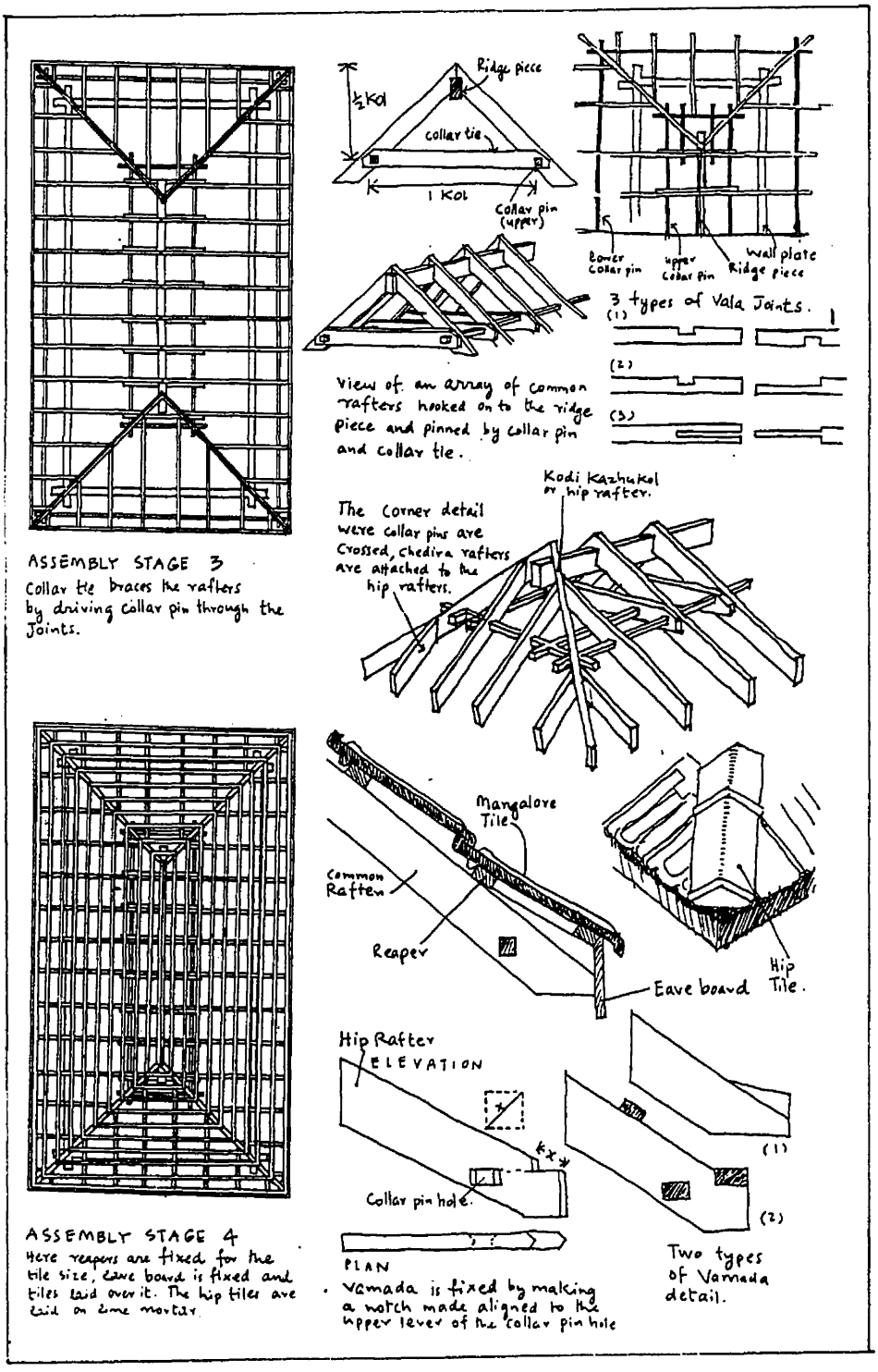

Figure 4.19: *Details of collar tie, collar pin, 'vamada', eaveboard, reapers and tile cladding.*

4.5.b.d. *Vamada* and eaves board

Vamada is a detail at the end of the rafters making an outer bend or curve so that rain water is driven farther away and the foundation is protected. There are various ways in which this detail is executed in different parts of Travancore. The common method is described here. The usual width and thickness are 2*a*.12*y*. x 1*a*.6*y*. The diagonal of the '*vamada* square' is marked from the lower tip along the upper surface of the hip rafter. A straight line is drawn connecting the upper edge of the collar pin hole and the tip of upper side of the rafter (Refer Figure 4.19). The portion below the 'x' length till this line is chopped off vertically. The eaves board is a thin vertical plank fixed to the edge of rafter tips as in the Figure 4.19.

4.5.b.e. Tiling

Mangalore tiles were the most popular type of terra-cotta tiles used for covering pitched roofs. This tile has an approximate size of 45 cm x 30 cm. It has buts and grooves on its lower side which helps it to hook on to reapers fixed over the rafters and to grip each other. On the hip and ridge edge there are angular tiles which are laid in lime mortar so as to cover the edges neatly.

4.6. Conclusions

This section documents different roof types with respect to their variations in assemblage of members, through a few cases; and examines the process of computation of the lengths of various members and the steps of assembling the roof frame. This study is vital in that it provides a primary material basis for discussion on the scope for adaptation and change of these systems to contemporary requirements.

Concluding Remarks

From a contemporary standpoint, theories on the construction practices that prevailed and evolved within the realm of traditional domestic architecture of Kerala can be drawn using the *empirico-inductive*[1] method. In this thesis, drawing upon the extensive field work and documentation and their analysis that I have conducted, I will postulate my theories on the subject inductively, summarizing my findings. Also, since these findings open up views to conceive the study as part of a larger picture of the history of domestic architecture of Kerala, I will attempt to extrapolate the findings as a working hypothesis for further studies on the topic.

C.1. Inferences

C.1.a. Domestic techniques as dialogue of 'responsive architecture'

During the period of 600 years[2] between 14th and 20th centuries, Kerala had an economy and social structure shaped predominantly by agriculture. This was manifested in its domestic architecture too. Apart from the principal visual, functional and structural component of the roof and the roof frame, the major element of a traditional Kerala house was the *ara-nira.* This feature can be observed in the houses of all caste-classes among Brahmins, Kshatriyas, Nairs, and even Christians and Muslims. The case studies cut a section in the corpus of traditional domestic architecture that belong to an agrarian sector of the society; and the *ara-nira* was found to be a common element in all the houses. These two elements --the roof frame and the *ara-nira*-- and the dimensions of their various components became the key aspects to be dealt with in the construction of the house.

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[1] *Empirico-inductive* method is explained in 'A Dictionary of Philosophy'as: " Knowledge which can only be justified by at least some appeal to experience (basically the five senses, and perhaps introspection) is called *empirical. Induction* in its widest sense, is any rational process where, from premises about something of a certain kind a conclusion is drawn about some or all of the remaining things of that kind. An argument is inductive in a narrow or strict sense if it claims to draw such a conclusion from such premises directly." In this sense, the inferences that I draw out of my documentations follow the method of *induction* from *empirical* evidence.

[2] With reference to the house samples subjected in Chapter 4, the date of construction is approximated to fall within 600 years before from today.

The common notion is that the *Vedic* planning principles as mentioned in the *Thatchushasthram* were strictly followed in traditional domestic architecture in Kerala. This includes the belief that the *vasthupurushamandala* and the related principles of spatial planning, the calculations of *aya-vyaya, yoni* and other astrological characters[3] etc. were widely in use. My contention is that a full implementation and a strict adherence to the entire set of rules as stipulated in the *Thatchushasthram* occurred only in the constructions of religious buildings (temples and temple related structures) and the houses of Brahmins and certain nobles. In all other cases, the entire set of rules were not followed, some were compromised. The preconceiving complexity involved in the construction of a house resulted from assembling the roof and *ara*[4]*-nira*[5] two components and their parts and computing their dimensions. In a traditional house, it can be seen that the most widely applied rules were limited to the ones determining the perimeter that gives the length of the *uttaram*, from which were calculated the dimensions of each of the members of the roof frame such as the wall plate, rafters, *aaroodam*, *monthayam*, *vala*, *vamada*, *mughapu*, *koodam* etc. (Refer Chapter 3 in general and later half of Chapter 4 for details concerning the complexity of the roof assemblage). The *ara-nira,* literally a granery or storage chamber, a paneled wooden box exacted to the dimensions of the wall plate[6] so as to fit with the dimensions of the whole house, formed one major component in all traditional houses across caste,class and religion.

Since each member of the roof frame had to be conceived in its exactness of dimension as well as details of joinery to ensure an error-free assemblage of the frame, the mathematical calculations based on certain elementary geometry were accurately followed. This geometry allowed the projection of perimeters and subsequent dimensions of roof frame members to different scales of monumentality of the structures ranging from a palatial *pathinarukettu*[7] to the single block *alpakshethra* (i.e. *ekashala*). This rule

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[3] Refer Chapter 2 for details of these features and their determination prior to building a house.

[4] wooden chambers usually meant for the storage paddy, forms an essential necessity of the -rice culture society- here. The Syrian Christian houses in Thazhathangadi where as used them for storing molasses and other food products they were trading.

[5] Refer Chapter 3 for details of its construction.

[6] projected from the perimeter.

[7] a multi courtyard dwelling comprising of 16 blocks.

was followed in the house construction of all caste-classes. Even though houses belonging to the affluent sector depict the extent of decorative arts and skills adapted from the school of temple architecture that prevailed here, it does not essentially represent the commonly applied traditional domestic architecture. Such decorative efforts were noticed in all the four examples such as Sample H-4, H-6, H-7 and C-4 demonstrated in detail in Chapter 4 (Refer Figures 4.2 - 4.13, Picture 3.11, Picture 3.12, Pictures 3.32 and Picture C.17). The commonly applied are represented in the more frequently found smaller houses performing higher workmanship in the first two major components (Refer the roof profiles and schematic layouts depicted in 6 such types of houses from the field survey shown in Figure 4.14). The four methods of roof assembly as depicted in Figure 4.15 form only a fraction of the potential variations that might have already existed or still exist but not yet found.[8] While recording the complexity of the oral traditional practice of the roof devising method of the fourth[9] and currently popular type, the thought that the other three compositions would make another three complex formulae implicates the extent and complexity of this region's traditional domestic wood construction practices. The modular prefabrication system enabling fabrication of every member, measurements as well as joinery details was applied through a mathematical procedure supplemented by certain elementary geometric drawings.

Another major criteria that was prevalent in the construction of houses dealt with specific materials available locally and the means of transportation that enabled their delivery on site. Sample H-3 is a very good example which shows the development of regional and local specific characteristics out of material availability. The house is built entirely of materials procured from the coconut palm. Assemblage of rafters in the older fan pattern is fabricated without losing any elegance. The roof cover is from mats knit out of seasoned coconut palm leafs tied on to the roof again with its leaf and fibers extracted from the leaf stem (Refer Picture C.6). Located in an extensive coconut estate on the

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[8] As mentioned in Chapter 2, "Courtyard houses were widely built and lived in originally about 400 years ago when these building speculations were widely applied. Political and cultural changes influenced the dwelling and construction methods in the later stages when *ekashala* became popular. Correspondingly, the mandates of *alpakshethra* concepts became more popular."

[9] refer Figure 4.15.

fringes of a lagoon, this house overlooks the river mouth into the Arabian sea. Nonavailability of other major hard woods and a thorough understanding of the methods of seasoning and structural properties of this local timber enabled such an extensive use of that material. It is also significant to mention that the laterite used for basement in this building was transported from the upper lands by '*vallams*'[10] through the network of rivers and canals serving as communication means, a typical feature common to the coastal belt of Kerala (such a material usage represents *North-South-Low*[11] in general. Occasionally teak, jack, anjili and other hard wood varieties were also used). It is also observed that *South-Up/Mid* zones identified in the survey show the mortarless chiseled granite masonry and well crafted wooden works form the typical characteristic of this particular region. This is purely due to the abundance of these materials, and to the influence of stone architecture from the neighboring states of Tamil Nadu. In the *North-Up/Mid* lands cut laterite and granite were moderately used whereas wood like teak, jack and *anjili* and other rain forest varieties were extensively used (Refer Figure 4.1, Chart 4.1, Chart 4.2, Chart 4.3 and Appendix-).

C.1.b. Practice over theory

It is evident that a strict adherence to the principles of perimeter computation resulted actually from its absolute necessity from a practical aspect, namely to ensure an accurate assembly of the roof frame. So also, the dimensions of the *ara-nira* were computed to fit with the perimeter dimensions. The important point that comes to the fore here is regarding the nature of theory: that theoretical principles (in this case the *Thatchushasthram* in Kerala) were always 'a posteriori,' that is to say, they followed the contingencies of practice. From this light, the notion of the development of theory of traditional domestic architecture in Kerala takes a different turn. *Vedic* planning principles and treatises were introduced in Kerala following the Aryanization of the region. The treatises were reinterpreted and rewritten through a process of adaptation to

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[10] large local wooden boats used for transporting goods.

[11] refer Figure 4.1 for geographical zones identified to have influenced the material usage in house building practices in Travancore.

the already existing customs and practices of construction in Kerala. As Arnold Pacey notes,

> "sometimes 'responsive inventions' are like a dialogue or dialectic in which recipients of a new body of knowledge and technique 'interrogate' it on the basis of their own experience and knowledge of local conditions. In these instances the initial 'transfer of technology' itself is only the first stage in a larger process."[12]

Such an argument can be further supported by another example: Elsewhere in India, the kitchen and the hearth were to be located in the North-West corner, as per the principles. In Kerala, the treatise *Manushyalayachandrika* stipulates the kitchen and hearth to be located in the North-East corner. This must have followed from an observation of the already existing practice of placing the kitchen in the North-East, which in turn was in response to the local climatic conditions of the monsoons and the prevailing wind directions. The development and canonization of a theory for house construction specific to the Kerala context, even while having its roots in the ancient *Vedic* treatises, occurred only as a contiguous process along with or even following the classical refinement in the building craft and construction in the period from 14th-15th centuries. *Manushyalayachandrika*, the treatise on traditional house building in Kerala was written around this time. In the formulation of the theory, the already existing practices had to be accounted for. The principles of *yoni* and perimeter computation, unique to Kerala because of its wood construction, thus were assimilated into the body of the treatise in its refinement following centuries of practice. All these were rendered an unquestionable authority by their canonization based on the tenets of the Hindu religion and also astrological principles. Deviations from the theoretical principles were quite frequent in later house construction except for those of the Brahmins as mentioned earlier. The houses of other casts and of Christians and Muslims exemplify this. The iconography and decorative patterns of Christian houses particularly illustrate this point. The peacock icon on the locks of the *ara* in house of a Syrian Christian house in Pulinkunnu and that seen in Sample H-16 at Moncompu form good examples for this (Refer Picture 3.43 and Picture 3.44). Similarly it is noticed that Syrian Christians in Kerala built houses using

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[12] Arnold Pacey, Technology in World Civilization, A Thousand-Year History (Massachusetts: The MIT Press Cambridge, 1990), viii.

the same techniques of wooden construction incorporating the same components while having their own religious icons such as the crucifix, grape wines or Roman dates to be inscribed on them (Refer Picture C.1 and Picture C.2). However the basic domestic building practices adopted were more or less the same (Refer Picture 4.1 to Picture 4.12), regardless of caste, class or religion applied to this region during the period of time mentioned (Refer Picture 3.38 depicting *chithrapootu* in a Nair Hindu house and Picture 3.39 to that in a Syrian Christian house, Sample C-5). Also noteworthy is the difference in the spatial organization arrangement in Christian and Muslim houses, resulting from the difference in customs and practices of these religions from those of Hinduism. These differences in detail as well as spatial organization occurred even while following the general principles of perimeter computation and that of *ara* dimensions.

C.2. Evolution of domestic architecture in Kerala: the larger picture

This thesis examined the domestic architecture during the classical Hindu period of Kerala architecture, which extended to the first quarter of the century. The conclusions drawn from the study points to the importance of the socio-cultural milieu that existed in Kerala prior to Aryanization, and the cross-cultural and technological transactions that occurred between Kerala and other regions at the time and then influence on its domestic architecture. Only a study that locates within such a broad context can accurately trace the factors that influenced the course of domestic architecture history, over the years in Kerala. Numerous scholars have studied the similarities observed in crafts and techniques pertaining not only to house building but also agricultural implements, boat building and so on in various regions in Asia, and have proposed theories on the transactions and movements that might have occurred between these regions. Arnold Pacey identifies a wet-rice culture common to South China, Southeast Asia and South India, and argues in favor of a cross-migration of technology between these. What played a major role was the craft developed here centered on the --wet rice culture and tree crops. The Arab and Chinese seamen trading between the Persian Gulf to the Malay peninsula, Indonesia and South China were the carriers of such transactions, since the

coast of Kerala forms a strategic transit point in voyages that took place in the Indian Ocean (Refer Figure 1.2 and Figure 1.3 for maps explaining these sea routes).

Pacey points to the craft of boat building by sewing planks together by means of coir ropes passed through holes bored in them, which were later sealed with putty, that is common in all wet-rice cultures in South India, South China and Southeast Asia, to strengthen his argument.[13] Water wheels were another feature found identical in these regions. The mechanisms and tools used in irrigation activities such as water-raising devices in South India, Southeast Asia and South China were closely related (Refer Appendix C.3 [14] and Appendix C.4 [15] for tables comparing the different types of *norias* or water wheels). The typical water wheels commonly found throughout Kerala points to such transactions, not only in agricultural technology but also in carpentry expertise. The documentation studies of wood framework of traditional dwellings prevailing in various parts of Southeast Asia by Yoshihito Katsuse, when compared to that existing in Kerala, further strengthens this theory (Refer Appendix C.1.1, Appendix C.1.2 and Appendix C.1.3 for those documented construction practices in Southeast Asia).[16] Refer Appendix C.2.1 and Appendix C.2.2 for few examples of the traditional Japanese scrolls detailing the wooden joinery. Many of the joinery details resembles that existed in Kerala. Apart from conditions relating to climate, soil and ecology, the events of large scale migration of people from the coast of Kerala to Southeast Asian regions and back[17] explains this phenomenon of technological cross-transfer. George Coedés points to the Austro-Asiatic civilization which existed in Kerala before first Dravidianization and then Aryanization. According to Coedés, this civilization extended from southern India to the Malay Peninsula and the islands of the pacific. One hypothesis is that, the Dravidians and the Aryans in succession, entering India from the northwest, pushed the aboriginal

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[13] Arnold Pacey refers strongly to this argument in the first chapter 'An age of Asian technology, AD 700-1100 in "Technology in World Civilization."

[14] Ibid, 1-20.

[15] Bruno Jacomy, Une histoire des techniques (Paris: Éditions du Seuil, 1990), 126.

[16] Yoshihito Katsuse, The Wood Framework of Traditional Dwellings in Southeast Asia, "Traditional Construction Practices," Traditional Dwellings and Settlements-Working Paper Series, Vol. 1 to 55, (Berkeley: University of California, 1988, 1990 and 1992), 27-51.

[17] Pacey, Technology in World Civilization, 13.

populations into eastern and southern India; these people migrated to Southeast Asia, where they brought about a sort of pre-Aryan Indianization. The Indonesian peoples were those who left the continent to populate the islands during the second Bronze Age [in Europe].[18] It can be presumed that, following the Dravidian occupation of South India, Arabian and Chinese traders in their trade transactions with Kerala and South-East Asia continued the process of technology transfer. Jain and Buddhist influences that originated from North India reached Kerala through the sea only after spreading in China and South-East Asia over land. Aryanization started in the predominantly Buddhist Kerala around third century AD and was a slow process. Hinduism took full hold of the society and started flourishing only after its revival during 8th century. By the time Europeans first entered here during late 14th century, the Brahmins had already established the feudal phase of Aryanization after the eradication of once prevalent Buddhist and Jain cultures. Following these developments, the history of domestic architecture in Kerala could be seen as passing through distinctive phases: The 'rudimentary' phase which, must have been "primitive," resembling the structures of the hill tribes of Kerala today. The earlier circular forms of *garbhagriha* of Kerala temples are presumed to originate from the forms of mud walls of tribal huts.[19] This was followed by a 'folk' period characterized by attempts to make permanent dwellings using more durable and locally available materials such as wood, and adapting to climatic conditions. The development of the 'folk-vernacular' culminated in the cult of Jains followed by that of the Buddhists when the architecture attained a certain 'classical' refinement between 4th and 7th century AD. This further underwent changes with the advent of Islam and Christianity, followed by the domination of Vedic Hinduism over the earlier religious cultures which started around 7th century AD. The genealogy of architectural 'tradition' was consistent throughout the religious and societal transformations through succeeding vernaculars, one improving over the other and at times achieving 'classical' refinements. The last of such a refinement occurred during the interval from the 14th to the 17th centuries when the

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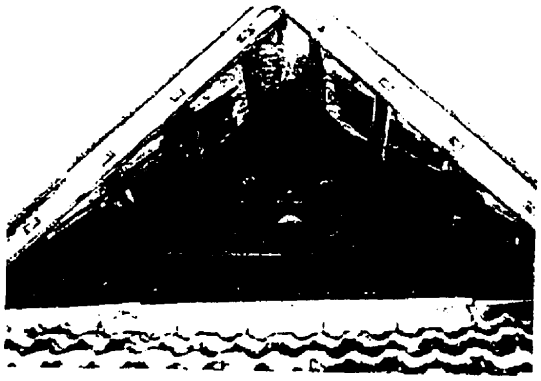
[18] George Coedés describes about the early migrations that have taken placed in prehistory from India to the Southeast Asian regions in "The Indianized States of Southeast Asia."

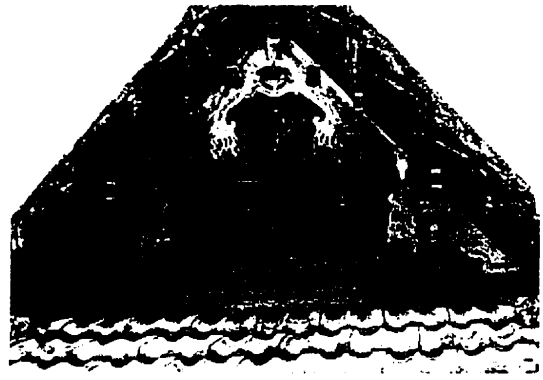
[19] N.V. Mallayya, "Nagara, Dravida and Veshara," Journal of the Indian Society of Oriental Art, Vol. 9, (Calcutta: 1941), 81-96.

treatises *Manushyalayachandrika*, *Mayamatha*, *Thantrasamuchaya* and *Shilparathna* were (re)written; and was sustained through the following years until the turn of the 20th century.

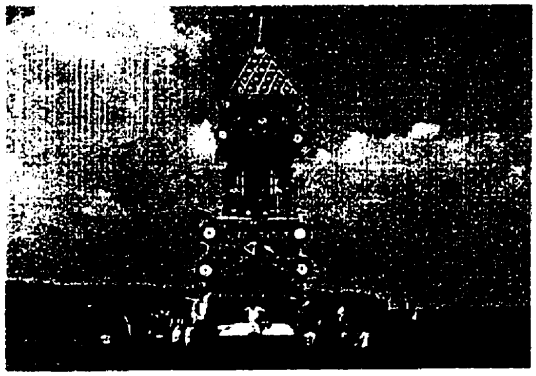
This brief and sketchy outline of the history of construction practices, and of domestic architecture of Kerala in general, takes a broader outlook in conceiving Kerala as a part in a larger network of socio-cultural, religious and technological transactions that existed in space and time from the early civilizations. To dispel the shroud of ambiguity that surrounds the domestic architectural history of Kerala, a pioneering study in this direction needs to be undertaken.



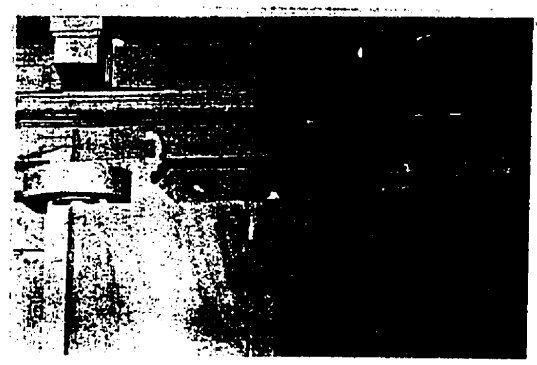
Picture C.1: *A gable end found on a Syrian Christian house depicting a cross symbol.*



Picture C.2: *A decorated gable typical of Hindu houses.*

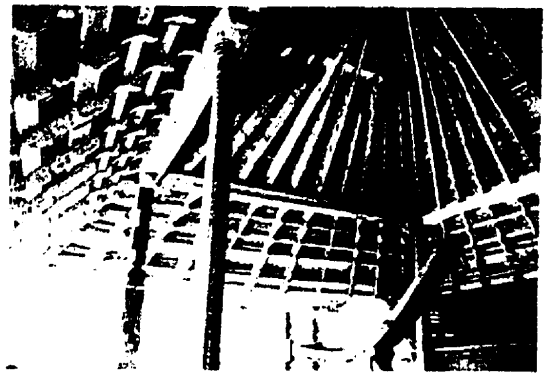


Picture C.3: *'Kettukazhcha' at Aranmula is reminiscent of Buddhist origin.*



Picture C.4: *This pivoting detail of door hinges were of Chinese origin.*

Picture C.5: *This Syrian Christian house entrance resembles Japanese 'thoras'.*



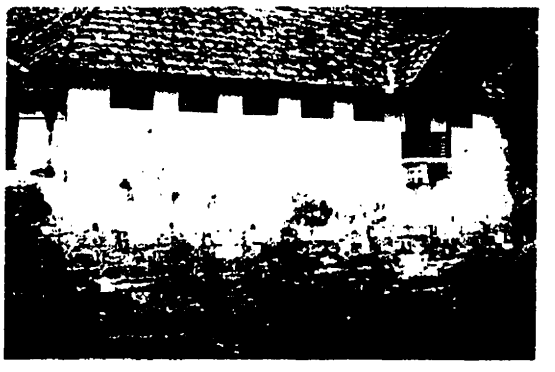
Picture C.6: *Coconut palm rafters and thatched roof of an Ezhava house.*

Picture C.7: *The pervading palace campus next to Padmanabhaswami Temple.*

Picture C.8: *A court yard inside Ammachi Veedu, Sample H-4.*

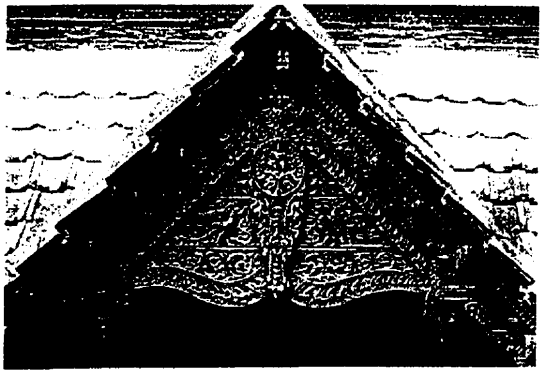
Picture C.9: *Padmanabhaswami Temple and the urban concert staged around.*

Picture C.10: *Grand entrance to Padmanabhapuram palace complex.*



Picture C.11: *Granite masonry typical of southern Travancore.*

Picture C.12: *An array of gables and screens showing versatility in wooden craft.*

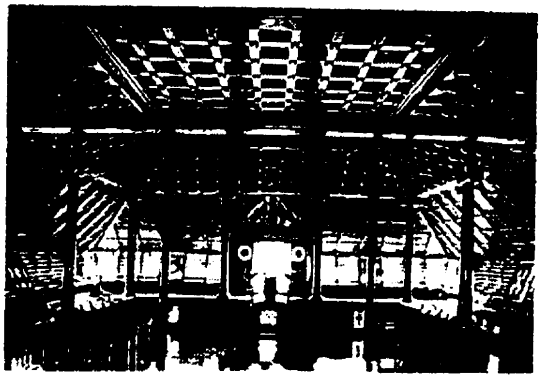


Picture C.13: *A detail of the gable, Padmanabhapuram palace.*

Picture C.14: *A part of Padmanabhapuram palace showing influence of Colonial style.*

Picture C.15: *Detail showing lime washed walls, granite pillars and wooden palisade.*

Picture C.16: *Cool interiors and bright exteriors.*



Picture C.17: *Absolute in wooden luxury, Padmanabhapuram palace.*

Epilogue

With reference to the research question framed at the beginning of the thesis, having completed the study, I am better poised to take a stance regarding the issue. Did Kerala's construction practices derive from the *Vedic* theories of the *Vasthushasthra* or develop from indigenous craft practices? I would contend that it is not an either-or situation: both played crucial roles in traditional domestic construction. From a 20th century perspective, at first sight it might seem that the houses were built following strictly the principles of *Vasthushasthra.* Only a deeper investigation reveals the "play" involved, that came with the architect-craftsman's innovative interpretations of the principles, incorporating his craft skills and know-how which were part of oral traditions that existed much before. The identification of these two layers to be present simultaneously in the houses makes it possible to acknowledge the authority of the principles without depriving the recognition due to the craftsmen. In other words, theory when strictly followed becomes instrumental, a mere "how to." Only when the craftsmen applies his creative imagination to re-interpret the principles in the process of making, will the architecture come alive and be meaningful. Nowhere is this more evident perhaps, than in the traditional dwellings of Kerala.

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List of Appendices

Appendix 3.1.

Descriptions of qualities and duties of the craftsmen according to *Mayamatha*

Mayamatha describes the qualities and duties of the craftsmen as follows:
The *sthapathi* [architect] is from a renowned land and he is of mixed caste; a man of quality, he must know how to establish buildings and must be well versed in all the sciences; he must be physically perfect, just, compassionate, disinterested, free from envy, without weakness, handsome and learned in mathematics; must know the ancient authors and must be straight forward and master of his senses; must be able to draw and know the whole country; must be generous and not greedy; his health must be good, must be attentive and free of the seven vices, possessor of a well chosen name; he must have crossed the ocean of the science of architecture.
The *suthragrahin* [measurer] is the disciple or the son of the architect and follows his directions; he is skillful in all the arts; he knows how to make the rod and the rope fly and how to measure length, height and proportions.
The *thakshaka* [joiner] is so named because he cuts the stone, wood, bricks....etc. into small or large pieces.
Versed in masonry, virtuous, capable and cognizant of his trade, he who assembles and correctly erects the pieces cut by the *thakshaka* is the *vardhaki* [carpenter/mason]; it is said that he always works under orders from the *suthragrahin*.

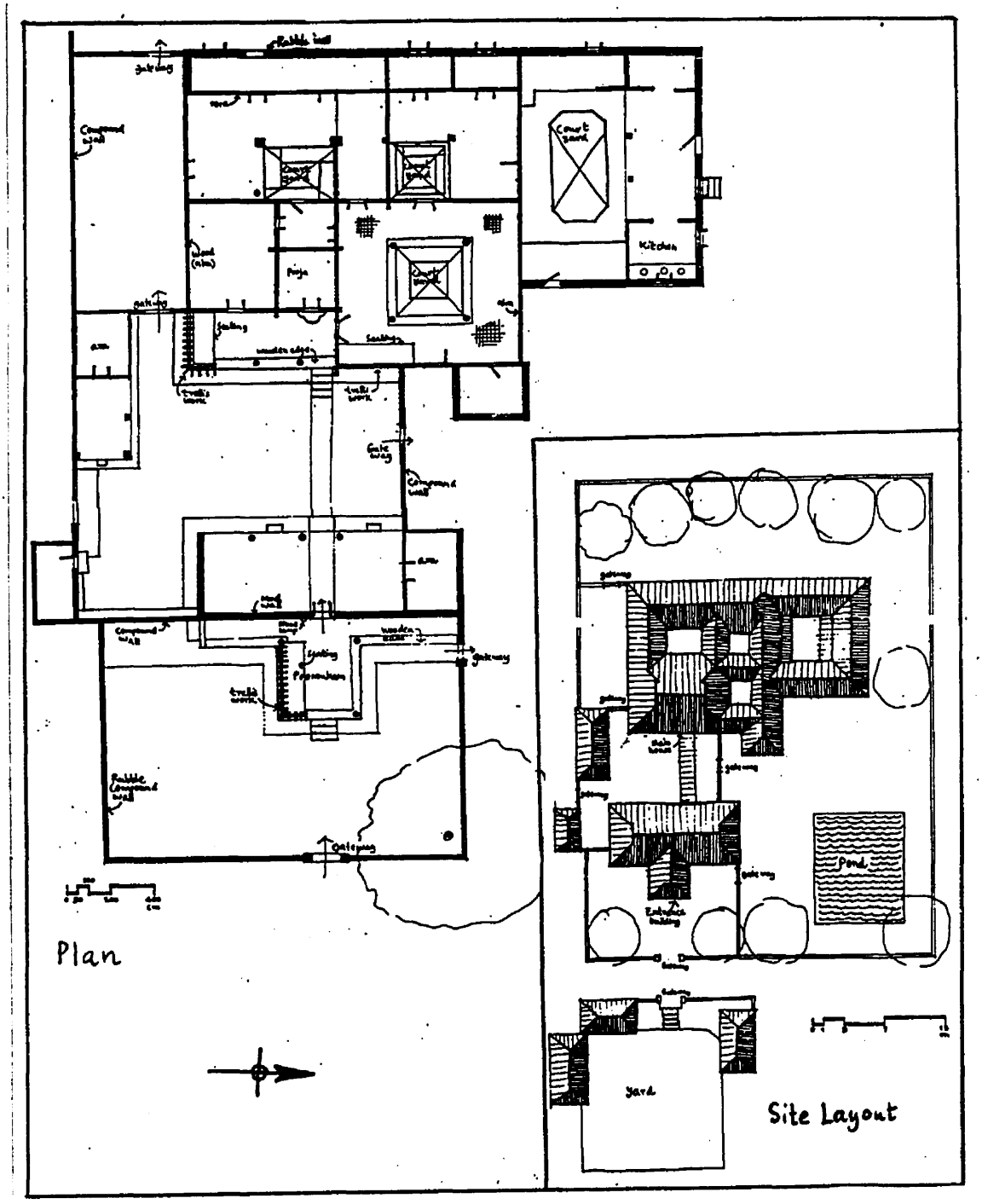
Appendix 3.2.

Types and properties of timber available in Kerala

common, local name	botanical name	color	use	density gm/dm^3
Teak-thek	(tectona grandis)	yellowish brown	carvings, all purpose bldg.	
Rosewood-iitti	(dalbergia lalifolia)	reddish black	furniture	700
Anjili-aini	(artocarpus hirsutus)	yellowish	doors, windows, roof	800
Jack-plavu	(artocarpus integrifolia)	yellowish	sculptures, all purpose	600
Mahogany	(swietenia mahogany)	light red	furniture	-
Dhaman-unnam	(grewia tiliaefolia)	deep brown	furnitire, tools	750
Arjun-nirmaruthu	(terminalia arjuna)	off white	-	900
Hopea-pongu	(hopea parviflora)	deep brown	-	900
Benteak-ven thek	(lagerstromia microcarpa)	reddish brown	ceiling planks	650
Cadam-kadambu	(anthocephalus cadamba)	yellowish white	planks	600
Ebony-karimaram	(diospyros ebenum)black		-	1100
White cedar-vella akil	(dysoxylum malabaricum)	yellowish brown	-	720
Red cedar-chuvanna akil	(toona ciliata)	light red	furniture, door panels	500
Kumbil-kumizhu	(melina arborea)	off white	good for polished work	500
Coconut tree-thengu	(cocos nucifera)	off white, red	furniture, rafters, posts	-
Pamyra-karimpana	(borassus flabellifer)	deep brown	rafters, beams, posts	-

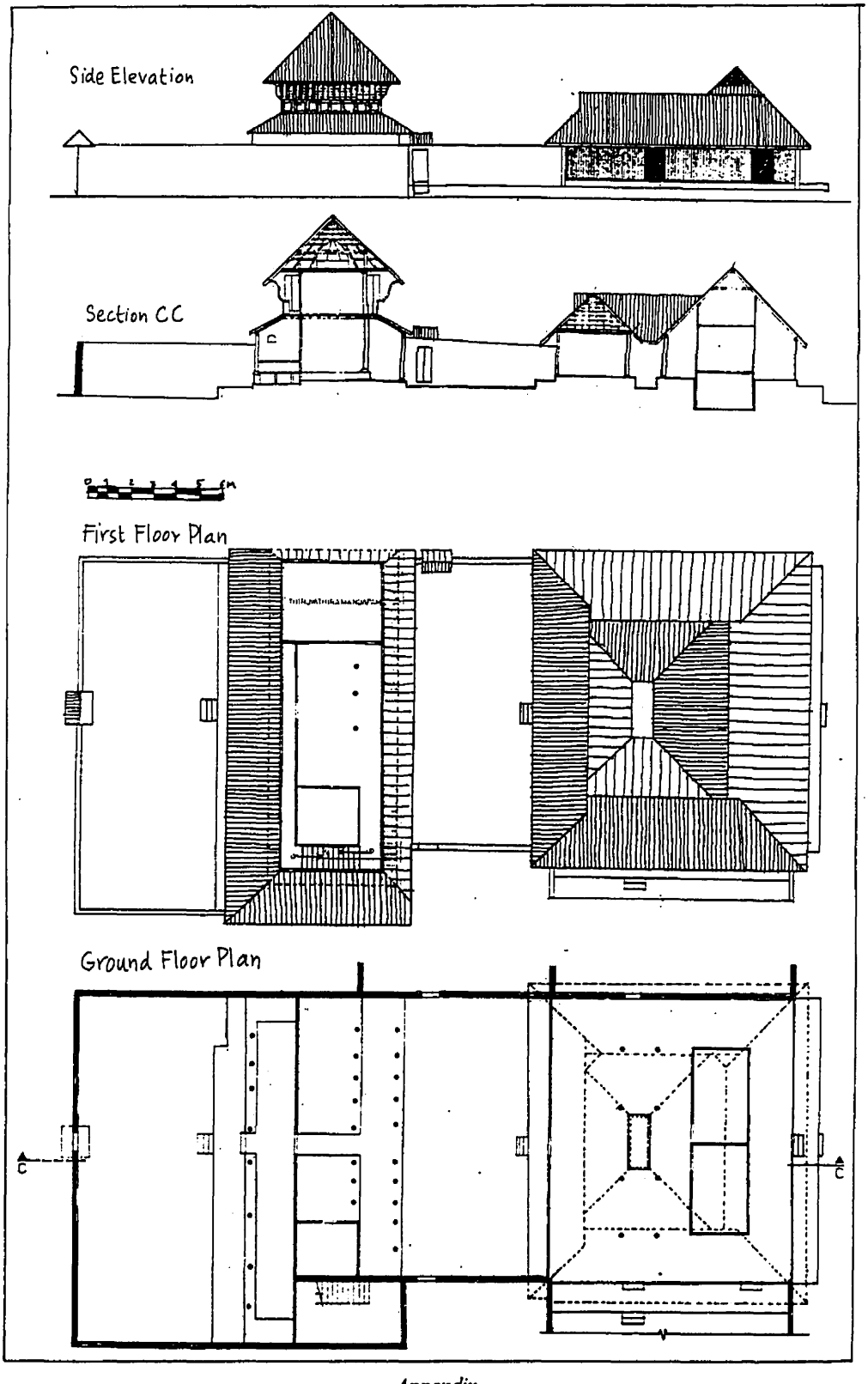
Appendix 4.1

House Sample - H-1 House Name - *Valiya veedu* Location -Talakulam, Kalkulam



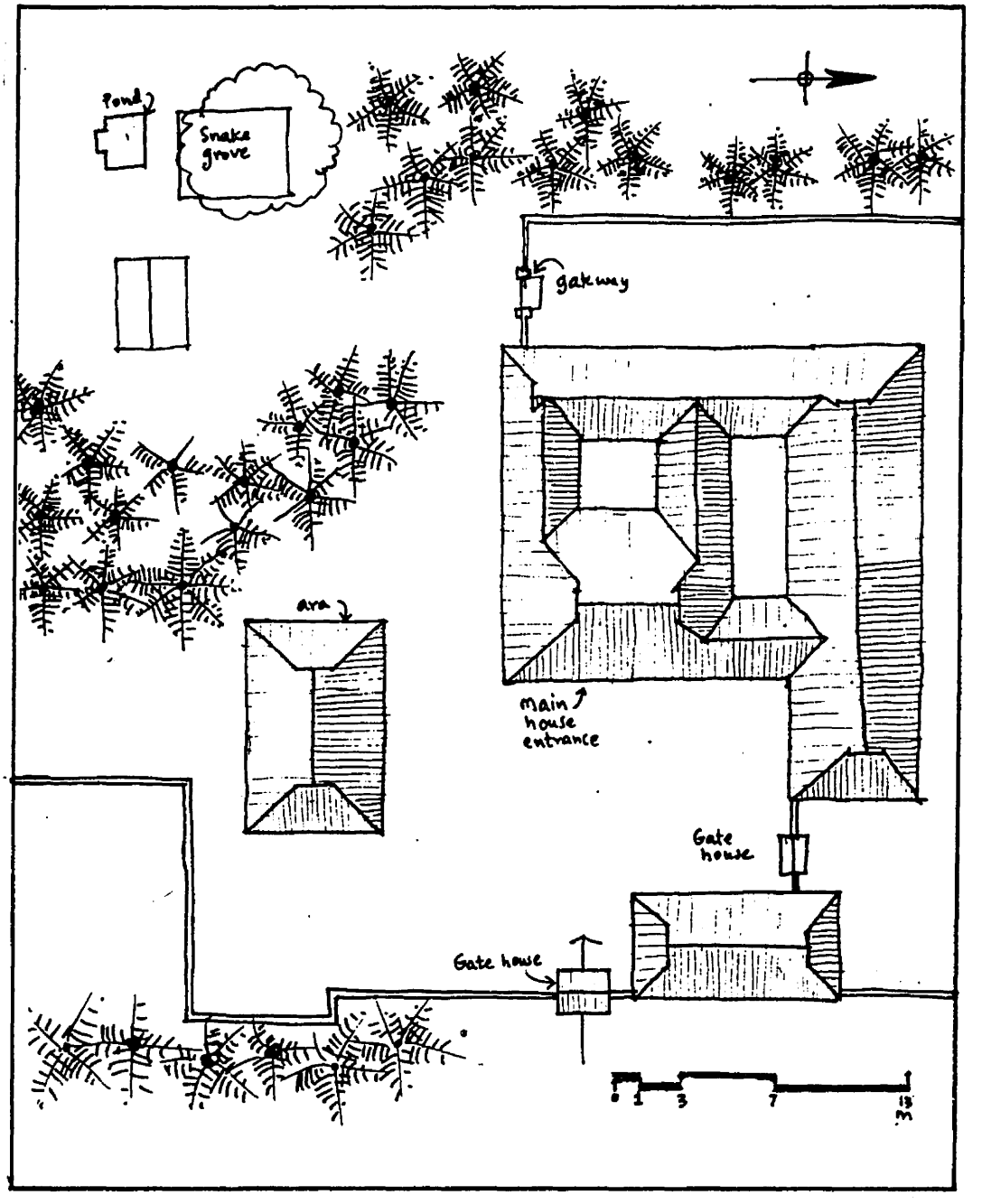
Appendix 4.2

House Sample - H-2 House Name - *Kalpazha madom* Location - Choozhal, Parashala



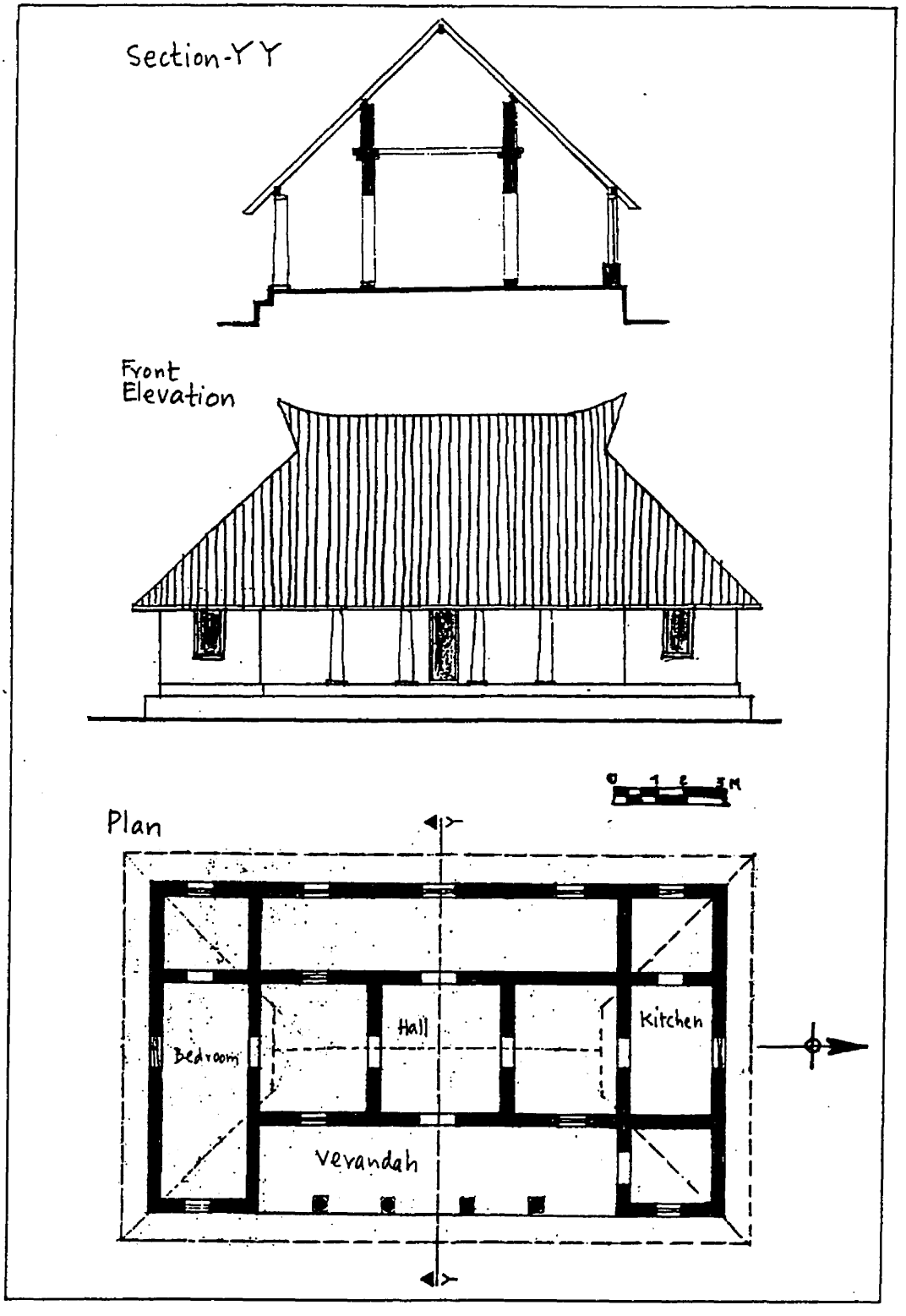
Appendix 4.3

House Sample - H-3 House Name - *Narakathara veedu* Location - Edayar, Thiruvallom



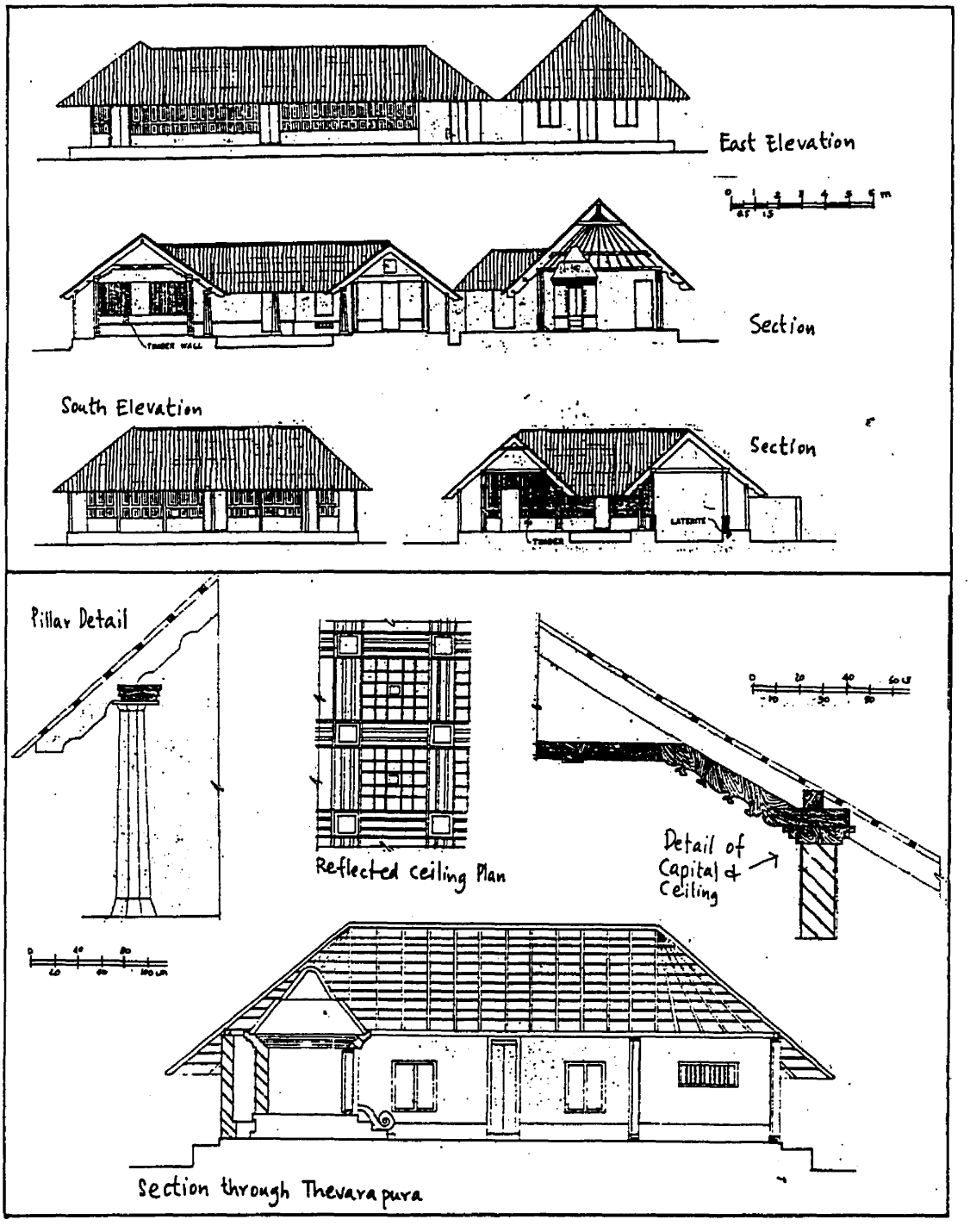
Appendix 4.4

House Sample -H-5 House Name -*Mangalavil veedu* Location - Ulloor, Thiruvananthapuram



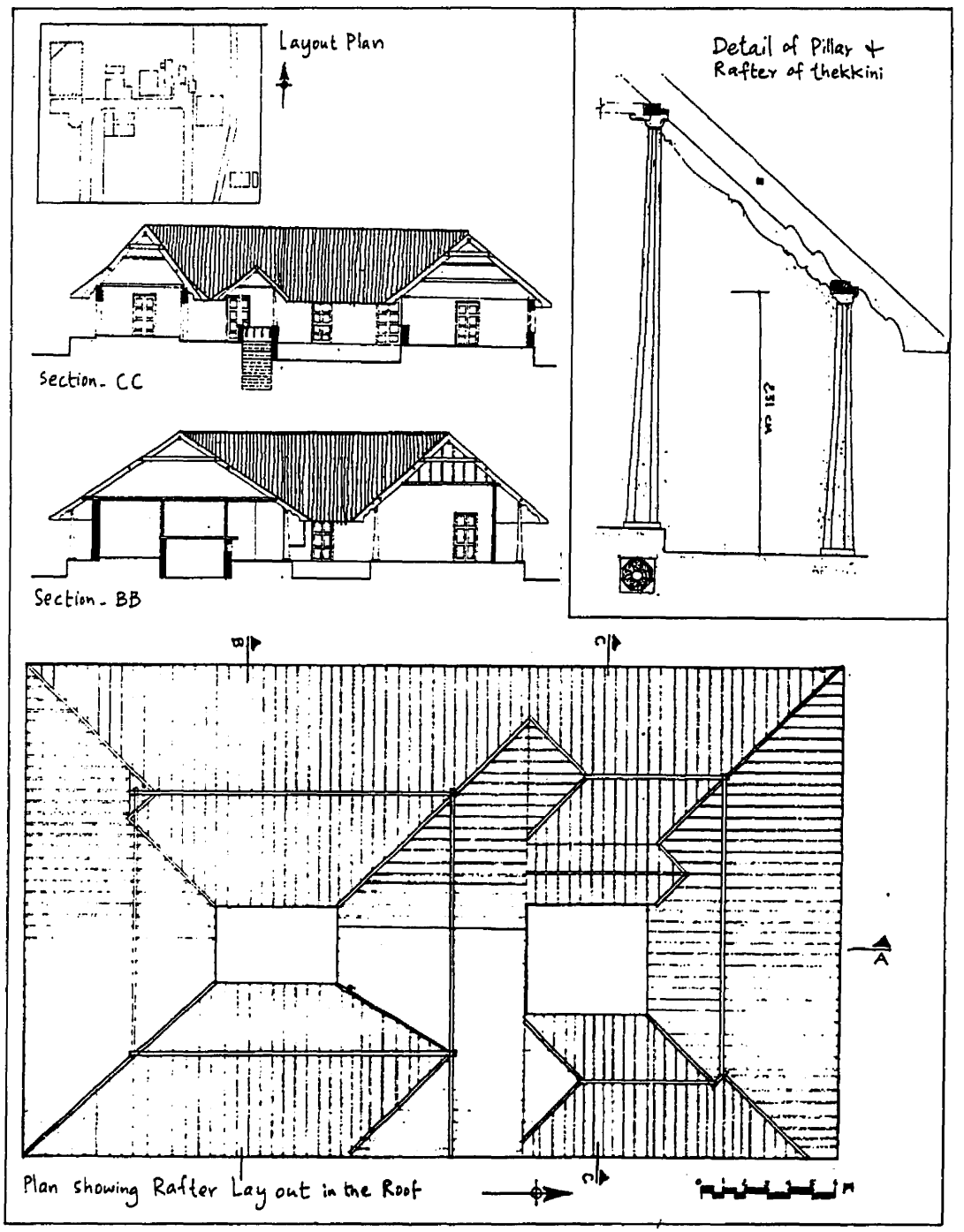
Appendix 4.5

House Sample - H-8	House Name - *Vadakke kottaram*	Location - Panthalam



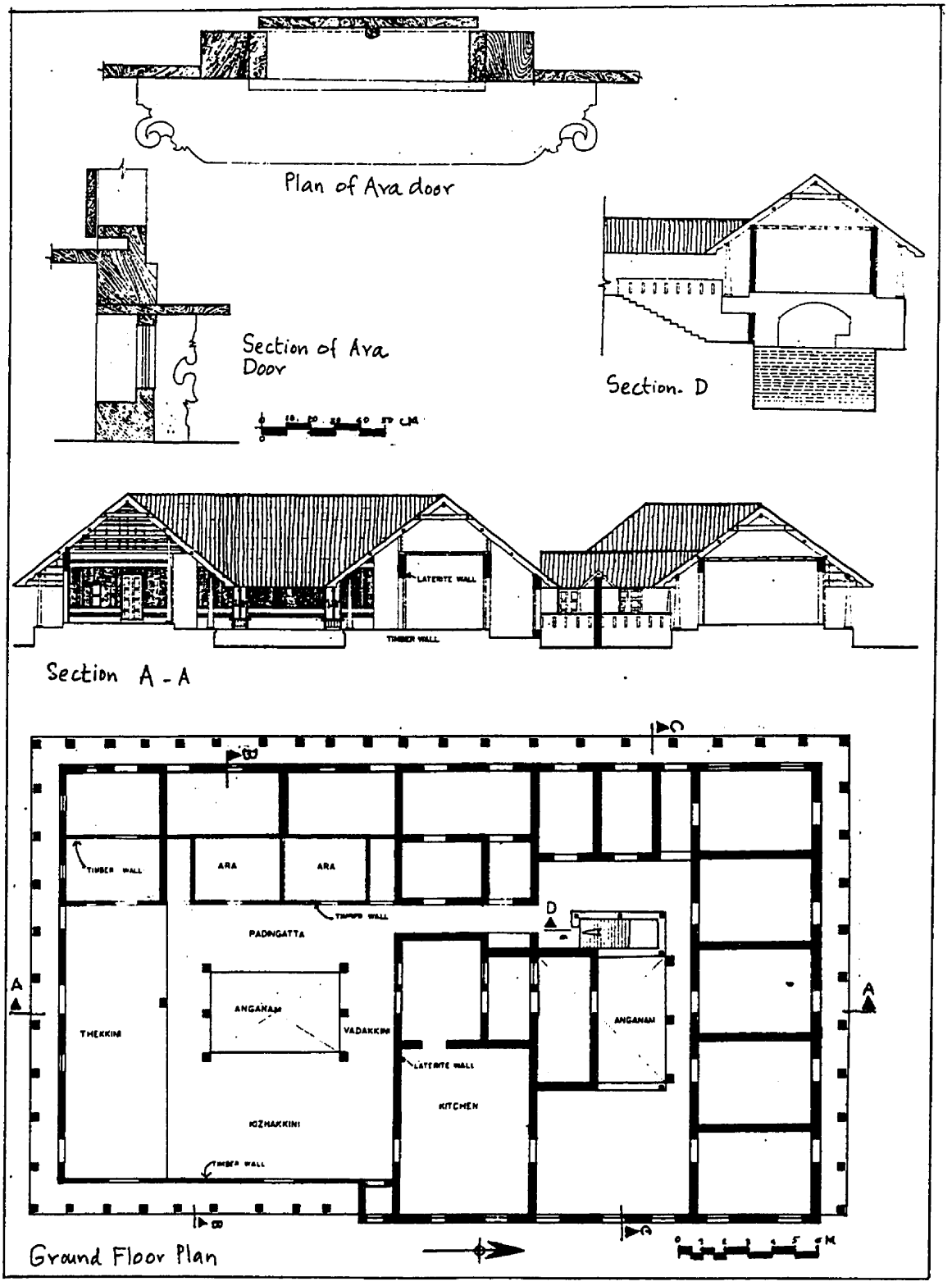
Appendix 4.7.1

House Sample - H-10	House Name *Puthenkoikkal kottaram*	Location - Panthalam



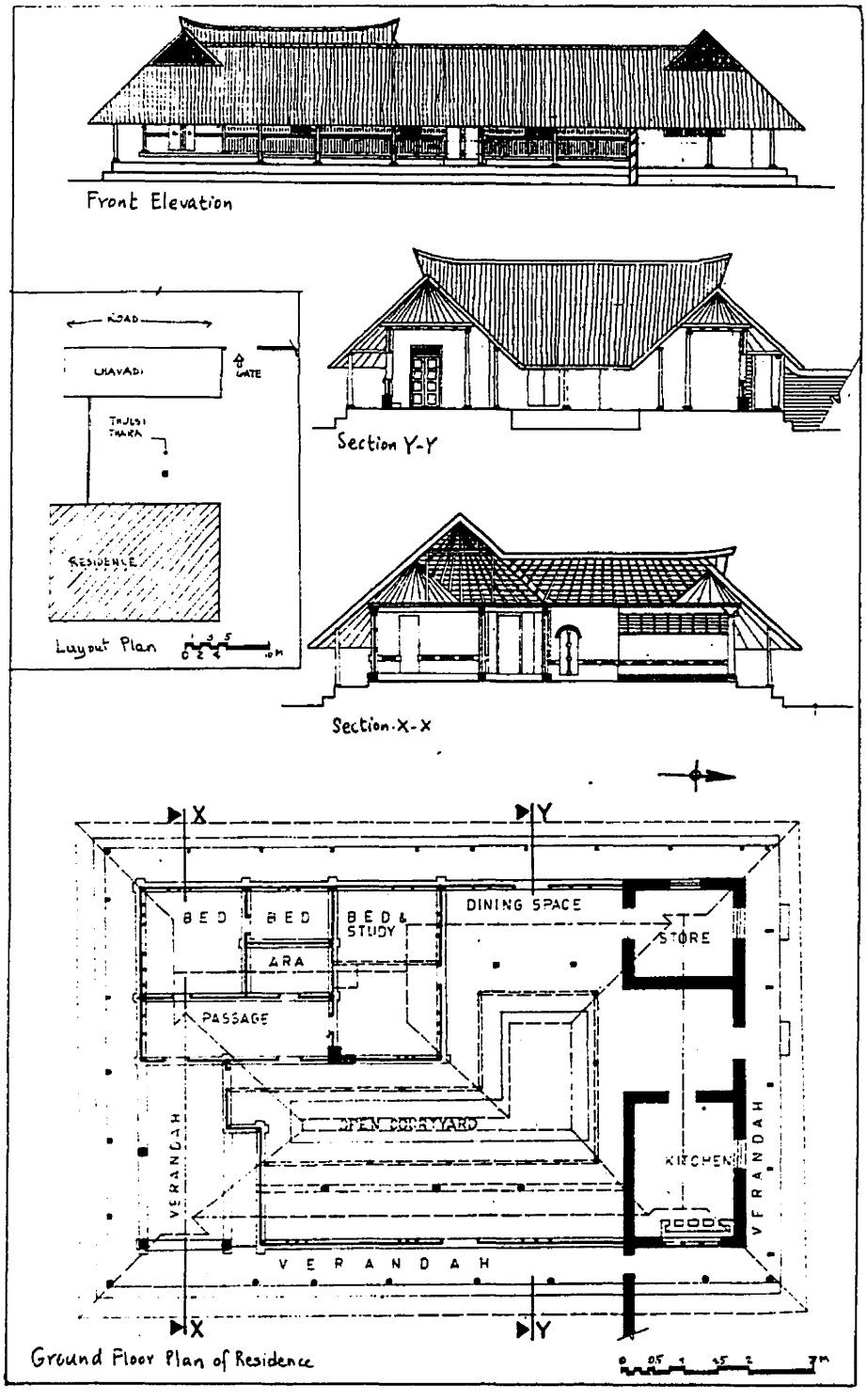
Appendix 4.7.2

House Sample - H-10	House Name *Puthenkoikkal kottaram*	Location - Panthalam



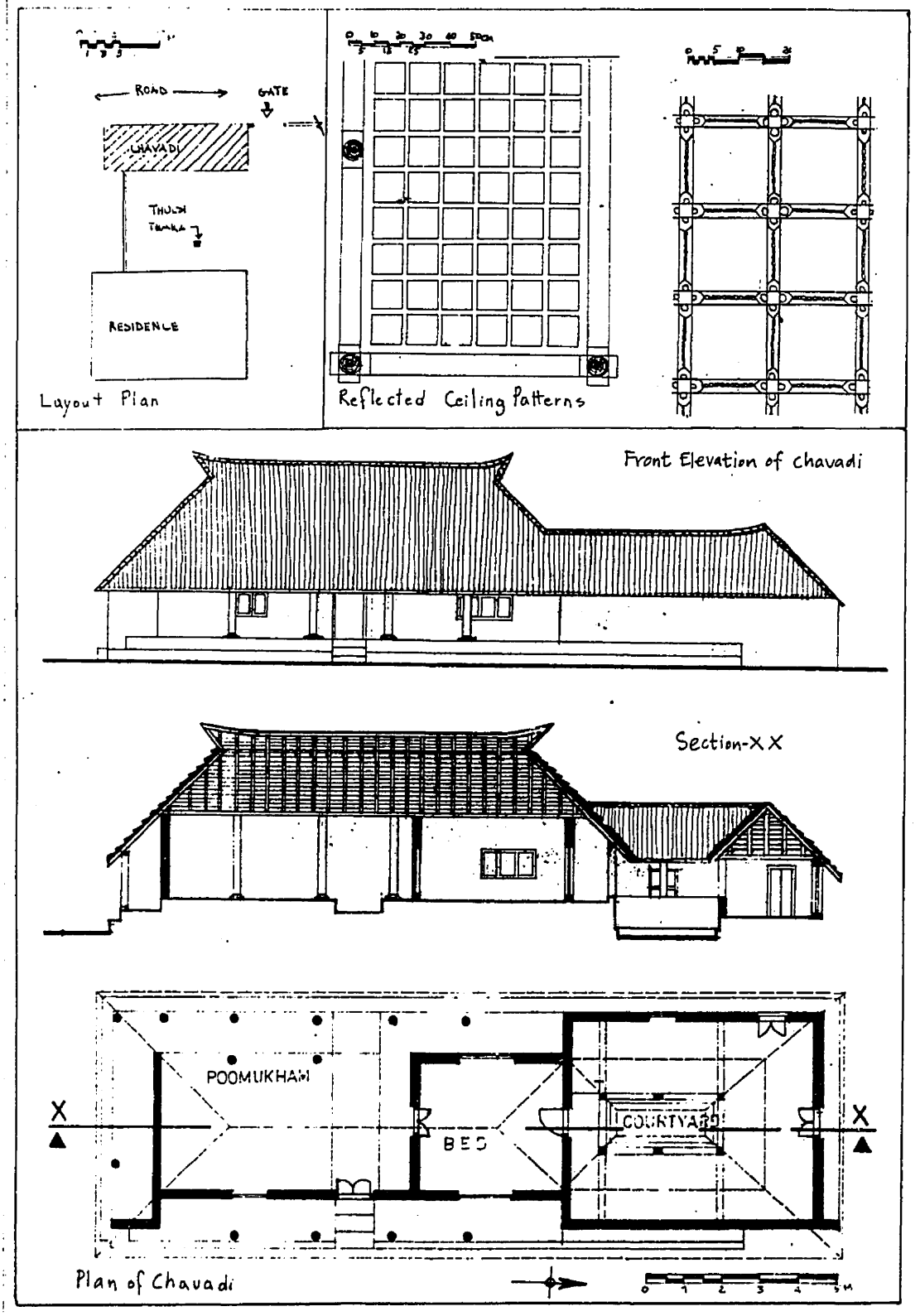
Appendix 4.8.1

House Sample - H-11	House Name *Vadakkottu veedu*	Location - Chavadi, Kollam



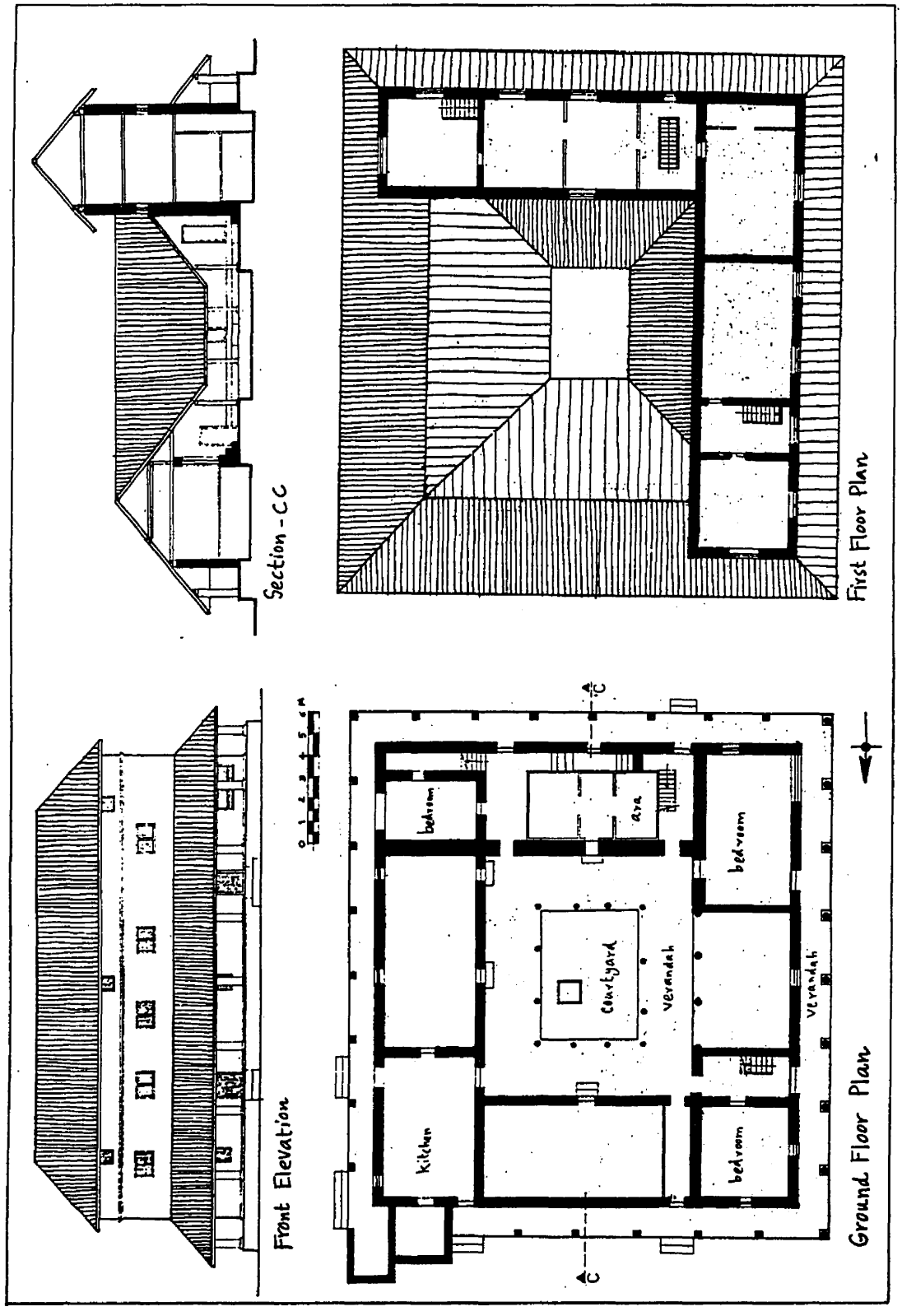
Appendix 4.8.2

House Sample - H-11 House Name *Vadakkottu veedu* Location - Chavadi, Kollam



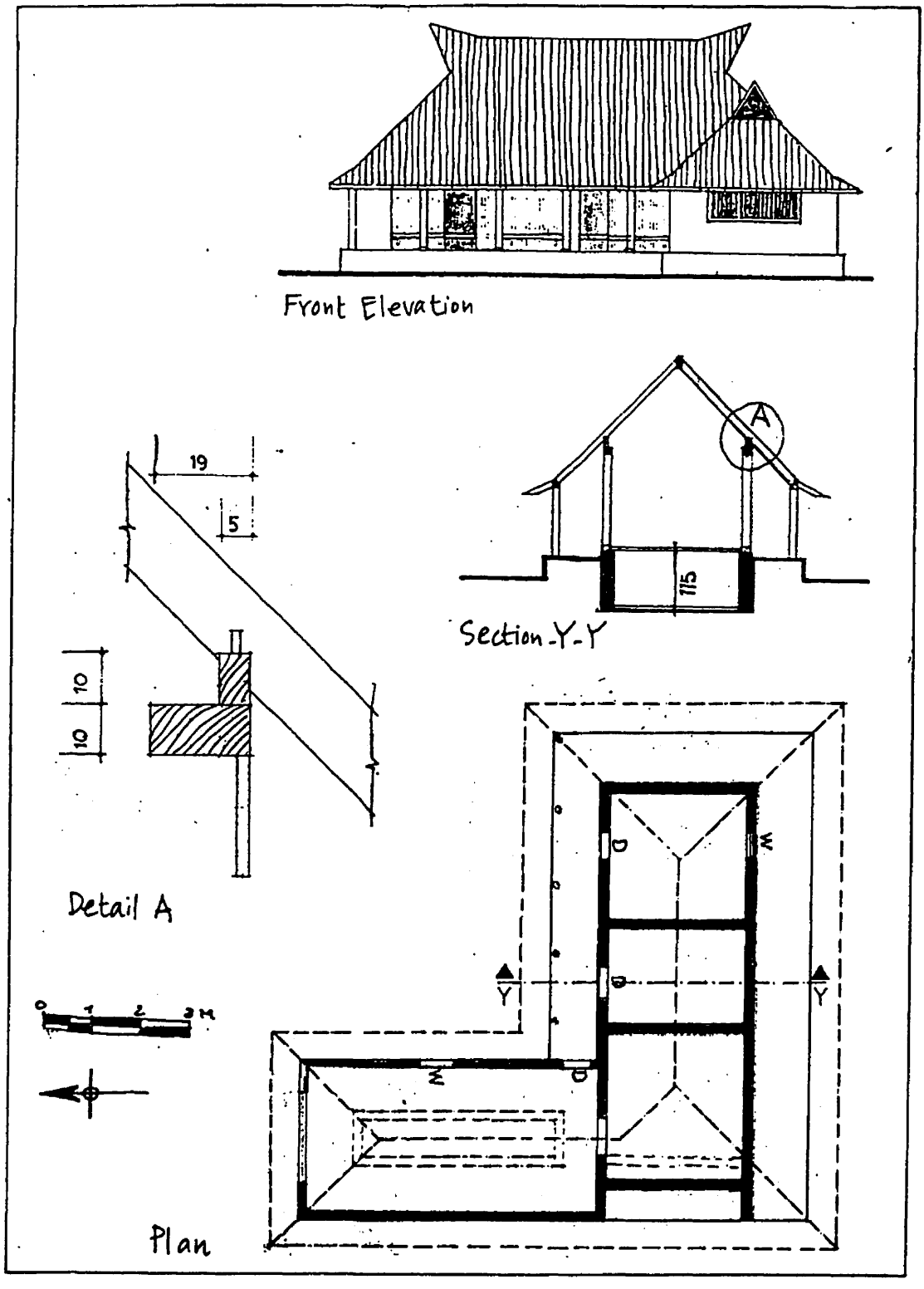
Appendix 4.9

House - Sample H-12 House Name - *Padinjaredath mana* Location - Cherpu



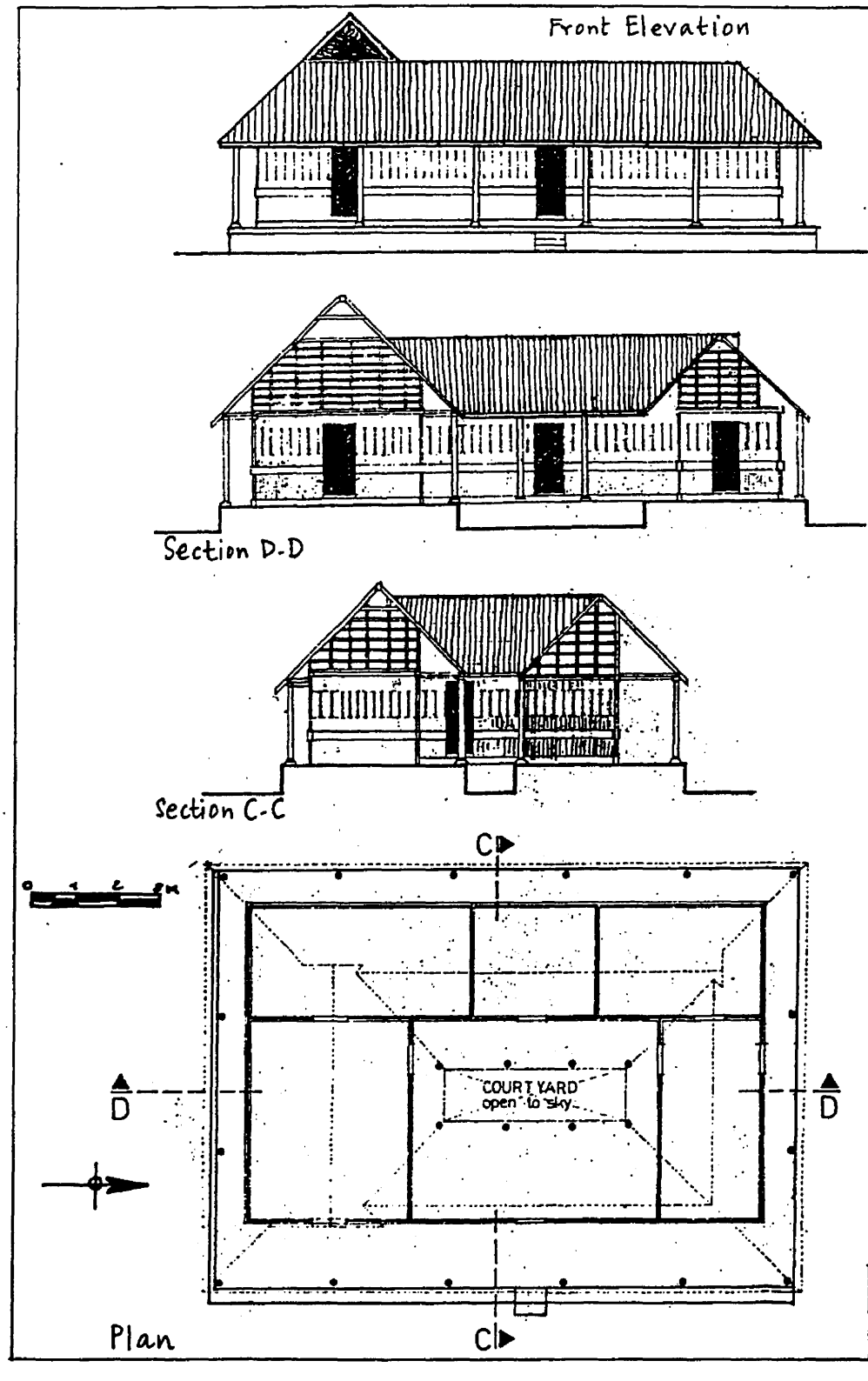
Appendix 4.10

House Sample - H-13	House Name - *Umbakkattu veedu*	Location - Vaikkom



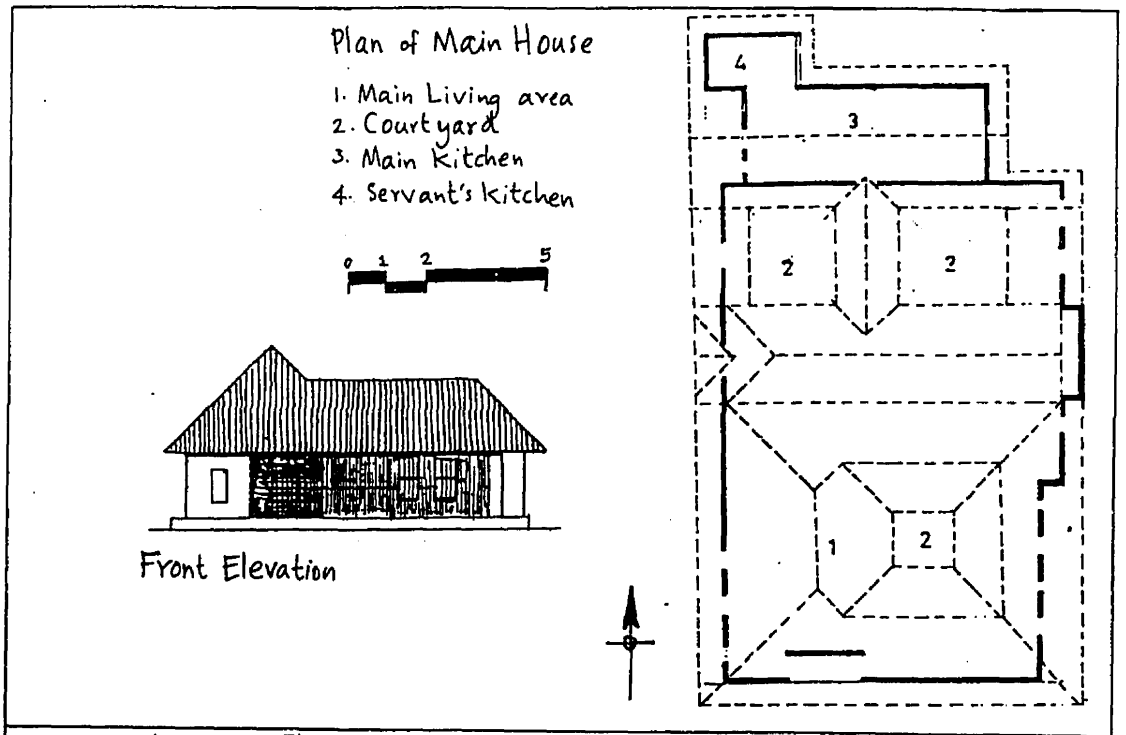
Appendix 4.11

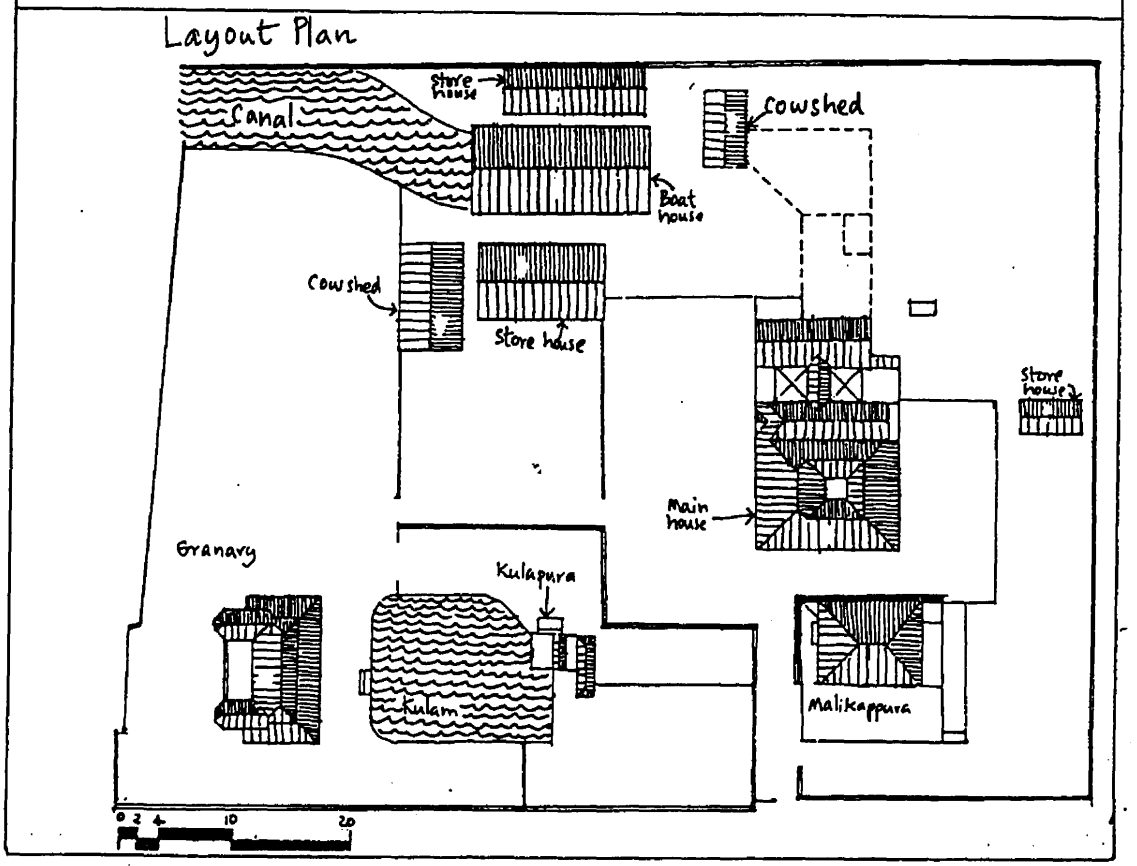
House Sample - H-14	House Name - *Mantra madom*	Location - Ambalapuzha



Appendix 4.12

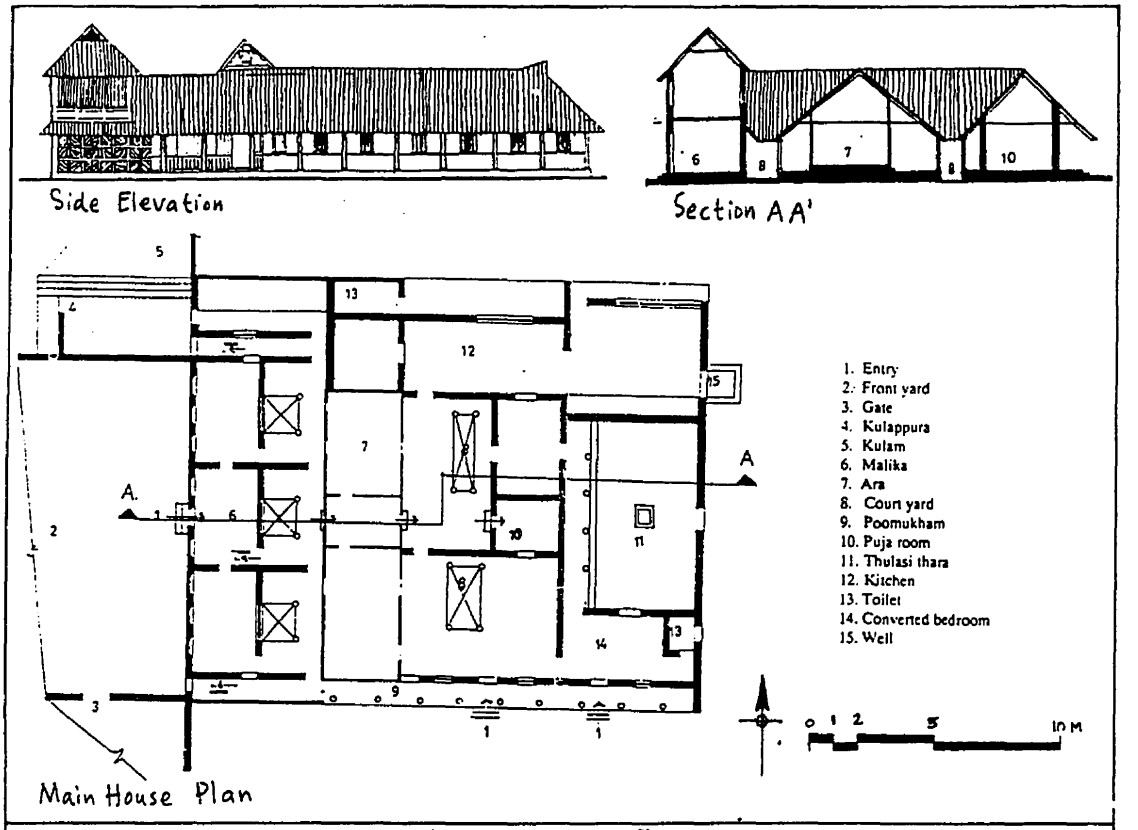
House Sample - H-15 House Name - *Kottaram veedu* Location - Moncompu, Kuttanad

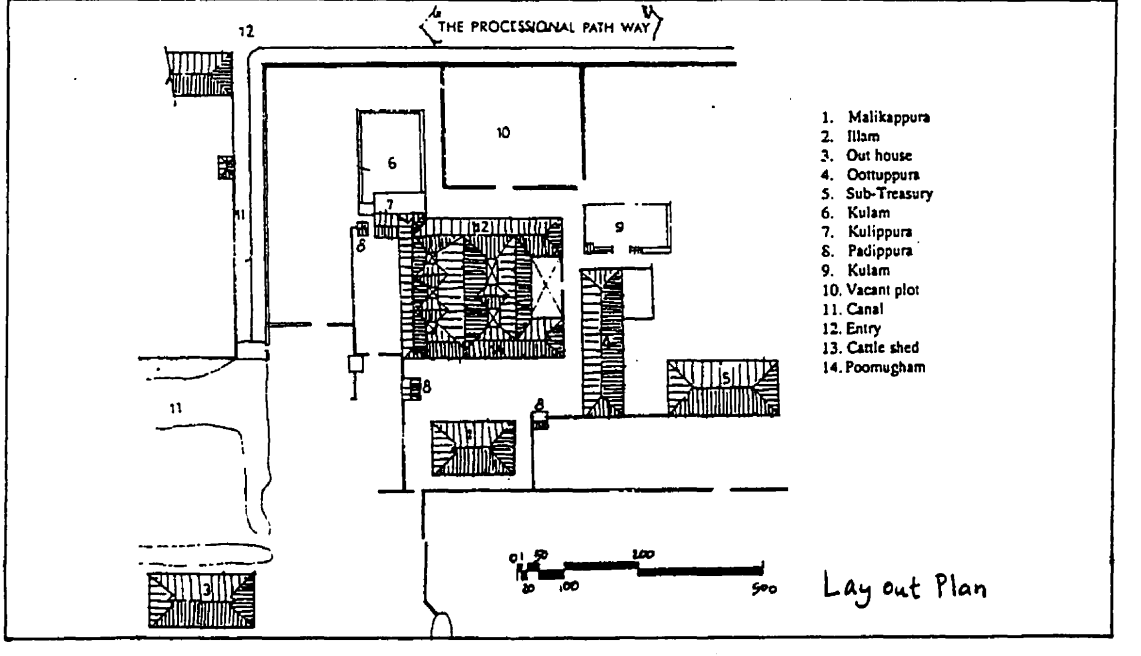




Appendix 4.13

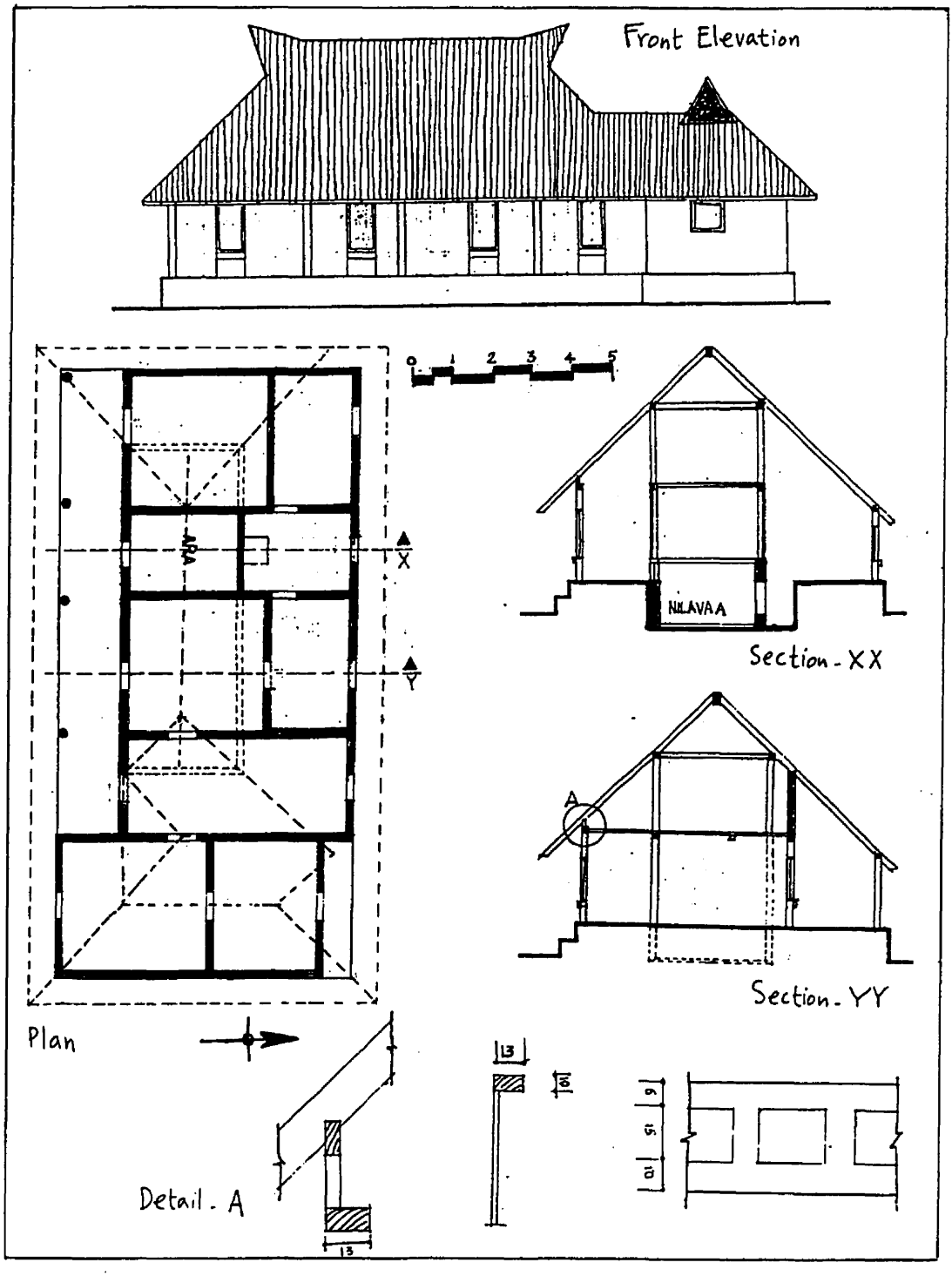
House Sample - H-16 House Name - *Kullangara illom* Location - Moncompu, Kuttanad





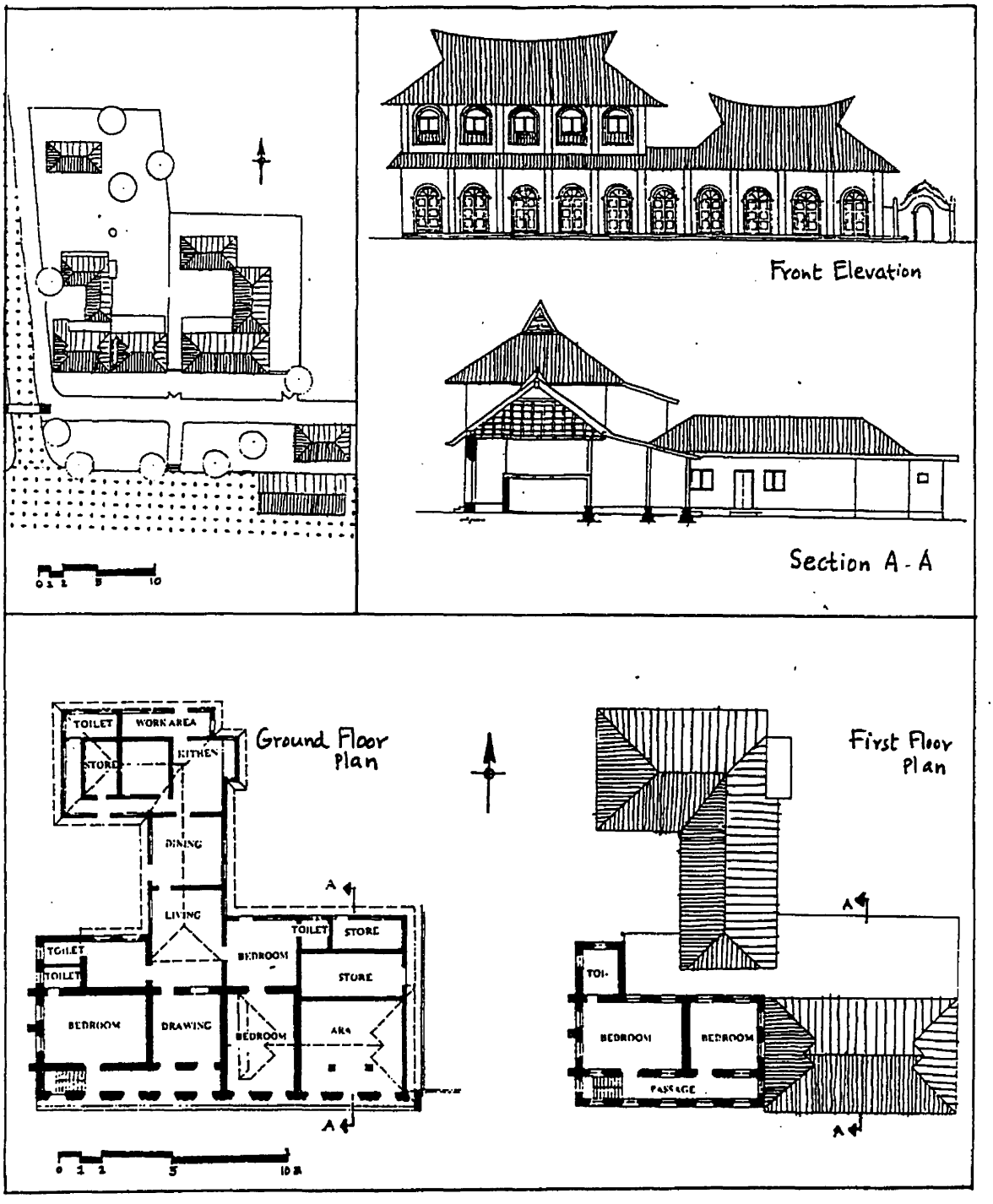
Appendix 4.14

House Sample - H-18	House Name - *Therettu Lakshmi bhavanam*	Location - Kottayam



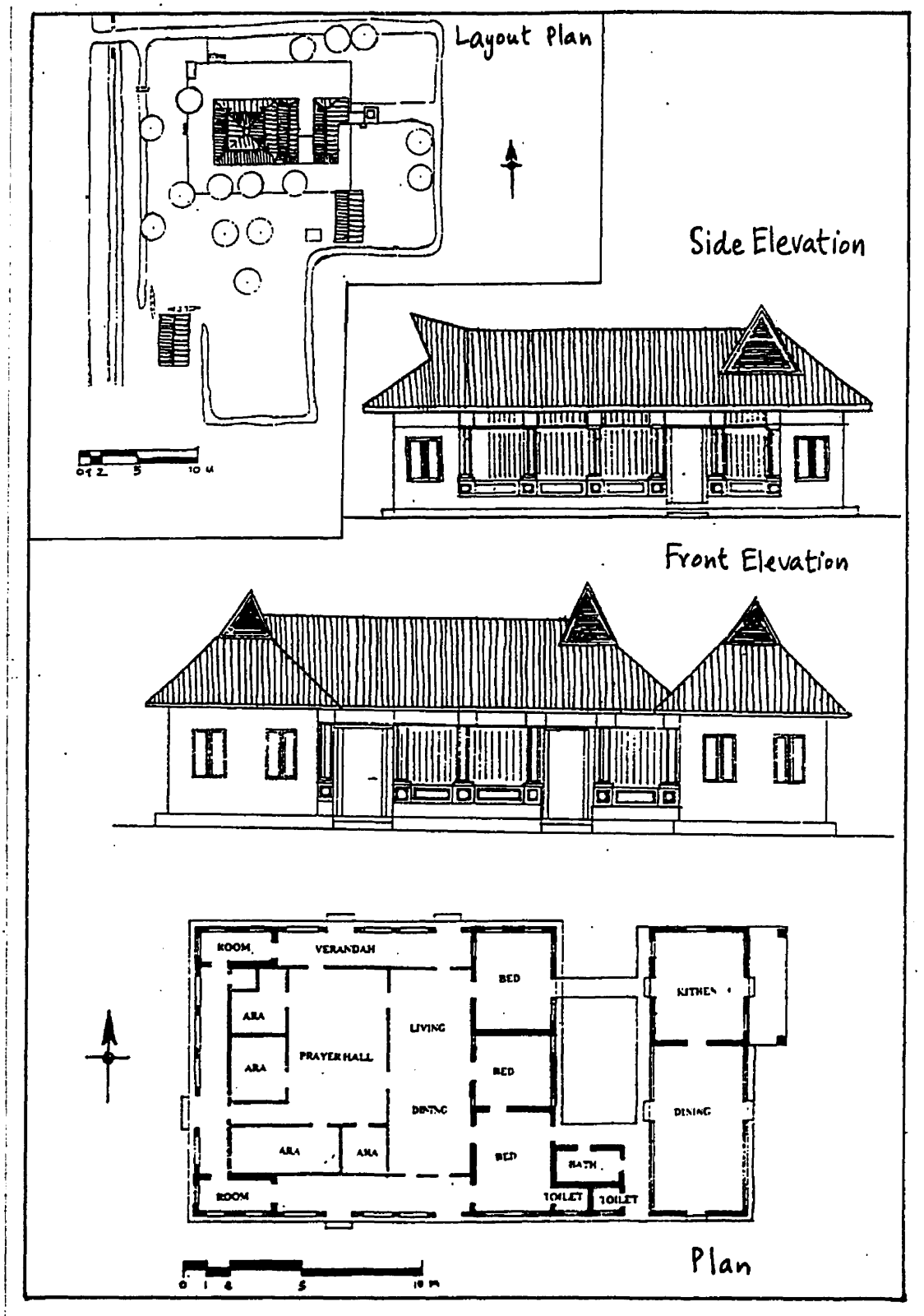
Appendix 4.15

House Sample - C-1 House Name - *Pazhayaparambil veedu* Location - Pulinkunnu, Kuttanad



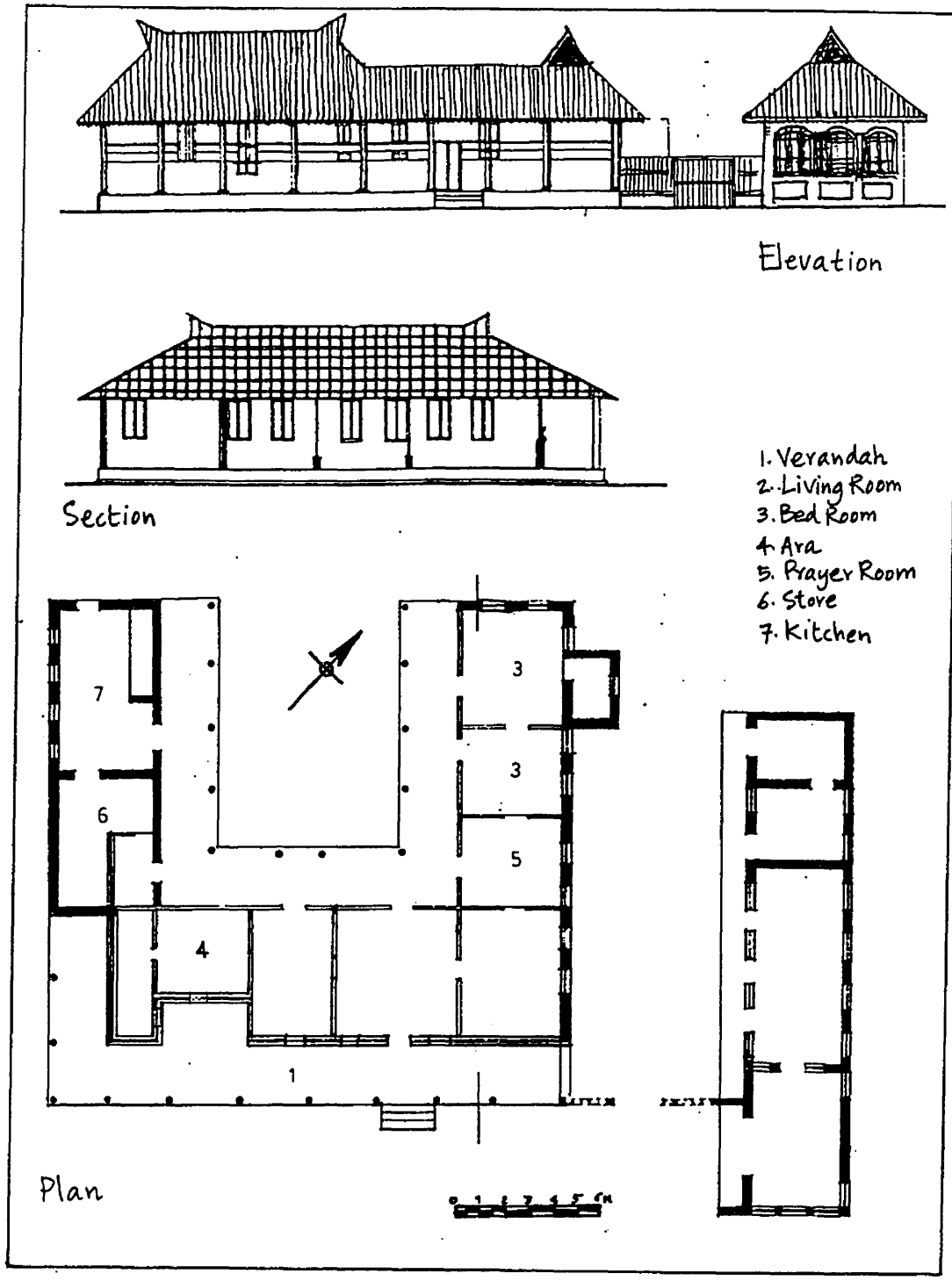
Appendix 4.16

House Sample - C-2 House Name - *Puthenpurackal veedu* Location - Pulinkunnu, Kuttanad



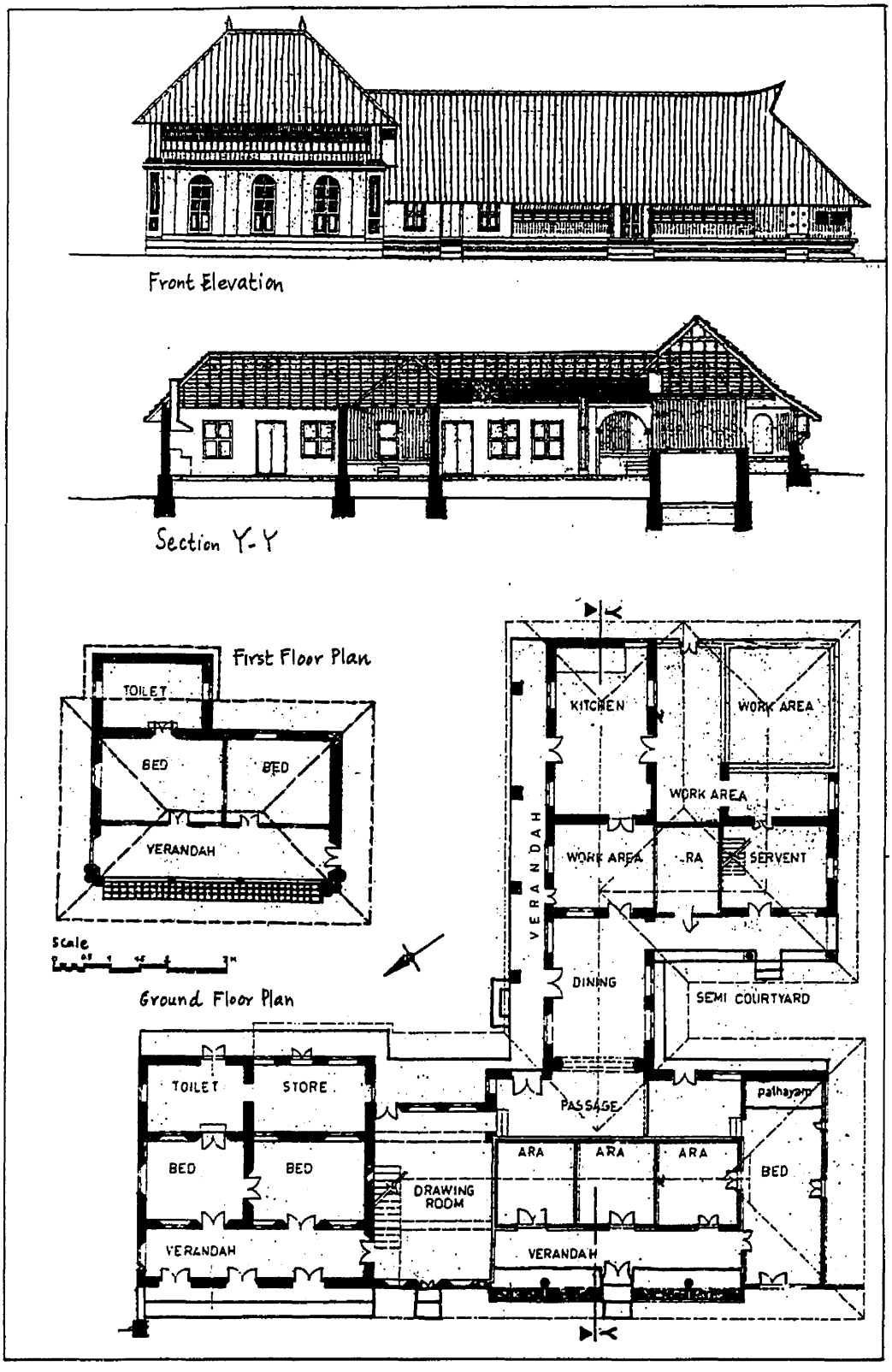
Appendix 4.17

House Sample - C-3 House Name - *Wachaparambil veedu* Location - Pulinkunnu, Kuttanad



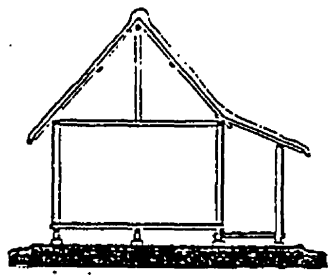
Appendix 4.18

House Sample - C-5	House Name - *Thazhathangadi - House 2*	Location - Kottayam

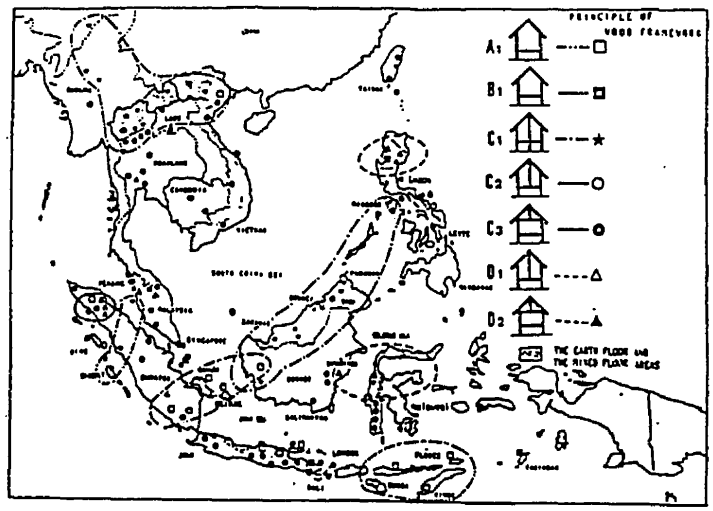


Appendix C.1.1

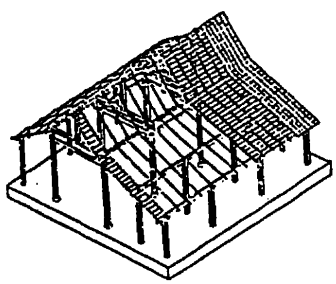
Southeast Asian wooden Houses



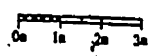
The house in Naga village, West Java

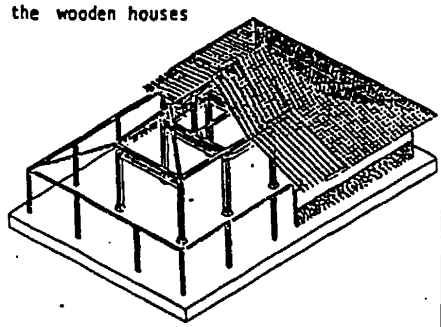


Distribution map of the wooden houses

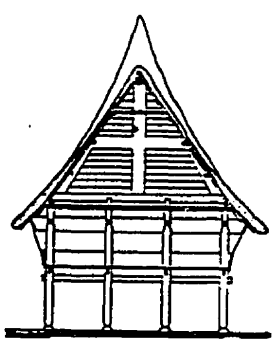


Srotong with the gable roof
(Java name)

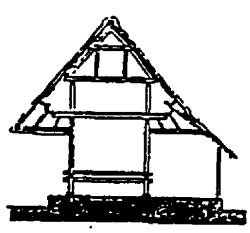




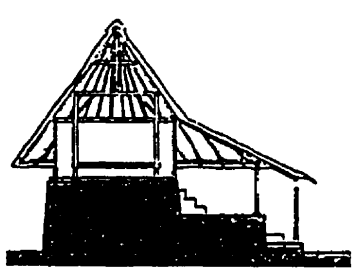
Limasan with the hipped roof
(Java name)



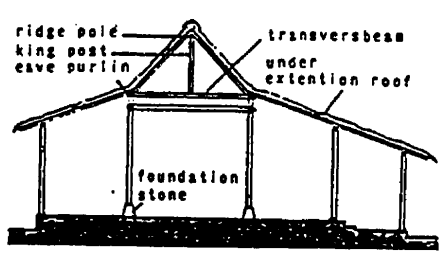
Batak house from the Lake Toba region in Sumatra



The house in Tennganan, Bali



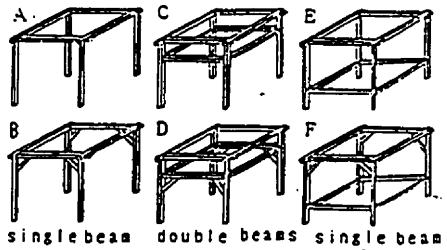
The house in Sukaraya Lombok



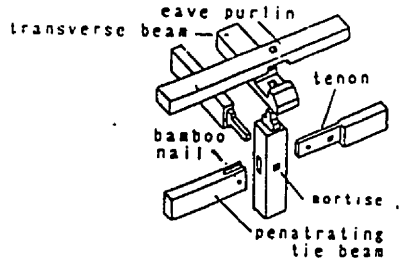
The house in Mojokarta, East Java

Appendix C.1.2

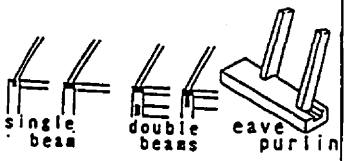
Southeast Asian wooden Houses



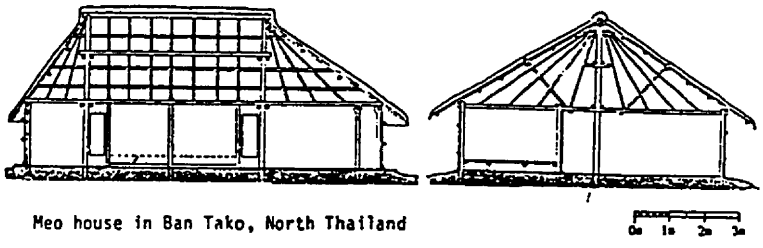
Frame unit system



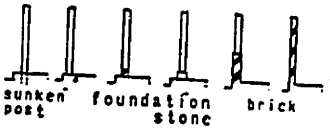
Joint detail of double beams



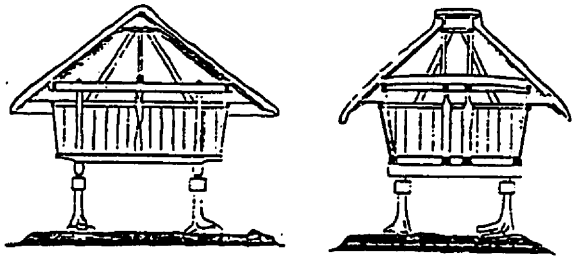
Joint detail of the eave qurlin



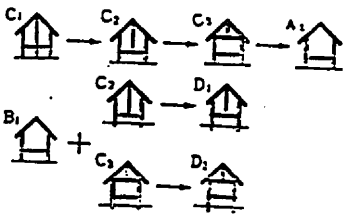
Meo house in Ban Tako, North Thailand



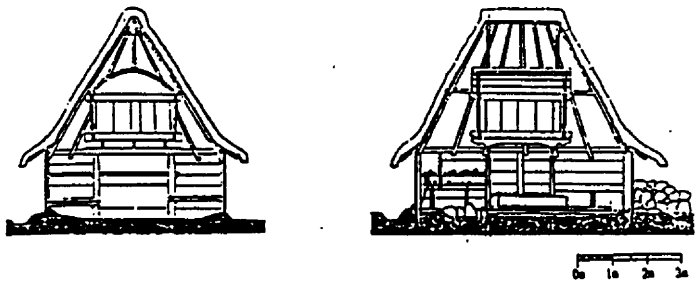
Foundation on the platform



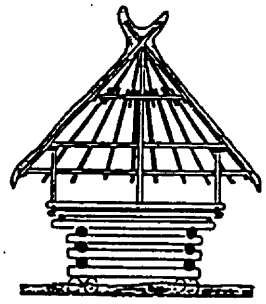
Ifugao house in Amdutog Kiangan, North Luzon



Idealization of shifting process



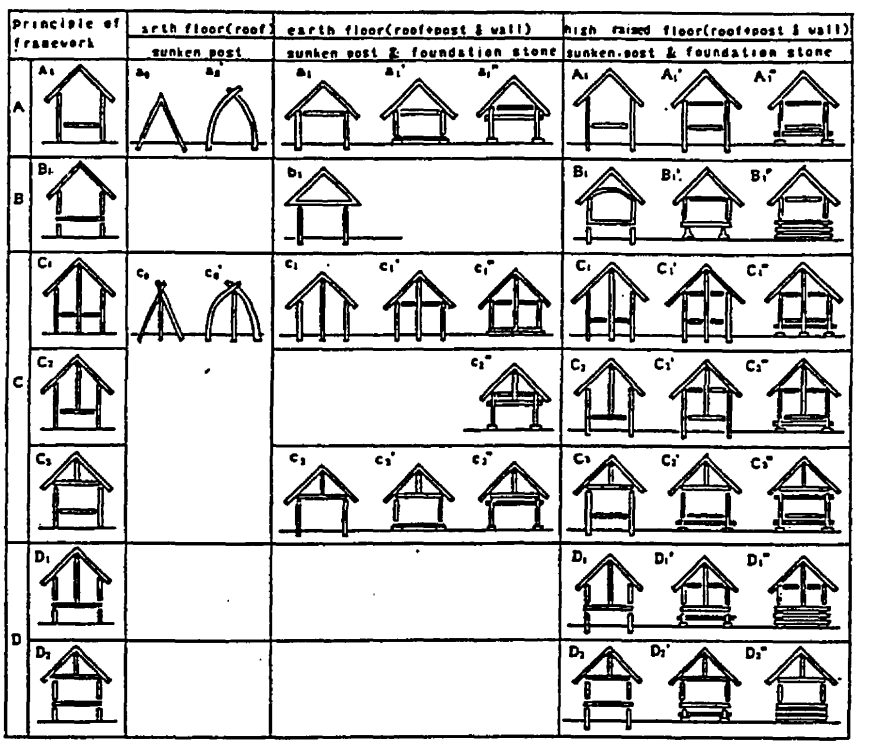
Ifugao house in Demang Sagada, North Luzon



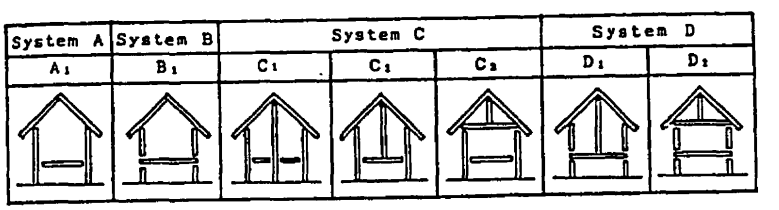
Paroe Toraja house in Kerawi, North Sulawesi

Appendix C.1.3

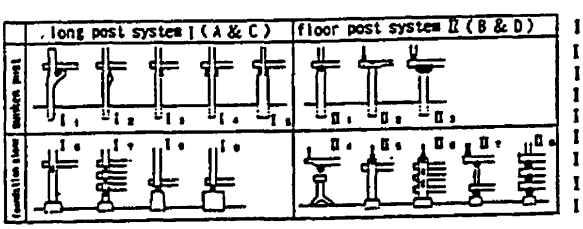
Southeast Asian wooden Houses



System of the wood framework



Principle of the framework system



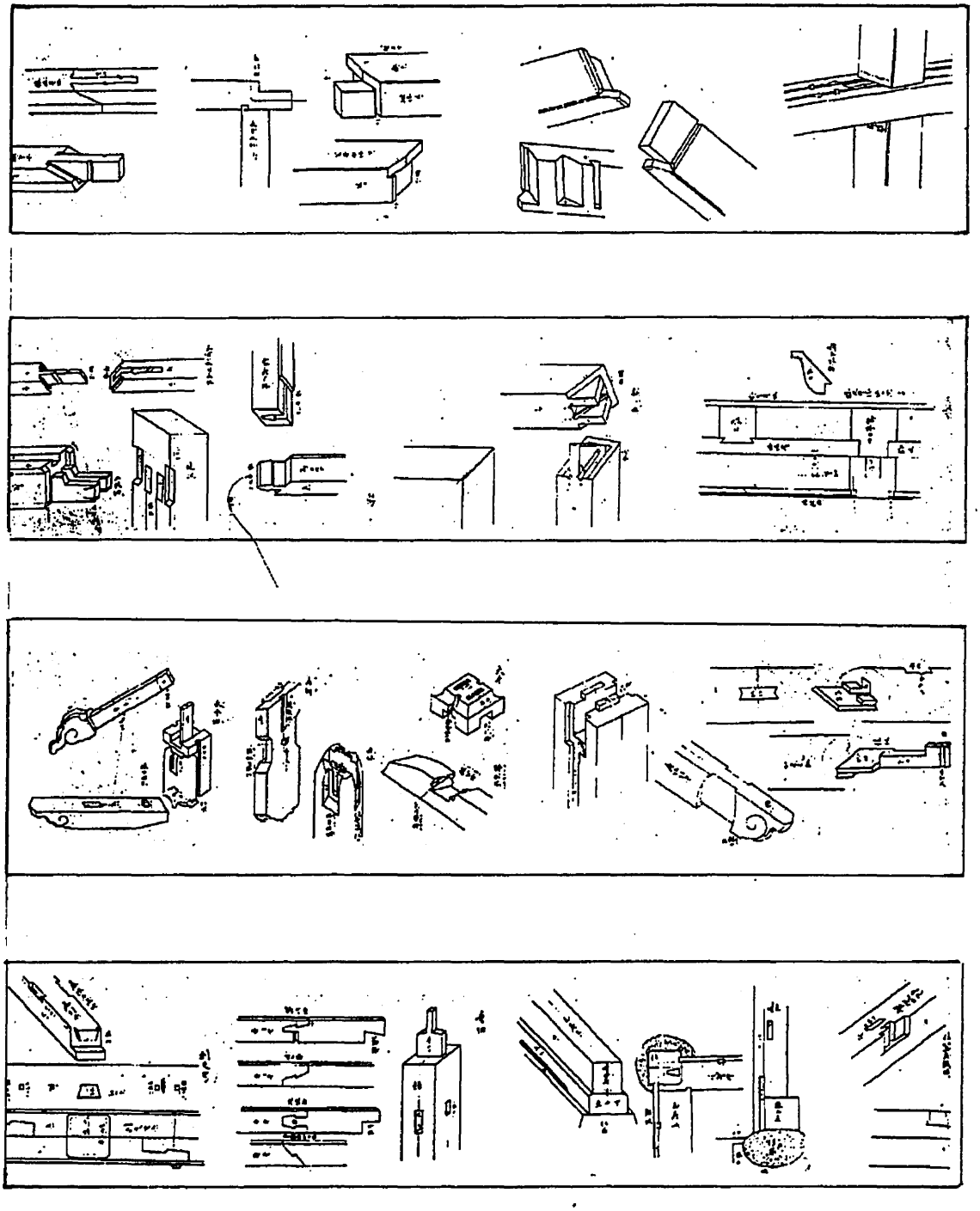
I 1:Lishu
I 2:Banon Lauy
I 3:Thap Nam
I 4:Banon Lauy
I 5:Bansaimae
I 6:Malag
I 7:Batak
I 8:Vest Java
I 9:Vest Java

II 1:Samarinda
II 2:Ifugao
II 3:Ifugao
II 4:Ifugao
II 5:Nias
II 6:Toraja
II 7:Paroe
Toraja
II 8:Toraja
:Batak

Type of the floor construction

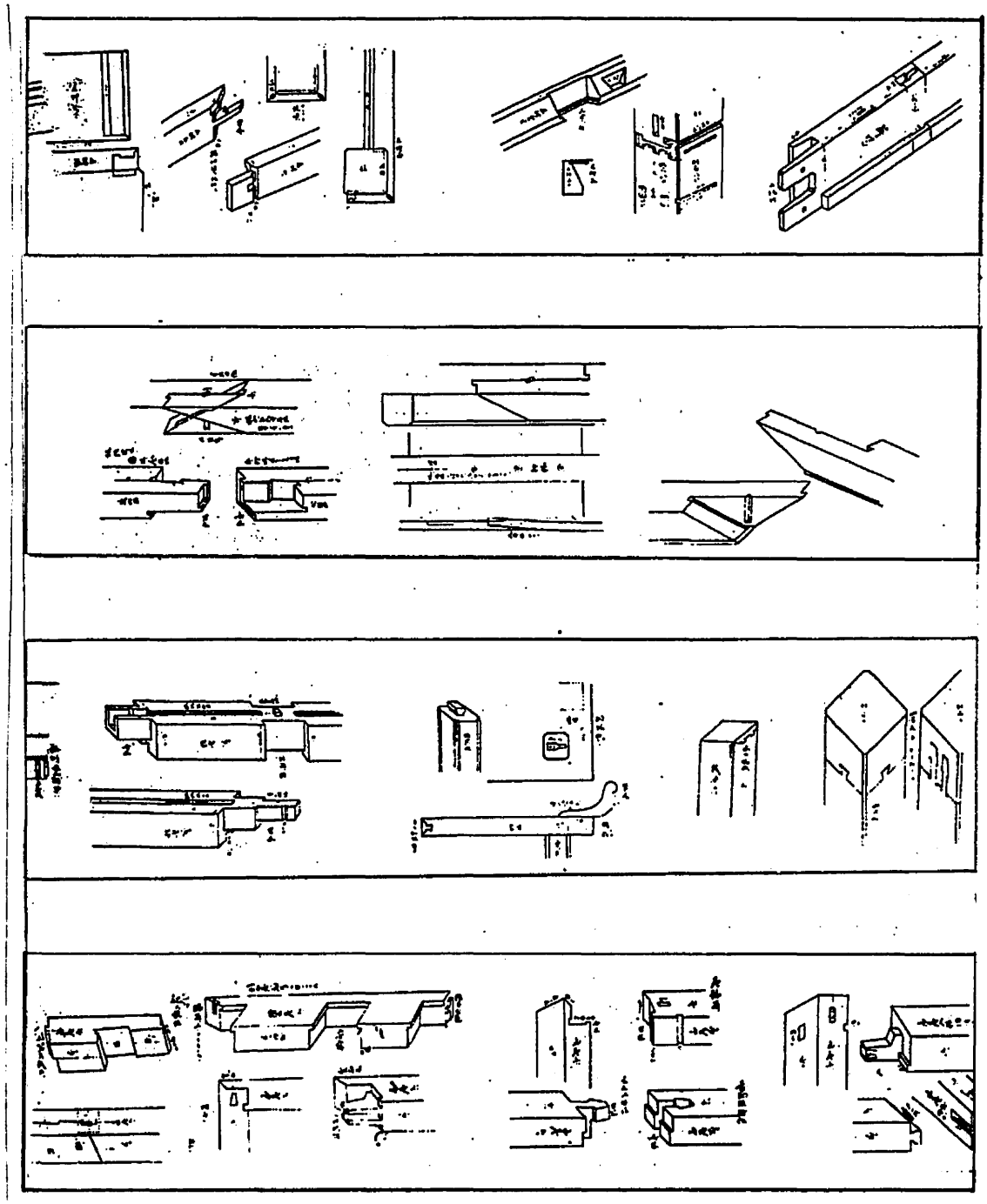
Appendix C.2.1

Few examples from Japanese carpentry scroll



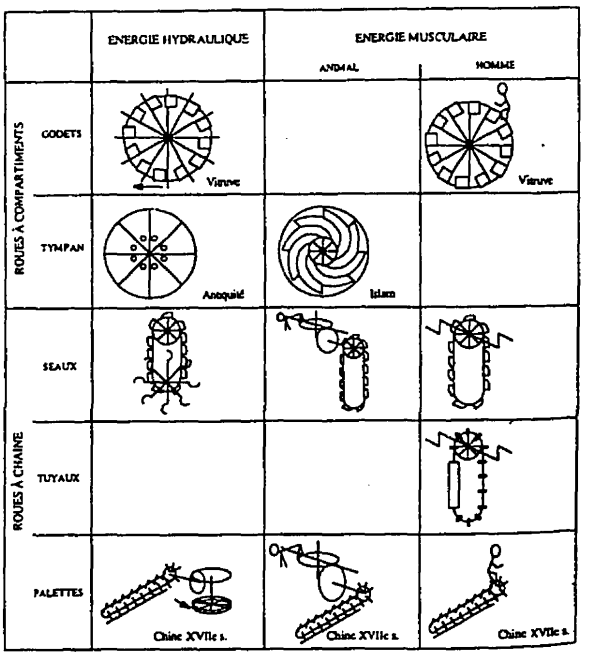
Appendix C.2.2

Few examples from Japanese carpentry scroll



Appendix C.3

Different types of norias as observed by Bruno Jacomy



Appendix C.4

Arnold Pacey's classification of wet rice culture Technology complexes

Region	*Basic 'survival technology'*	*Machines*	*Engineering works*
IRAN AND IRAQ	Irrigated agriculture	*Extensive use* (water-wheels, windmills, spinning wheel, gears, cams, pulleys)	*Large-scale* (dams, canals)
NORTH CHINA	Dryland and irrigated agriculture	*Extensive use* (water-wheels, spinning wheel, gears, cams, pulleys, cranks)	*Large-scale* (canals, flood-control works)
SOUTH CHINA	Wet rice culture	*Less extensive* than North China, but similar	*Mainly small-scale* (small reservoirs or ponds for rice irrigation)
SOUTH INDIA and SOUTHEAST ASIA	Wet rice culture and tree crops	*Very limited* (water-raising devices)	*Mainly small-scale* with exceptions in Lanka and Angkor (small reservoirs or 'tanks' for rice irrigation)
CENTRAL ASIAN GRASSLANDS	Animal husbandry	*Almost none* apart from portable looms	*None*