THE TRANSFORMATION OF TRADITIONAL THAI HOUSES: STEPS TOWARD RECOGNITION OF CHANGING VERNACULAR FORMS

By
Poomchai Punpairoj

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree
DOCTOR OF PHILOSOPHY
Program of Architectural Heritage Management and Tourism
(International Program)
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The emergence of the new types of vernacular houses shows the evidence of change leaping from the popular image of the *traditional Thai houses*. The change is impacted from many factors including contemporary cultural needs. New vernaculars, which are found in the central Thailand, are *transformed Thai houses* and *reproduced Thai houses*. These two occurrences began since the 1960s (for the first type) and the 1990s (for the second type). The traditional house is assumed as an archetype of the Thai vernacular house. The vernacular houses were surveyed in three districts: Pakkran village, Ladchado village, and Bangpahun area in Phra Nakorn Si Ayutthaya province during the late 2000s. These new vernacular houses have developed from the *traditional Thai house* among other modern housing developments. However, there is a lack of awareness and understanding of this change. Most of the policies from Thai government, study courses and research topics have focused only on the image in the past. Accordingly, contemporary vernacular tends to be disregarded.

To redefine the new vernacular, there are three main subjects: 1. viewpoints on vernacular architectures both from local and international scholars; 2. definitions and previous studies relating to vernaculars; and 3. establishment of new vernacular architecture, which closely relate to the *traditional Thai house*. This study involves developing an understanding of the transformation of the vernacular houses, as well as providing ways to expand the scope of vernacular studies. The findings show the ways in which vernacular traditions have been integrated within modern contexts in various ways. The process of transformation and change in the architectural elements are indicated. These reflect the direction of development of Thai vernacular houses. The results suggest that the developments have been influenced by the non-traditional characteristics of the early period of the modernization. Although some traditions are in a declining stage, much local experience, knowledge and skills have been transmitted to the new generation.

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Thesis Advisor's signature .....

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Chapter 1
Introduction

1.1 Statement and significant of the problem

Traditional buildings are disappearing in many cultures and societies. In Thailand, very few traditional houses have been maintained in their original condition to the present. Most everyday houses, especially those owned by local residents, generally are transformed from a common archetype to accommodate to modern ways of living. These changes can bring about both advantages and drawbacks. One advantage is protecting and extending the life of traditional houses; the process of ownership and stewardship add to the buildings' survival. However, significant drawback is that an uncontrolled change causes adverse impacts on preservation and conservation. The types of houses, which merge traditional houses with non-traditional constructions, can be classified as the "contemporary vernacular house".

Modest traditional houses are rarely evaluated by governing boards or conservators to have value in the same way that more traditional "archetypical" vernacular houses do. A lack of policies or budgets for these houses reveals the prejudices of Thai government officials, who are unaware of the importance of this kind of architectures. The purpose of this study is to be the document and understand the processes of change within vernacular traditions in order to formulate ways of evaluating their heritage value.

In the "Venice Charter", the first article calls attention to non-monumental architecture. This includes vernacular houses with special cultural importance, such as the "classic" vernacular building of countries, for example Thailand.

"The concept of an historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or an historic event. This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time."

Many active protection policies have been in place for important monuments

throughout Thailand. Most recent this policy is found in the Enhancement and Conservation Act in 1992. However, no policies have been clearly prescribed to dwellings in settlements belonging to “ordinary” people and representing “ordinary tradition”.

Vernacular houses are typically extended or modified from traditional houses, based on available resources and limited budgets. Over-restoration and uninformed changes have been common. Some residents have removed valuable characteristics to maintain and continue use of their houses. Due to rapid changes in the central region, surviving *traditional Thai houses* nowadays are confronted with uncontrolled adaptation and a disappearance of vernacular traditions. A lack of supportive guidelines and policies means the Thai vernacular heritage is become gradually reduced in the last few decades and may rapidly disappear in the early period of the twenty-first century.

1.2 Research questions

1. Will vernacular architectures survive in the face of cultural, ecological, and technological change?
2. Can vernacular architectures be sustained in the twenty-first century?
3. Are there ways that vernacular architecture can be better appreciated as part of a broad context?

1.3 Goals and objectives

1. To establish a more thorough understanding of Thai vernacular houses
2. To identify the dynamics and transmission of vernacular traditions
3. To recalibrate official attitudes toward Thai vernacular houses in this century

1.4. Scope of the study

The study focuses on the active nature of vernacular buildings instead of embracing a preservative approach. Because vernacular buildings are not resistant to change, the study shows how vernacular buildings have changed from the archetypal (the *traditional Thai house*) to contemporary models. The study also shows how

traditional houses adapt to the environment and condition of the twenty-first century.

The scope of study is concerned with contemporary vernacular houses, which have been transformed or are in the process of being transformed. A comparative study is applied for better understanding of similarities and differences among various locations. Two limitations are recognized in the study:

1. Because of cultural significance, the study is concerned with the vernacular houses that can be traced back to the *traditional Thai house.* These houses have undergone different processes of transformation or were newly built with combination of the original and the contemporary style.

2. The study focuses on single or clustered houses owned by ordinary residents in Thai villages. The houses owned by the Thai elites or organizations are not included.

1.5 Process of the study

This study consists of three sections:

1. The first clarifies background of the research, the hypothesis and the dissertation for understanding traditional house forms. Theories, statements and problems relating to vernacular buildings are summarized and discussed. The studies that have been carried out about this vernacular subject are reviewed. Two chapters are used to develop this part.

2. The second step explains the methodology, analysis criteria and site selection. The principles of data collection are presented, including the research questions and approaches to case studies. Survey procedures are given in detail: the survey form and the classification of collected data. This is followed by a description of statistics used for the analyses. In the last part of this section, the research sites and how they are selected as the study areas are also comprised.

3. The third section forms the core of the research. The main types of the *traditional Thai houses* are grouped and explained according to their physical appearance. The process of transformation and reproduction are discussed by referring to the archetype and construction period. The relations and the significant differences in various locations are further presented and analyzed by statistics. Conclusions and considerations for further study are presented in this last part.

Chapter 2
Literature Review

This chapter reviews previous studies that provide background for the study of vernacular buildings. Definitions relating to vernacular and traditional subjects are also clarified.

2.1 Vernacular buildings

In this study, vernacular houses include not only traditional-style houses but also the various types of buildings which have been evolved or developed for ordinary people. Oliver (1989) stated that vernacular houses are handed down as a heritage from generation to generation. He also mentioned that vernaculars houses are always changing from traditional forms to contemporary ones, while traditional houses are fixed to the beginning of their history. Lawrence (1987) argues that vernacular houses evolve in accordance with living activities and value of the residents.

The development of vernacular buildings throughout history has been a response to their environmental contexts (Oliver 1997). Since the beginning of industrialization, change in vernacular tradition has accelerated for various reasons including modernization and globalization. These have stimulated more rapid kinds of change than those that evolved during the pre-industrial period (Strike 1991).

2.1.1 Definition of vernacular buildings

From the Concise Oxford Dictionary (2004), the meanings of vernacular with regard to the field of architecture are: *adj.* concerned with domestic and functional rather than public buildings. Some of their synonyms are: indigenous, local, and native. In his book, “Architecture without Architect”, Rudolfsky (1981) gave several terms to describe this type of architecture: vernacular, anonymous, spontaneous, indigenous, and rural. Correa (1998) defined vernacular architecture as an organic process. He described the use of the vernacular as not the product of any individual architect, but that of an entire community, working through its history. Lim and Beng

(1998) claimed that the term “vernacular architecture” is one of the most commonly used but least understood terms in the field. They also argued about the interchangeable of the term “traditional” and “vernacular”.

The term “vernacular architecture” has been additionally explained as building activity, which provides for the simple activity of ordinary people, strongly related to its place, especially through the use of local building materials (Brunskill 1986).

Vernacular architecture has been a subject of academic interest since the nineteenth-century (AlSayyad 2006; Oliver 1997).Official interest in vernacular buildings developed through the building conservation movement (Brunskill 2000). The increase of courses and research programs in the last two decades reveal its significance. Academic and professional interest has been concentrated on the documentation, study and preservation of historic and traditional buildings before their loss or irreversible alteration. Recently, the vulnerability of vernacular traditions under the threat of modern development is the issue most commonly addressed, used as object of research and applied to policy.

Rudolfsky (1964) assumed that the traditional architecture does not go through fashion cycles but is clearly immutable or unchangeable. The origin of building forms and construction methods is lost in the distant past. Upton (1993) argued against this viewpoint and suggested that the study of the field of vernacular architecture has been held back by the limitations of its own assumption and definitions.

To understand and sustain the vernacular in the twenty-first century, Vellinga (2006) suggested focusing on new and emerging vernacular traditions as well as on enduring ones and on the ways in which they interact and relate to one another. He noted that vernacular traditions have not all vanished, but that they have merged with modern ones to create new manifestations of traditions or localized hybrid forms that better suit current circumstances and requirements.

Rappoport (1969) stated that the chief characteristic of vernacular is its additive quality, its unspecialized and open-ended nature. These qualities enable its architecture to accept changes and additions that would visually and conceptually be opposite to the “designed” or academic architecture.

However, only few researchers have attempted to study changes in traditional building and relate this idea to adaptations of vernacular buildings. Alsayyad (2006)

encouraged scholars of the vernacular to face the world of global communication. He supported the Oliver's advice that change in an era of technological advancement and increased communication is a key to understanding "anonymous" or vernacular processes. Therefore, the study of the vernacular in the twenty first century involves developing an understanding of the changes and ensuring that the changes are sensible, appropriate, and sustainable.

2.1.2 Sustainability of vernacular buildings

In many societies and cultures, vernacular buildings are disappearing. Rappoport (1969) gave a number of reasons but one of the obvious was: many types of contemporary functions and buildings are too complex to create in traditional fashion and that introduces the rise of specialization and differentiation within various trades and professions.

Achieving sustainability is central to the planning of historic cities, particularly in developing countries (Siravo 2003). Matero (2003) states that sustainability has evolved as a mode of thought in almost every intellectual activity since the 1970s. He explains the meaning of sustainability in conservation context, which always has been misunderstood. In nature conservation, sustainability is about finding ways to design and manage essential resources to be renewed faster than destroyed. In the building industry, sustainability has become synonymous with "green architecture" or buildings designed with healthy work environments, energy conservation systems, and environmentally sensitive materials.

Sustainability in the conservation context means, however, ensuring the contribution of heritage to the present through the thoughtful management of change (Teutonico 2003). Conservation consequently becomes a dynamic process involving public participation, agreement and an understanding of associated traditions and meanings in the creation, use, and re-creation of heritage.

To attain sustainability in historic cities, Siravo (2003) encouraged looking for an alternative to the two solutions commonly adapted in developing countries. The first solution, which he calls "the museum solution", cannot be sustained because there are not enough resources or visitors. The second solution, which he calls "the right to modernize", proposes modern development, clearing traditional buildings and

space except a few monuments, and replacing them with contemporary solutions. Traditional areas are usually evaluated as little better than slums and places deserving to be completely transformed. Rice (1991) has also supported this argument and insisted that preserving traditional buildings in museum condition can not sustain historic environment.

Fairclough (2003) explains the concept of achieving sustainability by managing change. He has noted that conservation should not only be a witness to, but a central part of the process of change. He has referred to the misconception of sustainable development by English Heritage in 1992. The green issue was widely held without relevance to heritage. Fairclough points out that shifts in thinking began to make sustainability more relevant. Heritage is continually remade, changed, and modified, and its significance is reconstructed under the influence of new perspectives, new participations, and new policies. Conservation should seek to manage change within the historic environment.

Bourdin (1986) implied that historic areas needed to be incorporated within larger contexts in order to continue their evolution. Similarly, Hewison (1987) showed concern that historic areas not be frozen in an image of a non-existent past. New movements in the interpretation heritage have resulted in new attitudes towards conservation, enhancement, modernization and the re-use of building (Choay 1992).

2.2 Vernacular buildings in Thailand

Paribatra (2002) states that one of the celebrated vernacular Thai buildings, the *traditional Thai house* which is a representative of "Thai style", is actually not a static phenomenon. He described its evolution, from its 13th century heritage, through centuries of development and adaptation, to the present day. From the Sukhothai, Ayutthaya, Lanna, to today's Ratanakosin era, he explained the influence of Thailand's neighbors on national building tradition. Built entirely from wood, the houses have the capability of being dismantled, moved periodically to new sites and reassembled or rebuilt with adaptation for modern-day use.

Evidence of civilization dating back about 5600 years is visible in the northeastern town of Ban Chiang district. The Dvaravati civilization, which was established between the 3rd and 12th century, was strongly influenced by Buddhism

from India. Dvaravati was later under the influence of more powerful Khmer leaders from Cambodia. In 1238 C.E., the first Thai capital at Sukhothai was established by the Thais. The Kingdom of Sukhothai lasted until 1350. and was succeeded by the Kingdom of Ayutthaya. The Ayutthaya period lasted for 417 years. In 1782, the capital moved to Bangkok, which maintained the splendor of the previous capital (Horayangkura 2001).

In Thailand, vernacular buildings normally have the meaning of dwellings in rural areas. For example, the vernacular buildings described by Roonrakwit (1997) are huts, feudal houses, the Siamese house and the Chinese shophouses. To gain a broader idea of vernacular building, more types of building that may be defined as vernacular building are included in this sub-chapter. In this respect, it should be understood that some of formal architectural styles, associated to monumental buildings, can be categorized as vernacular architecture in the present context as well (Figure 1).

Figure 1

Various monumental architectures made throughout the Ayutthaya period

2.2.1 Vernacular Thai houses

Before the 13th century, the form of the vernacular houses in Thailand cannot be determined exactly (Roonrakwit 1997). However, it can be estimated that the houses in the central part of Thailand were built on high columns. The roof shape is A-frame, using grass thatch as the roofing material. Wood and bamboo were the

Figure 2

A centuries-old painting illustrates the use of bamboo and wood. (Source: Jotisalikorn 2002)

Figure 3

Plastic ropes at frame joint of bamboo structure

Figure 4

A *reproduced Thai house* with the traditional style combined with the contemporary style.

Figure 5

A contemporary house with enclosed space at the ground floor

principal materials for the house, resulting in lightweight construction (Figures 2 and 3). The house could easily be disassembled and relocated or reassembled when necessary. Houses were usually built in closely associated communities along canals or waterways.

Nowadays, with the construction of motorways and local roads, houses are built along these new communication routes. The major change in layout consists in the cladding of the enclosures at the ground level to form two-storey houses (Figures 4 and 5).

In contrast to the precise order of formal architecture (described in sub-section 2.2.2), Horayangkura (2001) states that there were more humble traditional structures consisting of ordinary residences. In the central region of the country, the houses of a water-based culture were built either as floating houses along the rivers and canals (Figure 6), or as houses on stilts on the banks of the water ways (Figure 7). Denpaiboon (2001) divides the typology of houses in central Thailand into two types: the structural floating houses on the water and; houses on stilts situated along the riverbank or on land. Houses on stilts are also categorized into two types: the temporary type or semi permanent type made of bamboo and the permanent types made of wood. The house type considered in this research is the latter.

During the 19th century, a new vernacular type, called "Shophouse", was built by Chinese immigrants in urban contexts. Thongsakul (2001) explaines that shophouse serves the dual functions of business and family living. A typical shophouse setting forms a row of uniform dwellings located along a commercial road. The ground floor is used for commercial purpose, while the upper floor is usually residential or sometimes used as warehouse (Figure 8).

Figure 6

Raft houses along a river

(Source: Jotisalikorn 2002)

Figure 7

Houses on stilts along river bank

Figure 8

Shophouses with load bearing walls and
wood frame structures

2.2.2 Formal traditional Thai architectures

Horayangkura (2001) categorizes formal architectures in Thailand into three groups, starting from the Sukhothai period to the current. In the first period, formal architecture blends the traditions of use of wood and masonry. Using masonry as main building materials, building features imitate timber construction in shape and form.

Ayutthaya was the capital and the first cosmopolitan city of Thailand (named Siam at that time). Architecture in Ayutthaya integrated the styles of Dvaravati, Lopburi, and Sukhothai periods. The multi-layered roof was developed and became the typical roof of a Thai temple and also the predominant component of formal traditional Thai architectures (Figure 9).

The Bangkok (Rattanakosin) period continued the multi-layered roof of Ayutthaya architecture, while accepting influences from Chinese immigrants and European domination. In the early 1900s, the highly articulate, multi-layered, and high-pitched roofs were used together with modern construction (Figure 10). This new form was developed for large scale public buildings, which contained new functions such as institutional buildings.

Figure 9
Multi-layered roof of the temple in Ayutthaya

Figure 10
Multi-layered roof of the temple in Bangkok
(Source: Campbell 2000)

2.3 Traditional Thai houses

Pavlides (1997) has explained about an "archetype" of the vernacular. He states that archetype constructed through rigorous categorization of a few aspects of a building, such as the plan, and the most common features of the elevation, decorative details and shapes of openings. These can define the typical house in the specific area.

Vernacular houses are different in each region of Thailand, but the style considered to be the most classic is that of the central plains (Jotisalikorn 2002). This house is called the *traditional Thai house* built around the region where Thailand's kingdoms of Sukhothai, Ayutthaya and Bangkok are located and where the Thai reached the peak of their culture.

This house is called "Reun Thai" (the *traditional Thai house*) in Thai language. In fact, it can be considered as a further development of the Lanna Thai house, found in the northern region before the 13th century (Horayangkura 2001). The *traditional Thai house* was widely built due to its aesthetic appeal and its practicality in the central region. Like many Thai vernacular houses in other regions, its construction elements were made from wood, principally teak. The timber floor of the houses was raised above accessible height for avoiding seasonal floods. The residents used a ground level area for multipurpose usage, such as open living space in the daytime, sheltering animals at night and mooring a boat during times of flooding.

Recently, *traditional Thai houses* have been considered to have heritage value and to be a symbol of Thai architectural identity. Jotisalikorn (2002) suggests that the *traditional Thai house* is one of the most enduring icons of Thai style and design. Many textbooks explaining Thai architectures illustrate the *traditional Thai houses* along with the other more formal architectural models.

The *traditional Thai house* is described by Horayangkura (2001) as having unique features: a steep roof, a raised-up floor on pillars, a semi-enclosed central terrace and a covered veranda, inward sloping walls, tapered windows, an outdoor staircase, a prefabricated wooden structure and enclosing elements (Figures 11 to 14). To enlarge the *traditional Thai house*, additional structural units are attached to the terrace instead of increasing the size of each unit.

Figure 11

Steep roofs with high-peaked bargeboards

Figure 12

Raised-up floors on pillars and a semi-enclosed central terrace

Figure 13

A semi-enclosed central terrace

Figure 14

An outdoor staircase

The high-pitched roof with the graceful lines of a high-peaked bargeboard and curved feature at lower end, together with its ornamented gables is uniquely Thai, especially in terms of architectural refinement and the carpentry work that went into the construction (Figure 15). The typical Thai house in the central region is made totally of wood except for the roof tiles. Wooden dowels and pegs were originally used throughout the house but bolts and nails were popular with some construction elements later. Prefabricated walls are used as part of a main feature of a skeleton construction (Figure 16). The carpentry produces very light prefabricated walls throughout, along with small structure members.

Figure 15

Curved feature of a bargeboard

Figure 16

Walls with modular system

A description of the *traditional Thai house* is also provided by Jotisalikorn (2002). He identifies five basic elements: stilts, inward sloping walls, high gables sloping downward into long projecting eaves, a large raised veranda connecting the separate rooms, and extendable room. The element that differs from the first description is the extendable room. The size of a house varies from a single-family house to a cluster house (Figures 17 and 18). The smaller house is composed only of a bedroom and kitchen, while the cluster house has possibly up to five or six bedroom units. The bedroom units are arranged around the terrace or veranda. In keeping with the extended family system in Thai culture, additional bedrooms were added as the family size increased.

Figure 17

A single family house

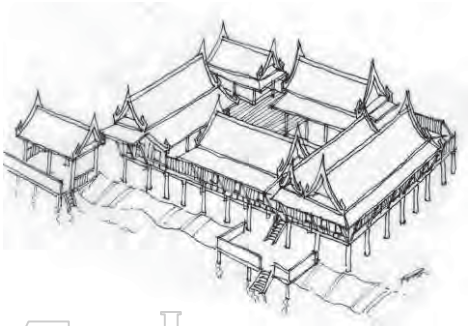


Figure 18

An extended family house

2.4 Characteristics of traditional Thai houses

There have been many descriptions of the characteristics of *traditional Thai houses*. Jotisalikorn (2002) highlights transportability as the key characteristic. He states that the word traditionally used in Thai for house building is “Prung”, meaning “assemble”. A house quickly assembled or dismantled and moved from site to site is a common occurrence.

Piromya (2002) proposed twelve distinct characteristics: prefabrication, structural frame, house size, roof materials, house plan, shape, partitions, floor, staircase, bonding and craftsmanship. However, only five characteristics could be categorized to relate to construction. These consisted of prefabrication, the structural frame, house size, joinery, and craftsmanship.

Before the late of nineteenth century, neighbors usually help each other in various activities that required labor, such as planting and building houses. To build a new house, the owners announced their intention to their neighbors as a means of

acquiring help to build a house. In accordance with village based traditions and religious ideals, the role of the community was to assist in construction and to know how to properly build houses and temples according to traditional believes and expertise (Piromya 1995). The *traditional Thai house* can be built within one or two days on the site. This is because it is composed of prefabricated units in which all components are prepared before construction (Jaijongrak 2002, 1996). There was no formal payment for helping and donating labor for someone's work in Thai vernacular society. This relationship in the village is called "Long Khak" in the Thai language (Nartsupha & Leardvichadha 1998). The archetype and its transformation will be explained in Chapter 4.

The construction process for traditional houses involves putting all the completed woodwork together, in what could be defined as a "prefabricated system". Jaijongrak (2002) explained the process of construction of the house as follows:

1. The ground is leveled before placing the foundation posts and house posts;
2. The principal post is erected according to tradition;
3. The remaining posts are erected and the structure of the house is put in place;
4. The roof truss is assembled on the ground before being placed on the house structure;
5. The purlins are nailed to the roof truss before roofing;
6. The joists are laid and the planks placed over them;
7. The wall joists, door and window frames are fixed and the panel attached;
8. The front verandah is added on to the house;
9. The kitchen is placed in the back of the main house; and
10. Staircases are fixed in the front and the back of the house.

Traditional beliefs were important to the house construction. According to Jaijongrak (2002), there were many prohibitions related to house construction. Monks and local astrologers were the specialists in construction rules. The main principles of construction covered various aspects of the process. This included choosing an auspicious location, materials and times. The most critical steps are the ceremonies of digging the first hole for the first post, splitting of the gable top, and raising the house posts.

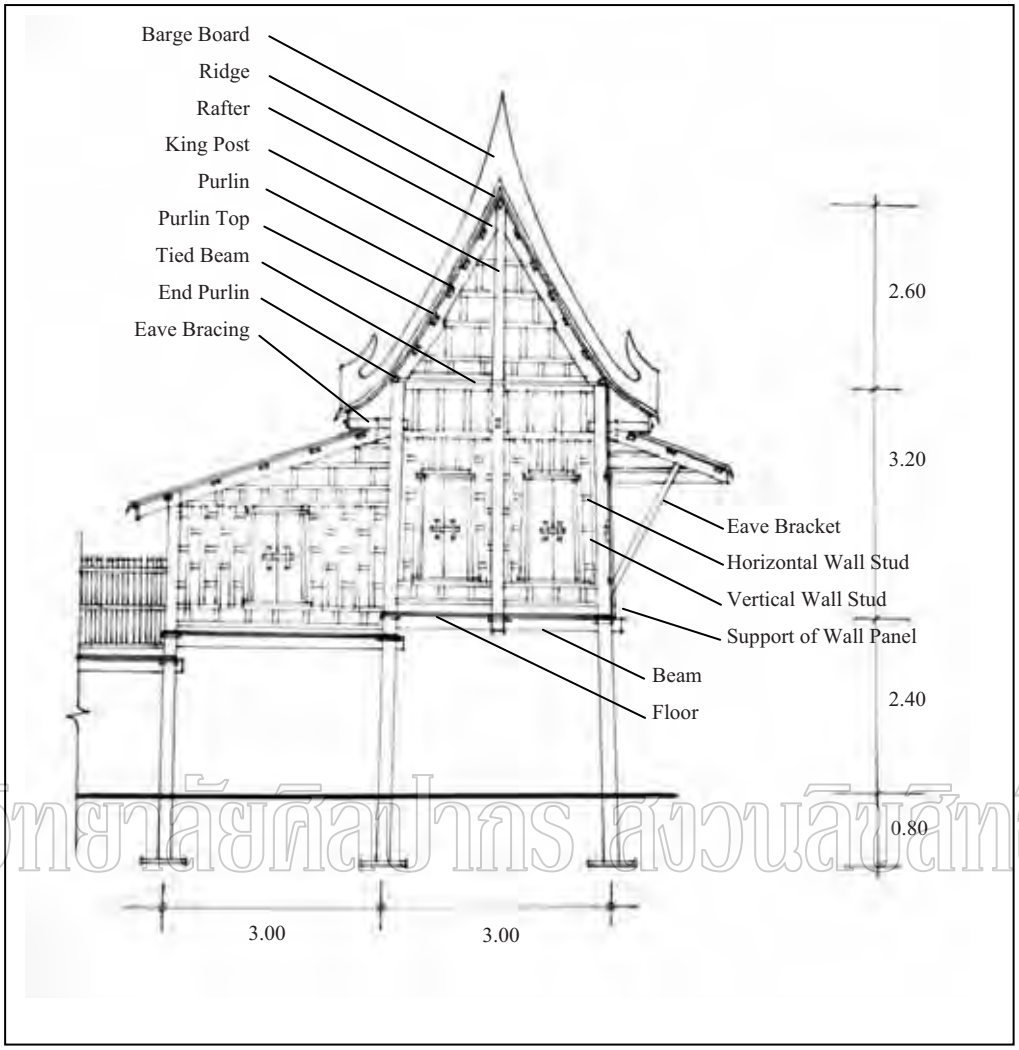


Figure 19 Construction components of the *traditional Thai house*

Traditional Thai houses are built around a fundamental skeleton structure or a load-bearing frame structure and cladding. Frames are made of timber, while cladding is made of timber planks or split and woven bamboo. The main components of the frame are posts, beams, wall studs, kingposts, rafters, and purlins (Figures 19). Four-fifths of the house components are prefabricated on site (Roonrakwit 1997). The building material used is one third to one quarter the amount of building materials used in western houses (Nimmanahaeminda 1969).

Almost every procedure and component of construction has associated symbols and beliefs. Builders have to choose the right time, day, and month when placing the first pile. They also have to consider the direction that the house is going

to face. The number of components, such as the number of steps and columns, is also dependant on traditional belief. The width and length of the house are measured so as to relate to lucky numbers.

The traditional Thai measurement system for distance includes the “Wah”, “Sok”, “Khueb” and “New”. The quantities of boards are calculated in “Yok”. The size of the house depends on the function of the building but always follows the archetype. The widths of the narrow size of a main building are 3, 3.5, and 4 meters. The height from floor to tied beam is 3.5 meters. The height of the lower space is 2 to 2.5 meters (Piromya 2002).

Figure 20
Prefabricated gable roof

Figure 21
Group of buildings with a raised floor and usable space underneath

Figure 22
Verandah with modern covering

Figure 23
Walls and columns lean inward.

Figure 24

Mortise and tenon joint

The rise of a gable roof is approximately four-fifths of the width of the narrow side (Figure 20). The shape is a rectangular one-storey house with a raised floor and space underneath (Figure 21). The gable roof covers the veranda on one side (Figure 22). The house columns and walls lean inward in all four directions (Figure 23). The connection is made with mortise and tenon joints to join the frames without nails or screws (Figure 24). However, in the last few decades, steel bolts and nails are more commonly accepted.

2.5 Periods relating to development of vernacular buildings in Thailand

The periods and developments described here are based on the previous study by Horayangkura (2001). The first Thai capital was set up in Sukhothai. It was around this time that this kingdom was officially called “Siam”. The Sukhothai Empire lasted for more than a century before it was succeeded by the kingdom of Ayutthaya. This empire was built up over 417 years. During this period, foreign immigrants, mainly from China, nearby countries and later from other regions, mainly from Europe, started to arrive. The European influences appeared mainly in the later period after the establishment of Bangkok.

During the Sukhothai and Ayutthaya period, the vernacular house was typically a hut made from bamboo and timber planks which is considered to be the prototype of the *traditional Thai house* (Puvanant 1999). In the early Ratanakosin era (1782-1851), there were both bamboo houses and timber houses, which evolved from

the earlier prototype. Many houses were made completely from timber except for the roof cladding. Importantly, they have been regarded as comprising the *traditional Thai house*, the most enduring icon of Thai style and design (Jotisatikorn 2001).

In 1932, a new generation of technocrats supporting democratic reform, led to a change in government from absolute to constitutional monarchy. The name of the country, "Siam", was changed to "Thailand" in 1939. Following this reform, most architectural design followed the modern movement of the western architecture.

In the past, timber was used as the main building material. Brick and cement were used only in the construction of royal residences, palaces, and temples. In the early twentieth century time, cement for concrete work became cheap especially after 1913 with the rise of cement production on a large scale. The innovations included first plywood production began in 1951. Although the first "Industrial Promotion Act" was promulgated in 1954, modern Thai industrialization effectively started in the early 1960s.

Modernism, an important architectural movement, began to be popular in Thailand during 1950s and 1960s. In 1970s modern buildings with international standards were constructed for both the government and private sectors. In this period, new design concepts and modern building technology were applied throughout the country, most extensively in areas close to major transportation routes.

The involvement of the United States in the Vietnam War was a great influence, because Thailand became a base for the American forces. The Americans introduced modern prefabrication systems to accelerate construction of support facilities during the war (Puwanant, 1999). The United State's influence in Thailand gradually gained acceptance from many Thai architects. In 1963, the Association of Siamese Architects established the standards of Professional Practice, which is similar to the standards drawn up by the American Institutes of Architects.

With the introduction of modern forms and manufactured materials, the "bungalow" was one of the first common house-type to break Thai boundaries and move the country into an international culture. In the 1960s, the housing projects around the Thai capital, Bangkok, were designed by the architects who graduated from the Thai universities with western-style educational systems (Horayangkura 2001). The houses usually followed the style of the American bungalow. This style

spread widely and was accepted from the residents in rural villages. However, this style was revised and constructed by the local builders (Figure 25).

According to Pinijvarasin (2004), the bungalow house, which is the product of modernism, was the subject of increasing attention in the Thai village during the 1960s to 1970s. The bungalow was not just a symbol of modernity; it was also cheap and practical. The Thai bungalow was not totally prefabricated, like some of the American equivalents, but partially based on on-site construction as the labor cost was very low (Puwanant, 1999). Since the 1960s, the bungalow style has been used as a template for local development.

Figure 25 A Thai bungalow in Pakkran village

According to Horayangkura (2001), Thailand became increasingly dependent on the economic and military assistances after the Vietnam War period. Since the end of the 1970s, the policy of Thai government has been to increase self-reliance and stimulate economic development, particularly within the building industry. Significant improvements were among both materials and methods of construction as a result. Since that time, commercialism has become a major influential factor in importing the various western styles, found in European and American communities. Thonsakul (2001) states that these influences were once limited to urban housing projects during the 1980s but recently they have expanded to the houses in rural areas.

2.6 Contemporary Thai architectures

Lim and Beng (1998) have stated that contemporary vernacular practices can show a dynamic architectural direction to meet the challenges of rapid urbanization and development. In a different view of the trends and changes, Oliver (1987) has pointed to the importance of evolving neo-vernacular buildings. He has referred to a "Fourth World" comprised of indigenous cultures surviving within industrialized societies. Recycled and manufactured materials are adopted in former traditional contexts. The definitions of this process are various including "unauthorized", "illegal", and "spontaneous".

Vellinga (2004) has examined the two contemporary themes among the vernacular houses of Minangkabau village, Indonesia. The first theme he defines as a "decline" of old vernacular houses. The second theme is described as "revival" of new vernacular houses built in the traditional style, but with modern requirements, materials and techniques.

There have been several studies on the topic of contemporary Thai architecture but the essay on the subject of the architecture of Thailand by Horayangkura (2001) most clearly described the combination of contemporary and the influence of tradition from the early period to the present.

Though Thailand was never formerly colonized by European powers, western influences have transformed most of settlements from water-base to land-base. Similarly, contemporary architecture has always been inspired by western ideas and practices. During the nineteenth century, the western classical style, dominated the design of buildings in Bangkok. The most important palace in Rattanakosin dynasty, Chakri Maha Prasat, is an obvious beginning of integration of Thai and western culture. In this example, neoclassical façades is topped with a multi-tiered Thai roof, reminiscent of the palace at Ayutthaya.

During the reign of King Vajiravudh reign (1910-1925), some institutional buildings demonstrated the more thorough application of Thai elements. Thai architecture from 1932 to the end of the World War II in 1945 demonstrates the states of transition, in which various forms were established to meet new public demand. There were attempts to adapt the traditional Thai style to modern styles, which were mainly plaster works, bricks and concrete structures, during this period.

After the World War II, the search for national identity during the leadership of “Marshal Pibul” (1946-1957) resulted in another style of neo-traditional Thai architecture, which has been called “Applied Thai-Style Architecture”. During this period, institution buildings around Thailand were typically built with in this style. However, the Applied Thai Style was negatively criticized by many modern architects.

Since 1958, many economic development plans have been created to both promote and cope with economic growth. Bangkok was reconceived as a land-based city, and reconstituted by American planners in the 1960s. Efforts to adapt traditional Thai style to modern needs and construction techniques continued because the Applied Thai Style from the earlier period was still limited to government buildings.

In the second half of the 1980s, Thai identity was emphasized in modern buildings under rapid economic growth. Several approaches from various groups of architects were used achieve this goal. Many efforts were considered to be inappropriate by scholars. However, a few attempts found acceptance by creating Thai characteristics and atmosphere. Examples of characteristics used to represent the essences of modern Thai architecture included steeply pitched roofs, overhanging eaves, lightness, spatial arrangement and integration with nature.

The contemporary vernacular of northeastern of Thailand was explained by Thongsakul (2001) and based on the previous research conducted by Hengrasamee, Phalawattana and Sutthitham (1992). Thonsakul stated that the contemporary style in the study area tends to imitate styles created by property development companies. This contemporary style can now be found everywhere among suburban housing projects. This kind of house has a single story or two stories. Its structure is enclosed by concrete blocks or masonry walls and it is built with reinforced concrete. Roofs are built in hip or gable shapes, covered with concrete tiles or corrugated asbestos cement sheets.

All of these trends have affected the course of present-day Thai characteristics. In looking at examples of Thai buildings it is possible to identify numerous influences from earlier times and from contemporary practice both in Thailand and aboard. These buildings include “archetypal” forms, adapted forms and those “in between”.

As stated times in the introduction, this study concentrates on dwellings that build upon the *traditional Thai house*s, but exhibit distinct processes of adaptation. For clarify, I refer to them as "the *transformed Thai houses"* (Figures 26 and 27). In contrast, the example of contemporary house, which was designed to give it a traditional Thai appearance, is shown in Figures 28 and 29.

Figure 26

A transformed Thai house on river bank

Figure 27

A transformed Thai house on land

Figure 28

A contemporary house with Thai style

(Source: Public Works Department of Thailand, 2008)

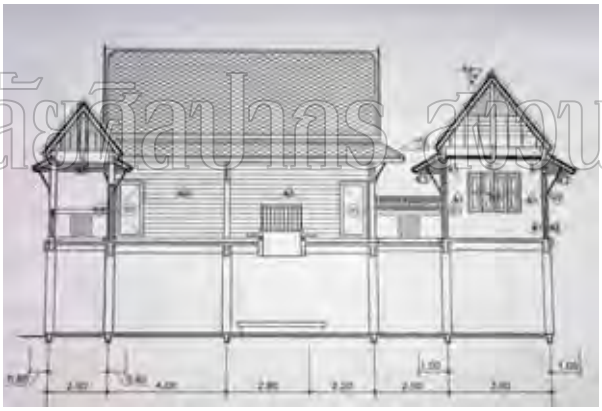


Figure 29

Cross section of reinforced concrete construction

(Source: Public Works Department of Thailand, 2008)

2.7 Previous studies on Thai vernacular houses

The first studies of Thai vernacular houses begun in the 1950s but the number of enthusiasts increased in the 1990s. Horayangkura (2001) has compiled a list of academic studies on Thai architecture and categorized into three main types: studies of regional houses; studies of impermanent houses; and studies of the houses of specific ethnic groups.

The study by Horayangkura has revealed that most of the studies focus only on the traditional houses and do not relate to contemporary vernacular houses. Only some studies are concerned with new or emerging vernacular houses, which have been transformed in recent times.

2.7.1 Studies on vernacular houses in the past

This category of research has focused on the traditional houses in the four main regions of Thailand: the central region; the northern region; the north-eastern region; and the southern region. Within this body of work, little has been written on the temporary houses and the houses of specific ethnic groups. Interestingly, the traditional houses that have been studied are the models that typically appeared during the eighteenth century to the nineteenth century.

The studies of the *traditional Thai house* in the central region were concluded in "The Status of Academic Outputs in Architecture in Thailand" (Horayangkura and et. al. 2001). The earliest article was written by Anuman-Rajadhon (1950) but the studies by Piromdah (1974) and Jaijongrak (1975) increased the interest of vernacular houses among Thai scholars. More studies on the *traditional Thai house* were produced in the 1990s and 2000s (Jaijongrak 2000; 1997; 1996; Silapanon 1997; Kullayanamitt 1996; Piromdha 2000; 1995; Paknam 1992).

In the 1990s, many studies of the traditional houses focused on the northern region is Kalae house (Panin 2002; 1997; Charoenpakul 1997; Jindawong 1997; Temiyabandha 1997; 1995). In contrast, studies of the traditional houses in north-eastern region (Nilathi 2002; Silpanon 1997; Srisuro 1995) and in the southern region (Rattanajarana 1995; Suwankiri 1995) are rare.

Horayangkura (2001) stated that only the studies of the *traditional Thai house* in central region show the measured works and some systematic analyses of the physical appearance of the houses. Most of the studies in the other regions were based by unsystematic analyses and lacked architectural details.

These studies as a whole provide a valuable understanding of the traditional house. However, studies in this group are limited by their own assumptions and definitions without the understanding of the dynamic nature of vernacular architecture. The proper vernacular houses, considered to be the "Thai authentic"

traditional building and deserved to be studied, are considered as only the houses in pre-modern times. From the literature review, it is clear that some scholars tend to work on traditional houses with similar focuses and results.

2.7.2 Studies on contemporary vernacular houses

Before the twenty-first century, there were only a few studies concerned about the contemporary vernacular houses. In the 1990s, only the studies by Temiyabandha (1995, 1994) reported on the changes of the traditional houses, "Kalae House", in northern region. He stated that in the contemporary "Kalae House", the building enclosures have usually changed with the use of new materials and the techniques of construction while retaining the characteristics of the floor plan. However, his studies lacked systematic analysis.

There have been increasing numbers of studies on the contemporary vernacular houses since in tern of the twenty-first century. These have included dissertation at University of Melbourne, University of Florida, and Chulalongkorn universities.

Pinijvarasin (2004) studied the Thai vernacular house in the central region and the relationship of architecture to its meaning. The study confirmed that vernacular houses have progressively changed in accordance with the change of the villagers' sense of well-being. Thungsakul (2001) studied about the vernacular living space in the north-eastern region. The study indicated a continuous transition of space-use pattern in accordance with the change of lifestyle.

Additionally, a few studies have been conducted at the master's level in Thai universities. Ladawan (2002) studied the settlement of hill tribe in northern region and concluded that the style of dwelling has changed according to social and economic shifts. Wongkham (2001) has explored the development of the vernacular house in the north-eastern region and concluded that the house style has changed while the patterns of plan and space have remained unchanged.

These research projects have begun the new direction in the study on Thai vernacular buildings. The expanded scope raises awareness and understanding of contemporary vernacular buildings. It refreshes as well trends in vernacular architecture studies in the new century (Vellinga 2006). However, there are still many

unexplored fields of research at an international and inter-disciplinary level that deserve examination.

2.7.3 Unexplored research topics

According to Vellinga (2006), studies that pay attention to recent and modern vernacular buildings are relative rare. Although not as exotic or distinctive as the traditional buildings, these are the majority of buildings in the context of society. They nonetheless have still not received the academic and professional attention. Vellinga has also noticed that all buildings, whether “traditional”, “modern” or “modernized hybrid”, should be regarded as vernacular because of their distinctive cultural expressions. The merging of old and new buildings still needs further studies.

Pinijvarasin (2004) has stated that there has been insufficient consideration of changes to Thai vernacular houses to response to changing socio-cultural conditions resulting from modern development. Because her research was in a single locality, she suggested a cross-cultural, comparative study. This type of study would highlight similarities and differences among various cultures, regions and societies. Two interrelated topics for further study were raised: 1. the study of local significance that has to be re-invented; 2. the study of applications of cultural and global knowledge.

Similar to the suggestions from Pinijvarasin, a comparative study was advised as the potential area of future research by Thongsakul (2001). Other potential topics were environmental behavior, meaning and value, and change of materials and construction technologies.

Horayangkura (2001) stated that there are three approaches of the studies on Thai vernacular houses: “contextual”; “interpretation”; and “evolution”.

There have been many fields of research in the area of contextual studies but most have concentrated on physical characteristics, and relationship between the houses and the people activities and beliefs. Also in this area, there has been increasing number of studies of climate responsive design. In contrast, the studies about construction and structure have been limited by few scholars such as Temiyabandha (1995; 1994).

Studies in the area of interpretation group have been increasingly conducted and have provided a better understanding of principles, descriptions and meaning of

the houses. Significantly, studies of “evolution”, which began in the 1990s, have continued to increase in the twenty-first century. Although there are courses on vernacular architecture in some Thai universities, this group still shows a lack of reference to international and inter-disciplinary work.

In conclusion, there have been a few scholars who focus on the contemporary vernacular houses. Importantly, studies about construction and structural factors are rare. None has been found on the contemporary vernacular house.

Chapter 3
Research Methodology and Sites

3.1 Introduction

The investigation of the transformation of the contemporary vernacular houses has been aimed at studying the physical appearance of the house and attitudes of the residents and local builders. The change of architectural elements was the key information of the study. Transformed and reproduced houses were used to discuss the development. Procedures of the study were as follows: research methodology; collection of data; analysis of data; research locations; and categorization of data in research sites.

3.2 Research methodology

The study involves a distinct method for analyzing of transformed houses. The methodology used in this study requires both qualitative and quantitative data. Samples were selected to be representative of the vernacular building stock in three study locations.

3.2.1 Research instrument

Survey forms were used to obtain the data of transformation and historical information. The survey forms were designed to investigate the various times when there were modifications and extensions. The various types of graphic documentation were used for data gathering during and after the site visiting.

Two groups of data have been analyzed: one set based on physical appearances and another set addressing historical development of the houses. The present physical appearance of the houses was obtained by physical observation, while an understanding of their historical development has required information that can only be revealed by the local residents themselves. Thus, the survey forms included two parts: Interview and observations.

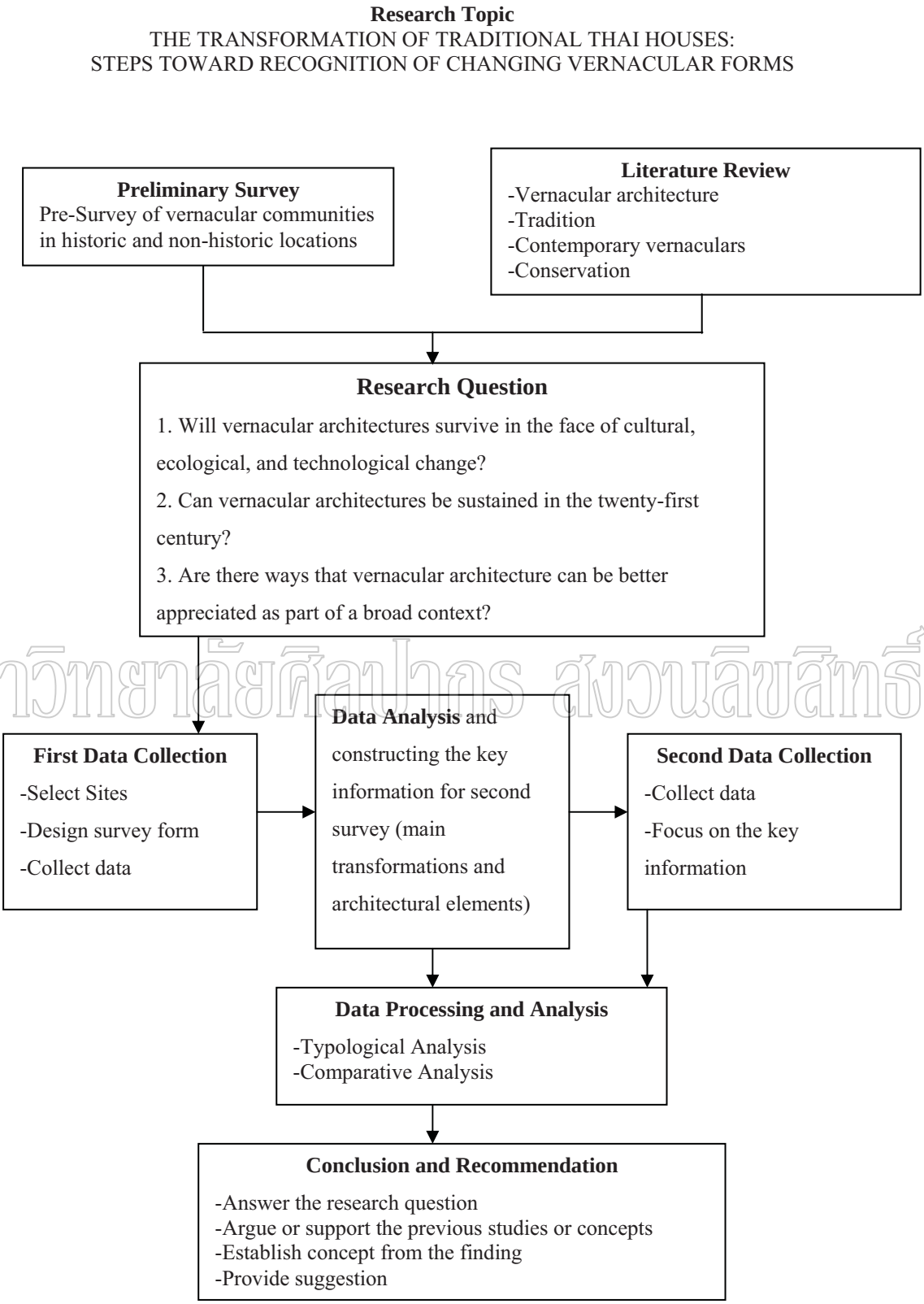


Figure 30

Research methodology and procedures

3.2.2 Collection of data

For gathering data, techniques used included direct documentation, interviews and observations. Photograph, drawing and sketching provided a way to observe the inside and outside of the houses. The graphic data of physical features resulted from the measurements and rough sketches. Data on modifications came from the interviews with household members.

Documents also helped the research and define changes within localities and the transformations of vernacular houses in the study areas. Primary sources of information about the research site came from municipal records and annual reports prepared by governmental agencies. In addition to documentary data, municipal officers were interviewed for history and background on the study areas.

Other supporting data derived from various government agencies. These included demographic information; reports about changes in the environment and surrounding areas of the locality, such as floods and the development of roads; and other information that could bring about changes to vernacular houses.

3.2.3 Analysis of data

Typological analysis is the main method used in this research. It has been frequently applied to the study of vernacular building (Oliver 1997). Typological analysis is a method of distinguish and organize time and place. This analysis is used factoring in limitations, such as geographical, technical or historical factors and reduced complex phenomenon, to establish principles that convey meaning. Classification, or typology, is not only a system of dividing things into different types, but is also an important analytical tool for establishing the idea of continuity and process of change in architectural form over time.

To analyze the house transformations, construction components are presented by means of several types of drawings. Elevations, plans and cross sections are taken into account. In some cases, three dimensional drawing indicate features that reveal the key transformations. Along with drawings, observational and interview data are used to better understand the transformations.

In addition to typological analysis, descriptive statistics and the residents' narrations are used to clarify the historical developments. The data from the residents'

narration are used to reveal the historical developments which can not acquired from the observation. Furthermore, the analyses are based on the comparative study of various locations.

3.3 Research locations

To answer the research questions, it is necessary to conduct an in-depth study in specific areas that are categorized as vernacular. A case-study approach is important to provide an exploration of the house transformation.

Case studies from different regions or from different localities provide more opportunities for comparative perspective than those taken from one location. Although Thai vernacular houses in different regions or localities display some similarities in architectural features, they are always different in the details of physical appearance and the activities and beliefs of the residents (Panin 1999; Temiyabandha 1994). A comparative study could show contrasts or clarify similarities among different type (Rapoport 1981). Case study in one location is suitable for a study that requires very detailed information and has limitation of time.

This study applied a case-study approach in two or three localities that will provide comparative detail of the houses. The sampling process in each locality needed to contain all types of transformations and developments.

3.3.1 Selection of Ayutthaya

The vernacular house considered to be the most classic Thai house is that of the central plain. This is where Thailand's kingdoms of Ayutthaya, Sukhothai and Bangkok are located (see Appendix A) and where the Thais reached the peak of their culture and power (Jotisalikorn 2002).

The centre of Ayutthaya province is one of Thailand's most valuable cultural heritage areas. It is also known for being one of the major locations of *traditional Thai houses*, sometimes called "classic Thai houses". Accessibility from Bangkok City (75 km), the cross-region motorway and influences of urbanization and modern development have accelerated changes to the local character of the province (Figure 31). Despite their historical importance, *traditional Thai houses*, which have been the

key feature of the cultural landscape in this province for a long period, are now diminishing in quantity and changing in their architectural characteristics.

The choice of Ayutthaya as the province of the study areas was a response to the following:

1. Ayutthaya has a several distinct sites and types of sites: suburban, rural, and motorway locations;

2. It has an adequate number of the contemporary vernacular houses that can be related to *traditional Thai houses* for analysis;

3. It has householders who live a traditional lifestyle;

4. It is typical of the central provinces. So, the research results can be applied to other provinces; and

5. It has an already developed conservation plan as a *World Heritage Site* in the city centre. The findings from the study can be applied to the action plans under an existing master plan.

Figure 31
Map of Thailand and Location
of Ayutthaya Province

Ayutthaya was the capital of Thailand for 417 years (from 1350 to 1767). It is presently both an ancient city and a modern city with a population of around 727,000. The province occupies an area of 2,547 square kilometres and is located 76 kilometres north of Bangkok (Figure 32). A shift from agriculture to manufacturing and service sectors became apparent during the 1980s (Chulalongkorn University 1980). Part of the city centre was declared a UNESCO World Heritage Site on 13 October 1991, and a second master plan for conservation and development was released in 1999 (Pinijvarasin 2004). The magnificent craftsmanship of its architecture, mural paintings, sculptures, and fine art was handed down to the Rattanakosin era, 1768 to 1851 (Horayangkura 2001).

Figure 32
The locations of Ladchado (1),
Bangpahun (2) and Pakkran (3)
(Source: Silpakorn University 1999)

A number of research projects have been conducted in Ayutthaya. One of the most important studies, relating to vernacular architecture, is the project called Masterplan II entitled the "Conservation and Development of Ayutthaya the Historical City (1997–1999)". The aim of this project was to prepare a plan for conserving the archaeological and heritage value of Ayutthaya's historical city. The

project was divided into disciplines such as history and archaeology, vernacular architecture, landscape architecture, sociology, economics, and tourism.

In regards to Ayutthaya's vernacular houses, the master plan project concluded that Pakkran retained one of the best sampling of vernacular dwellings and environments in Thailand. However, there is no action plan, applied to the area at the present (Pinijvarasin 2004 and see "Laws and Regulation" in Appendix B).

The boundaries of study within Ayutthaya province were chosen to fulfil two requirements: to calibrate different rates of change due to locations relative to transport networks; and to determine the influence exerted by the policy for the World Heritage Site and the zoning regulations for the urban and rural areas. After surveys of potential sites, Pakkran village, Ladchado village, and Bangpahun area were selected (Figure 33). Both village sites display a degree of variety of traditional houses and also have cases of transformed houses. The more disposed Bangpahun area also presents an excellent range of examples of house types including the modern fashion reproduction.

Figure 33
The locations of Banpahun (2) and Pakkran (3)
near the World Heritage Site
(Source: Silpakorn University. 1999)

3.3.2 Selection of study areas

Preliminary selections of study areas were suggested by researchers involved in previous studies. After a visual survey of potential sites, Pakkran village, Ladchado village and Bangpahun area were selected because of the quantity and variety of the houses that met the requirements for the research. The data on villages and the area and the numbers of vernacular houses were based on information collected by government offices and public health centre of sub-districts in 2008.

3.3.2.1 Pakkran Village

Pakkran is considered to be one of the best sites for vernacular settlements in Ayutthaya district (Panin 1999). The area is located about 2 kilometres from the UNESCO World Heritage Site, and is directly linked to the city centre (Figure 34). The new conservation master plan will include Pakkran in the expanded conservation area (Silpakorn University 1999). Surveyed by local government officer, the village includes 980 houses, half of which can be interpreted as transformed from the *traditional Thai house*. The information in this research derives from observations and interviews with the resident from around 5% of 490 houses. These samples are classified as "*transformed Thai house*". In this study, Pakkran is categorized as "a village in suburban area".

In 1975, a road was constructed through the village (Figure 35). This road has made the houses more accessible. The development and the addition of sub-local roads within the villages have changed the access from the river to the roads.

A number of modern period houses and contemporary houses built entirely of concrete are now appearing among vernacular houses. There are modifications that have transformed almost every *traditional Thai houses*. This phenomenon is thus changing the overall environment of the locality.

3.3.2.2 Ladchado Village

Ladchado village is located in the northwest part of province, about 40 kilometres from the city centre. The village, surrounded by often flooding agricultural fields was established in the 1760s. Surveyed by local government officer, there are 2,100 houses and half of these houses have been transformed from the *traditional*

Thai house to the transformed houses as of 2008. The information in this research is derived from observations and interviews with residents from around 5% of 525 houses. Similar to the houses in Pakkran, these samples are classified as "*transformed Thai house*". In this study, Ladchado is categorized as a village in rural area.

Ladchado village currently is defined as the main center for Pakhai district. Compared with the other sites, Ladchado was the farthest from the city centre and transportation network (Figures 36). Ladchado village probably contains vernacular houses that are transformed from the *traditional Thai houses* more than any other villages on the Ayutthaya border. It is initially assumed as well that this village has maintained living conditions close to the vernacular tradition.

The houses in Ladchado village are arranged in clusters, usually occupied by people closely related to each other. The clusters are linked by concrete or wooden bridges, used in the flood periods. Transportation has traditionally relied on the river until the first main road on the northern side of the village was constructed in 1985 (Figure 37). Most of the houses in the village had been inaccessible by car until construction of first local road, finished in 2004.

3.3.2.3 Bangpahun Area

The Bangpahun area, a buffer zone along the main motorway, was chosen to as a comparison site for the vernacular villages. The motorway, connecting Bangkok to northern Thailand, was constructed in the 1960s and has become one of the importance motorways in the country (Figures 38). However, the Bangpahun village, located close to the buffer zone and once the site of many *traditional Thai houses*, does not fall within the scope of this study. The villagers sold their old traditional houses and built new houses in different styles after the construction of the motorway (Figure 39). Bangpahun village has changed greatly to become modern in many ways. Most of the *traditional Thai houses* have disappeared but there are an increasing number of contemporary style houses.

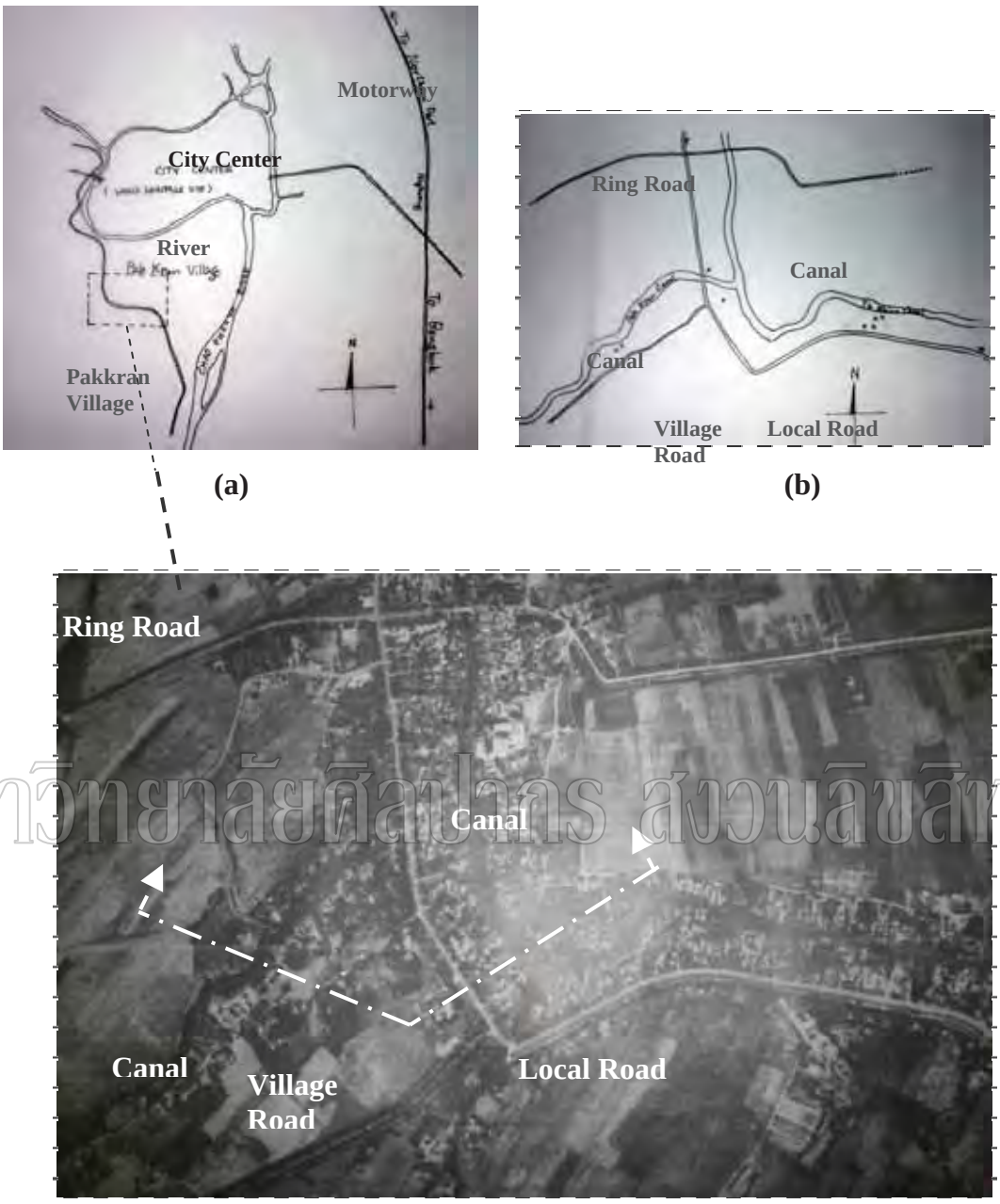
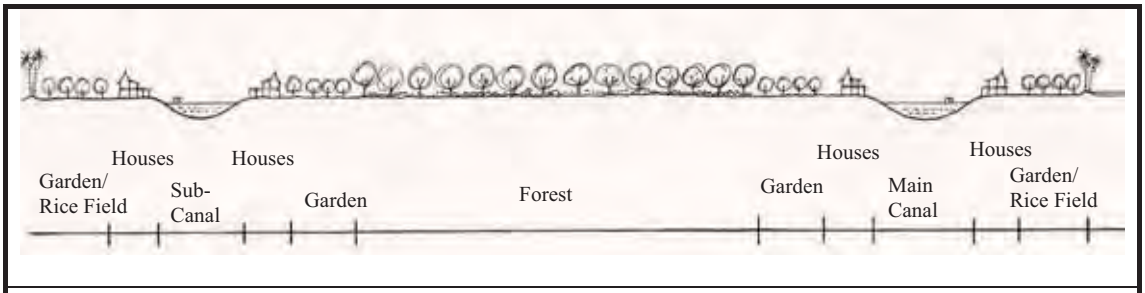


Figure 34 Pakkran village in 2008

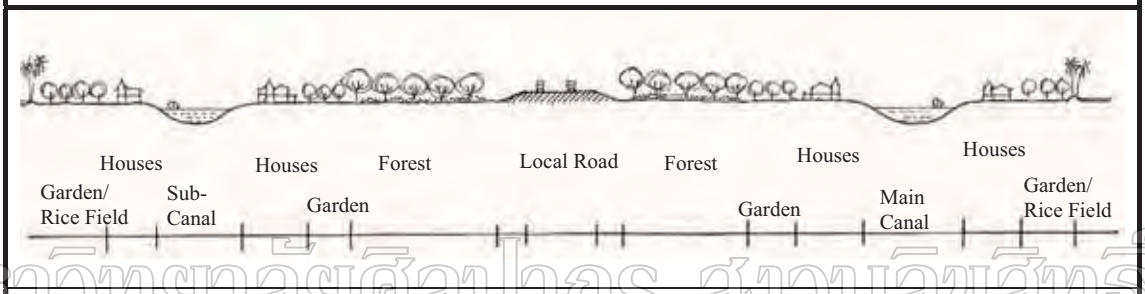
(a) Location of the village comparing to the city centre

(b) Canals and road in the village (c) Aerial photograph of the village

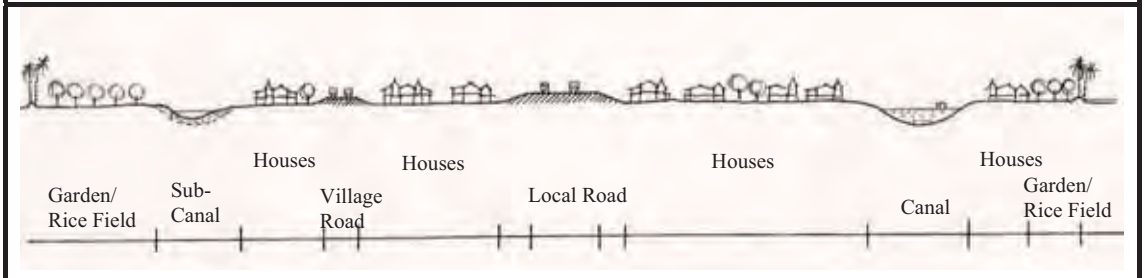
Source: Division of Aerial Map Collection of Thai Army, 2008



Year: 1950s
Appearances of the settlement:
-Linear settlement along the canals



Year: 1975
Changes of the settlement:
-Beginning of the local road along the main canal
-No flooding in some areas since the construction of the local road



Year: 2008
Changes of the settlement:
-Road inside the village
-Lack of use of the sub-canal
-No flooding since the construction of the village road in 1990s

Figure 35 Cross section of Pakkran village in 1950s, 1975 and 2008

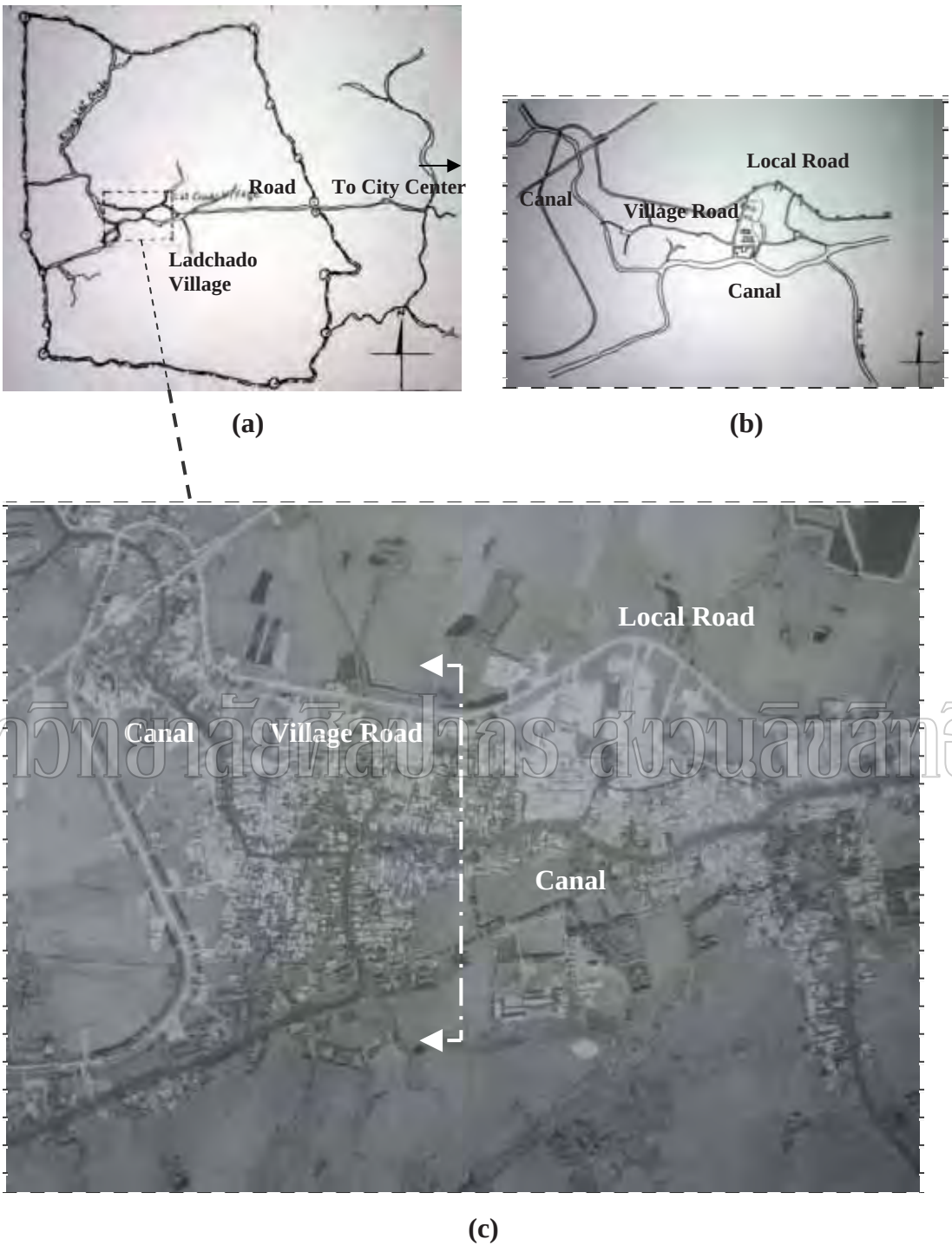


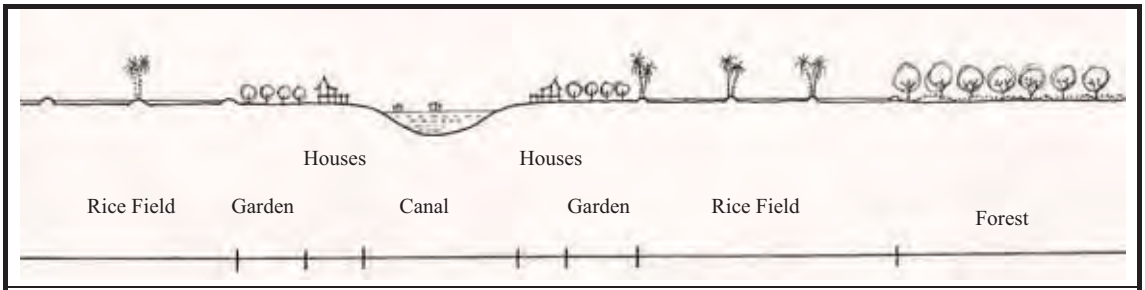
Figure 36 Ladchado village in 2008

(a) Location of the village comparing to the city centre

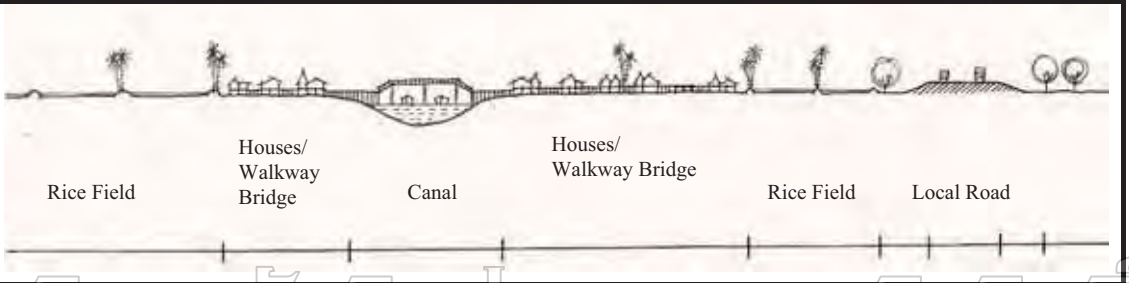
(b) Canals and road in the village

(c) Aerial photograph of the village

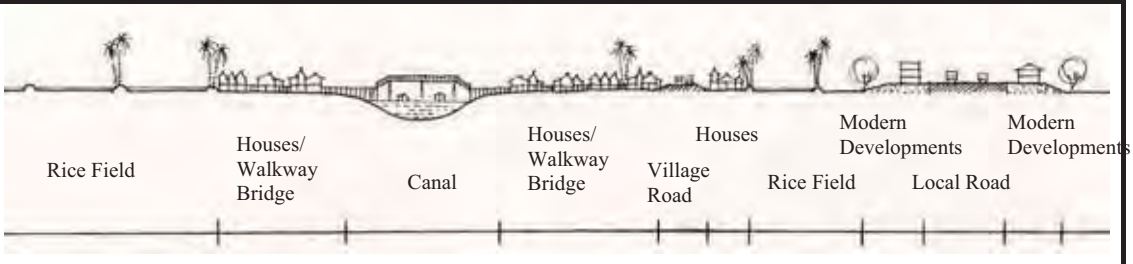
Source: Division of Aerial Map Collection of Thai Army, 2008



Year: 1800s
Appearances of the settlement:
-Linear settlement along the canal
(Serious damage of fire in 1938)

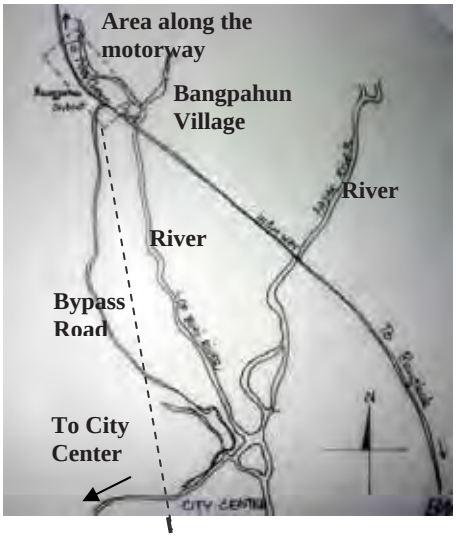


Year: 1980s
Changes of the settlement:
-Extending of cluster settlement behind the linear settlement
-Beginning of the walkway bridge network
-Beginning of the local road close to the village

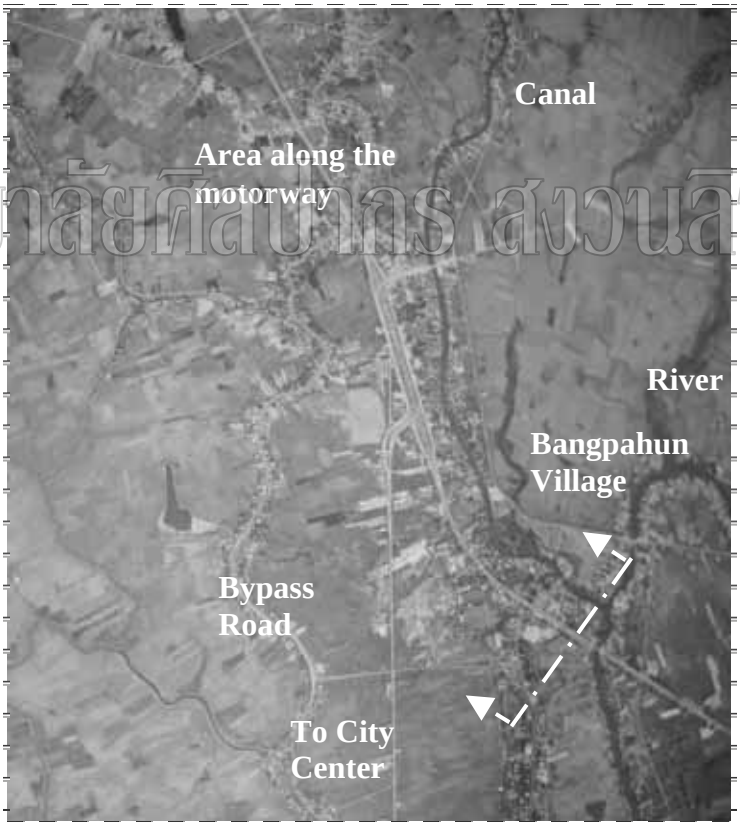


Year: 2008
Changes of the settlement:
-The asphalt road replacing the main walkway bridge in the village
-No flooding in some areas since the construction of the village road in 2002
-Beginning of modern buildings along the local road

Figure 37 Cross section of Ladchado village in 1800s, 1980s and 2008



(a)



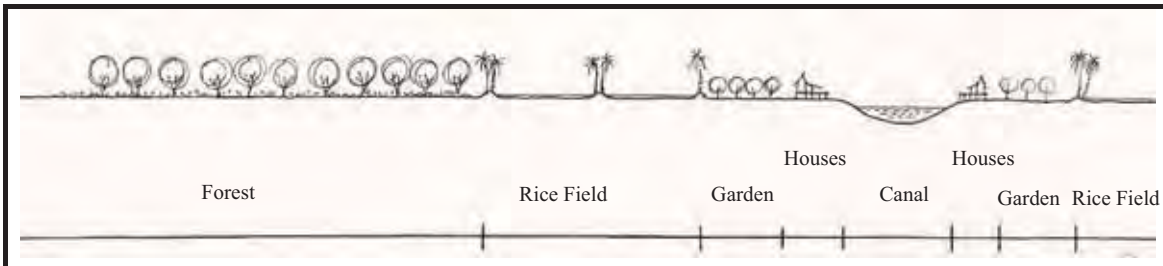
(b)

Figure 38 Bangpahun area in 2008

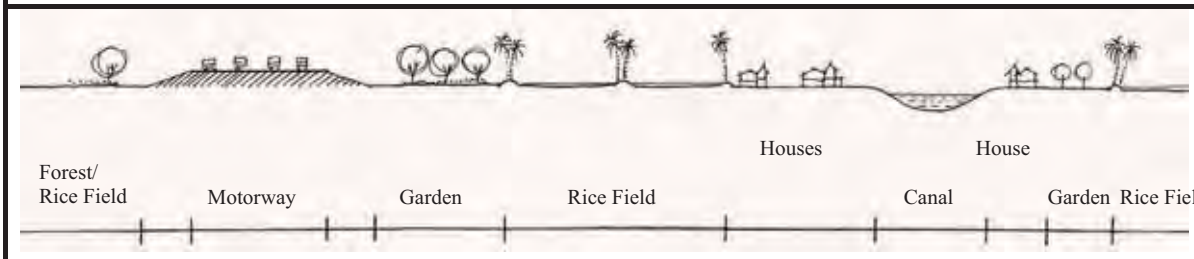
(a) Location of the area along the motorway comparing to the city centre

(b) Aerial photograph of the area

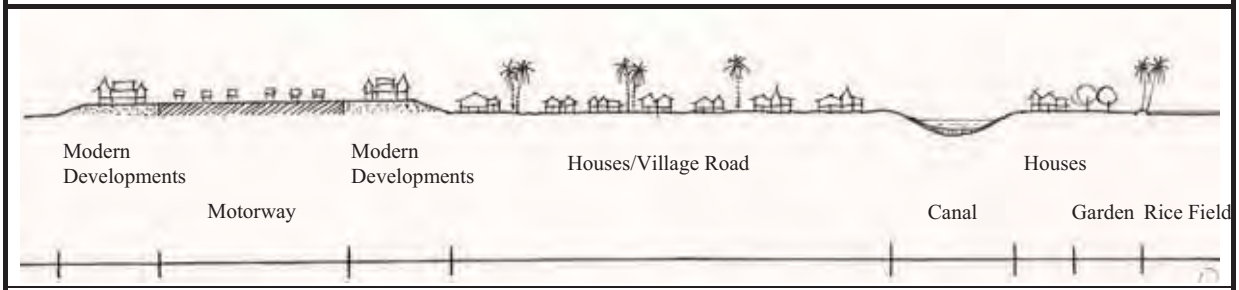
Source: Division of Aerial Map Collection of Thai Army, 2008



Year: 1950s
Appearances of the settlement:
-Linear settlement along the canal



Year: 1970s
Changes of the settlement:
-Extending of settlement behind the linear settlement
-Beginning of the motorway (4 lanes)



Year: 2008
Changes of the settlement and area along the motorway:
-Expansion of the motorway to 8 lanes
-Cluster settlement with village road behind the linear settlement
-Local builders establish the workshops along the motorway
-Many modern developments including the reproduced Thai houses along the motorway

Figure 39 Cross section of Bangpahun village and the area along the motor way in 1950s, 1970s and 2008

In addition to traditional houses, as of 2008, there are about 30 houses, built in the “revival style”, in Bangpahun area. The information for this project is derived from observations of and interviews with residents of around 25% of 30 houses. The buildings in the revival style are the result of local house builders adding to traditional house or simply building new houses in a distinctive “Thai revival style”. Many local builders have maintained their careers by building houses for foreigners or urban people. The new customers are rich or have the budget to support the revival of the traditional house forms. These houses are suitable for new life styles, bigger than *traditional Thai houses* extended by local residents, and uses upgraded materials. The builders often try to maintain some characteristics of Thai houses. Most of the houses located along the motorway belong to local builders. In this research, these houses are classified as *“reproduced Thai house*”.

3.4 Categorization of data in research sites

The aim of this section is to clarify the categorization of nontraditional characteristics, which is important for the discussions in chapter 5 and chapter 6. In the literature review, traditional characteristics have been described in section 2.3 and section 2.4. The development of vernacular buildings in Thailand was also explained in section 2.5. In this section, the categorization of nontraditional characteristics is defined by more recent historical periods and current developments in Thailand. From Table 1, it is seen that groups of Thai vernacular houses are classified by period and development into three categories: traditional, intermediate and contemporary. Characteristics of the nontraditional groups are described below.

3.4.1 Characteristics in the intermediate period

In this study, a set of intermediate characteristics is defined by the style and technologies used in the vernacular Thai villages from the 1920s to the 1970s. Horayangkura (2001), who defined this development period, emphasized that the first steel bridge in 1932 in Thailand introduced a new era of technological advancement. Puvanant (1999) supported that this period was the beginning of the use of new forms of construction materials and features. Many construction material factories opened during this era as well.

When modern styles and new manufactured materials began to be common to the urban housing in this period, *traditional Thai houses* were initially adapted to modern construction and manufactured materials. The data of style or characteristic in the study areas will be discussed in chapter 5 and 6.

Table 1 Period of development and characteristics of the vernacular Thai houses

	Sukhothai/ 1st Capital	**Ayutthaya/** 2nd Capital	**Bangkok (Ratanakosin)**/3rd Capital (Divided by period of Kings and policies)			
			Early	**Colonialism**	**Transition**	**Current**
Period (AD)	1238-1349	1350-1767	1782-1851	1851-1925	1925-1983	1983-2007
National Influence	India	China, Khmer	Europe	Europe	U.S.A.	International
Architectural Impact	-	-	Westernization	Westernization	Modernization/ Industrialization	Post-modernism/ Globalization/ Localization
House Style	Sukhothai Tradition	Ayutthaya Tradition	Thai (Siamese) Tradition	Thai Tradition/ Colonial Architecture	Modernism	Sustainable Architecture/ Architectural Identity
Characteristic	Tradition	Tradition	Tradition	Tradition	Inter-mediate	Contem-porary
Pakkran Village (Suburban) Develop-ment				Beginning of village (1900s)	Road (1974)	
Ladchado Village (Rural) Develop-ment			Beginning of village (1700s)	Big Fire (1938)	Walkway bridge (1975)	Road (1985, 2004, 2005)
Bangpahun Area (Highway buffer area) Develop-ment				Beginning of Village	Beginning of development along the construction of motorway (1970s)	

Note: 1. The data of *year, influence and impact* are derived from Horayangkura's diagram in 2001

2. The period of developments is taken from the sub-district bureau of Thai government in 2008.

3.4.2 Characteristics in the contemporary period

This category is defined by the style and technologies used in vernacular Thai villages from the early 1980s to the current. Horayangkura (2001) and Puvanant (1999) similarly placed the latest development in this period because of the rapid development growth experienced during this time. Thailand has been recognized as one of the "Newly Industrialized Countries" by the end of the 1980s. Puvanant (1999) mentioned that Thai consumers of urban housing projects always prefer imported-looking materials, new technologies and modern styles.

The construction process characterized by this category is currently employed by contractors and real estate developers. The process is typically used with suburban housing projects but has begun to be used in rural areas as well. Contemporary materials include pre-cast and cast-in-situ concrete (usually professionally built), glass, concrete block, concrete roof-tiles, and terracotta floor-tiles. Steel is used for the roof structure, ceiling joist and wall studs. Aluminum is common for covering extended garages or for additional shading elements.

Chapter 4
Transformation of the traditional houses

4.1 Introduction

In this chapter, the idea of the "*transformed Thai house*" is explored to clarify the process of change in physical character and appearance. This change has occurred rapidly in the last few decades. In this study, vernacular houses in the study areas are categorized into three types: the *traditional Thai house;* the *transformed Thai house;* and the *reproduced Thai house.* The *traditional Thai house* is considered as an archetype, with respect to the changes to be evaluated. Both the *transformed Thai house* and the *reproduced Thai house* are derived from the *traditional Thai house* but are developed from a different basis. The *reproduced Thai house* is a new development and is examined to better understand the trend of the vernacular houses; while the old house found in the *transformed Thai house* is considered as one of the Thai heritages. Therefore, the two types of investigated houses provide important examples of development and sustainability for traditional houses in Thailand.

The *transformed Thai house* is a combination of traditional house and modern modifications or extensions. In this kind of house, the residents have stopped using traditional forms. Their house may have a modern look in the extension, but they are usually constructed with local knowledge and cheap labour. Differently, the *reproduced Thai house* is built by merging traditional forms with modern appearance and components. These houses are newly constructed, using more modern methods and are redesigned as whole buildings. The houses are usually built or supervised by the builders who have experiences of building *traditional Thai houses*.

In Section 4.2, the analytical tool in this chapter is described. This part also explains the work prepared before the on-site survey and the sources of the acquired information. The main parts of the houses and functions are explained in Section 4.3. A comparative archetype has been established to measure change, and the original buildings in the study area are described in Section 4.4. The major transformations of vernacular houses in the city centre area and the rural area are then analyzed in

Section 4.5, including their construction elements. As a comparison to the study of transformation, the development of the reproduced vernacular houses is described in Section 4.6. Conclusions are drawn in Section 4.7.

The aims of the analysis in this chapter are intended to explain the physical appearance and the major transformations of vernacular houses relating to architectural elements. The aim is also to clarify what lies behind recent vernacular houses.

4.2 Typological analysis of the transformation

The concept of typology is an important analytical tool for investigating the idea of continuity and process of change in architectural form over time. As described in Section 3.4, the information used in this study was derived from direct observation and by interviews conducted in 2009 with 62 households; 23 samples in Pakkran village; 31 samples in Ladchado village; and 8 samples in Banpahun area (see plans and elevations of the samples in Appendix C). Fifty-four of the houses recorded belong to the class of *transformed Thai houses* and the rest are *reproduced Thai houses*. The number of *reproduced Thai house*s is relatively small because of the limitation of house population in Bangpahun area.

Architectural element grouping were defined prior to the field research in order to avoid confusion during the on-site observation. From a review of previous studies, the elements were classified into two primary groups: structure and cladding. Structure includes example of foundations, ground level columns, upper level columns, ground level beams, upper level beams and roof structures. The cladding sample includes example of ground level walls, upper level walls, ground level floors, upper level floors and roof cladding.

Components of the houses are illustrated by photographs and drawings. The images and types of drawing, such as isometrics, plans, elevations and cross sections, are emphasized by shading, line and arrow. Simple statistics are used to show general trends in size and the year of development. The charts and tables illustrate the differences between the vernacular houses and the archetype.

The analysis is comprised of five steps:

1. Classifying the main parts of the vernacular houses from the previous studies and indicate their transformation;
2. Defining the archetype;
3. Grouping the construction elements which will be discussed;
4. Discussing the transformation and data from the survey;
5. Identifying essential issues of recent vernacular houses.

4.3 Classification of spaces and functions

For the purpose of studying the modification and growth of houses over time, the houses are divided in ground level and upper level. Table 2 provides a classification of internal and external spaces for each residence, identifying principle functions and major physical transformations.

The change in the physical appearances of the four types of the vernacular houses in the study areas are illustrated in Figures 40 to 43. The main spaces are represented by numbers 1 to 7 in three views: plans, isometric views and sections of the houses. The traditional buildings are shaded for comparison with various other house types. Using this technique, the *traditional Thai house* is fully shaded, while the *reproduced Thai house* is not shaded. The *transformed Thai houses*, which are the main focus of this study, are drawn from two vernacular villages, Pakkran and Ladchado. These houses are shaded to indicate original parts and left un-shaded to the extended or modified parts.

Table 2 Functions and transformation of spaces of the vernacular houses

Space	Level	Function	Transformation
1. Central terrace	Upper	Socializing, living and working	- From a central terrace to a hall (Outdoor to enclosed space) - From a multi-level floor to a single level floor
2. Area under a raised dwelling	Ground	Socializing, living, working and eating	- Added a ground level room - Compact soil to a concrete floor
3. Bedroom unit	Upper	Sleeping and storage	- Link directly to a hall instead of the intermediary of a verandah
4. Verandah	Upper	Socializing, sleeping and eating	- Combined to be part of a hall - Build a porch at front
5. Kitchen unit	Upper	Cooking	- From separated unit to part of a hall
6. Dining area	Upper	Eating	- From a verandah and a terrace to a hall
7. Bathing area	Ground/ Upper	Bathing and Sanitary	- From outside to inside

The classification of parts is based on the documentation by previous researchers. The studies conducted by Pinijvarasin (2004) and Thungsakul (2001) are amongst the useful sources. The explanations of the functions and features are concluded from the interview and survey. The reasons for the transformations will be discussed in Section 4.5.

4.3.1 Central terrace

This part of the *traditional Thai house* is a core for circulation and activities. Since the bedroom and kitchen are separated units, the ventilation is maximized through the walls. In some examples, the area of building unit is less than the area of central terrace. In a *transformed Thai house*, the central terrace is enclosed to form a hall. It is usually used for many purposes, such as family socializing and entertaining, watching television, and finishing schoolwork. In the *transformed Thai house*, the hall is also a sleeping part for family member, relatives and very close friends of family members.

4.3.2. Area under a raised dwelling

In daytime, the area under the building is a common area for daily routines. In the afternoon, a shady space in this area is the most comfortable to live, as the temperature rises up at the upper level. This part of the house is built without walls and is comprised of a raised platform on top and an earthen floor. For many functions, it could be exchanged with the central terrace. Furthermore, it provides ventilation for the residents at the upper level through floor gaps and steps. During floods, it becomes a place to moor boats. Activities include food preparation, child care, socializing with neighbors, receiving guests, handicraft works and domestic tasks. Some residents use this area for relaxing, parking cars, selling goods, and storing agricultural products and equipment. The area could also be used to keep cattle, pigs, and poultry.

4.3.3 Bedroom unit

The sleeping areas can be located in many parts of the upper level. One of the sleeping areas is usually a bedroom unit. It is a closed, not allowing by visitors. In most houses, residents sleep on mattresses laid over mats and under mosquito nets. In the *traditional Thai house*, all family members sleep in the bedroom unit with a separate room provided for daughters, the latter of which is a very private zone. This room is also used as a spirit room and storage room for precious belongings.

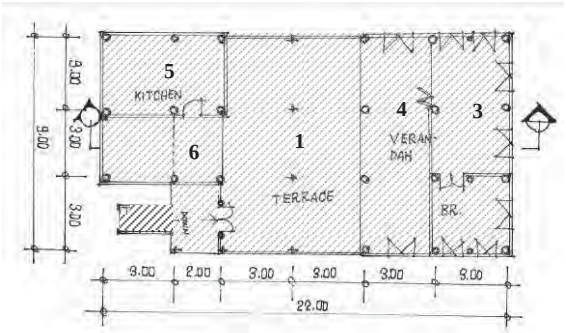
During summer, sleeping may sometimes take place in the verandah because of its better ventilation. In the *transformed Thai house*, most of the households stated that they sleep in the hall. The bedroom is abandoned and then used for praying and storage. As a result of this practice, the sleeping area is not only the bedroom because the activity could take place in other areas.

4.3.4 Verandah

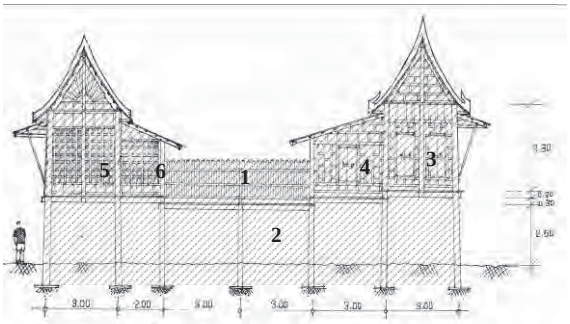
The verandah is one of the dominant parts of traditional houses in Thailand, because it appropriately responds to the traditional Thai life style and beliefs.
In the *traditional Thai house,* it is normally located between the bedroom unit and the central terrace. The verandah is partially-covered, shaped as a strip platform and raised above the central terrace.

Traditional Thai House (Archetype)

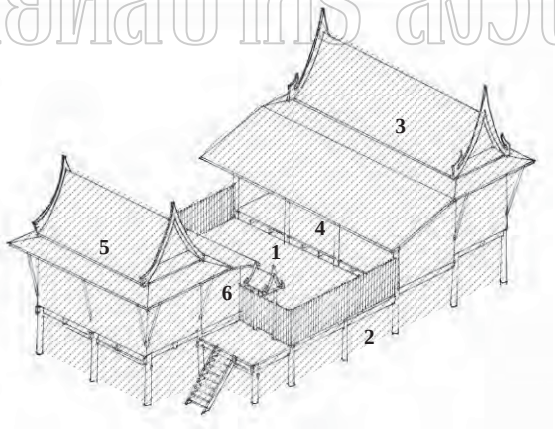
Plan



Section



Isometric



Key:

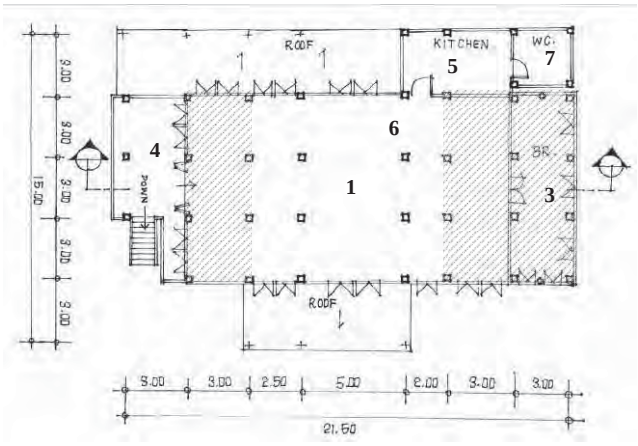
1. Central terrace
2. Area under raised floor
3. Bedroom unit
4. Verandah
5. Kitchen unit
6. Eating part

Source: House no. P-PK-13 **Note**: The original buildings with traditional style are shaded.

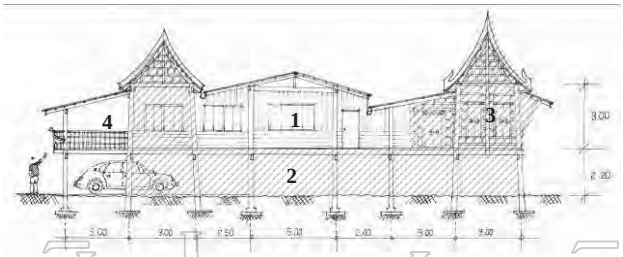
Figure 40 Plan, Isometric and Section of the *traditional Thai house* (Archetype) in Pakkran (Drawn by Punpairoj 2009)

Transformed Thai House

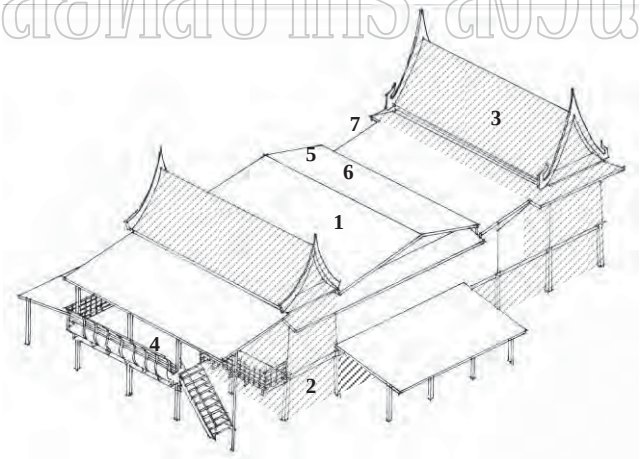
Plan



Section



Isometric



Key:

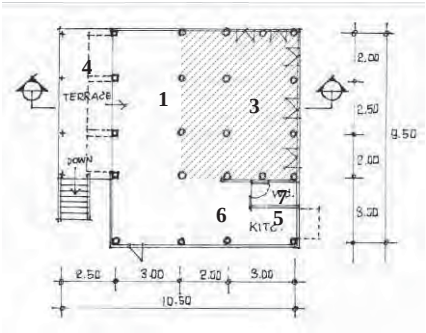
1. Hall
2. Area under raised floor
3. Bedroom unit
4. Porch
5. Kitchen unit
6. Eating part
7. Bathroom

Source: House no. P-PK-02 **Note**: The original buildings with traditional style are shaded.

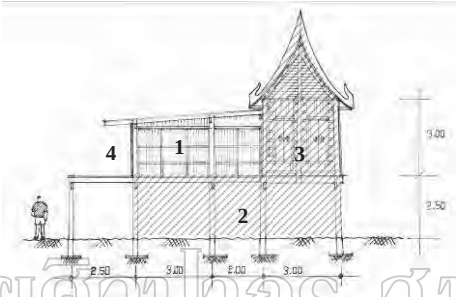
Figure 41 Plan, Isometric and Section of the *transformed Thai house* in Pakkran (Drawn by Punpairoj 2009)

Transformed Thai House in Ladchado

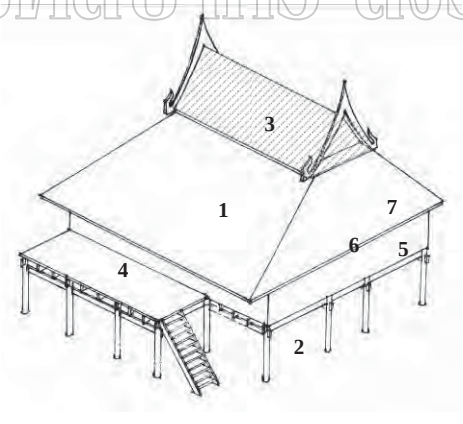
Plan



Section



Isometric



Key:

1. Hall
2. Area under raised floor
3. Bedroom unit
4. Porch
5. Kitchen unit
6. Eating part
7. Bathroom

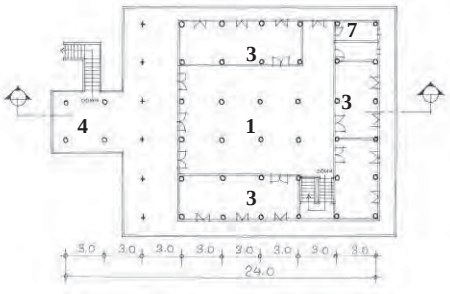
Source: House no. P-LD-09 **Note**: The original buildings with traditional style are shaded.

Figure 42 Plan, Isometric and Section of the *transformed Thai house* in Ladchado (Drawn by Punpairoj 2009)

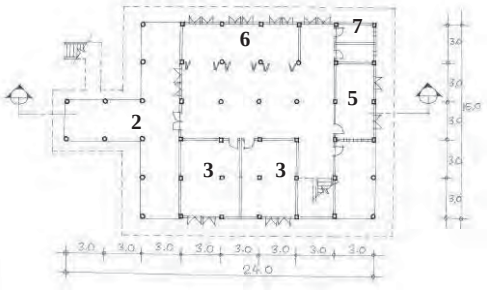
Reproduced Thai House in Bangpahun

Plan

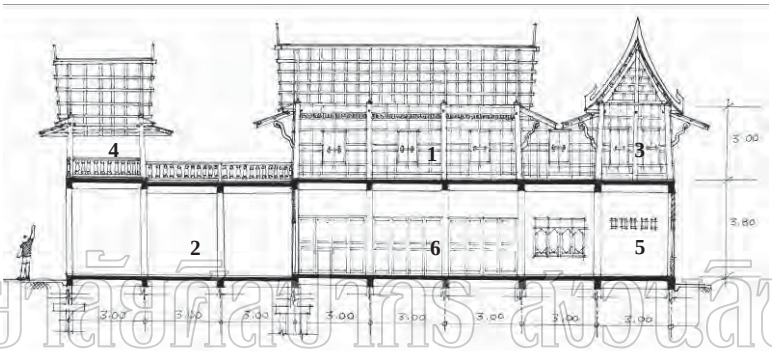
Upper level



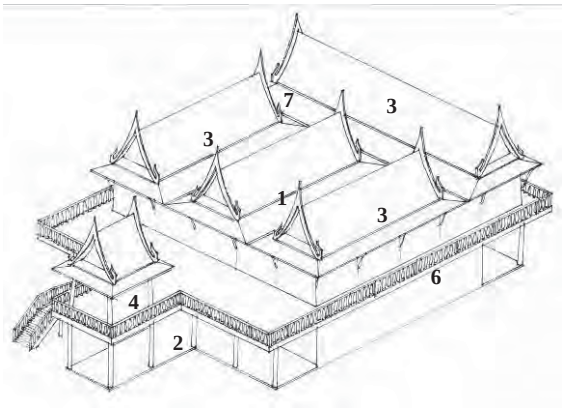
Ground level



Section



Isometric



Key:

1. Hall
2. Area under raised floor
3. Bedroom
4. Porch
5. Kitchen
6. Dining room
7. Bathroom

Source: House no. D-BH-11 **Note**: Whole part of building is newly constructed.

Figure 43 Plan, Isometric and Section of the *reproduced Thai house* in Pakkran (Drawn by Punpairoj 2009)

The verandah functions as a transitional space for the multi-level floor. Many activities are performed in this portion of the building, including family members taking rests or naps. It is also regarded as an informal place for family living. The verandah is sometimes used to receive guests who have a close relationship with family members. The verandah is kept clean so that it can be used for sitting or reclining (Jaijongrak 2000).

4.3.5 Kitchen unit

The kitchen unit typically is located at the back of the house, at the corner of the central terrace or hall. Furthermore, it is often located on the northern side of the building because of the direction of the wind from the south. If the family could not afford to have a kitchen, the verandah was used as a temporary kitchen. However, it is typical to have a separate kitchen from various reasons: to prevent fires; to separate living parts from smell, dirt and ashes created from uses of charcoal; to separate the orderly living parts from the untidy cooking area; to better ventilate the bedroom unit; and to divide the activities of men and women (Jotisalikorn 2001).

The residents explained that the usual meals are prepared in the kitchen, but these important meals usually are prepared in the area under the dwelling. These meals are for festival days or for formal guests. The family may spend more than half a day in food preparation. Some cooking requires multiple cooks and helps, large space and outdoor area.

4.3.6 Dining area

As in other Southeast Asian cultures, the residents of Thai houses usually rest, sit and eat on the floor, which is kept carefully clean. The residents and visitors have to remove the shoes when entering a house. There is no unit or area function as a dining room either in the *traditional Thai house* or the *transformed Thai house*. Eating activities take place both on the verandah and central terrace. In a transformed house, this activity takes place in the hall close to the kitchen unit. Some meals are arranged under the dwelling, when there are social ceremonial events take place.

4.3.7 Bathing area

In the traditional house, there is no bathroom or toilet. To relieve themselves, people went to the fields or used a vessel and threw the waste away. Bathing was done in the river, canal or on the terrace. With the construction of new parts, an internal bathroom is often included. Toilets are sometimes located at the ground level at the back of the house. However, most of these are now built at the upper level and attached to the central hall.

4.4 Archetype of the traditional house in study areas

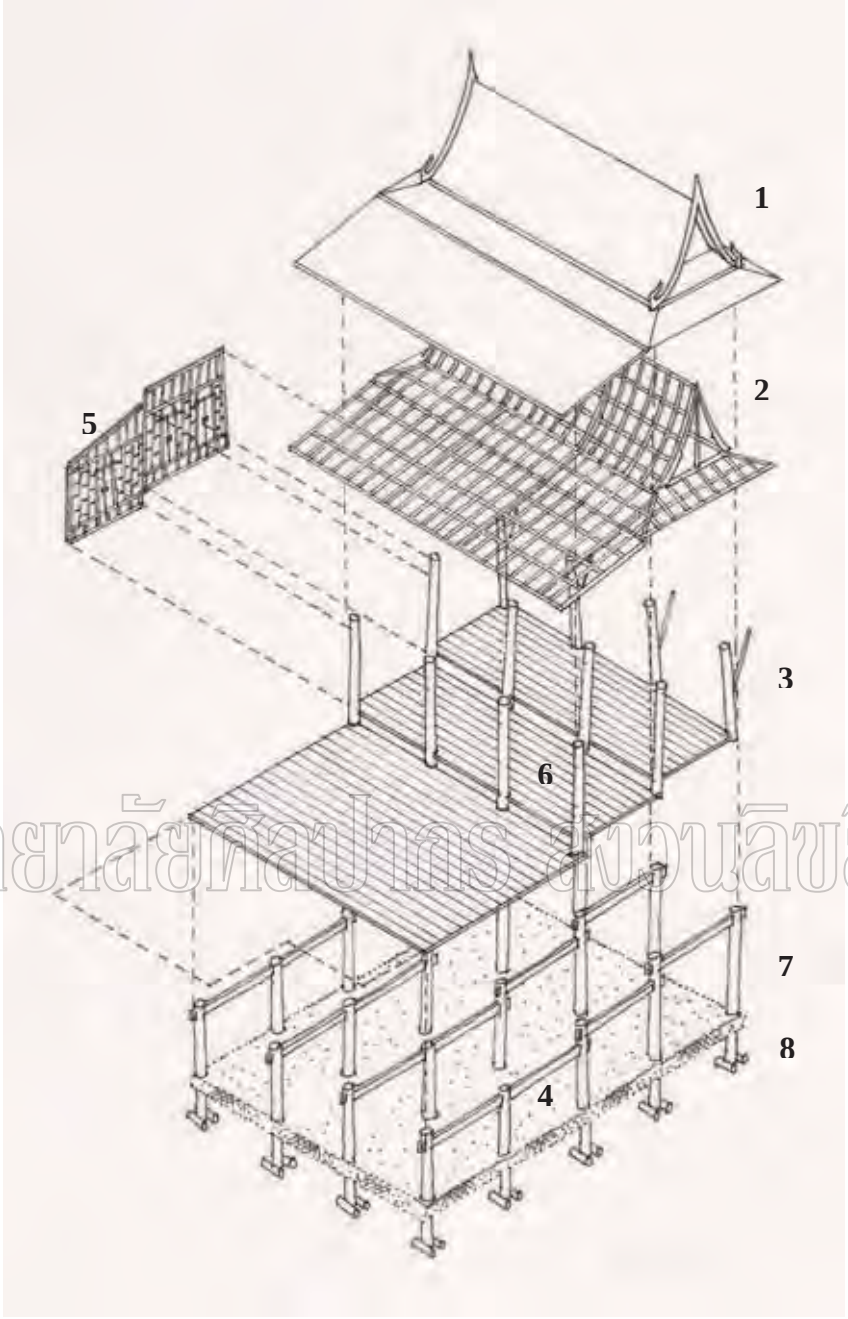
From the previous studies in Section 2.2, there are many types of vernacular building in Thailand. The archetype of the vernacular building in each region is different but can be conceived as five main types: Northern; Hill-tribe; Eastern; Middle; and Southern style. Generally, only the vernacular house associated with central part of the country is called the *traditional Thai house*. In the study areas addressed in this study, a few vernacular houses classified as the *traditional Thai house* remain. The remaining examples are usually in a compact cluster, composed of a bedroom and a kitchen unit. These houses demonstrate the essence of the *traditional Thai house*. Only two *traditional Thai house*s, classified as archetypes, are found in Pakkran village (see in Figure 44). These archetypes are used for evaluating the changes.

Figure 44 The *traditional Thai house* found in Pakkran village with changes at roof cladding (A) and ground level columns (B)

As discussed in Section 2.2, there are many variations in the house styles, ranging especially in size, from a single-family to an extended family house. The smaller house consists only of a bedroom, a kitchen, and a narrow terrace; while the cluster house may have up to five or six bedrooms and a wide central terrace. In the selected study areas, *traditional Thai houses* are timber buildings with high-pitched roofs and lifted above the ground (Figure 45). The building compound generally consists of several separate buildings. These buildings historically were clustered around a central terrace, which was the core of the whole dwelling.

The extended family system enlarges the housing compound by increasing the number and range of new building components. One unit of the building includes a bedroom, a verandah, and a part of terrace, which is attached to the central terrace. In some occasions, if family members want to start their own household or need to relocate, these additional buildings could also be moved away to form a new house. Because they were built mostly of prefabricated components, *traditional Thai houses* are easily dismantled and transportable.

Lacking exterior sheathing or panels, the underside of the house is open and has multiple uses. Access to the house is by a staircase, which leads to the terrace. There are two types of buildings: bedroom units and kitchen units, both of which are clustered around the terrace. The buildings are built with columns inclined inwards on all sides.



Key:
1. Roof cladding
2. Roof structure
3. Upper level column
4. Upper level beam
5. Upper level wall
6. Upper level floor
7. Ground level column
8. Foundation

Source: House no. P-PK-13

Note: No construction of beam, wall, and floor at ground level in an archetype

Figure 45 The archetype of the *traditional Thai house* and architectural elements (Drawn by Punpairoj 2009)

In a housing compound, a bedroom unit may be increased from one to five units or more. Inside, the bedroom unit can be divided into two spaces, sleeping and praying. The bedroom unit is usually attached to a verandah, which serves as an intermediary space. Floors are organized into three levels: the bedroom; the verandah; and the central terrace. The walls are of two types; wooden infill walls and bamboo infill walls (Figures 46).

(a) (b)

Figure 46 Wall of the *traditional Thai house*
(a) Hard wood infill
(b) Bamboo infill

The kitchen unit is usually a single building in a housing compound. Some kitchen units are attached to the verandah in a similar way to the bedroom unit. The floor level is always raised from the terrace. Ventilation is increased in living units with bamboo infill or combination of bamboo and wooden infill (Figure 47).

Figure 47 A wall with combination of bamboo and wooden infill

In the *traditional Thai house*, the steeply pitched roof (around 60 degrees) is constructed with wooden frames. The rafters and purlins are curved, which results in curved roof cladding (Figures 48 and 49). The high gable extends the height of the room for heat convection (Jaijongrak 2000), while the long projection eaves protect the house from heavy monsoon rains. Palm leaves and vetiver grass were widely used for cladding the roof.

To ensure proper comfort and ventilation under severe heat and high humidity, the houses were normally oriented in a North-South direction, to face the wind, which usually comes from a South-Western direction. However, if a house is located along a waterway, the orientation will normally be toward the water. The front of the house and its terrace also provide a main access to a waterway.

Figure 48 Curved rafters, purlins and battens

Figure 49 A high-angle roof of the *traditional Thai house*

4.5 Major transformations of the traditional house

This section describes the transformation which has usually occurred among *traditional Thai houses* in Ayutthaya. The discussion begins with the modernization of villages, changes within settlements and the differences between two locations. The research indicates that the main transformations have occurred among traditional

houses. The information was derived from an examination of fifty-four houses in Pakkran and Ladchado villages in 2009.

Before more recent modernization period, Thai villages were shaped by the existing topographical features of natural elements such as rivers, canals, and agricultural land, each of which influenced settlement patterns. The land throughout the country traditionally belonged to the King. Modernization of Thailand began in the 1850s but the lifestyle of people has increasingly changed since the era of the King Rama the fifth (1910 to 1945) of the Chakri dynasty (1768 to present). Chaweewan (2001) proposes the following main factors relating to changes in settlement patterns.

1. The land ownership right permitted by King Rama V meant people could occupy land;
2. The construction of roads, especially in the last sixty years, has provided land communication between the existing settlements or create the new settlements; and
3. Work places and the commercial districts had changed from the waterfront areas to the areas along the road.

The first settlement of Pakkran village is recorded in late 1890s (Sub-district office in Pakkran district 2009). Traditional houses were arranged as compact clusters, often representing extended families. Many clusters were located along the canal and combined into linear settlements. The residents began to move or modify their houses and reorient them to the new earthen roads in the 1950s. In the 1970s, the first concrete road was constructed close to the village. The disconnection between houses and canals is also noticeable in new access roads and paths to houses located between the canal and the road. The layout of the new roads promoted the expansion of the village behind the linear settlement along the canal. The new houses are typically arranged along or beside the previous linear settlement and are commonly accessible from the road and have no relation to the canal.

Ladchado village was established in the late 1700s (Sub-district office in Pakhai district 2009). The arrangements of houses were linear along main canal and many sub-canals, which made this settlement into a cluster village from the beginning. Different from Pakkran village, many houses were located behind the

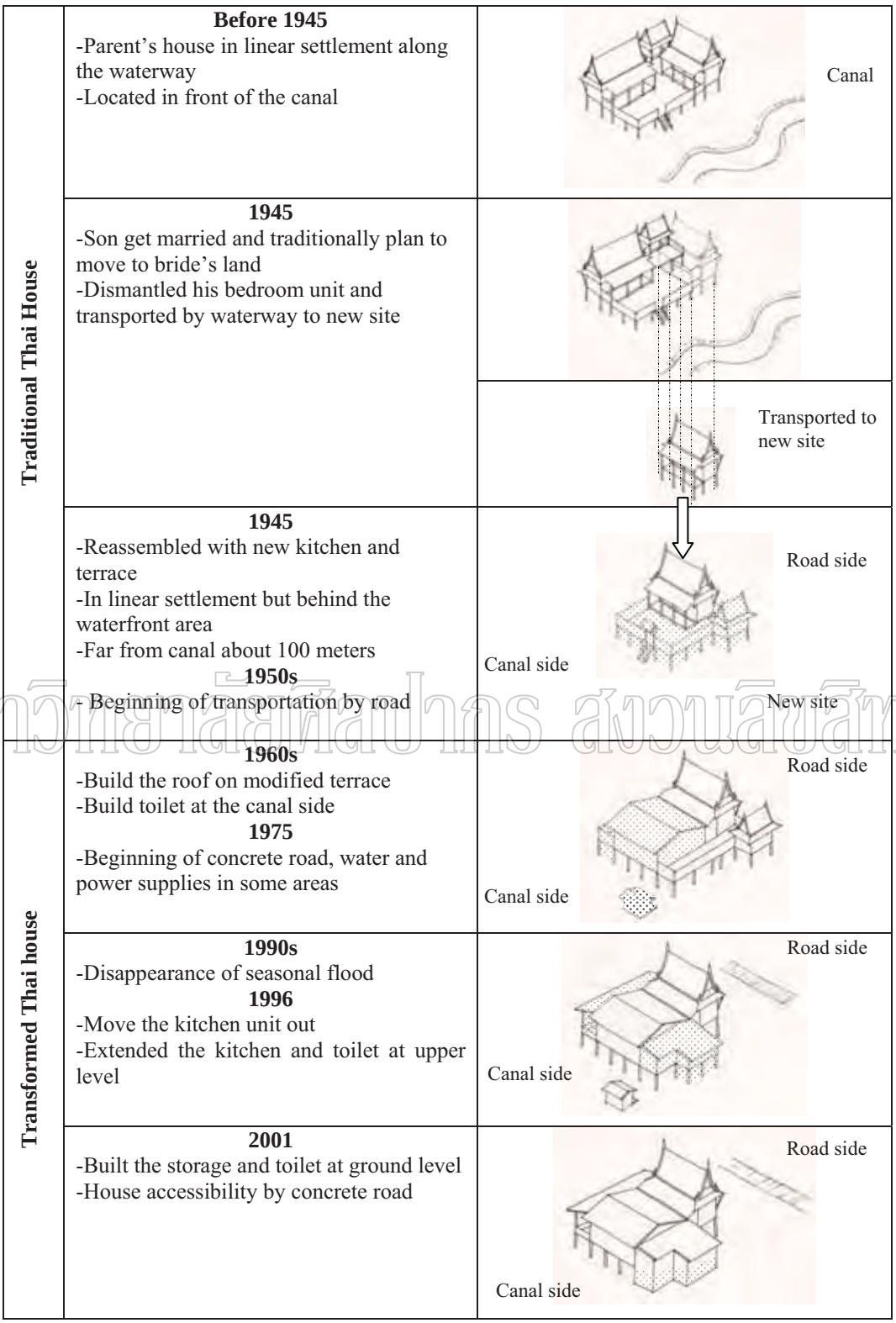
waterfront houses and did not have access to or from a road. The residents of these houses gained access from pedestrian ways and used boats when the village was flooded. In the last thirty years, walk-way bridges made from wood became common. In 1975, the first concrete structures were constructed and extended to the increasing number of houses. At the same time, the residents modified their entrances to relate to these bridges. A concrete road was initiated in 2002 and finished two years later. This caused the decline in seasonal flooding and the accessibility by cars in some areas.

These changes have had impacts on the building compound. The multiple units of extended families that clustered around a central terrace have been transformed to become compact buildings for single families. As seen in Figure 50, the *transformed Thai houses* in Pakkran and Ladchado village appear as individual units. However, these houses are still grouped together with relatives' houses.

(a) (b)

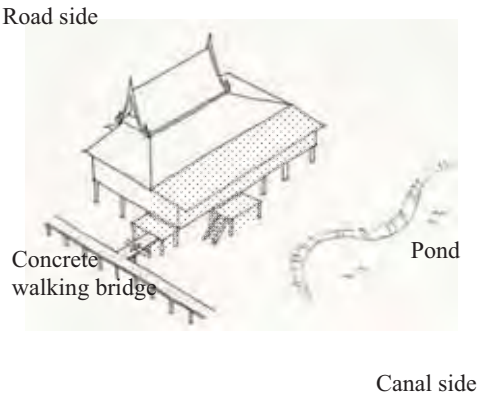
Figure 50 *Transformed Thai houses* as a single house
(a) In suburban area (Pakkran village) (b) In rural area (Ladchado village)

From Figures 51 and 52, it is evident that transformed houses, which are modified traditional houses, developed in two ways: first, the houses were moved from other places; and second the houses were modified on their original location. Both house types were modified and new parts were added. Houses built in the first manner represent the distinctiveness, transportability, of the *traditional Thai house*. The house can be quickly dismantled, assembled or moved from site to site. Even among more recent traditional building are shifted, rotated, and adjusted on the original site when needs for change arise.



Source: From the interview of the households in house no. CH-PK-04 **Note:** The new or extension parts are shaded

Figure 51 Typical separation and transformation of one of the sample in Pakkran from cluster unit to individual unit (Drawn by Punpairoj, 2009)

Traditional Thai House	**1885** - House constructed -In cluster settlement behind the early linear settlement -Far from canal about 300 meters -Great fire disaster in the village in 1936	
	1970s -Wooden walkway bridge network in the village **1985** -Extended verandah and terrace	
Transformed Thai house	**1990** - Concrete walkway bridge -Extended roof and built walls for enclosing hall -Combined kitchen to main building -Toilet was located behind the house	
	1992 -Connected entrance to walkway bridge -Moved stair to bridge side **1999** -Build toilet at the upper floor -Infrastructures with water pipe and electricity **2004** -Road construction causing the disappearance of seasonal flood in some areas	

Source: From the interview of the households in house no. U-LD-11 **Note:** The new or extension parts are shaded

Figure 52 Typical transformation of one of the sample in Ladchado village from cluster unit to individual unit (Drawn by Punpairoj, 2009)

In the traditional extended family system of Thailand, additional bedroom units were added when the family size increased. The central terrace platform is extendable, while living units are typically added on. Often, the son left his family home to join the wife's family. He would remove his bedroom unit from his parents' house and attach it to his wife's home or extend this unit with a new terrace and a kitchen unit.

The size of the enclosed space of the original Thai house is rather small compared to the contemporary Thai house. This area is around 170-200 square meters for a single family in the contemporary house (Puwanant, 2004). The *traditional Thai house* is usually about 40-50 square meters (Jaijongrak, 2002). Additionally, Jaijongrak (2002) states that the area of the terrace normally is 40 percent of the total floor area. This area increases to 60 percent if the verandah is considered as part of the open area. One of the reasons for the small size is that the Thai house historically contained almost no furniture. Instead, the residents used several reed mats on the floor for sleeping or sitting. Most of the activities take place outside the building. The house is generally composed of a bedroom unit and a kitchen unit. In the *transformed Thai house*, the enclosure of the central terrace to serve as a hall provides an extra space for accommodation. In addition, the verandah is modified to be part of the hall. The multi-level floor is also adjusted to become one continuous level.

Consequently, the most obvious change among physical features of transformed houses is the enclosure of the central terrace which was enclosed by new roof and walls (see Figure 53). The two parts combined together in the *transformed Thai house* are: 1. Original core and 2. Modified or extended sections.

The original core still employs wooden posts extending from ground to the roof. In some houses, the wooden pillars underneath the houses have been replaced by concrete columns. There are new types of gable which differ by the shape and angle of the roofs (Figure 54 and 55). The first type has medium pitch (around 45 degrees) which may be assumed to have developed from the original roof shape. The second type with a low pitch (10-20 degrees) is an adaptation from the bungalow roof. Both shapes cover the wider rooms and reduce the height of the ridge. The first type may be considered as a traditional roof if the materials and the structure are the same as the roof of the archetype.

(a) (b)

(c)

Figure 53 Central hall and roofs in P-PK-02 sample

(a) Inside of the enclosed terrace

(b) Outside of the enclosed terrace and the bungalow roof

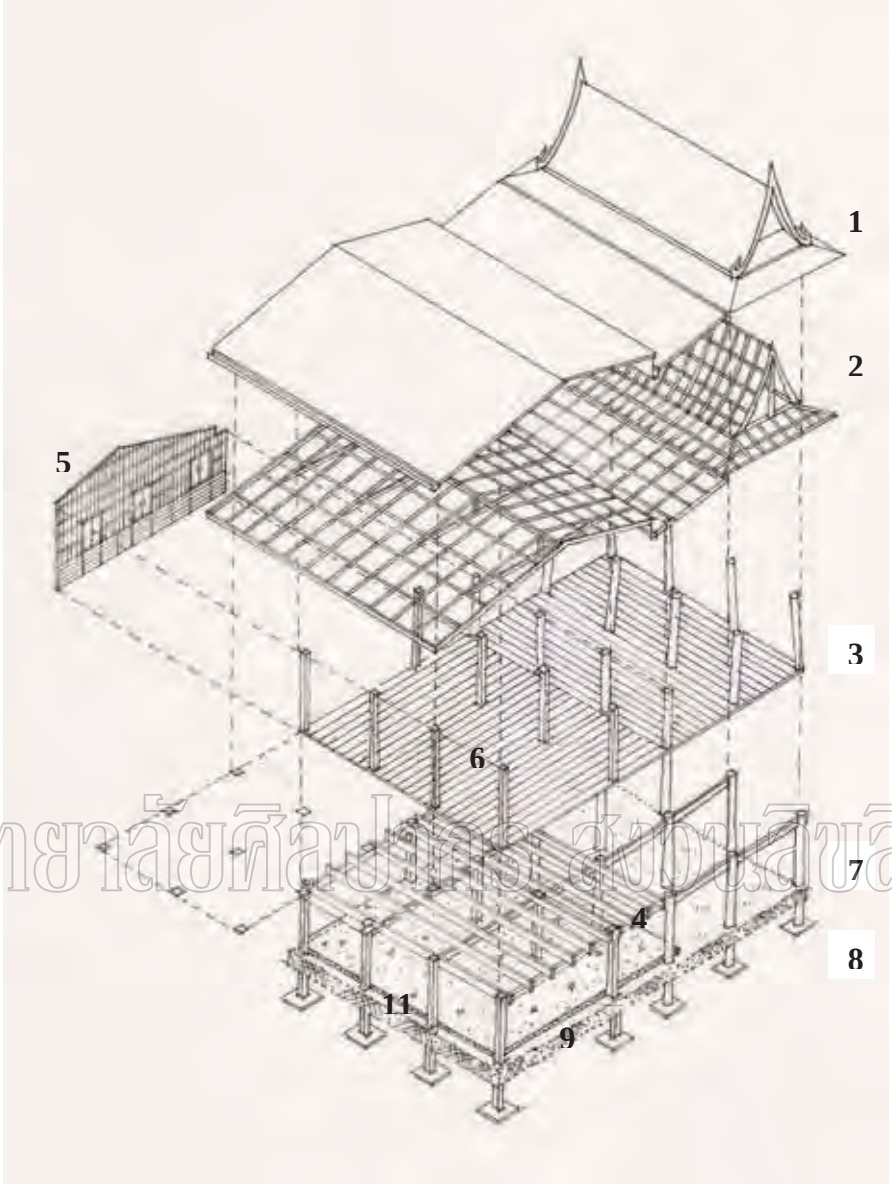
(c) A medium-pitched roof

Over the last one hundred years, roofing materials have changed from grass to cement tiles or alternative, corrugated metal sheets or corrugated cement tiles. Some of the wall panels remain the same as the original but some have been changed to corrugated metal sheets or a cement board (see Figures 54). Cement board is a combination of cement and fibers. It is normally used without plaster in the surveyed sites. Cement board with asbestos fiber has been gradually replaced by a non-asbestos cement board.

(a) (b)

Figure 54 Change of wall panels at sample in Pakkran

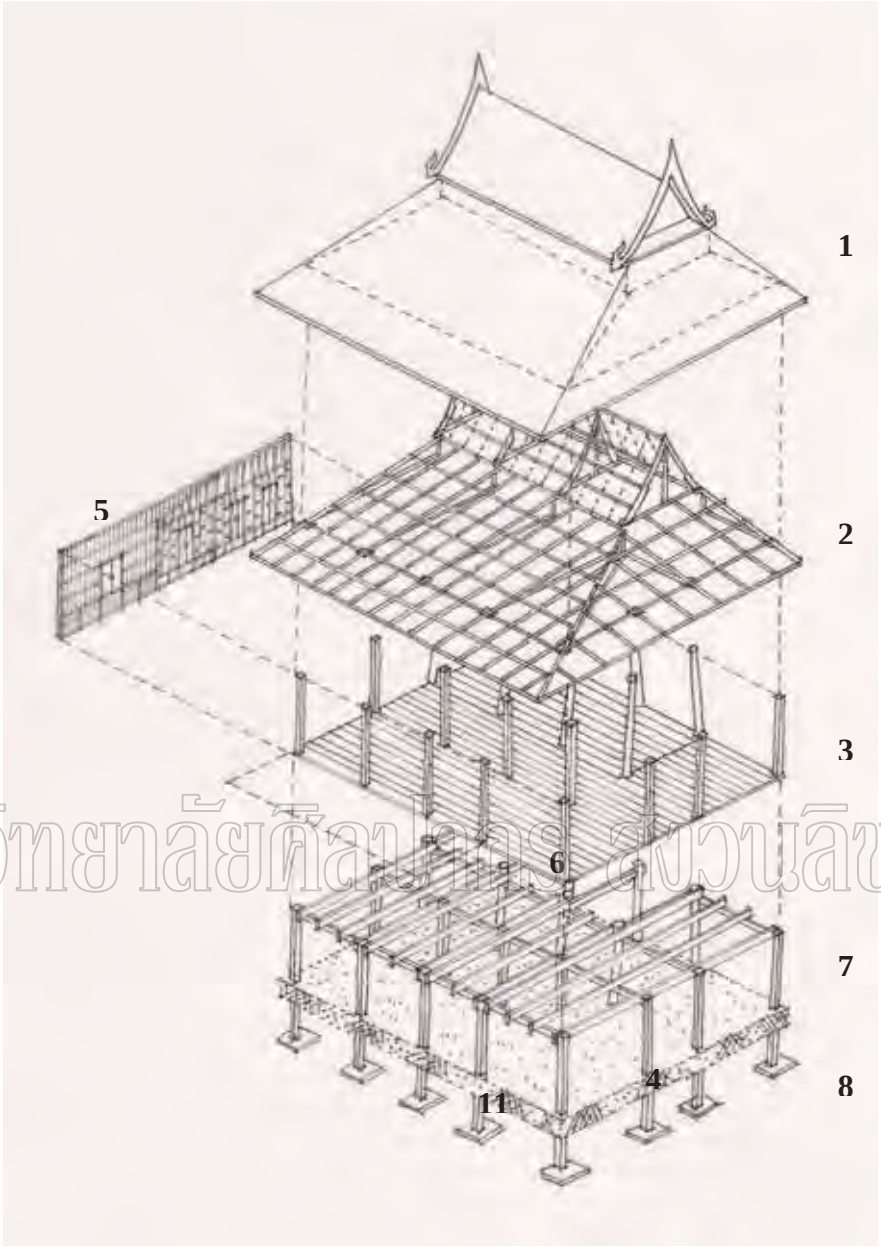
(a) Corrugated metal panels (b) Cement boards



Key:
1. Roof cladding
2. Roof structure
3. Upper level column
4. Upper level beam
5. Upper level wall
6. Upper level floor
7. Ground level column
8. Foundation
9. Ground level beam
10. Ground level wall
11. Ground level floor

Source: House no. P-PK-02 **Note:** Beam, wall and floor at ground level are new elements comparing with the archetype.

Figure 55 Architectural elements of one of the *transformed Thai house*s in Pakkran



Key:
1. Roof cladding
2. Roof structure
3. Upper level column
4. Upper level beam
5. Upper level wall
6. Upper level floor
7. Ground level column
8. Foundation
9. Ground level beam
10. Ground level wall
11. Ground level floor

Source: House no. P-LD-09 **Note:** Beam, wall and floor at ground level are new elements comparing with the archetype.

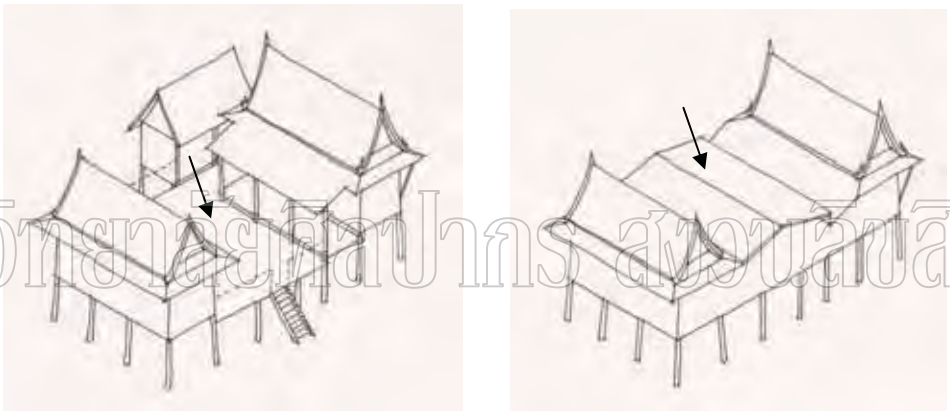
Figure 56 Architectural elements of one of the *transformed Thai house*s in Ladchado

Architectural elements in major transformations

As explained earlier, the *transformed Thai house* is the *traditional Thai house*, adapted by adding new construction and the merging of the original parts (see Figures 55 and 56). This sub-section is presented to clarify the physical appearances of the architectural elements in the transformed house. Five major transformations are found in the surveyed villages

4.5.1 Central terrace to hall / multi-level to flat floor

Central terrace to hall



Source: House no. P-PK-14 and P-PK-02

Figure 57 Central terrace of the *traditional Thai house* and main hall of the *transformed Thai house*

An enclosed terrace forming a central hall is the most substantial change to the *transformed Thai house*. The terrace is the largest single area of the *traditional Thai house*. It forms the centre of house units and functioned as a linkage, because it was necessary to cross the terrace to go from one unit to another (see Figure 57). Some parts of the central hall were newly constructed or re-constructed with materials, taken from the central terrace, to create a more compact shape.

The central hall is composed of two constructive elements: the roof and the wall. Three types of roof covering have been identified: the bungalow, hip and gable styles (Figures 58 to 59). The bungalow roof is most widely used probably because its

properties can cover a wide span of terrace. Another reason is the residents' habit to imitate the style of real estate development projects in the urban area.

(a) **(b)**

Figure 58 Structure of a bungalow roof of the sample in Pakkran village

Figure 59 Example of a hip roof in Pakkran village

Wall panels for houses in Pakkran village can be classified into two types: semi-enclosed and entirely enclosed panels (see Figures 60). Some panels can be pushed open or may be closed to form a wall. The panels, hinged at the top function like eaves when they are opened. The results of changing a terrace to a central hall are provision of a large internal space, new levels of circulation, and a move away from the feeling of a multi-unit house.

(a) (b)

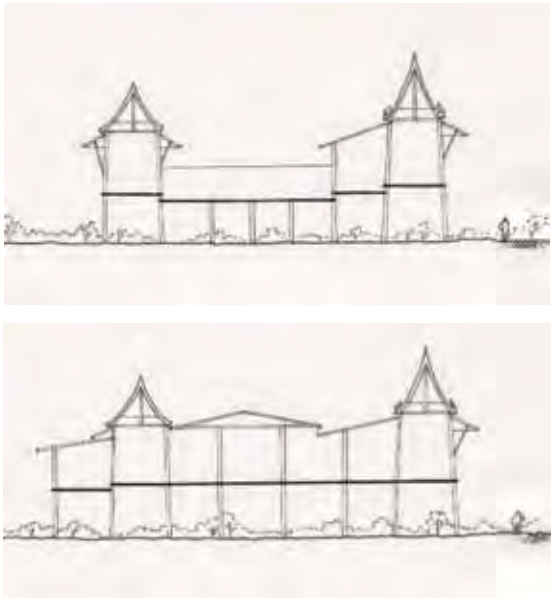
Figure 60 Examples of walls in Ladchado village
(a) Semi-enclosing panels
(b) Enclosing panels

Multi-level floor to flat floor

This transformation usually occurs at the same time as the enclosing of the central terrace. In the past, the floors of the *traditional Thai house* were divided into three main steps. The terrace floor was the lowest; the verandah floor was the middle; and the bedroom unit floor was the highest level (see Figure 61). Each platform was elevated 30-50 centimeters. The gaps between levels were left open for drainage from central terrace and for ventilation beneath the house through the upper level. Another function of the step was to provide seating because there was no use of furniture in Thai tradition.

In the *transformed Thai house*, multi-level floors are usually leveled to a flat floor at the same time the central terrace was enclosed to be a hall. This adjustment of levels has occurred both in traditional and new structures. The residents stated that the main reason was the need for entirely enclosed space in central hall for security as described previously. The openness of multi-level floors can be allows for entry of thieves or burglars. In a few transformed houses that retain the steps, the gaps were closed for this reason. Some residents explained that there is no need for drainage because of the new roof over the central space. The introduction of furniture and modern life styles are amongst the main causes.

The adjustment of merging a verandah with a central terrace area creates a large interior space that allows for activities. The disadvantage is an absence of ventilation from underneath the house.

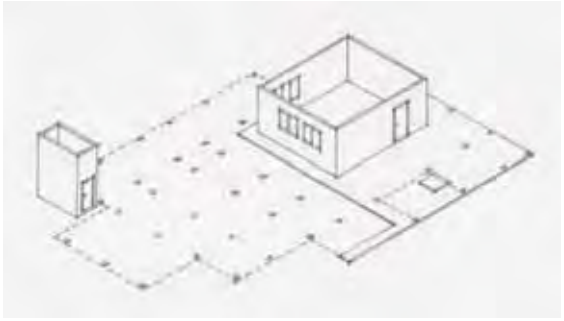


Source: House no. P-PK-14 and P-PK-02

Figure 61 Multi-level floor and flat floor

4.5.2 Changes of an area under a raised dwelling

The residents in Pakkran said that the absence of flooding in some years since the 1970s and end of floods since 1996 has provided the possibility of building a room at the ground level (see Figures 62 to 64). Only a few houses in Ladchado have a room at the ground floor. Similar to Pakkran, the construction of a road in 2004 lessoned the chances of a flood in some areas as well. Some residents in Ladchado explained that they plan to build a room at the ground level if a flooding ends.



Source: House no. P-PK-03

Figure 62 Rooms and concrete floor at ground level

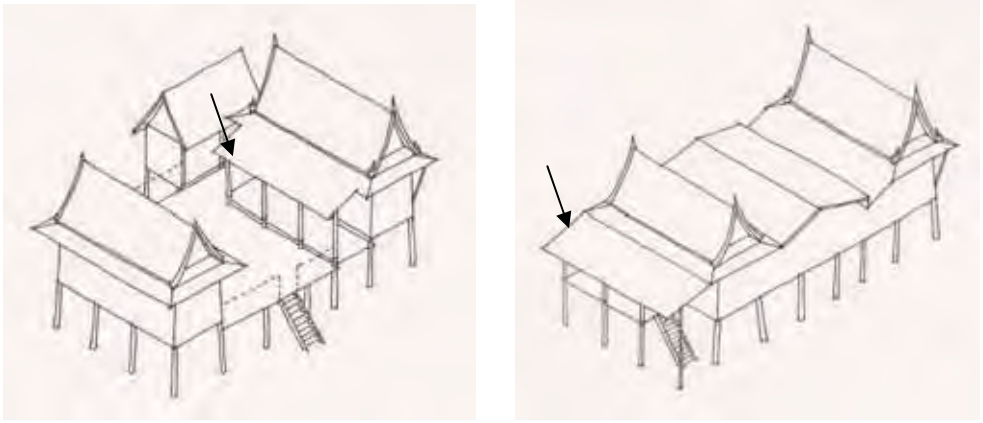
Figure 63 Parking space

Figure 64 Rooms at ground level

4.5.3 Disappearance of verandah and erection of porch at front

The original verandah is covered with a long eave and is enclosed by three panels to form a platform facing the terrace. The terrace then it functions as transitional space before residents enter to the bedroom. Because the terrace is transformed to become the central hall, a verandah, which is attached to the terrace and the bedroom unit, is also transformed to become part of a central hall (see Figures 65 and 66).

A porch constructed to provide a transitional space is a typical feature of *transformed Thai house* (see Figure 67). It is usually located at the front of the house, facing the roadside unlike the central terrace of the *traditional Thai house*. The most common type of porch is constructed as a separate structure from the house. Its size depends upon the house and column span. The lean-to roof is the most widely used form for the porch. The porch is approached by the staircase or ladder. The area of a porch is less than half of the area of a verandah in the archetype. The verandahs of the archetype are found outside both the bedroom units and kitchen units, resulting in a larger area.



Source: House no. P-PK-14 and P-PK-02

Figure 65 A verandah of the *traditional Thai house* and a porch at the *transformed Thai house*

(a) (b)

Figure 66 Verandah is placed between the terrace and the bedroom unit.

(a) Activity around the transitional space

(b) Step between the verandah and the terrace

(a)

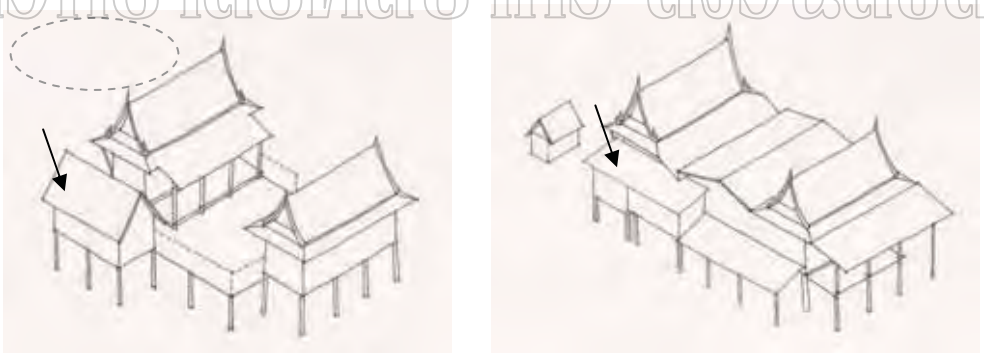
(b)

Figure 67 Porch at the front of the transformed house

(a) A *lean-to* roof and a staircase (b) A bench at the porch

4.5.4 A bathroom at upper level

In the past, the residents used the forest around their houses for their diary toilet. They took baths in canals or carried water from natural sources to bath in the space beneath their dwellings. From the information obtained from the public service officer, external bathrooms have been common in the village since the 1960s.



Source: House no. P-PK-14 and P-PK-02

Figure 68 Bathrooms at the back and upper level of the dwellings

At first, a bathroom at ground level was recommended by the public health service staff. Many householders followed their advice. However, more recent bathrooms have been built on upper level because of the need of convenience and privacy. Nowadays, bathrooms are usually found on the upper floor, at the space underneath the houses, or at the back of the dwelling (see Figure 68). The internal bathrooms are always located at the corner of the expanded part of the house. The

structure of bathroom is usually kept separate from a structure of the *traditional Thai house* (see Figure 69).

(a) (b)

Figure 69 External and internal bathrooms

(a) Bathrooms at the ground and upper level

(b) A bathroom at the corner separated from the traditional structure

4.5.5 A kitchen unit to cooking space

Interviews have revealed that there are many reasons for the disappearance of the kitchen unit. First, the cooking unit is made from less durable materials compared to the bedroom unit. Second, the kitchen units are often converted to bedroom units. Third, the land plot of the dwelling has been divided into smaller and narrower units; so that it is difficult to locate the kitchen unit at the corner of the house. Fourth, some houses were dismantled, relocated, and assembled without kitchen units. As a result, the builders tend to place cooking spaces inside the house to replace the separated traditional kitchen unit (Figure 70).

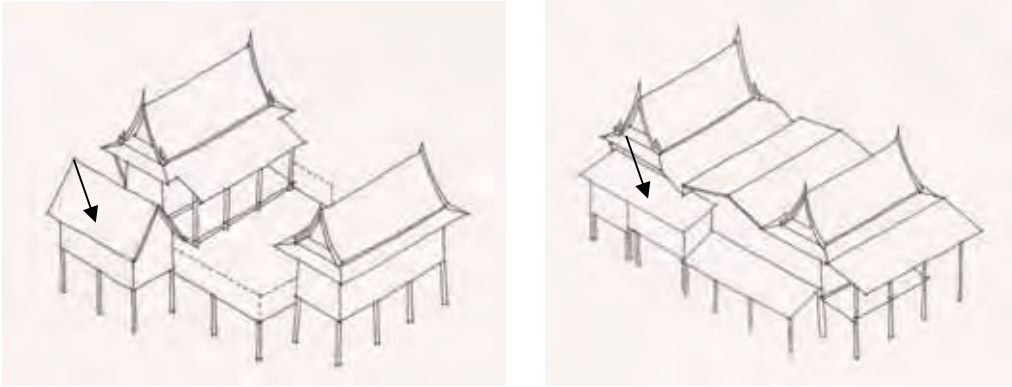
The cooking areas are usually located at the corner of the house to allow for ventilation. These can be built inside the house or as part of an extension of the house. There are four types of kitchen or cooking part in the *transformed Thai house:*

1. Original cooking units, found in a few houses;

2. The in-house cooking spaces are built with moveable wall. Some panels in this space can be pushed open and to function like a large window;

3. The in-house cooking spaces are built with semi-enclosed panels for ventilation purposes; and

4. The small terrace for cooking with handrails and balustrades instead of panels. It is built on a cantilever floor in some samples. This terrace is always combined with the in-house cooking area (see Figure 71).



Source: House no. P-PK-14 and P-PK-02

Figure 70 Kitchen units as cooking spaces in the transformed house

(a)

(b)

Figure 71 Semi-enclosed walls for ventilation

(a) Terrace functions as a cooking space

(b) In-house cooking space with a small terrace

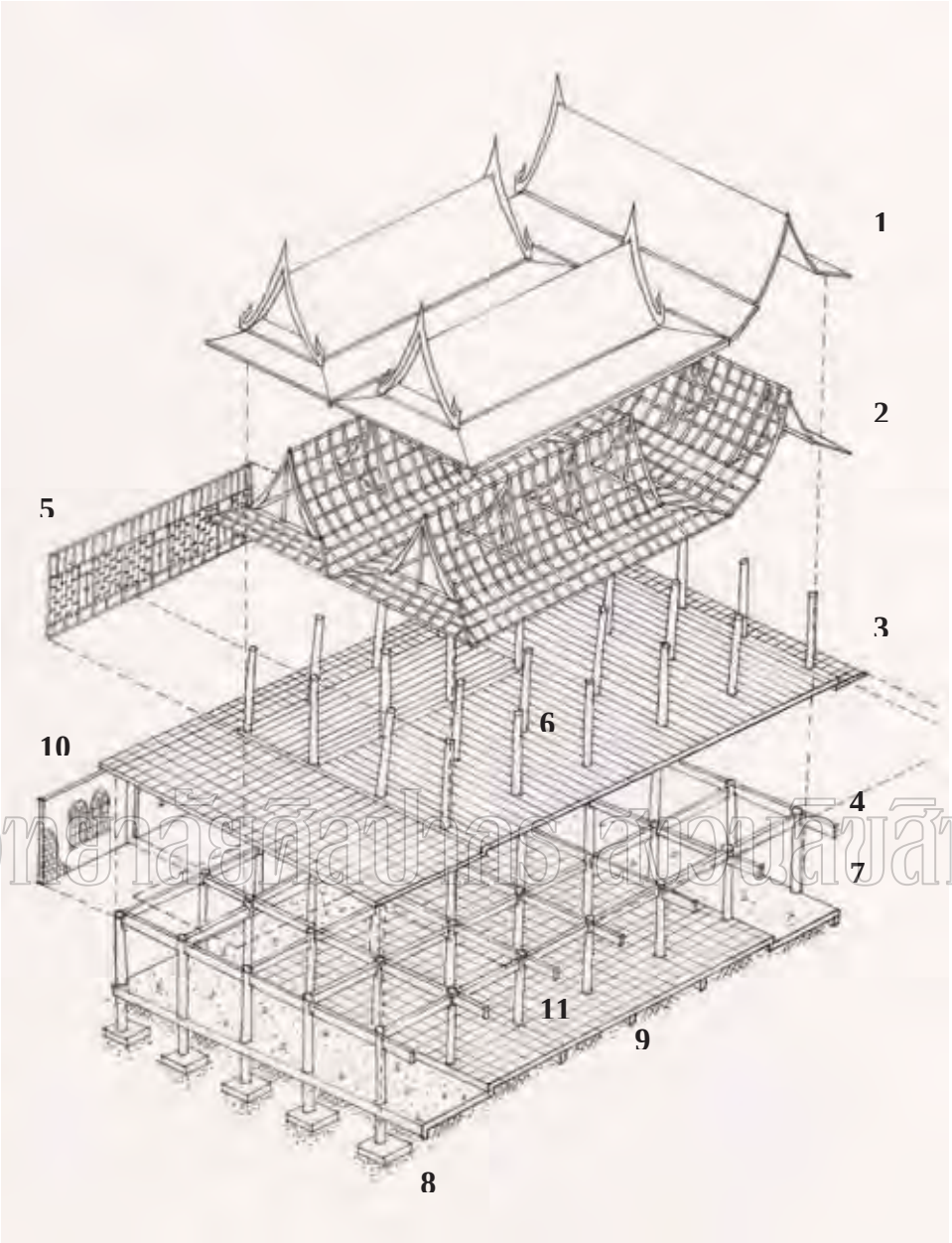
4.6 Reproductions in the motorway buffer area

A number of *reproduced Thai houses*, which have been sited along the highway in Bangpahun areas and the Phaholyotin road, have developed since the 1970s (Sub-district Office 2008). These houses appear as a single house instead of as the compound house of the *traditional Thai house*. Although these houses are similar to the *transformed Thai house* (see in Figure 72 and 73), there are many different factors that distinguish them:

1. It has not developed from the old *traditional Thai house* but was built to have some appearance of the traditional house;
2. The entire building was newly constructed, including both the modern style and traditional style parts;
3. Most of the modern appearances are located at the ground level; and
4. The materials and technologies used in these houses are comparable to those in contemporary houses in modern housing projects.

These houses can be ordered to build at any sites from the customers who may not be local people. The information was obtained about eight houses in Bangpahun area in 2009. These individual houses were constructed by the local builders who have an experience of building the original *traditional Thai house*. Most of the houses belong to the builders and are located near the builder's work shop. Some of the houses could be shown to customers as an example of their work.

The *reproduced Thai houses* are based upon the fundamentals of traditional house and contemporary houses but have developed for modern life. The groups of builders are divided into traditional carpenters and modern builders. Since the forest protection laws, the traditional materials were not obtained from Thai forests but from other sources, such as imported timber from neighboring countries.



Key:

1. Roof covering
2. Roof structure
3. Upper level column
4. Upper level beam
5. Upper level wall
6. Upper level floor
7. Ground level column
8. Foundation
9. Ground level beam
10. Ground level wall
11. Ground level floor

Source: House no. D-BH-11

Note: Beam, wall and floor at ground level are new elements comparing with the archetype.

Figure 72 The *reproduced Thai house* and architectural elements

Figure 73 A *reproduced Thai house*

Figure 74 A narrow-shape terrace

The reproduced houses have been influenced by western style houses and break many sets of traditional rules. For instance, they are not grouped in the traditional way but are attached to form a large living space. Most of them do not have a main terrace but feature narrow-shape terraces around the group of buildings (see Figure 74). The most obvious elements are the traditional roofs at upper level and the contemporary style is used at ground level.

The whole upper part still uses timber utilizing various methods of construction. Some traditional methods are the same as original ones, but some are adapted by modern-day tools or to integrate with the concrete structure at lower part of the buildings (see Figure 75). The wall panels are the same as the original, but there are no ventilated panels. This upper part of the house can be accessed from the stairs both inside and outside the house. The plan is entirely different from the traditional style. The living room at this level has functions similar to the central terrace of the *traditional Thai house*.

The ground level section is similar to the contemporary houses built by housing estate developers. Materials are mainly concrete and cement brick. This part is enclosed for the main living area, toilet, and kitchen. The main entrance leads to the living room for receiving guests and family living. There is extensive use of air conditioners at both levels.

Figure 75 Concrete structures at ground level

4.7 Conclusion

The study shows that there are five types of major transformations. From traditional houses to evolved ones. In most cases, the residents have developed their traditional houses to the new form, which has its own unique characteristics. The transformed houses are a combination of an old traditional building and a modern construction in accordance with the residents' current life styles and domestic conditions.

The major transformations are as follows: 1. Central terrace to a hall / multi-step floor to a flat floor; 2. changes to the area under a raised dwelling; 3. the disappearance of verandahs and the erection of porches at front; 4. addition of a bathroom at the upper level; and 5. kitchen units transform to cooking spaces.

The physical appearances of vernacular houses have gradually changed from the archetype of the *traditional Thai house* to the *transformed Thai house* over the last 50 year period. The roofs have been altered from the high-pitched roofs to the various-angle roofs. The small house units around the central terrace have been expanded to become a larger house with a central hall. Inside the house, the multi-level floors between the main spaces have been adjusted to become flat floors. These houses contain large spaces inside, though they are compact and require smaller and narrower lots.

The transformed houses have also developed from the raised floor house to a house with more attachments at the ground level. At the front of the house, a porch is often a replacement for a verandah, which has been converted to be a hall. Bathrooms are always built from modern materials (brick and concrete) in contrast to traditional

materials (timber) at the upper level. The cooking space is merged with the parts of the house and could be detected from the presence of a ventilating wall.

The transformed houses have become compact dwellings, while they still retained many characteristics of the traditional house. The residents are confident to call their altered houses by the archetype's name: Reun Thai. Although the artistic creativity and craftsmanship is in declining state, the residents believe that these transformations are the appropriate way to continue the use of their heritage.

Chapter 5
Changes in Architectural Elements

5.1 Introduction

The architectural elements considered in this study include roof claddings and structures, columns, walls, beams, floors, and foundations. Changes are measured over a period from the 1800s to the 2000s. Quantitative data on the elements were collected from the survey conducted in 2009. These data and information from the interviews are used for supporting the discussion throughout this chapter. The development period of traditional, intermediate, and contemporary are used to group the samples (described in Section 3.4).

The overview of changes in Thai vernacular houses is described in order to introduce the complex circumstances of the vernacular houses in the three different settings (Section 5.2). The developments of 11 architectural elements of the *transformed Thai houses* and the *reproduced Thai houses* are discussed in Sections 5.3 to 5.5 in order of their historical grouping: traditional, intermediate and contemporary. The data of physical appearances (shape, form, and size) are shown along with the information from the residents. The *transformed Thai house* and the *reproduced Thai house*, which are the key building in this study, are compared to those in the suburban location, the rural location and the motorway buffer area. Although the study focuses on the *transformed Thai houses*, data on the *reproduced Thai houses* is used to evaluate their development.

5.2 Overview of Changes

Development of the *traditional Thai houses* can be traced along two main lines: the transformation of the *traditional Thai house* and the emergence of a new house type that aspire to look like *traditional Thai house*s, but differs in many fundamental aspects. In the surveyed locations, many *traditional Thai houses* have been in continuous use since the late nineteenth century, adapting to changes in use and demands of modern and contemporary living, by integrating with modern forms

and technologies of construction. Extensions, built in the bungalow style, were one of the early construction changes applied to traditional house. Traditional houses that have undergone such change are defined as the *transformed Thai house* (described in Section 4.5). From the survey, the bungalow style has maintained its popularity to the present day, both as extension to the traditional house and as a stand-alone building. Some of the new houses in Pakkran and Ladchado village were recently built in the form of the *transformed Thai house*, combining the traditional and the bungalow styles.

While the bungalow style has been used continuously in many vernacular houses, the more recently kind of vernacular building type, the *reproduced Thai house*, has emerged in the zone along the motorways, as already described in Section 4.6. Similar to the *revival* cases presented by Vellinga (2004), the new vernacular typology is built not only to reproduce the popular image of the *traditional Thai house*, described in Section 4.4, but has been redesigned to merge with contemporary construction, found in the typical urban housing development in Thailand. As a result, these houses conform to modern demands, using a variety of styles, materials, and techniques.

The emergence of new types of the vernacular house, the *transformed Thai house* and the *reproduced Thai house*, demonstrates the evolution of the *traditional Thai houses* and revival of the traditional Thai style in newly constructed houses. The drivers of change were discussed previously in Chapter 2 and 4. In the reproduced houses, traditional construction has been combined with modern construction technologies and techniques. It has appeared as a familiar part of the transforming house. Although the traditional parts in the dwelling are usually maintained in a good condition, they may be inhabited, or used as a prayer room or a store room, or left unoccupied.

Among all newer and existing houses, nontraditional materials have often been used in some architectural elements. Some traditional elements are modified to match new parts of the dwelling. For this reason, the *traditional Thai houses*, which have been clad under a new skin or merged with nontraditional constructions, appear to be *transformed Thai houses*.

In a different way, the *reproduced Thai houses* can be interpreted as new constructions, built by using both traditional and modern characteristics. The appearance of a building at the roof and the upper level is significantly developed from the archetypes of the *traditional Thai house*. While the modern characteristics found at the ground level are built with expensive materials, the traditional characteristics at the upper level are professionally built with timber. At the present, timber is rare and even more expensive than many other modern construction materials. At the upper floor level, the local builders use both old techniques for showing their skills and recent techniques, to save time and money, and to ensure that the buildings are appropriate for modern life styles.

Although the construction at the upper floor level usually has a larger space than the archetype, some residents of the *reproduced Thai houses* leave this space empty and live in the enclosed space at the ground level. Vellinga (2004) explains that the houses with a combination of tradition and modern facilities are used to claim a high status and symbolize social differentiation. He also stated that the old vernacular houses can no longer satisfy the desires of their modern owners. In the same way, the *reproduced Thai house* is intended to have the appearance of a traditional house but function as a modern house. In the present study, the circumstances of vernacular Thai houses will form substantial part of the discussions throughout the further sections.

5.3 Development of architectural elements

The discussion in this section is focused on the development of the architectural elements. As discussed in Chapter 4, traditional elements have been gradually developed along with the transformations of the *traditional Thai houses*. The elements of *reproduced Thai house*s have grown recently more from influences deriving from the modern housing market.

In order to obtain information during the survey period, architectural elements in this study are categorized into 11 types: eight drawn from the *traditional Thai house* and three found both in the *transformed Thai house* or the *reproduced Thai house*.

To group these elements, the house can be conceived of in three layers: the roof; the upper level, and the ground level (see Figure 76). This division corresponds to the division used by local Thai builders who refer to them as Kreang-bon, Deau-lang, and Deau-bon respectively (Piromya 2000). The roof is comprised of cladding and structure. At the upper floor level, the construction elements are composed of columns, beams, walls, and floor cladding. At the ground level, the construction elements are columns and foundations (see the archetype of the *traditional Thai house* in Section 4.4). Elements are found only in the recent houses, either as a result of a transformation or a reproduction including beams, wall claddings, and floor claddings at the ground level.

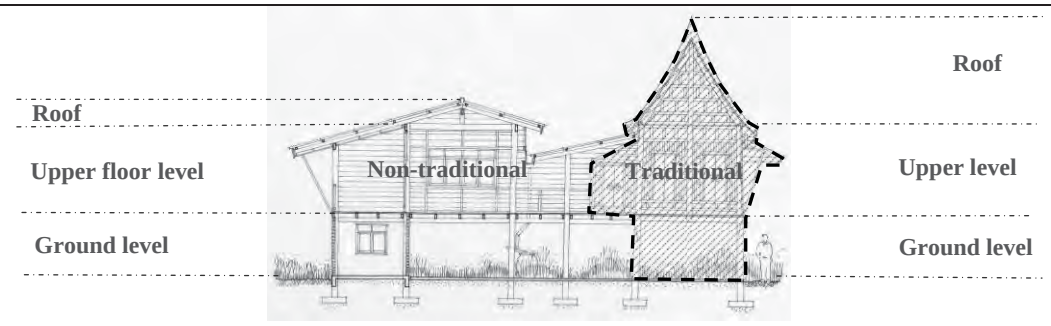
The analysis of each element begins with a description of the archetype, drawn from previous studies. This is followed by comparisons of the findings from the house samples. The house samples are located in the suburban village, the rural village, and the motorway buffer area.

For the discussions about development, the house is divided into two parts: "tradition" and "non-tradition" (see Figure 76). For the *transformed Thai house*, "tradition" means the remaining part of the archetype and "non-tradition" means the expanded or modified part. For the *reproduced Thai house*, "tradition" is the newly constructed building, which has revived the appearance of the *traditional Thai house*, and the non-tradition is the newly constructed building, which is built in the contemporary style.

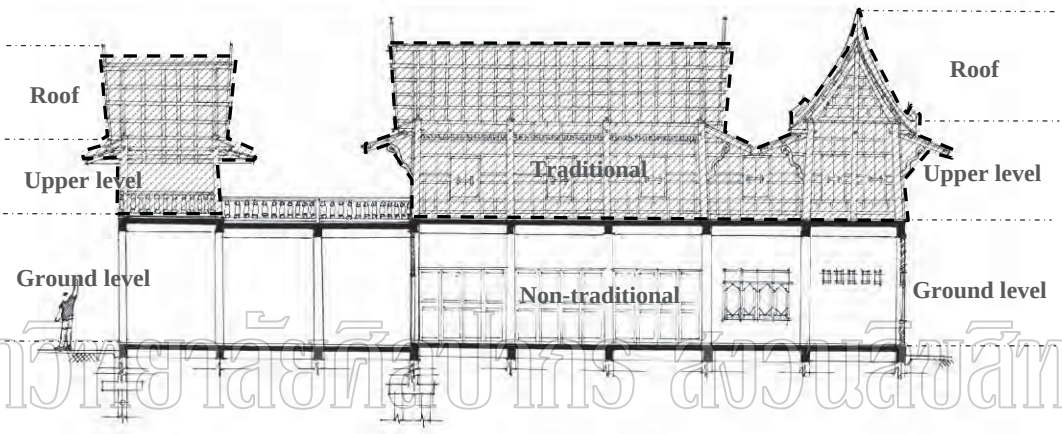
In Sections 5.4 and 5.5, various archetypes are selected from three historical groups: traditional, intermediate, and contemporary. The characteristics are classified by methods of construction (described in Section 2.4). Sources of the archetypes are as follows:

1. Data on the *traditional Thai house* are drawn from the house which was recorded and accepted from Thai scholars (described in Section 4.4). Although there are a few archetypes remaining in Pakkran, some materials and construction elements have been changed.

2. Data on the intermediate house are drawn from the information collected in the 1960s, which was provided by the Public Works Department of Thailand (2009).



Transformed Thai house



Reproduced Thai house

Architectural Elements (Found at the archetypes)
Roof: 1. Cladding and 2. Structure **Upper level:** 3. Column, 4. Wall, 5. Beam and 6. Floor **Ground level:** 7. Foundation and 8. Column
Architectural Elements (Found at the recent constructions)
Ground level: 9. Wall, 10. Beam and 11. Floor
Key of shading: = Traditional part = Nontraditional part

Source: Transformed Thai house: House no. U-PK-05 and Reproduced Thai house: House no. P-PK-02

Figure 76 Section of the *transformed Thai house* and the *reproduced Thai house* showing 8 traditional construction elements and 3 recent construction elements

A number of private houses, which are based on this archetype, were constructed in the intermediate period and are normally found in the surveyed areas.

3. Data on contemporary houses are drawn again from Public Works Department of Thailand (2009). The private houses based on this archetype were constructed recently in the surveyed areas.

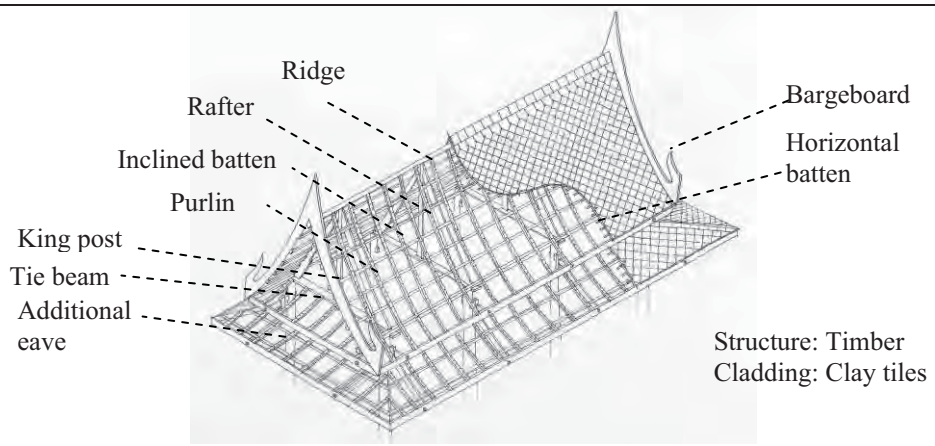
In Sub-sections 5.4.1, 5.4.2 and 5.5.1 to 5.5.5, the discussions concentrate on shape, form, dimension, and categorization of each element in two groups: the houses in the villages (the *transformed Thai house*s in Pakkran and Ladchado); and the houses located in the motorway buffer area (the *reproduced Thai houses* in Bangpahun). There are 54 examples in the first group and 8 examples in the second group.

The discussions in Sub-section 5.4.3 and 5.5.6 focus on the differences or similarities within the three different settings: Pakkran, the village in a suburban area; Ladchado, the village in a rural area; and Bangpahun, located in a rapid growth area. There are 23 examples in Pakkran; 31 examples in Ladchado; and 8 examples in Bangpahun.

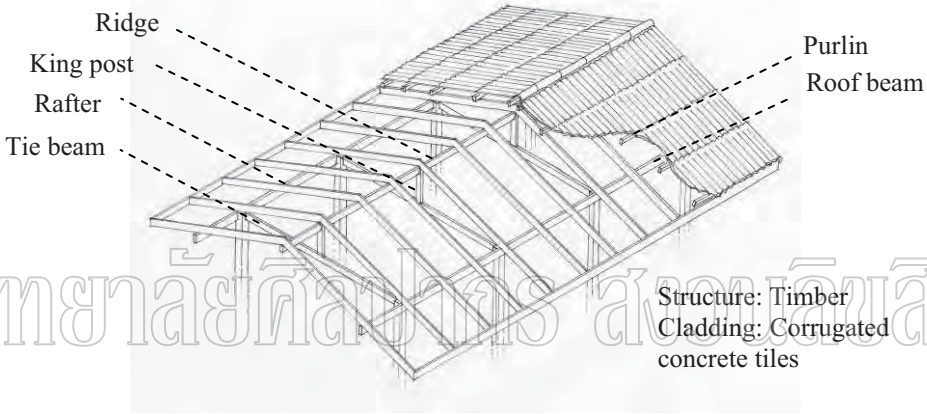
5.4 Elements of roof construction

Roofs of Thai houses share the primary form, the gable roof, of dwellings found throughout Southeast Asia and parts of East Asia (Sthapitanonda 2006). The roofs of the *traditional Thai house* developed from early traditional houses, constructed with thatched roofs and bamboo structures. Some studies (Tamiyabandha 1995, Piromya 1995) claimed that roofs are the most dominant of form in Thai traditional architecture.

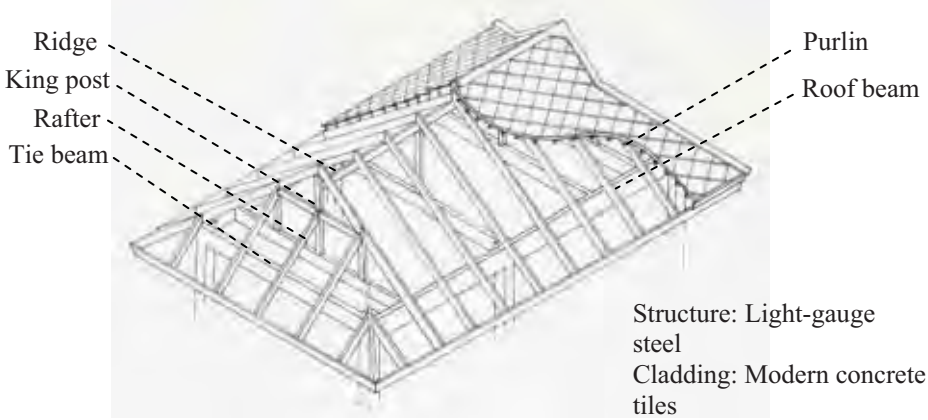
In Figure 77 (A), a traditional gable roof, built with steep pitch (55-60 degrees) and concave shape is shown. A slightly curved lines form the ridge, rafters and bargeboards. Additional eaves on four sides provide protection from intense sunlight and monsoonal rain. On the side overlooking the central terrace, the eave is longer and supported by brackets to create a shady area. The main decorative feature is the bargeboard, which covers the edge of the roof at the gable ends. It also has the important function of preventing wind from displacing the thatch or the roof tiles.



A) Traditional
Source: Traditional Thai house (Jaijongrak 2000)



B) Intermediate
Source: Standard house in central Thailand in the 1960s, provided by the *Public Works Department* of *Thailand* (2009)



C) Contemporary
Source: Standard house in central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show the roof covering and structure.

Figure 77 Archetypes of the roof in traditional, intermediate and contemporary groups

Figure 77 (B) shows the gable roof of bungalow style. This is an undecorated gable roof with very low slope (15-20 degrees). There is no additional eave, found in a traditional gable roof. The bungalow roof began to be used in the intermediate period and was developed along with the introduction of many manufactured materials (Puwanant 2004).

Figure 77 (C) shows the roof of a contemporary house. It is a hipped-gable roof, sloping on all four sides. The hipped-gable roof combines the hipped form with gables at the pitch on both sides. The hipped-gable roof began to be used in Thailand during the colonial period (1800s-1900s) and was common as well in neighboring countries (Sthapitanonda 2006). At present, both hipped and hipped-gable roofs are commonly used in most of the houses built recently in Thailand (Puwanunt 2004). The roof cladding most commonly found in the surveyed areas is concrete tiles.

5.4.1 Roof Cladding

Roof cladding is directly exposed to the effects of heavy rain, intense sun and high humidity. The roof traditionally covers all house components, apart from the terrace. Hence, roof cladding is repaired or replaced more frequently than other elements.

Figure 78 (A) shows three traditional types of roofing, including thatching, clay tiles, and ceramic tiles. Thatching used to be main roofing material for the *traditional Thai houses*, but was replaced by clay tiles. From the interviews, it is apparent that thatched roofing has not been used with the houses in the surveyed locations since the early 20th century. However, thatched materials may still be used for roofing in many small or temporary buildings (e.g. field shelters, roadside sheds, stalls and rice barns). According to Jaijongrak (2000), the examples of thatched materials used in the traditional house were grass: Faek (Vetiveria zizanioides and nemoralis) and Ya Kha (Imperata aundinacea); and palm leaf: Nypa (Nypoideae) (see Figure 79).

Clay tiles paralleled the development as bricks and were typically fired within the same kiln. A few uses of the clay tiles are found in the *transforming Thai houses* in the villages. The tiles are more durable than thatched materials but need to be partially replaced every few years as they get damaged or lost in strong winds. Local

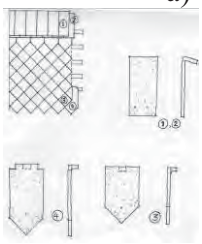
	Drawing	Description/Size
A) Traditional	 a)  b)  c)	a) Palm leafs or grass thatch / Size of bamboo batten grid: 35x100 cm b) Clay tiles tiles / Thickness: 0.5-0.8 cm, long: 10-20 cm. c) Ceramic tiles / Thickness: 1.0-1.2 cm, long: 12-15 cm.
B) Intermediate	 a)  b)  c)	a) Local concrete tiles / Thickness: 0.5-0.8, long: 10-20 cm. b) Corrugated concrete tiles / Sawn to fit with traditional purlins / Thickness: 1.0-1.2 cm, long: 60-120 cm. b) Corrugated metal sheets / Long: 100-120 cm.
C) Contemporary		Modern concrete tiles / Thickness: about 2 cm, long: about 33-35 cm

Figure 78 Drawings of the roof claddings in traditional, intermediate and contemporary groups

builders in Bangpahun explained that the damage occurs because of the inconsistent shape of tiles from the local factory.

Ceramic tiles are similar to the local clay tiles but are more recently produced in the modern factories and have more durability and a greater range of colors. The styles often imitate the clay tiles. They have been produced for Thai temples since the fourteenth century and for Thai-style public buildings more recently. In Thailand, people in the past did not like to build their houses with the same materials as temples or palaces because of their cultural beliefs (Piromya 1995). The residents stated that this belief has been retained in their villages for many centuries, but has decreased recently. The ceramic tiles are the only traditional materials used in the *reproduced Thai houses* in the buffer zone with high proportion.

In the traditional part of the *transformed Thai houses*, a few of the roof cladding are still clay tiles. The residents said that clay tiles have usually been damaged and need to be replaced. Most owners replaced or wish to replace clay tiles with other modern materials, such as corrugated concrete tiles if they have the resources.

(a) (b)

Figure 79 Thatched materials in the traditional group: (a) palm leaf and (b) grass (Source: Temporary shelters in the surveyed locations)

The traditional or historic appearing portion of *reproduced Thai houses* is mostly covered with ceramic tiles. Only one house was covered with corrugated concrete tiles. These ceramic tiles are more durable than traditional clay tiles and can be attached firmly to the battens using wires.

Figure 78 (B) shows three intermediate type of roofing with examples of local concrete tiles; corrugated metal sheets, and corrugated concrete tiles (see Figure 80). Local concrete tiles were produced with the same shape and size of clay tiles. Similar to clay tiles, these tiles can be easily damaged from strong wind. They have to be installed on traditional structures using battens. Few these tiles were found in the *transformed Thai houses* in the villages.

Both corrugated materials are durable, easy to handle and can be fixed to the roof frame structures with nails or screws. Compared to clay tiles, they are less prone to leaks and more resistant to damage from fire and dampness. Corrugated metal sheet rusts when its coating wears off and hence requires regular maintenance. Many uses of these materials are found in the *transformed Thai houses* in the villages. The corrugated metal sheets are used less than the corrugated concrete tiles.

In the traditional or historic parts of the *transformed Thai houses*, builders slightly modify the traditional structure when covering with corrugated materials by taking the tile battens out. Local builders in Pakkran and Ladchado commented that corrugated materials are suitable for the traditional structure because of their light weight (13-15 kilograms per square-metre). In addition, these materials can be easily cut to size, making them appropriate for concave rafters and purlin interval (50-60 centimeters). Most of the traditional roofs in the *transformed Thai houses* were changed to be the corrugated materials.

The nontraditional parts of the *transformed Thai houses* are mostly covered with corrugated materials. The corrugated concrete tiles are the most common type used. These tiles have been produced for a long period and originally contained asbestos (Siriruttanapruk and Taptagaporn 2003). The Hazardous Substance Committee (Department of Industrial Works of Thailand 2004) has placed asbestos under review with plans to ban asbestos in the near future.

Although the corrugated pattern of concrete tiles is normally larger than a pattern of metal sheets, these two roofing materials have a similar size and require a similar supporting structure. They can be used as replacements for each other, but most corrugated metal sheets have been replaced by corrugated concrete tiles more recently. Many residents in Pakkran and Ladchado agreed that houses covered with corrugated concrete tiles keep their house at a lower temperature during the day. They

also explained that rain water, collected from the roof made of corrugated concrete tiles, can be used for drinking and cooking as it has less pigment than corroded corrugated metal sheets.

From the residents' point of view, the corrugated concrete tiles are the most appropriate materials for house roofing. These materials are still produced and come from modern factories. Only a few residents are aware of the danger of asbestos.

(a) (b)

Figure 80 Roofing in the intermediate group: (a) Corrugated metal sheets and (b) Corrugated concrete tiles

Figure 78 (C) shows one of the most common contemporary roofing materials, modern concrete tiles. These tiles are very popular for contemporary houses. However, there are only a few instances of use of these kinds of tiles in the *transformed Thai houses* in the villages and no instances of use in the buffer zone. Modern concrete tiles are very durable and heavy (40-41 kilograms per square-metre) compared to the corrugated materials (13-15 kilograms per square-metre). Flat slab concrete roofs are discussed in the nest sub-section. Local builders explained that these tiles are too heavy for the typical roof structures in the villages, leading to their relative lack of popularity.

The nontraditional part of the *reproduced Thai house* is the construction without pitch roof covering roof at the ground level. The roof of this construction is a flat slab concrete and commonly used as a terrace (see Figure 76). It is made of reinforced concrete and covered with ceramic floor tiles.

In conclusion, it is found that roofing from the intermediate group continues to be in use. The old and damaged corrugated materials are typically still replaced by similar corrugated materials. In contrast, more modern types of concrete tiles have not been used in the surveyed houses.

5.4.2 Roof Structure

The roof structure of the *traditional Thai house* is the most complex element, especially when compared to the other feature of the house type. It consumes more time to build and requires highly skilled labor. The roof structure functions not only to protect the house but as an ornamental element as well. It is typically constructed without a ceiling. Damage to the roof structure is usually caused by a lack of maintenance of the roof cladding. Modification, relocation, or reassembly of some houses may affect the roof shape and can lead to damage. The roof structure is normally well protected from the environment. However, the purlins and the ridge at the gable rims are exposed to the environment and typically decay due to dampness from rain.

From the traditional group in Figure 81 (A), the main components of the traditional roof are composed of the rafters, the tie beams, the king posts, and the ridge. The roof structure is made of two hardwoods: Teak (Tectona grandis) and Teng (Shorea obtusa). Teak is mostly used in both the *reproduced Thai houses* in the buffer area and in the *transformed Thai houses* in the villages. Teak is typically found in the traditional part of the surveyed houses.

According to Piromya (1995), tie beams, battens and gable-rim bargeboards are unique to central Thai houses, especially when compared to the gable-roof structures in other regions of Thailand. The cross-roof beams (measuring approximately 5 x 20-25 centimetres) are set horizontally and tied between rafters. Battens are separated into 2 types: Klorn and Ranang. Klorn is an inclined batten made of flat timber (approximately 2.0 x 7.5 centimetres) and placed on top of the purlins. This batten is used for thatched materials. Ranang is a horizontal batten (approximately 3.5 x 3.5 centimetres) and placed on top of the Klorn in order to support clay tiles. Bargeboards at the gable rims are placed to protect thatch or tiles

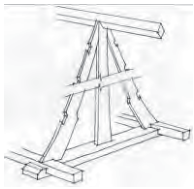
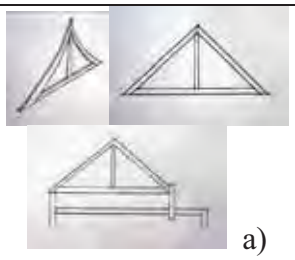
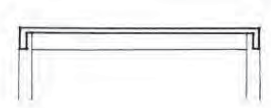
	Drawing	Description/size
A) Traditional		Timber structure, steep slope roof with curvy rafter and flat cross-roof beam / Size of section: flat tie beam about 5x20 cm., rafter about 5x25 cm. and king post about 5x20 cm.
B) Intermediate	 a)  b)  c)	a) Timber structure, modification of traditional gable form, Medium slope roof with straight rafter / Size: the same as the traditional structure b) Timber structure, gable or hip form, Low slope roof / Size of section of tie beams, roof beams, and rafters: about 5x15 to 5x20 cm. c) Timber structure, hip form, Medium slope roof / Size of section of tie beams, roof beams, and rafters: about 5x15 to 5x20 cm.
C) Contemporary	 a)  b)	a) Light-gauge steel, Truss frame, low angle roof slope/ gable or hip form / Size of section: roof frames 5x10 to 5x15 cm. b) Flat roof, Slab-on-beam concrete, Thickness: 10-12.5 cm.

Figure 81 Drawings of the roof structure in traditional, intermediate and contemporary groups

from the wind. Jaijongrak (2000) has stated that these bargeboards emphasize the curve of the steep roof and are carved in a horn-like shape at the lower ends (Figure 82).

The core sections of the *transformed Thai house* show the continued use of the traditional structure. Owner have taken the battens *(*Klorn and Ranang) out in most cases and covered them with corrugated roofing. Corrugated roofing can be nailed or screwed to the purlins without major roof modifications. There are three houses in Pakkran with distorted traditional structures. These structures are now supported by timber props, which were used as cross members. Most of the traditional structures were found in good condition although there is evidence of leaking of the roof cladding in some houses.

The traditional aspect of the *reproduced Thai houses* follows the precedent of the archetype except for the use of nails in unseen components such as battens. The difference of these structures from truly traditional building is the layout of multi-roofs which are connected to each other without the gap of the central terrace (see Section 4.6). These roof structures are normally intended to be seen from the inside, but in some examples the undersides are wholly or partially hidden by ceilings. This often occurs due to the use of air-conditioning at the upper level. From interviews with local builders, there is one house in Bangpahun that uses structural steel for the part of structure. This house was inaccessible and is not included in the sample.

An overview of the intermediate group in Figure 81 (B), shows that all of the roof structures have timber frames. Most of the timbers are domestic hardwood but imported timbers are also used. A large number of uses of Teng (Shorea obtuse) are found in the *transformed Thai houses* in the villages. The other timbers such as Daeng (Myrtaecae) are used to a lesser extent. The drawings in this group show three types of roof structure: modified traditional; gable with low pitch; and hipped with medium pitch. The imported timbers are softwood species, such as pine (Casuarina junghuhniana), and hardwood species, such as Mahogany (Swietenia macrophylla) and Eucaliptus (Camaldulensis eucaliptus). Mahogany is the most commonly used imported timber in the villages. The modified traditional structures appear to have some components that differ from the archetype. These roof structures were built with

ordinary tie beams or straight rafters. Some structures were built with double tie beams to increasing the roof span.

Gable structures of low pitch were typical of bungalow-style houses. Compared to the traditional roof structure, the angle of this roof considerably reduces from 55-60 degrees to 10-20 degrees, as a result of the corrugated roofing. Corrugated metal can drain rainwater better and is more durable and, therefore, does not require such a steep pitch. This roof is simple and quicker to build compared to the traditional roof.

The hipped structure was used in houses influenced by late colonial or contemporary styles. The roof angle is typically 30-45 degrees. The roof structure is more complicated than that of older roofs with valley rafters, hip rafters and jack rafters.

The most nontraditional aspect of some *transformed Thai house* is the presence of a gable structure with low pitch, similar to the bungalow style roof. The hipped roof is found in few cases and always mixed with the bungalow style roof. The materials are the same hardwoods as used in the *traditional Thai house* structure. However, the section of timber is smaller because of the lighter weight of the corrugated roofing materials.

Figure 82 Bargeboards of the traditional roof structure

Figure 83 Hipped roof of a vernacular house in Ladchado village

Figure 81 (C) shows the contemporary roof of the houses recently constructed in the surveyed areas. The hipped or hipped-gable roof is a popular style at present (Figure 83). It is usually built with light-gauge steel members but some houses, which are not in the samples, were built with timber. The light-gauge steel members are welded on-site to form roof trusses. These roof structures are strong enough to

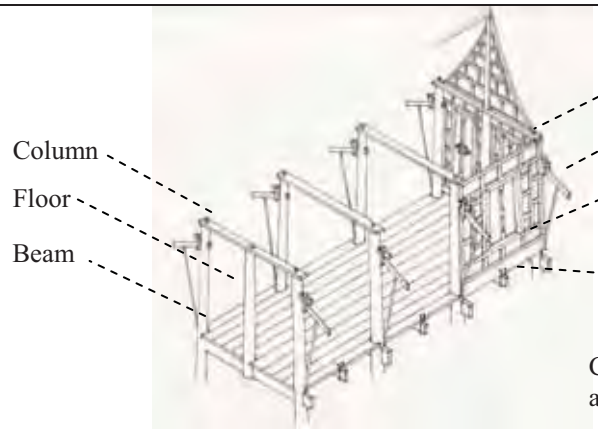
carry the weight of the concrete tiles, which are the most popular cladding materials. Similar to the hipped roofs in the intermediate group, the roof angle in the contemporary group is 30-45 degrees. However, the contemporary roofs are hardly found in the *transformed Thai houses* in the villages and no use in the buffer zone. A flat roof is not popular to cover a whole roof but is built in just some parts of a roof, which function as a terrace at the upper level. Flat roofs are always found with the contemporary houses in every surveyed location and built in-situ with concrete. The uses of flat concrete roofs are frequently found in the *reproduced Thai houses* in the buffer zone.

The most "untraditional" part of the *reproduced Thai house* is the flat roofed structure. In-situ concrete is used for the roof which also functions as a terrace. This structure is built without a waterproof membrane or thermal insulation but is typically covered with ceramic floor tiles. This roof is found in every surveyed house in Bangpahun.

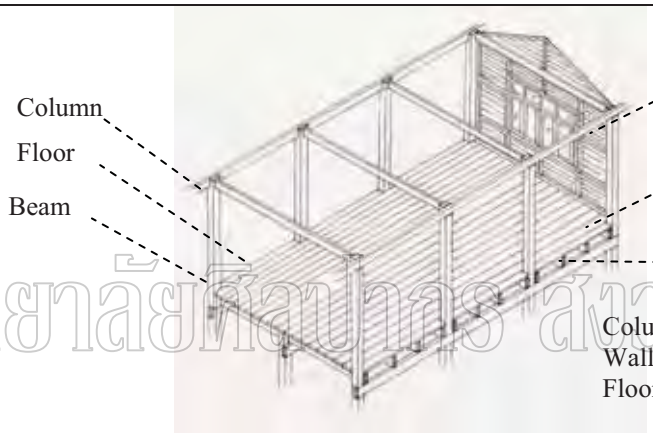
From purposes of discussion, the traditional roof structures for traditional house have mostly remained unchanged, although battens have been removed when corrugated materials have come into use. There is no reproduction of traditional roof structures in the samples of the *transformed Thai houses*. All extensions for this type of building are built with bungalow or hipped style roofs. The traditional roof structures are reproduced only in Bangpahun. Most of them are built by professional builders and present a high level of craftsmanship.

5.5 Elements beneath the roof construction

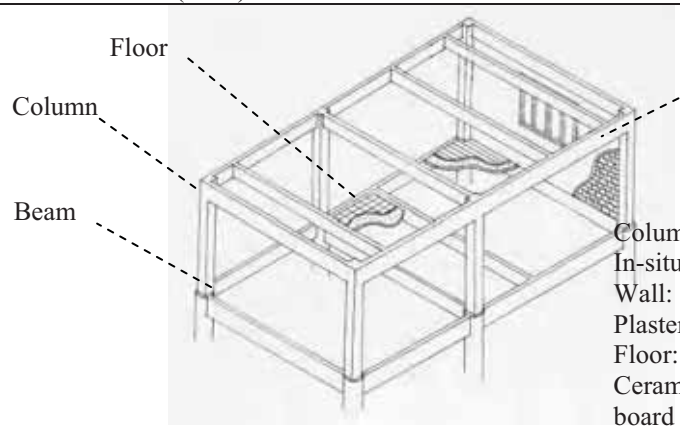
In addition to roofs, main architectural elements for all vernacular Thai houses are columns, walls, beams, and floors. They are categorized at two levels: the upper level and the ground level. The living spaces and all enclosed areas of the *traditional Thai house* were located at the upper level. A raised house on high columns is one of the primary images of the *traditional Thai house* (Jaijongrak 2000). The houses were constructed as raised dwellings especially in flooded locations (see Section 4.3 and 4.4). At present, the absence or decline in the number of floods has increased the opportunity for resident to live permanently at the ground level.



A) Traditional
Source: Traditional Thai house (Jaijongrak 2000)



B) Intermediate
Source: Standard house in central Thailand in the 1960s, provided by the Public Works Department of Thailand (2009)



C) Contemporary
Source: Standard house in central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show columns, beams, walls and floors at the upper level.

Figure 84 Archetypes of the upper level construction in traditional, intermediate and contemporary groups

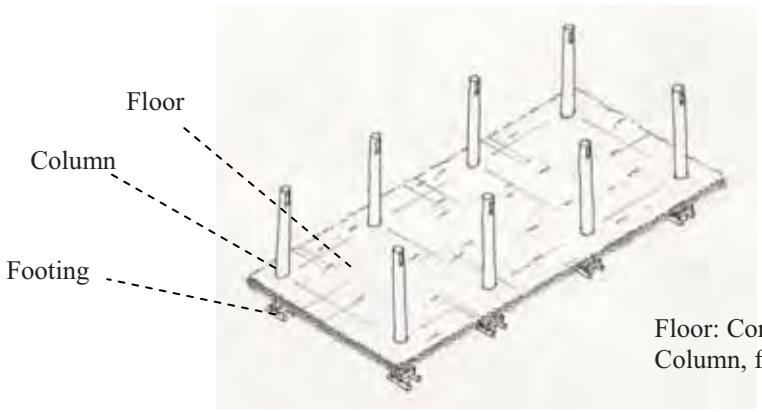
In the *traditional Thai house*, space under a raised house had multi-purpose functions. However, these activities were normally limited to the day time because there is no enclosed space. At the ground level, there were traditionally only two construction elements: the foundation and the column. The other construction elements: walls; beams; and floors were added or newly constructed to provide an enclosed space in the *transformed Thai house* and the r*eproduced Thai house.*

At the upper level, the construction elements are composed of columns, walls, beams, and floors. Figure 84 illustrates the upper level archetypes in three historical groups: the traditional, the intermediate, and the contemporary.

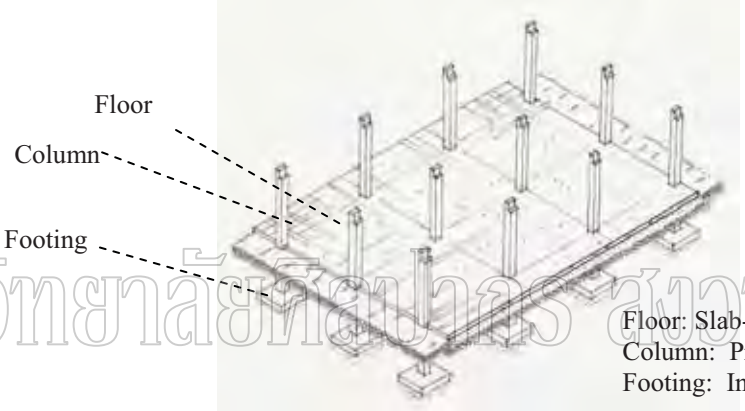
Figure 84 (A) shows the columns and walls of the *traditional Thai house*. Significantly, all of these incline inwards. As a result of this, the floor area is slightly larger than that near the roof. From interviews with professional builders in Bangpahun, the leaning walls and columns provided for greater stability of timber houses during flooding or rainstorms. Piromya (1995) explained that the leaning construction adds to the strength of prefabricated connections. Jaijongrak (2000) mentioned that the degree of incline is about 1.5 degrees from perpendicular. However, the degree of incline is slightly different and depends on various builders' own rules.

Figure 84 (B) shows the upper level of a bungalow-shaped construction in the *transformed Thai house*. Its structure is built with timber beams and columns, enclosed with weatherboards. The layout, plan and dimension of this construction were always flexible in their application. The construction methods from the intermediate period began to be used with this type of dwelling. The residents in the surveyed areas stated that the simplicity of this construction make if affordable compared to traditional construction.

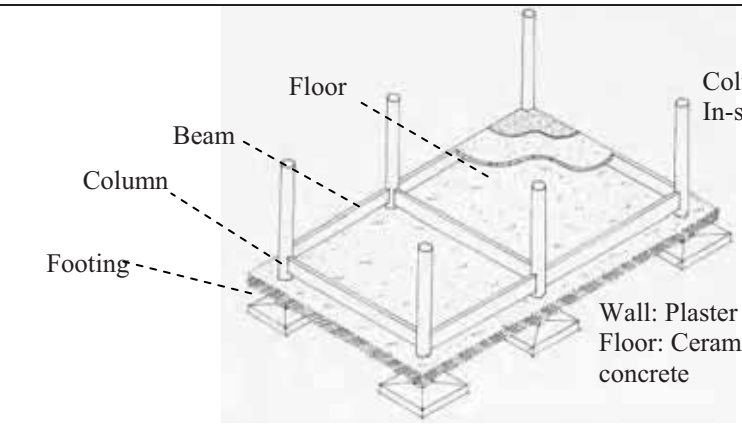
Figure 84 (C) shows a reinforced concrete structure, enclosed with a masonry wall. Because cement is produced in Thailand, the cost of concrete construction is currently low compared with the other construction methods (Puwanant 2000). The space at the upper level of the contemporary house is mainly used for the bedroom and lavatory area. Contemporary houses in the surveyed locations often have small terrace, made of concrete, next to bedrooms.



A) Traditional
Source: Traditional Thai house (Jaijongrak 2000)



B) Intermediate
Source: Standard house in central Thailand in the 1960s, provided by the Public Works Department of Thailand (2009)



C) Contemporary
Source: Standard house in central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show ground level columns and foundations. They also show some recent construction elements (beams, walls and floors at the ground level).

Figure 5.5.2 Archetypes of the ground level construction in traditional, intermediate and contemporary groups

At the ground level, the construction elements are composed of columns, walls, beams, floors, and foundations. However, only columns and foundations are found in the traditional archetype. Figure 85 illustrates the archetypes at the ground level of the three historical groups.

Figure 85 (A) shows two construction elements: columns, and foundations. Compared to the elements at the upper level, these are simple and consist of only a small number of elements at the ground level. Columns incline inwards at the same angle as the upper level columns. Floors consist of compacted soil; and there are no walls or beams at this level. Footings are composed of logs and beams without piles.

Figure 85 (B) shows the ground level of bungalow-type construction. Columns are built with timber or precast concrete members and footings are built with in-situ cast concrete. Following the example to traditional houses, there is commonly no ground level beams or walls. The floors consist of compacted soil or concrete. However, an enclosed space is found in some cases. This is built with corrugated materials wall and usually has concrete floor. The layout and plan of this construction commonly follows that of the upper level. There are some houses where the ground level layout is larger than that of the upper level.

Figure 85 (C) shows a reinforced concrete structure built using an in-situ cast concrete. In the contemporary house, the spaces at ground level are usually used as living rooms, dining rooms, kitchens and toilets. Footings with concrete piles are typical. The precast concrete floor is alternatively employed to reduce the time needed for construction. Concrete is extensively used for columns, beams, floors, and footings. The construction at the ground level is sometimes covered by either a pitched or a flat roof.

5.5.1 Columns

In Figure 86 (A), the traditional column had a round (circular) section. This was typically one solid piece of timber running from the ground to the top without any joints. The column was inclined inwards, as mentioned previously. With the scarcity of timber, a single long log for the column became too expensive. Thus, the use of two columns, connected at the upper floor level, became more practical and is sometimes used in more recent constructions.

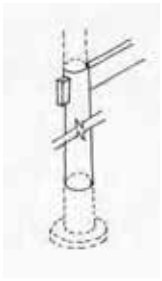
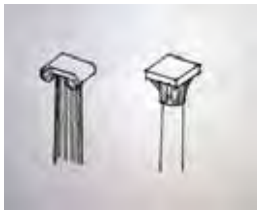
	Drawing	Description/size
A) Traditional	 1)  2)	Columns made of timber / round-shape / Mortise-and-tenon joint / Tapering at the top 1) Upper floor level column: 20-23 cm in diameter 2) Ground level column: 23-25 cm in diameter
B) Intermediate	 1) 2) 3)	1) Reinforced concrete column / rectangular shape / Cross section: about 20x20 cm 2) Steel column / round-shape / Diameter: 7.5-10 cm 3) Timber column / square-shape / Cross section: about 20x20 cm
C) Contemporary	 1)  2)	1) In-situ cast concrete column / rectangular shape / Cross section: about 20 x 20 cm 2) In-situ cast concrete column / rectangular or round shape with plaster ornament / Cross section: 20-25 x 20-25 cm

Figure 5.5.1.1 Drawings of the column in traditional, intermediate and contemporary groups

Timbers used for the traditional columns at the upper level and the ground level are generally similar. The upper level columns are mostly made of Teak (Tectona grandis) and Teng (Shorea obtuse). Most of the ground level columns are also made of the same woods: Teak and Teng. The rest are Rung (Shorea siamensis), Makha (Afzelia xylocarpa), or Dang (Myrtaecae).

Figure 86 (A1) shows a traditional column at the upper level. This is attached to a roof tie beam at the top. Typically, the top end of column is shaped as a round-shaped tenon to connect with a tie beam. The column is also mortised to receive the structural frame of an additional eave (see Figure 5.5.1.2 a). The diameter of the upper level column is about 22-23 centimetres at the base and about 20 centimetres at the top.

Figure 86 (A2) shows a traditional column at the ground level. This is frequently damaged by seasonal floods and termites. It therefore needs repairs or replacement on a regular basis. The column is mortised to receive the floor beam. Its diameter is approximately 25 centimetres at the base and approximately 23 centimetres at the top. The column is placed on a timber footing at 0.80-1.00 metres below ground level.

Most of columns at the ground level have been replaced in recent years by precast concrete columns. This has taken most recently in Pakkran (see Figure 87 b and 88 a). In contrast, the timber columns have been often used for replacement or repair in Ladchado (see Figure 88 b). Some timber columns with mortise-and-tenon connections are still used for replacements. However, most of the new columns, either precast concrete or timber, are connected to the old columns with bolts or nails.

Figure 86 (B) shows a precast concrete column, a timber column, and a steel column. The section of square concrete and timber column measures around 20 x 20 centimetres. These columns do not lean inwards and are not tapered at the top. They are made by the same type of hardwood as traditional columns.

In these examples, the columns are connected to the ground level columns, which are made of timber or precast concrete (see Figure 87 b). Between the columns, the timber stud (2.5x7.5 centimetres in section) is used to fix weatherboard walls using nails. Steel columns are used in some areas of the house to support the roof structures of modified or new sections. The diameter of a round steel column is

approximately 7.5 centimetres. This steel column is light and can be placed on a timber board or concrete floor.

(a) (b)

Figure 87 Upper level columns: (a) Mortised traditional columns; and (b) Joint of columns, beams and joists of the *transformed Thai house*

(a) (b)

Figure 88 Ground level columns: (a) Precast concrete columns; and (b) Local builders repairing a decaying timber column.

In the new parts of the *transformed Thai house*, the support is mainly square timber columns at the upper level and precast concrete columns at the ground level. The in-situ cast concrete columns are found in bathroom constructions at both the upper and ground levels. The residents stated that they prefer to use timber columns at the upper level. However, they accept the use of in-situ cast concrete columns in the bath room at the upper level to prevent damage from moisture. For the same reason, precast concrete columns often replace decayed wood columns at the ground level.

The bathroom is commonly built only at the upper level. There are only a few houses in Ladchado in which the bathroom is built at the upper level with timber.

The concrete and timber columns measure about 20 x 20 centimetres in section and 3 metres in length. The upper level column is cast in place, allowing for a firm connection to the ground level columns by bolts (see Figure 87 b). The column is also interlocked with the upper level floor beam.

At the ground level, timber and concrete columns are used in combination in most of the house samples. Some houses are built with only concrete columns; and a few houses are built with only timber columns. There are examples of steel columns as well. In these cases, only a few steel columns (one or two columns) are used in each house.

Figure 86 (C) shows two types of column in used contemporary buildings: an in-situ cast concrete column, and an in-situ cast concrete column with a plaster decoration. The size of square or round column is approximately 20 x 20 centimetres but is sometimes larger when plaster decoration or moldings are applied. The actual columns are normally placed on the footing using concrete piles. In the 1990s, there was a wide spread of classical styles (Greek and Roman styles), which employed many classic style elements for decoration both inside and outside the building (Horayangkura 2000). This style was applied and developed on both public buildings and houses. In the surveyed location, some columns in the contemporary house are decorated by plaster or clad in brick and plaster, increasing their size to 40-60 centimetres in section.

Figure 89 Contemporary columns clad with plaster, bricks, and plaster ornaments

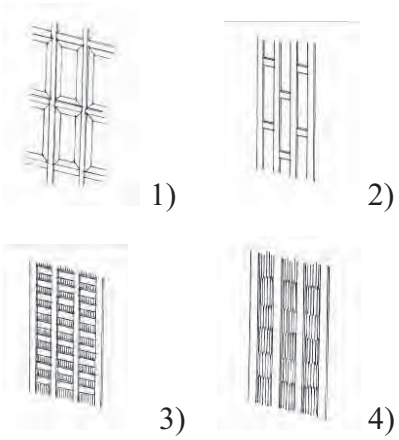
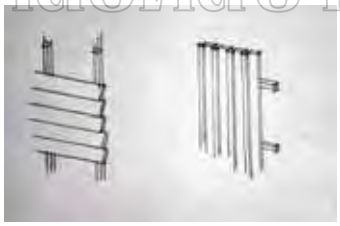
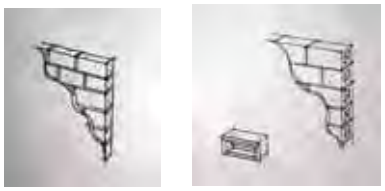
	Drawing	Description/size
A) Traditional	 1) 2) 3) 4)	1) Timber wall / Tall rectangular grid timber infill / Thickness: about 1.5-2.0 cm at the infill and about 5 cm at the stud 2) Timber wall / Timber stud and raised center infill / Thickness: about 2-2.5 cm at the infill and about 5 cm at the stud 3) Timber wall / Timber stud and bamboo infill / Thickness: about 5 cm at the stud 4) Timber wall / woven split bamboo infill / Thickness: about 5 cm at the stud
B) Intermediate	 1) and 2)	1) Timber weatherboard / Horizontal of vertical patterns / Cross section: 1-1.5 x 15 cm 2) Corrugated metal sheet / Vertical patterns / Length: 120-150 cm
C) Contemporary	 1) and 2)	1) Brick with plastering / Size: about 7 x 9 x 19 cm 2) Concrete block with plastering / Size: about 10 x 20 x 30 cm

Figure 90 Drawings of the wall in traditional, intermediate and contemporary groups

Contemporary type columns were found in the nontraditional part of the *transformed Thai house* (mainly at the bath room) and the *reproduced Thai house* (usually at the ground level construction). All of these columns were plastered or clad with ceramic tiles (inside the bathrooms). In Bangpahun, the columns in two of the houses were covered with brick, or decorated with plaster (see Figure 89).

5.5.2 Walls

Figure 90 (A) shows the traditional wall panels, used only at the upper floor level. There is no wall at the ground level in the *traditional Thai house*. The upper level walls are modular units that can be quickly assembled. The panels can also be easily taken out, relocated and reassembled elsewhere. They are made for cladding the inclined columns. The panel is shaped with a wide base and a narrow top. Their width is about 3-3.5 metres at the base and about 2.8-3.3 metres at the top. The height of pre-assembled panels, ready to install, is approximately 3.0 x 3.0 metres (width x height) and about 3-6 centimetres thick.

Various types of wall panels were evident in the surveyed areas. The variety is mainly due to the wall infill. The main panels are Fa Pakon (tall rectangular grid timber infill), Fa Loog Fak (raised center timber infill), Fa Samruad (woven split bamboo infill), and Fa Khat Thae (bamboo infill). There are other panels that are not illustrated in this research, such as Fa Krachang Orn, Fa Sai Bua, etc. The wall frame is usually made of Teak (Tectonal grandis).

Traditional walls of these types are often found in the old parts of the *transformed Thai houses* and the *reproduced Thai houses*. The traditional part of the *transformed Thai house* maintains the original walls of the *traditional Thai house*. The most common type of traditional walls is timber infill walls: Fa Pakon; and Fa Loog Fak. The first type is used slightly more than the second type. The bamboo infill walls, Fa Samruad and Fa Khat Thae, are found in a small number of houses. The residents in Pakkran and Ladchado explained that the traditional units, clad with woven bamboo infill walls, were typically kitchen units. This type of wall material allows more ventilation than the timber infill walls. However, many surviving kitchen units are currently used as a bedroom unit or store room. The function of the kitchen unit is found in the cooking spaces instead.

In the traditional parts of the *reproduced Thai house*, the upper level wall is similar to the archetype. Because the distance of floor to roof beam (approximately 3.5 metres) and the span of column (4-5 metres) increase from the traditional archetype, the walls are made with taller proportions. Although modern tools such as electrical saws and drills are used, the modular-panel walls are still built with traditional details, skills, and also strictly follow the traditional rule. All walls of the *reproduced Thai houses* in Bangpahun are Fa Loog Fak type. The builders commented that this type of wall requires highly skilled workmanship. They also stated that these kinds of walls provides better protection and are more durable than the other types.

At the ground level, enclosed spaces are found in some nontraditional parts of the *transformed Thai house*s and in every *reproduced Thai houses*. Typically, the enclosed space is not built beneath the traditional part of the *transformed Thai house*.

Figure 90 (B) shows two types of wall in the intermediate group: timber weatherboards; and corrugated metal sheets. Weatherboards, applied vertically, are normally made of teak (about 1-1.5 x 15 centimetres in section). They are fixed to timber studs (about 2.5 x 7.5 centimetres in section) using nails. Corrugated metal sheets (about 120 x 120 centimetres) have long been very popular for cladding bathroom units to resist dampness but they are recently being replaced by masonry walls.

The walls in this group are found in both the traditional and the nontraditional parts of the *transformed Thai houses*. These walls are typically used only at the upper level.

In the older or traditional parts of the *transformed Thai house***,** it was found that early manufacturing materials, such as corrugated metal sheet, are used as replacement walls for the traditional parts of the transformed house. One house in Pakkran used corrugated materials on three sides because of the lack of extended eaves. In another house in Ladchado, the wall was partially replaced. The residents explained that the original wall was damaged by water leakage from a roof.

The walls of the non-traditional part of nearly every *transformed Thai house* are made of weatherboards. Weatherboards are applied in a mixed pattern with the vertical pattern at the upper level and a horizontal pattern on at lower section. The remaining weatherboard is applied horizontally, while houses wholly clad with the vertical pattern are not found in the sample.

Corrugated metal sheets are used in some panels of the extensions and bathrooms. Bathrooms are commonly found at the upper level of the transforming house. The bathrooms are typically built of concrete and brick wall. Some bathrooms at the upper level in Ladchado are still clad in corrugated metal sheets. The residents stated that the use of corrugated metal sheets at the bathrooms ended in the 1980s, when masonry walls become more common.

Figure 90 (C) shows two types of walls in the contemporary sampling: brick walls, and concrete block walls. Different from local bricks, these modern bricks are usually made in modern factory kilns. Bricks may be solid, cored, or hollow, manufactured in standard size (about 7 x 9 x 19 centimetres). Concrete blocks are used for some houses because their larger size (about 10 x 20 x 30 centimetres) can reduce the time and labor cost. From the interviews with the local builders, it is clear that some masonry walls are strengthened using reinforced bars and cement grout-filled joints. However, these walls are not load-bearing wall because the house structure relies on a post-and-beam system. Plaster is applied over the masonry. Decorated plaster began to be used very recently.

The contemporary walls are evident in the non-traditional parts of the *transformed Thai house* and the *reproduced Thai house*. The use of masonry walls is typical in many *transformed Thai house* and in every *reproduced Thai house*. The residents said that masonry walls could withstand moisture and were more durable than weatherboards or corrugated metal sheets. In the *transformed Thai houses*, the masonry walls are used to enclose spaces at the ground level. In the *reproduced Thai house*, the masonry walls are used in most of the construction at the ground level and the upper level bathroom.

5.5.3 Beams

Figure 92 (A) shows the traditional timber beam at the upper floor level. There are two types of beams in the *traditional Thai house*: an upper floor level beam; and a roof tie beam. They both span between columns along the narrow side of the house**.** The data of the tie beams are discussed in the roof structure previously (see Sub-section 5.4.2). The ground level beam is not used in the *traditional Thai house*.

Because steps were used between the terrace, verandah and room, double beams were used between these three spaces. Beams (about 5x25 centimetres in section) are made of the same timbers as columns. It is fitted into a mortise of a column with either end extending about 20 centimetres. Traditionally, beams received a solid floor plank without a secondary joist (see Figure 91 a). In some cases, supporting beams were hung from the frame of wall panel to additionally support to prevent the floorboards from sagging (see Figure 91 b).

(a) (b)

Figure 91 Upper level beam: (a) Traditional beam and mortised column, (b) Supporting beam between the main traditional beams

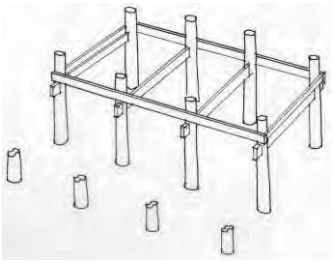
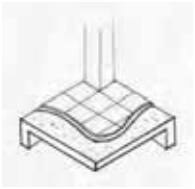
	Drawing	Description/size
A) Traditional		Timber beams with mortise-and-tenon joint/ Cross section: about 5-7.5 x 20-25 cm
B) Intermediate	 a)  b)	Timber beams / Cross section of a beam: 5-7.5 x 20-25 cm and cross section of joist: 5 x 15 cm a) Mortise-and-tenon joint with joists b) Bolted joint with joists
C) Contemporary	 a)  b)  c)	a) In-situ cast concrete beams with precast concrete floors / Cross section of a beam: about 10-15 x 25-30 cm b) In-situ cast concrete beams with in-situ concrete floor / Cross section of a beam: about 10-15 x 25-30 cm c) In-situ cast concrete beams with timber joists / Cross section of a beam: about 10-15 x 25-30 cm

Figure 92 Drawings of the beam in traditional, intermediate and contemporary groups

Figure 92 (B) shows two types of a timber beam in the intermediate group: beam fitted into a mortise with joists; and beams with joists. The first type of a beam is fitted into a mortise of a column the same as the traditional beam. Following scarcity of traditional timber, the floor plank thickness was reduced and joists were introduced to achieve required load capacity. The second type of a beam is widespread in the bungalow style houses with smaller size (approximately 5 x 20 centimetres in section) than the traditional beam. Joists (approximately 3.5 x 10 - 12.5 centimetres in section) are used to support a floorboard (about 3.5 centimetres in thickness), which are thinner than a floor board (approximately 5 centimetres in thickness) in the *traditional Thai house*s. Bolted connections replaced mortise-and-tenon joints to connect this beam with the column. Joists are placed on the beams and braced by timber brackets. Nails are used to fasten joists and floorboards.

The beams in this group are found in the nontraditional part of every *transformed Thai house*. These beams are made of timbers with joist-and-beam system and could be connected with timber or concrete columns. At the ground level of the construction constructed in the early manufacturing period, the area under a raised floor was commonly an opening space similar to the area in the traditional house. This space was sometimes floored with a slab-on-ground concrete, which a beam is not required. However, enclosed spaces, floored with a slab-on-beam concrete, are found in a few houses.

Figure 92 (C) shows the concrete beams in the contemporary group. These beams are made of reinforced concrete, which is constructed to receive a precast concrete floor, an in-situ cast concrete floor or a timber floor. The size is 10-15 x 30-50 centimetres in section. There is no use of a precast concrete beam in the study locations.

The contemporary beams are found in the nontraditional part of the *transformed Thai house* and in both the traditional and nontraditional part of the *reproduced Thai house*. In the non-traditional part of the *transformed Thai house*, beams at the bathroom are mostly made of in-situ cast concrete. Only a few bathrooms at the upper level in Ladchado are built with timber beams and joist-and-beam system.

In the traditional part at the upper level of the *reproduced Thai house*, the beam is different from the traditional archetype. From the samples in Bangpahun, there are two beam systems: beam-and-joists system; and beam and solid floor system. Beams of the first system support timber floor boards, fixed to timber joists placed between concrete beams. Because the structure of the ground level, from foundations to upper floor level beams, is concrete, the timber joists is on in-situ concrete beams spanning 4-5 metres. Beams of the second system are cast together with a concrete floor. The concrete floor is topped with concrete screed and timber battens (5 centimetres thick). After that, floorboards are laid on the battens. Most of the beams in the *reproduced Thai houses* are built with the first system.

5.5.4 Floors

Figure 93 (A) shows the traditional timber floor at the upper floor level. The floor is made of 5 x 40-50 centimetres (thickness x width) boards which are laid on the beams. The beams are fitted between mortised columns. The floor span is typically 2.8-3.5 metres. Without joists, the thick timber boards can firmly span between beams. An additional beam, hold from the wall frame, is sometimes used to support the floor instead of a joist. Each floor board is joined by wooden dowels (about 1 centimetre in diameter) or wedges (about 1 x 1.25 centimetres (thickness x length)). The floor boards inside a house are made of Teak (Tectonal grandis). At the terrace, floor boards are widely spaced with one centimeter gaps for rainwater drainage in order to prevent the floor from rotting. They are made of Teng (Shorea obtuse) or Rung (Shorea siamensis).

The traditional floors are found in the traditional part of the *transformed Thai house*. The original floorboards remain in many houses but most of the floorboards were additionally supported by joists. Some floorboards were initially built with beam-and-joist system. The wooden dowels or wedges for joining floorboards are still found in some houses. A step (30 centimetres) between the bedroom unit and verandah has been leveled by lifting the verandah floor up to the level of the bedroom unit floor. A few houses in Ladchado retain the steps though the gaps were sealed.

Figure 93 (B) shows three types of floor in the intermediate group: timber floors on joists and beams fitted into mortised columns; timber floors on joists and beams; and slab-on-ground concrete floor. The first and second type is similar at the joists but the beam fitting is different. The beam of the first type is fitted into a mortised column while the second type is placed beside a column and connected with bolts. Timber boards since the intermediate period have been thinner and need joists to prevent deflection. The size of floor is 2.5-3.5 centimetres in thickness and 25-30 centimetres in width. The floor span is typically 1.0 metre. They are made of the same hardwood as the traditional floor. Nails were used to fasten the floorboards to the joists. The third type, a slab-on-ground concrete floor, is typically used for the ground floor of a house in the early manufacturing period. The concrete slab (about 10-13 centimeters thick) is built without beam.

The floors in this group are found in the nontraditional part of the *transformed Thai house*. The timber floor was lifted to the same level as the bedroom unit and verandah. A step between the lifted verandah and non-traditional part was disappeared in most transforming houses.

Some areas of the living space or expansions at the upper floor level were typically built from the original timber floorboards from the central terrace. One centimetre gaps between floor boards were eliminated at the same time of reconstructing. Some ground level floors are still compacted soil (28 houses from 54). The others are made of slab-on-ground concrete floor (26 houses from 54). The slab-on-ground concrete is commonly used for the internal road in the contemporary and the *reproduced Thai houses*.

Figure 93 (C) shows three types of floors in the contemporary group: in-situ cast concrete floors; precast concrete floors; and timber floorboards on timber joists and in-situ cast concrete beams. Both the in-situ cast and precast concrete floors (10-12.5 centimetres in thickness) are commonly used for the contemporary houses inside and outside the surveyed locations.

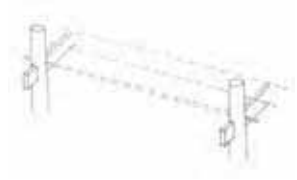
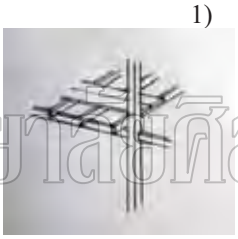
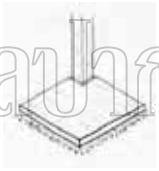
	Drawing	Description/size
A) Traditional	 1)  2)	1) and 2) Timber floorboards without and with supporting beams, hanged from wall frames / Cross section: about 3.5 x 30-50 cm
B) Intermediate	 1)   2) 3)	1) Timber floorboards / Beam-and-joists system / Beams fitted between mortised columns / Cross section: about 2.5-3.5 x 25-30 cm 2) Timber floorboards / Beam-and-joists system / Bolt connection / Cross section: about 2.5-3.5 x 25-30 cm 3) Slab-on-ground concrete floors / Thickness: about 10-12.5 cm.
C) Contemporary	  1)   2) 3)	1) In-situ concrete floors / Clad with ceramic tiles, timber boards or stone tiles / Thickness: 10-15 cm 2) Precast concrete floors on in-situ concrete beam / Thickness: 10-12.5 cm / width: 40-80 cm 3) Timber floorboards on timber joists and in-situ concrete beams / Thickness: about 2.5-3.5 cm / width: 20-40 cm

Figure 93 Drawings of the floor in traditional, intermediate and contemporary groups

The precast concrete floor is supported by in-situ cast concrete beams and columns. The precast floor is built with an array of narrow solid concrete slabs (40-80 centimetres in width), poured over with concrete screed (about 5 centimetres thick).The finishing is applied with ceramic tiles, terrazzo or tongued-and-grooved timber strips (about 2.5x10 centimetres in section). The third type is timber floorboards (about 2.5-3.5 x 20-40 centimetres in section), laid on timber joists and in-situ concrete beams.

The floors in this group are found in the nontraditional part of the *transformed Thai house* and every part of the *reproduced Thai house*. In the nontraditional part of the *transformed Thai house*, the in-situ cast concrete is commonly used for building a bathroom construction at the upper level. The floor is typically constructed all together with the beam and the column. This floor is finished by ceramic floor tiles. A few bathrooms at the upper level in Ladchado are built with timber. The floorboards were laid with half centimetre gaps for drainage.

In the traditional part of the *reproduced Thai house* at the upper level, the timber floorboards were typically laid on timber joists, supported underneath with concrete beams. The size of the floorboard in some houses is similar to the one in the archetype. The floorboard of the other houses is narrower and slimmer (2.5-3.0 x 20-30 centimetres thick and width). There is a house built with floorboards (2.5 x 20 centimetres thick and width) placed on a solid floor. All floors in the samples are not traditionally joined by traditional wooden dowels or wedges.

In the nontraditional part at the ground level of the *reproduced Thai house*, the precast concrete floors are used only in one house. In the other houses, all floors are made of the in-situ concrete. The residents stated that the in-situ cast concrete floor is more durable than the precast concrete floor.

5.5.5 Foundations

The foundation is the only element that could not be observed. In the study, the information is drawn from interviews with the local builders and residents. Similar to the ground level column, the timber foundations of the *traditional Thai house* need to be regularly repaired or replaced because of damages from floods and termite.

Figure 94 (A) shows three types of shallow foundation in a traditional group: a two-log footing; a four-log footing; and a flat footing. The first and second types are built by round timbers (50-70 centimetres in length and about 15 centimetres in diameter), placed at the base of each column. The column base is mortised to receive the beam which transfers the loading of the dwelling to footing. The first type is built by one beam and two round timbers and the second type is built by two beams and four round timbers. The third type is simplest and easy to construct. A flat circular piece of timber (5 x 7 centimetres in thickness and 30-40 centimetres in diameter) is placed at the bottom of the post-hole. The timber foundation is generally made of Thong Lang (Erythina orientalis) (Jaijongrak 2000).

The traditional foundations are found both in the traditional part and the nontraditional part of the *transformed Thai houses*. In many houses, damaged footings have been repaired or replaced with traditional timber footings or concrete footings. The houses, whose footings are still in good condition, are the ones where the footings were changed when the dwelling was relocated during the last two decades. From the interview, some were replaced with concrete but most were repaired or replaced with timber.

Figure 94 (B) shows the foundation in the intermediate group, which is an in-situ cast concrete footing with a precast concrete or square timber column. This foundation is found with short concrete or timber piles (3-6 metres) or without piles. The size of a footing is about 60-100 x 60-100 centimetres.

The foundations in this group are found both in the traditional part and the nontraditional part of the *transformed Thai houses*. In the traditional part of the *transformed Thai houses*, concrete footings are used for the replacement of damaged traditional footings described previously. These footings are built to connect with the timber columns about 30-40 centimetres above ground level.

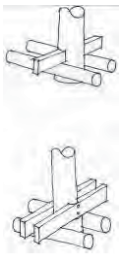
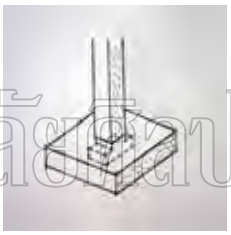
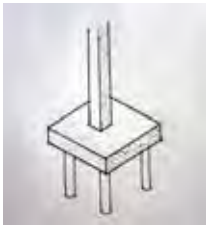
	Drawing	Description/size
A) Traditional	 1)  2)	1) Timber footing / 1-2 beams on top of logs / Diameter: 15-20 cm and cross section 5 x 15 cm 2) Timber footing / Flat circular shape / Diameter: 30-40 cm and thickness: 5-7 cm
B) Intermediate		Reinforced concrete footing / With or without shallow piles (timber or concrete piles) / In-situ casting connected with precast concrete or square timber columns / Size: 60 x 60 cm -100 x 100 cm
C) Contemporary	 1)  2)	1) Reinforced concrete footing / In-situ casting with in-situ cast concrete columns / With or without shallow piles / Size: 60 x 60 cm-100 x 100 cm 2) Reinforced concrete footing / In-situ cast with in-situ cast concrete columns / Deep concrete piles / Size: 80 x 80 cm-120 x 120 cm

Figure 94 Drawings of the foundation in traditional, intermediate and contemporary groups

In the nontraditional part of the *transformed Thai houses*, concrete footings are typically used. Most houses are built with precast columns under a living space and in-situ cast columns under a bathroom. The concrete footings at the bathroom are categorized in the contemporary group.

Figure 94 (C) shows a shallow foundation and a deep foundation in the contemporary group. The size of these footings is about 60-100 x 60-100 centimetres and about 80-150 x 80-150 centimetres respectively. The piles of a deep foundation are normally 18 to 23 metres in length, which is the base of competent soil in central Thailand. For the shallow foundation, short woods or precast concrete piles (about 3-6 metres in length and 15 centimetres in diameter) are used. Driven piles are typically used in Bangpahun but drilled piles are found in a few houses.

The contemporary foundations are found in the nontraditional part of the *transformed Thai houses* and the *reproduced Thai house*. Shallow foundations are used with a construction of a bathroom of the *transformed Thai house* while deep foundations are used in whole parts of the *reproduced Thai house*.

Driven piles are typically used with the *reproduced Thai houses*. The only house constructed with drilled piles is located close to neighboring houses. The residents said that they had to reduce the damage which may effect nearby houses during foundation works using drilled piles because of the vibrations of a pile-driver.

Chapter 6
Relation of the Transformations and Architectural Elements

6.1 Introduction

In this chapter, the findings from Chapter 4 and 5 are integrated and discussed for making a contribution to the recognition of Thai vernacular houses. The quantitative data of the *traditional Thai houses* and contemporary Thai vernacular houses are drawn. The data are shown and compared through various drawings of house grouping arranged chronologically, pie charts, time-scale charts and table of comparison. The percentage of the pie charts is presented in Appendix E.

In Section 6.2, fundamental data, which provide background for a discussion of the transformation, include size of the archetype, the origins of samples, the remaining of the past construction, and the period of modification and extension. In this section, the differences between reproductions and transformation are also discussed. In Section 6.3, the period of changing architectural elements (see in Sections 5.4 to 5.6) are discussed with their major transformations (see in Section 4.5). In Section 6.4, changing characteristics of architectural elements in the main transformations are discussed. The characteristics and periods of changing architectural elements (the roofs and elements under the roofs) is compared with their structure and cladding among the three locations in Sections 6.5 and 6.6. In Section 6.7, typical characteristics of transformed and reproduced houses are compared. The information of the residents' opinions about changes is also shown in Section 6.8. The conclusion is outlined in section 6.9.

6.2 Fundamental data relating to the transformation

This section provides the useful data for comparison between traditional houses and contemporary vernacular houses. The archetype is a representative of the traditional houses. The transformations of the *traditional Thai houses* in Pakkran and Ladchado village are compared with the archetype for checking the differentiation. The reproductions are also monitored with the archetype and the transformed houses.

6.2.1 Size of the archetype

For measuring changes, sizes of the archetype in this study are drawn from the book of *traditional Thai house* by Ruethai Jaijongrak (1975). The typical examples in this book have been widely accepted and used as a reference in Thailand. Table 3 (a) shows floor plans and enclosed space areas at the upper level. This enclosed space is composed of a bedroom and a kitchen unit. Table 3 (b) shows the areas, transformed in the contemporary vernacular houses. These areas of the archetype will be used in Section 6.3 and 6.4 for comparing with the areas of the *transformed Thai house* and the *reproduced Thai house*.

Table 3 Areas of the archetype in Ayutthaya

Floor plan areas (Square metres)			
Total area	**Upper level**	**Ground level**	**Enclosed space** (Upper level)
302	151	151	50

(a) Floor plan and enclosed space areas

Major transformation areas (Square metres)				
Central terrace (Upper fl.)	**Enclosed space** (Ground fl.)	**Verandah** (Upper fl.)	**Toilet** (Upper fl.)	**Kitchen** (Upper fl.)
72 (47.6%)	0 (0%)	29.7 (19.6%)	0 (0%)	18 (11.9%)

(b) Major transformation areas

6.2.2 Beginning of the samples

Table 4 shows the periods of the establishment of the houses in Pakkran and Ladchado villages. Most of the samples in Pakkran have been transformed from the relocated traditional houses. These houses were initially built at other sites, and moved to the current sites. In Ladchado, most of the houses have been transformed from the archetypes, built on the current sites from the beginning. In contrast to the transformations which started from the traditional houses, a small number of houses with the appearance of the *transformed Thai house*s have been newly built. The traditional unit and the other parts have not transformed but were built for creating the *transformed Thai house*s. These *transformed Thai houses* can be defined in the group of the reproduction. However, the data of the house with the appearance of the transforming house were not included in this study.

Table 4 Three types of the beginning of the transformed house

	Beginning of the transformed houses		
	The traditional house on current site	**The traditional house with relocated house unit**	**The transforming house with relocated house unit**
Pakkran (Urban village)	7 (30.5%)	10 (43.5%)	6 (26%)
Ladchado (Rural village)	23 (74.2%)	6 (19.3%)	2 (6.5%)

6.2.3 Remaining of the old constructions

Table 5 shows the areas of transformed house and traditional house. The houses in Ladchado are usually larger than in Pakkran. This was because a plenty of land in rural area encouraged more extensions. The areas and plans of the houses in Pakkran are more compact but slightly bigger than the archetype. The area, showing permanent uses at the ground level, is larger than the upper level. A kitchen, a toilet and a storage are sometimes found at this ground level. The areas of remaining traditional houses in Pakkran and Ladchado are almost identical. However, the house in Ladchado shows the reduction in appearance of the traditional house.

Table 5 The area of the transformed house and the remaining of the traditional house

Areas of the transformed house (Square metres)				
	Total area	**Upper level**	**Ground level**	**Remaining of Thai house** (upper level)
Archetype	302	151	151	151 (100%)
Transforming houses in Pakkran	324.6	154.3	170.3	38.8 (25.1%)
Transforming houses in Ladchado	433.8	215.5	218.3	41.2 (19.1%)

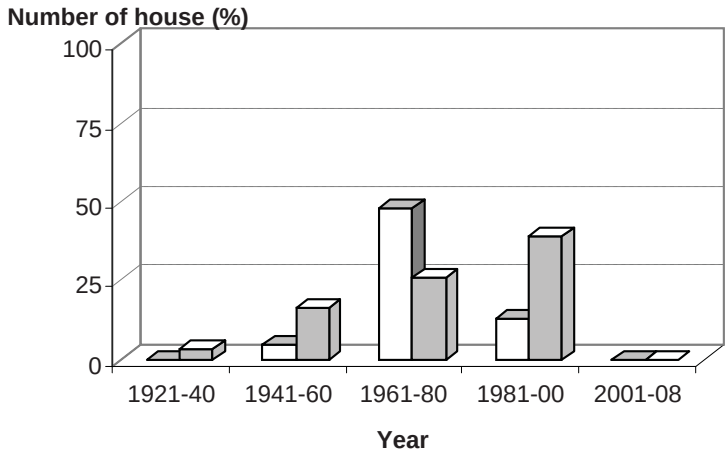
Table 6 shows that the archetype and the houses in Pakkran are almost in the same size. However, the enclosed spaces, which are composed of a bedroom unit and a kitchen unit, are much smaller than in Pakkran in comparison to Ladchado. This shows that transformed house both in Pakkran and Ladchado contain a much larger interior space comparing with the archetype.

Table 6 The area of the enclosed space at the upper level

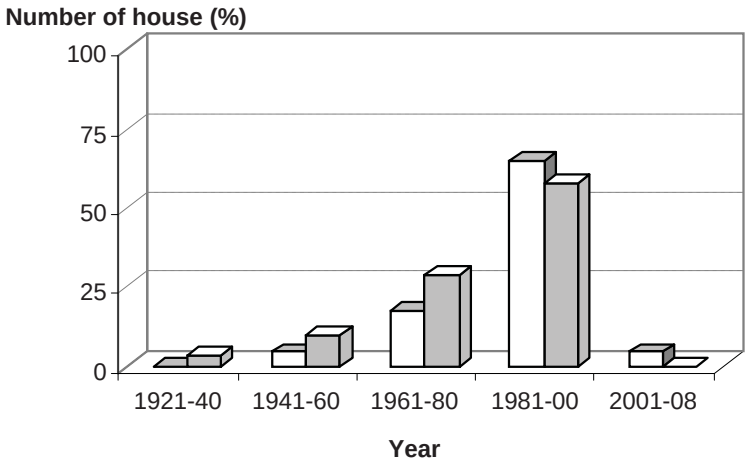
Areas of the enclosed space at the upper level (square metres)			
	Upper level area	**Enclosed space (Upper level)**	**Percent**
Archetype	151	49.5	32.7%
Pakkran	154.3	138.8	89.9%
Ladchado	215.5	200	92.8%

6.2.4 Periods of modification and extension

Traditional Thai houses were gradually modified; until they were merged to be a part of transformed houses. Because of the later developments, the highest numbers of modification in Pakkran occurred earlier than in Ladchado (see Figure 95 A).



A) Beginning of modification



B) Beginning of extension

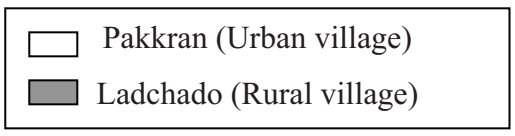


Figure 95 The numbers of the house beginning to be modified or extended

In Pakkran, the numbers of the first modification of traditional houses were highest during the 1960s to 1970s, while in Ladchado there was during the 1980s to 1990s. The starting of modification was obviously related to the time that the roads were constructed in 1975 at Pakkran and in 1985 at Ladchado.

About the extension, the houses in Ladchado were extended and declined earlier than in Pakkran (see Figure 95 B). From the interview in Ladchado, there was a big fire in 1938, which more than hundred traditional houses were caught fire. This event had resulted in many new house constructions in the damaged area. The traditional style could not be rebuilt because of the scarcity of timber. A house with bungalow style, imitated from the houses in the capital, was considered to be more economic and for constructing a new house. While developments of the house in Ladchado were influenced by the big fire, transformed houses in Pakkran were related to the transportation development, which clearly showed during the 1980s to 1990s.

6.2.5 Reproductions in a buffer area of the motorway

Table 7 shows a comparison of the areas between a *reproduced Thai house* and a house with traditional style. The reproduced houses in Bangpahun are approximately two times larger than the archetype and the transformed houses in Pakkran and Ladchado. They are also larger than a typical house built by housing developers. A size of urban housing project is around 150-200 square metres (Puwanunt 2004). From the interview, the residents who own the reproduced houses usually have high status in the local village and have high income from their business. Vellinga (2004) notes that vernacular houses with modern facility and popular image are used to claim the high status of the house owner.

Table 8 shows that the size of enclosed spaces of a reproduced house at the upper level is much larger the in a transformed house. By comparing with the archetype, the enclosed spaces are three times larger. However, the residents stated that the uses of the enclosed space at the upper level are limited and less than at the ground level. The main function at the upper level is only in an air-conditioned room. There are no routine activities in a central hall at the upper level. The residents may sometimes invite their guests to visit their home at the upper level.

Table 7 Comparison of the areas of the *reproduced Thai house* and the construction with the style of a *traditional Thai house*

	Total area	Upper level	Ground level	Construction with Thai style (upper level)
Archetype	302.4	151.2	151.2	151.2 (100%)
Transformed houses in two villages	379.2	184.9	194.3	40 (21.6%)
Reproduction houses in Bangpahun	613.9	301.6	312.3	-

Table 8 Comparison of the areas of the enclosed space at the upper level in reproduced house

	Upper level area	Enclosed space (Upper level)	Percent
Archetype	151.2	49.5	32.7%
Transformed house in two villages	184.9	169.4	91.6%
Bangpahun	301.6	269.9	89.5%

Table 9 shows major space areas in a *reproduced Thai house*. The proportion of the area of a central hall and the porch is similar to the archetype and a transforming house. The enclosed spaces are the most dramatically change. The residents usually have activities inside their house at the ground level. The toilet at the upper level is commonly found while a kitchen is located at the ground floor.

Table 9 Comparison of the areas of the major spaces in the *reproduced Thai houses*

	Central terrace (Upper fl.)	**Enclosed space** (Ground fl.)	**Verandah** (Upper fl.)	**Toilet** (Upper fl.)	**Kitchen** (Upper fl.)
Archetype	72 (47.6%)	0 (0%)	29.7 (19.6%)	0 (0%)	18 (11.9%)
	Central hall (Upper fl.)	**Enclosed space** (Ground fl.)	**Porch** (Upper fl.)	**Toilet** (Upper fl.)	**Cooking area** (Upper fl.)
Transformed Houses in two villages	86.3 (46.6%)	11.2 (5.7%)	15.3 (8.3%)	4.9 (2.6%)	13.9 (7.5%)
Houses in Bangpahun	134.3 (44.5%)	174.2 (55.7%)	31.7 (10.5%)	6.5 (2.1%)	0 (0%)

6.3 Period of the major transformations

A discussion regarding a period of major transformations of the studied houses is based on the data derived from the interviews with the local residents. Table 10 compares the areas in average between main spaces of the archetype and major transformations of the transformed houses in Pakkran and Ladchado villages. Accepted as a typical example of the *traditional Thai house* in Ayutthaya, the house defined by Jaijongrak (1996) provides the information about sizes of the archetype (explained in Subsection 6.2). These areas are used for discussion in each major transformation.

Table 10 The areas of the major transformations in Pakkran and Ladchado villages

	Central terrace (Upper fl.)	**Enclosed space** (Ground fl.)	**Verandah** (Upper fl.)	**Toilet** (Upper fl.)	**Kitchen** (Upper fl.)
Archetype	72 (47.6%)	0 (0%)	29.7 (19.6%)	0 (0%)	18 (11.9%)
	Central hall (Upper fl.)	**Enclosed space** (Ground fl.)	**Porch** (Upper fl.)	**Toilet** (Upper fl.)	**Cooking area** (Upper fl.)
Houses in Pakkran	81.2 (52.6%)	21.8 (12.8%)	13.2 (8.5%)	4.8 (3.1%)	11.7 (7.6%)
Houses in Ladchado	91.4 (42.4%)	0.6 (0.3%)	15.6 (7.2%)	5.1 (2.3%)	16.2 (7.5%)

The parts of the house which are directly related to the discussion are the central terrace, an area underneath of the house, a verandah, a bathroom, and an area for food preparation. Since there are no new constructions for eating and sleeping area, the discussion of the modification of these two areas is combined within the others such as central hall.

6.3.1 Central terraces to halls

From the interviews with the residents in Pakkran and Ladchado, there were many reasons for enclosing a central terrace. Figure 96 shows the number of houses, in which the central terraces were enclosed, had been constructed during the last six decades. This shows that before the coming of road in Pakkran in 1973, a few houses appeared with a central hall. To support the first reason of enclosing the central terrace, many of the interviewed villagers in Pakkran explained that they felt insecure, particularly from strangers who accessed the village by roads. They said that there were increasing cases of threats from thieves and burglars.

In Ladchado, the first road constructed in 1985 did not relate to the beginning of enclosing of a central terrace. Many houses already appeared with a central hall during from the 1960s to the 1980s. The beginning of the walkway bridge, elevated more than two meters above the ground level, appeared in 1970. Although the users of the walkway bridges were not strangers, the privacy of the central terrace, which was in the same level, was reduced.

In Pakkran and Ladchado, some residents explained about the higher density of houses. In the past, only relatives built the houses in their cluster and always left distances with the other clusters (Piromya 2000). When the numbers of households increased, there were more chances of building the houses adjacent to the houses of other families. So, the residents needed more privacy from the central terrace after the developments.

Because of the lack of timber for replacement in the later period, the roof of the hall was considered to well protect wooden floors exposed to the sun and the rain. The last and important reason was results from the additional function in this space. From the survey in the houses, furniture and mattress also appeared.

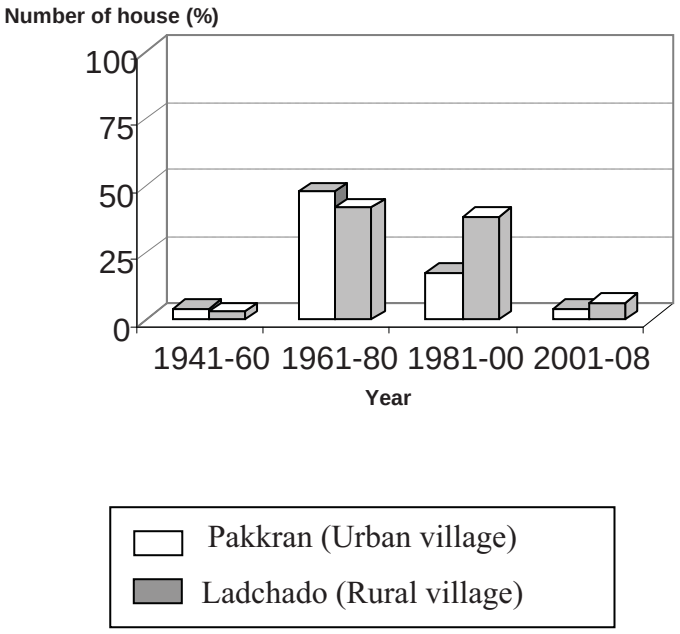


Figure 96 The number of the transformed houses, which a central terrace was enclosed and a multi-level floor was changed to a flat floor in the last six decades.

Some residents stated that because of their changes of life styles required more interior spaces and some explained about the increasing numbers of family members in limited land. Furniture is usually movable such as cabinets, tables, chairs, cupboards and drawers. Mattress can be fold and kept. However, most of the transforming houses contain only small amount of furniture comparing with contemporary house. The furniture is arranged against the walls for keeping central hall with wide space. Comparing to the central terrace, the interior spaces of a central hall have to receive more various activities.

In comparable to the process of enclosing, some houses that mostly were constructed during the last decade in Pakkran have been built with a central hall from the beginning. In this house type, there are seven houses found from 62 samples (see in Appendix D). This shows the residents' acceptation in urban village to the form of a *transformed Thai house*.

From Table 10, the central hall areas in Ladchado is larger than in Pakkran and the central terrace of the archetype. However, the percentage of this space and the

upper level in Ladchado are less than in Pakkran and the archetype. This means that the size of the house in Ladchado increase but maintain the area of the central terrace.

6.3.2 Areas underneath the house

The residents in Pakkran stated that the reasons of change their houses are the absence of flood, shortage of land, and the increasing of the family member. The floor of the *traditional Thai house* at ground level is an earth surface. The use of concrete to cover the earth surface is widespread. In some cases, the surface is covered with ceramic tiles. The residents still use this area for various purposes including some houses enclosed the space underneath the house. The enclosed space is usually used for a bedroom, a kitchen and a store room. The use of this area is still restricted in Ladchado because of the remaining of the seasonal flood in most areas. However, the recent road constructions are causing some flood disappearance. The houses and land along the road need to be elevated to the proper level. With these reasons, the villagers in Ladchado prepare to construct an enclosed room underneath their houses.

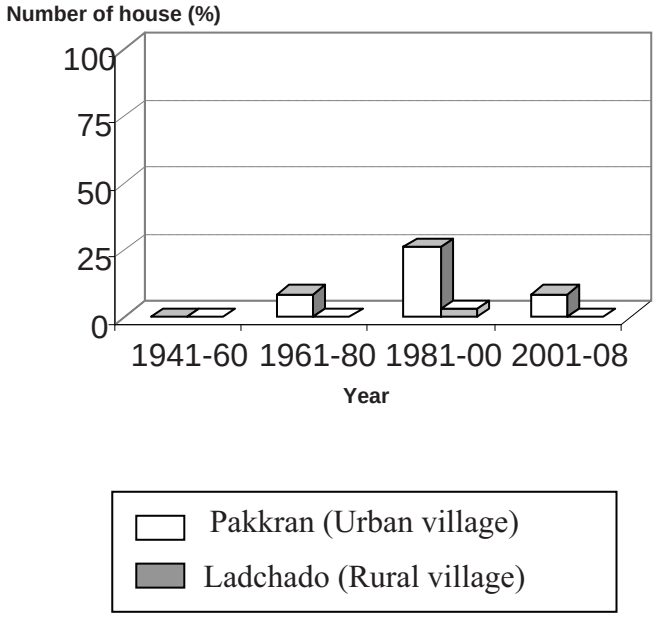


Figure 97 The number of the beginning of an enclosed space at the ground level of the transformed houses in the last six decades

6.3.3 Verandahs and porches at front

Figure 98 shows the periods of the erection of porch at the front of transformed houses. In both villages, the erection began almost at the same time but found more in Pakkran during the early period. The road constructions directly related to this change in Pakkran. The residents in Ladchado stated that the erection of porch came from the construction of the walkway bridge in the 1970s. Because the bridges were sometimes constructed at the side of the houses, the house could be entered directly to the central hall at the upper level. After that period, the residents began to change the entrance of their house and build the porch, which can be accessed both from ground level and bridge level.

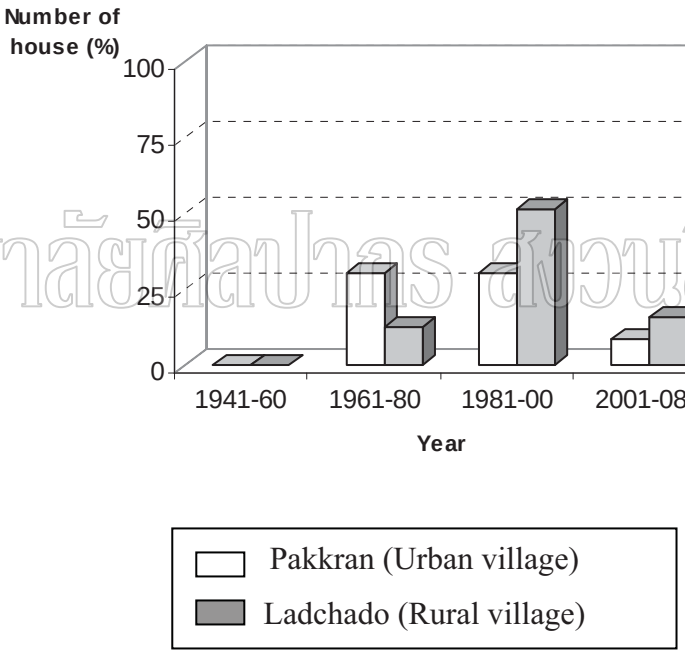


Figure 98 The number of the beginning of a porch at the transforming houses in the last six decades

6.3.4 Bathroom at the upper level

From Table 10, the sizes of bathroom in both villages is similar although the houses in Ladchado are larger than in Pakkran. Figure 99 shows the number of houses with a bathroom at the upper level during the last six decades. Some houses in Pakkran do not have a bathroom at upper floor but found at ground level. Bathroom construction in both villages mostly began in 1980s, but found more popular in

Ladchado. The residents in Ladchado stated that bathrooms at the upper level was necessary. Particularly in the past, a bathroom was built temporary because of the periodic flood. It began to permanently build a bathroom in the houses in the 1980s after the emergence of a central hall. In addition, the residents feel secured and have more privacy in having a toilet in the house at the upper floor. Hygienic control forced by local government officers in the 1980s was also important. The official house number would not be given to the house with a proper toilet.

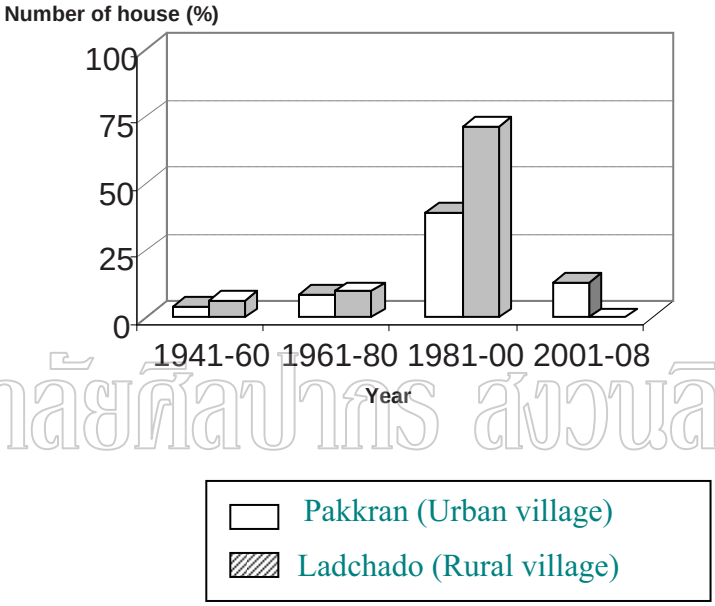


Figure 99 The numbers of the beginning of a bathroom at the upper level of the transformed houses in the last six decades

6.3.5 Kitchen units to cooking areas

Cooking areas in both villages are slightly smaller than the kitchen unit in the archetype (Table 10). Figure 100 shows the numbers of houses with a cooking space at the upper level during the last six decades. Similar to a bathroom, some cooking space is found at the ground level in Pakkran. The constructions of cooking space at the upper level are found more popular in Ladchado because of the small plot of land. The other reasons of merging of the kitchen from the residents in both villages are convenience and availability of inflammable roofing materials.

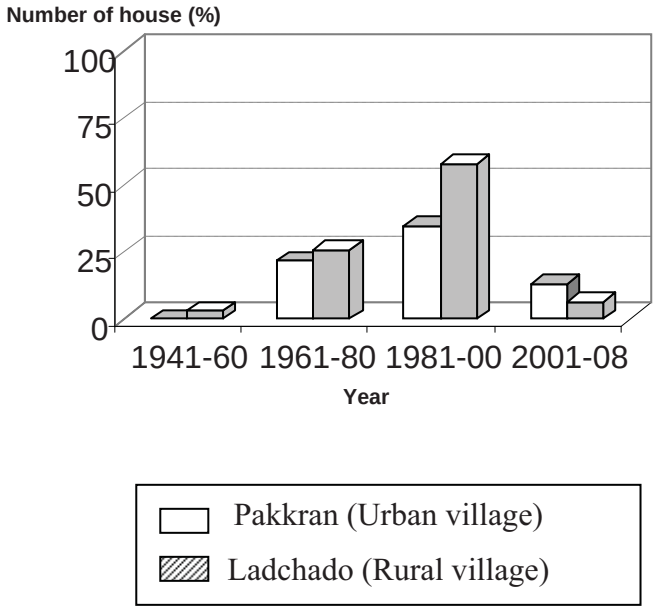


Figure 100 The number of the beginning of the cooking area at the upper floor of the transformed houses in the last six decades

6.4 Dominant characteristics of the main transformations

As discussed in Section 5.3 to 5.5, not only the space, form and lay-out of the vernacular Thai houses have changed, but their architectural elements have also changed. Since this research is aimed at understanding the relation of changing characteristics and the transformations, the style of 11 architectural elements are discussed following the five main physical transformations, which have occurred in the *transformed Thai houses*.

The numbers of houses with the most dominating style are shown in order to find the relation. The data are divided into suburban and rural areas. There are 23 houses in the suburban area (Pakkran village) and 31 houses in the rural area (Ladchado village).

6.4.1 Central terraces to halls

In Chapter 4, besides limited land areas of the house surroundings, a central terrace was transformed to a hall because the residents needed more internal spaces, limited land, privacy and security. Most of the residents gave their opinions about the

change in lifestyle which requires more internal spaces. In Table 11, the results of the study suggest that the style in the central terrace is similar to the style in the whole *transformed Thai house*.

The intermediate style is the most dominant characteristic for this transformation both in the suburban and the rural areas. The intermediate style in a form has been combined with the *traditional Thai house* at the central terrace for creating a hall, a single largest part of the *transformed Thai house*. For a bungalow-style construction, timbers were used with modern methodologies, and functional orientation.

Table 11 The most dominant characteristic of the architectural elements (at the hall)

Characteristics (Number of surveyed houses)				
	Traditional		**Intermediate**	
	S-Urban	**Rural**	**S-Urban**	**Rural**
1. Roof cladding	-	-	15	24
2. Roof structure	-	-	15	24
3. Upper. column	-	-	15	24
4. Upper. wall	-	-	15	24
5. Upper. beam	-	-	15	24
6. Upper. floor	-	-	15	24
7. Foundation	-	24	15	-
8. Ground. column	-	18	15	6

Keys:

-Ground. = Ground level, Upper. = Upper level

-S-Urban = Suburban

-Highlighted data show the most typical materials of the elements.

-There are 15 from 23 houses in Pakkran and 24 from 31 houses in Ladchado, which central terraces have been transformed to halls.

The bungalow-style roof covers the larger area of the central hall than the bedroom unit of the *traditional Thai house*. The span of the traditional Thai roofs is

limited at approximately 3.0 to 3.5 metres. The low-angle form of the bungalow style roof connected to the high pitched roof of the *traditional Thai house* creates one continuous space inside the house. The bungalow-style roof is more economic because of its compactness, simple form and lower cost of maintenance. The truss-style structure with low angle minimizes the use of materials both for structural elements and gable cladding.

Corrugated materials reduce maintenance works and leak problems compared to clay tiles and thatch. Although the cost of new roofing was higher than traditional roofing, the residents can reduce the cost of roof maintenance or replacement later.

The other construction elements were mostly built of timbers but with early manufacturing methods, which reduced the cost of using a highly skilled builder. Instead of using non-traditional materials such as concrete-base materials, local builders were familiar with timbers works even though shape, form and technique of the house construction have changed. The intermediate style could be used to cover a traditional central terrace and required minimum adjustments. The uses of the traditional style at the foundations in the rural area show only significant differences from suburban area. The residents have chosen to use the traditional style for foundations from the economic reason. They have preferred to repair or replace with timbers because of more availability of timbers, and cheaper labor in rural area than in suburban area.

The purpose of change from a multi-level floor to a flat level floor was to create a large interior space without steps. A flat level of floor was built with smaller size timbers than the traditional floor because of the introduction of joist and beam system. The non-traditional floor could share their structure with existing traditional beams and columns. Therefore, a flat level floor provides economical benefits when built with the intermediate style.

The information from both physical developments of architectural elements and residents' opinions suggests that function, durability and economics are the reasons of uses of style (bungalow and a single flat level) in the hall.

6.4.2 Area under raised dwellings

The residents' needs for more internal space have increased transforming the house not only at the upper floor but also at the ground floor. The number of enclosed spaces at the ground level is related to the absence of floods. The urban area of Pakkran shows a higher number of houses with enclosed space at the ground level than in the rural area of Ladchado. There has been no flood in Pakkran since 1996 and in some areas of Ladchado since 2004.

The activities under a raised floor are still mostly outside the enclosed space. Therefore, the areas of these enclosed spaces are rather small in both Pakkran and Ladchado (about 20% of the whole ground level areas) compared to Bangpahun (about 55% of the whole ground level areas). In Table 12, all enclosed spaces have been typically built with contemporary style (concrete structures and masonry walls), even though cost of building has been higher than intermediate style.

Table 12 The most dominant characteristic of the architectural elements (at the enclosed space at ground level)

Characteristics (Number of surveyed houses)				
	Intermediate		**Contemporary**	
	S-Urban	**Rural**	**S-Urban**	**Rural**
1. Foundation	4	-	6	1
2. Ground. column	4	-	6	1
3. Ground. wall	-	-	10	1
4. Ground. beam	-	-	10	1
5. Ground. floor	-	-	10	1

Keys:

-Ground. = Ground level, Upper. = Upper level

-S-Urban = Suburban

-Highlighted data show the most typical materials of the elements.

-There are 10 from 23 houses in Pakkran and 1 from 31 houses in Ladchado, which the area under raised dwelling is enclosed to be rooms.

The residents stated that materials used in contemporary style house can protect and endure damp better than the other materials. The concrete structures and masonry walls were built separately from the existing structure, which are the ground level columns and the foundations. Some enclosed spaces in Pakkran were economically built by using existing early manufacturing columns and foundations as structures. The information from both physical developments of the architectural elements and residents' opinions demonstrates that the uses of contemporary style in this part are mainly from the needs of durability.

6.4.3 Disappearance of verandahs and erection of porches

A porch provides a transitional space at the front of the *transformed Thai house*. This is different from modifying a central terrace to a hall. Porches are entirely extended from the front of the enclosed at the upper floor level. Roofs covering the porches are larger than the verandah of the *traditional Thai house*. In Table 13, the intermediate style is used mainly with the bungalow-style and low-angle roofs. However, there are a few porches that were constructed with the traditional style and high-pitch roofs.

The low-angle roof structures and corrugated roofing materials lower costs of both maintenance and construction. Similar to the hall, the traditional columns and foundations at the ground level show the difference between the urban and rural areas. The information from both physical developments of the architectural elements and residents' opinions shows that the uses of intermediate style in this part are mainly for reason of durability and economics.

6.4.4 Bathroom at the upper level

Bathroom has been built at the upper level because of the residents' needs of sanitation, convenience, and privacy. In Table 14, the results show that a bathroom is obviously the most modernized construction in the *transformed Thai house*. Except the roof, the construction elements are built with concrete structures and masonry walls. Plaster and ceramic tiles are applied at the floors and walls. Concrete structures are built separately from the intermediate or the traditional constructions.

Table 13 The most dominant characteristic of the architectural elements (at the porch)

Characteristics (Number of surveyed houses)				
	Traditional		**Intermediate**	
	S-Urban	**Rural**	**S-Urban**	**Rural**
1. Roof cladding	-	-	16	25
2. Roof structure	3	4	13	21
3. Upper. column	3	4	13	21
4. Upper. beam	-	-	16	25
5. Upper. floor	-	-	16	25
6. Foundation	-	15	16	10
7. Ground. column	-	15	13	10

Table 14 The most dominant characteristic of the architectural elements (at the upper level bathroom)

Characteristics (Number of surveyed houses)						
	Traditional		**Intermediate**		**Contemporary**	
	S-Urban	**Rural**	**S-Urban**	**Rural**	**S-Urban**	**Rural**
1. Roof cladding	-	-	13	22	2	4
2. Roof structure	-	-	13	22	2	4
3. Upper. column	-	-	-	3	15	23
4. Upper. wall	-	-	-	3	15	23
5. Upper. beam	-	-	-	1	15	25
6. Upper. floor	-	-	-	1	15	25
7. Foundation	-	1	-	9	15	16
8. Ground. column	-	1	-	2	15	16

Keys:

-Ground. = Ground level, Upper. = Upper level

-S-Urban = Suburban

-Highlighted data show the most typical materials of the elements.

-There are 15 from 23 houses in Pakkran and 26 from 31 houses in Ladchado, which the bathroom were constructed at the upper level.

The information shows that the uses of the contemporary construction in this part are mainly for the reasons of durability and function.

6.4.5 Kitchen units to cooking space

The kitchen units have been merged to the house for the residents' convenience and the limitation of house boundary. The residents gave their reasons about the problem of the flammable thatch roofing and thus solving by using the corrugated roofing. However, because of unaffordable construction cost, few residents built a cooking space of their house with the contemporary style, using a good property of materials with fire protection.

Table 15 The most dominant characteristic of the architectural elements (at the cooking space)

Characteristics (Number of surveyed houses)						
	Traditional		**Intermediate**		**Contemporary**	
	S-Urban	**Rural**	**S-Urban**	**Rural**	**S-Urban**	**Rural**
1. Roof cladding	-	-	16	29	-	-
2. Roof structure	-	-	16	29	-	-
3. Upper. column	-	-	12	27	4	2
4. Upper. wall	-	-	12	27	4	2
5. Upper. beam	-	-	12	27	4	2
6. Upper. floor	-	-	12	27	4	2
7. Foundation	-	18	12	11	4	2
8. Ground. column	-	18	12	11	4	2

Keys:

-Ground. = Ground level, Upper. = Upper level

-S-Urban = Suburban

-Highlighted data show the most typical characteristic of the elements.

-There are 16 from 23 houses in Pakkran and 29 from 31 houses in Ladchado, which the cooking spaces were constructed at the upper level.

The results in Table 15 show the characteristics of the cooking spaces, which is similar to the halls and the porches. Most of cooking spaces were built with the intermediate style, using timber by constructing with bungalow shape and modern methodology. The traditional columns and foundations at the ground level show the main difference between urban and rural areas. The residents in the rural areas explained that they could afford to reuse timber brought from other provinces, until the late 1990s. The information shows that the uses of the intermediate style in the cooking space are mainly for economic.

6.5 Characteristics and period of the roof (Comparison of roof structure to cladding)

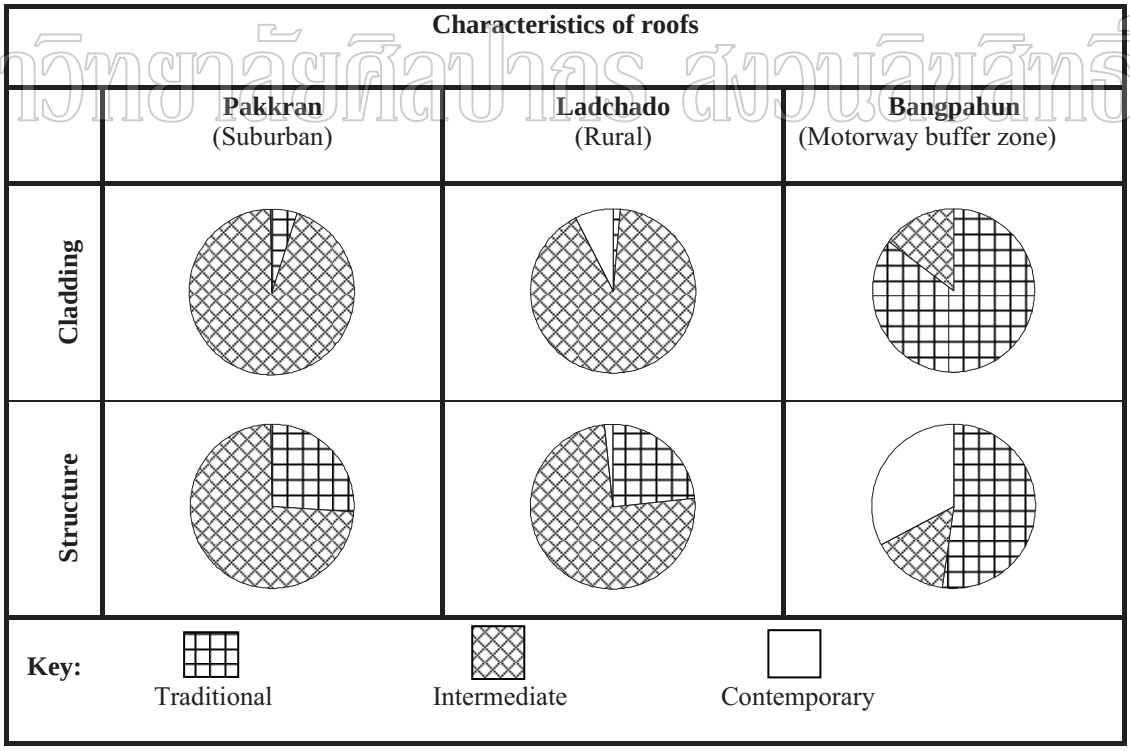
The data of characteristics are presented as percentage by pie charts. The different of each specimen is compared with three surveyed locations. From roofing construction, the analysis is drawn from the appearances of two architectural elements: cladding and structures.

The time-scale charts present years and a number of houses. The charts illustrate the beginning period of intermediate and contemporary characteristics (nontraditional characteristics). Years presented in the charts are the ones which began the nontraditional characteristics in each construction element. This chart is based on the information from 62 samples of the vernacular houses in the studied areas. Two locations, Pakkran and Ladchado, are in the village and another location, Bangpahun, is in buffer areas along the motorway. The data of characteristics and periods are discussed with a comparison of roof cladding and its structure. The numbers of percentage are presented in Appendix E.

From Figure 101 A, the roof cladding in the group of traditional houses is found in a small amount of appearances in the *transformed Thai houses* in Pakkran and Ladchado (4.9 and 1.5%). These traditional roofing are clay tiles. As discussed earlier in Section 6.2, construction elements of the *traditional Thai house* in the *transformed Thai house* remains 25.1 percent in Pakkran and 19.1 percent in Ladchado. However, clay tiles are vastly used for the roofs of the *reproduced Thai house* in Bangpahun.

These data support that clay tiles used in traditional parts of the transformed houses were mostly replaced by corrugated materials. The corrugated materials significantly used for roofs of the *transformed Thai houses* in both villages. The contemporary characteristics are rarely found in Pakkran and Ladchado (0.3 and 7.4%) and not found in the areas along buffer areas of the motorway. This indicates that there are a few changes of roofs after corrugated materials becoming popular in intermediate period. This still appears in most houses of Pakkran and Ladchado. Other materials are local concrete tiles and corrugated metal sheets. The corrugated tiles are still produced and commonly used for vernacular Thai houses.

The houses in Pakkran and Ladchado are mostly different at the roof cladding. In traditional group, clay tiles are used in Pakkran more than in Ladchado. In intermediate group, there are the uses of corrugated concrete tiles in Pakkran more than in Ladchado. Nontheless, local concrete tiles and corrugated metal sheets are



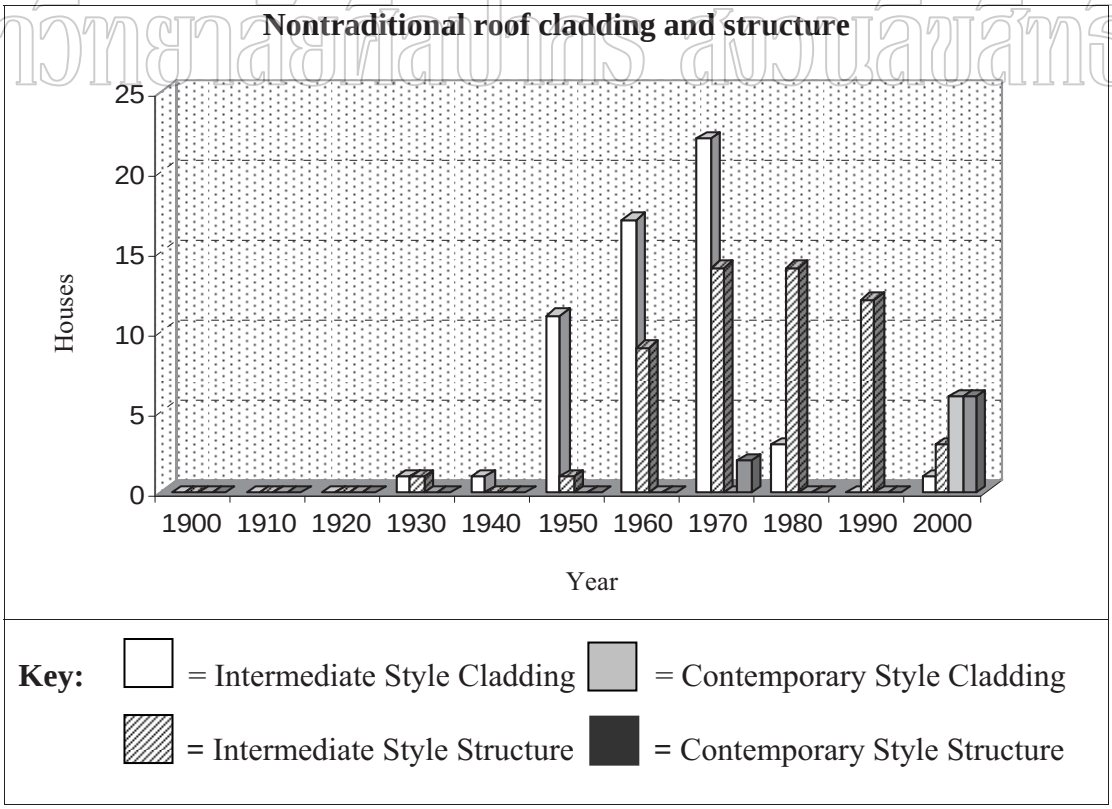
Note: The data are the averaged area of surface used in samples.

Figure 101 Characteristics of the roof cladding and structures in three surveyed locations

found in Ladchado more than in Pakkran. In contemporary group, modern concrete tiles are used in Ladchado more than in Pakkran.

The characteristics of roof structures in Pakkran and Ladchado are mostly belonging to the intermediate group with various types of timbers. In Pakkran and Ladchado, Teak is the most important materials for traditional structures, while Teng is mostly found in intermediate structures. Various timbers are used in the intermediate group.

There are very few contemporary characteristics in both villages (0.3 and 1.8%). There are some uses of steel (light-gauge steel) for reproducing traditional roof, usually found in Ayutthaya but outside the surveyed locations. However, in Bangpahun, only Teak and Teng, are used to build traditional roof structures. Concrete is applied for building a flat roof, which is functioned as a terrace, in Bangpahun. This manifests that the residents and builders are very conservative in choosing characteristics for a pitch roof but more flexible for a new roof form.



Note: Data were acquired from 62 vernacular houses in the three surveyed locations

Figure 102 The beginning of nontraditional characteristics (roof cladding and structures)

The beginning of nontraditional characteristics simply relates to the periods of construction of the original traditional dwelling, and later merged or extended to form the transforming houses. Most houses in the study were built during in the 1850s, 1880s and 1900s (see Appendix D). From the interviews, the houses in the 1850s and 1880s were mostly built in Ladchado and in the 1900s were mostly built in Pakkran. From the interviews, most roofs in Pakkran was begun with clay tiles. In contrast, many residents in Ladchado explained that thatches were originally used and replaced with clay tiles after the 1900s.

From Figure 102, an intermediate group shows the changes of uses from thatches or clay tiles to corrugated materials in the 1930s and became most common during from the 1950s to 1970s.. This change was because a big fire in Ladchado in 1938 and thus encouraging modification in many houses with bungalow shaped roof during from the 1950s to 1970s. The residents told that the fires spread rapidly to the houses, particularly with a thatched roof, and damaged more than a hundred houses. After the big fire, the residents were worried that fired might be happened again. Thus, corrugated materials for roofs are chosen to ensure fireproof and durability when they build a new house.

Most of the residents in Pakkran stated that roof cladding of their house was initially clay tiles. A few residents (3 from 23 households) indicated that roofing materials of their houses were thatches before changed to clay tiles. From the interview, the clay tiles began to be used in the reign of King Rama 4th in the 1840s. However, the residents have been familiar with thatch roof because of the continuity of using this material for their field shelters and rice barns.

The introduction of corrugated materials increased the period between roof cladding replacements. The residents in Pakkran and Ladchado stated that thatches had to be replaced every three to five years. Although clay tiles might last for more than 10 years, they could be easily damaged from strong wind. They also estimated that corrugated metal sheets could be last for at least 10-15 years, and corrugated concrete tiles for 20-25 years. In Pakkran, there are two transforming houses that started using imported metal sheet for the eave at their beginning in the 1900s. When these corrugated materials could be produced in Thailand in the 1930s, the uses of this

material expanded to the whole roofs and walls in many houses. First use of corrugated materials was during from the 1950s to the 1970s.

The first use of contemporary roofing was around about the beginning of the 21st century. Because clay tiles with color coating (used in contemporary architectures) are categorized in the traditional group, the flat-slab concrete is considered contemporary roofing found in Bangpahun. This shows that contemporary concrete tiles have not been used so far as a replacement of intermediate or traditional materials within the samples.

In the intermediate group, roof structures significantly have appeared since at the beginning of the 1960s, while roof cladding were used at the beginning in the 1950s and noticeably reduced after the 1970s. The replacement of roof cladding was found earlier than the replacement of structure for *transformed Thai houses*. The re-cladding of roof was initially used for replacement but the second erection of structure was initially used for expansion. This shows that the characteristics of replacements are changed more easily than the characteristics of new constructions.

In Bangpahun, contemporary roof structures are recently found in form of a flat roof. This concrete flat roof is necessary for the *reproduced Thai house* because of new layout of roofs and terraces at the upper level of the house.

6.6 Characteristics and period beneath the roof (Comparison of structure to cladding)

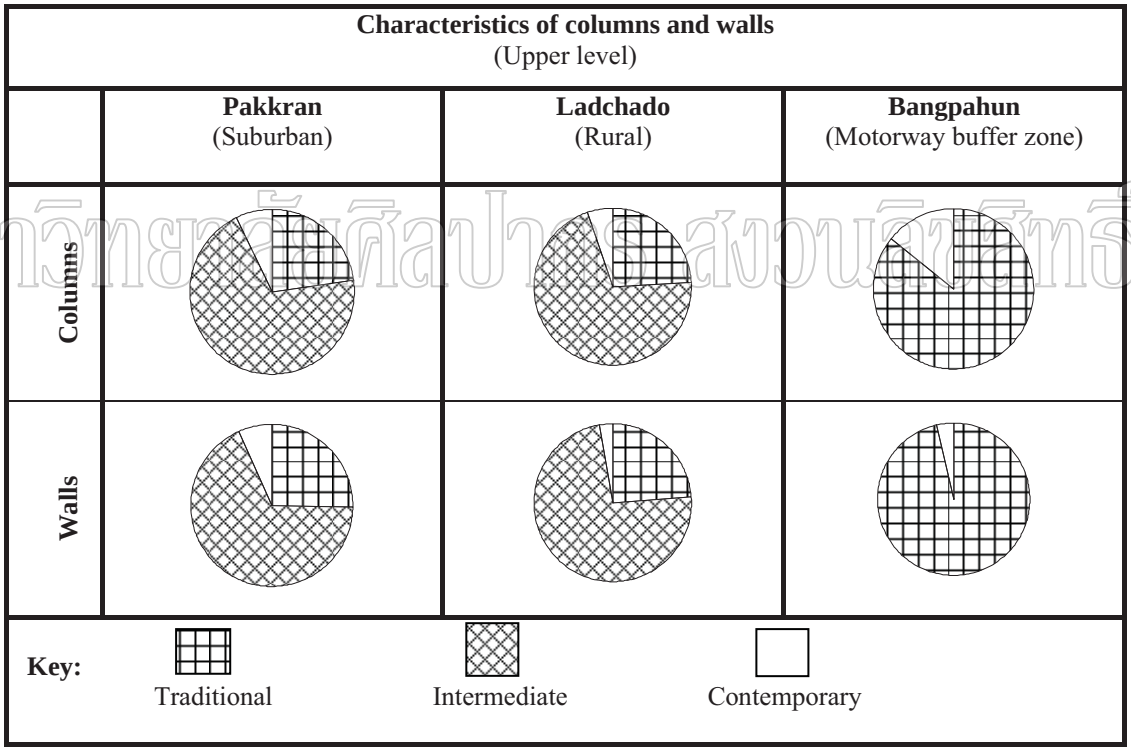
The data of the construction beneath the roof are presented and discussed in the same method as the one in Section 6.5. At the upper level construction, there are four architectural elements: columns; walls; beams; and floors. At the ground level construction, there are five architectural elements; foundations; columns; walls; beams; and floors. Three elements (walls, beams, and floors) at the ground level are found only in the recent constructions, while there are not appeared in the traditional construction.

The data are discussed in pairs of structures and claddings: 1. upper level columns and walls; 2. upper level beams and floors; 3. ground level columns and walls; 4. ground level beams and floors. In addition, the discussion compares the

difference between the upper level and the ground level. However, foundations are discussed individually.

6.6.1 Upper level columns and walls

From pie charts in Figure 103, traditional columns are found in the highest percentage in Bangpahun and Teng is the most used timber. The data significantly show greater numbers of traditional timber columns in the *reproduced Thai house* than in the *transformed Thai house*. In contrast, traditional columns are not found in the extension parts of the *transformed Thai house*. The residents restrict the uses of the traditional columns only at the traditional part.



Note: The data are the averaged area or amount of samples.

Figure 103 Characteristics of the upper level columns and walls in three surveyed locations

The characteristics of the intermediate group are mostly found in Pakkran and Ladchado (70% and 70.6%). They are mainly a simple square-shape timber column

with bolted connections. These are always used for the expansions of the transforming house. Teng is the most typical timber and similarly found in Pakkran and Ladchado.

The characteristics of contemporary group are found in small amount because in-situ cast concrete are typically used for bathroom construction. In Bangpahun, this appears in a higher proportion because there are more uses of in-situ cast concrete column for more bathrooms, cooking areas and storages.

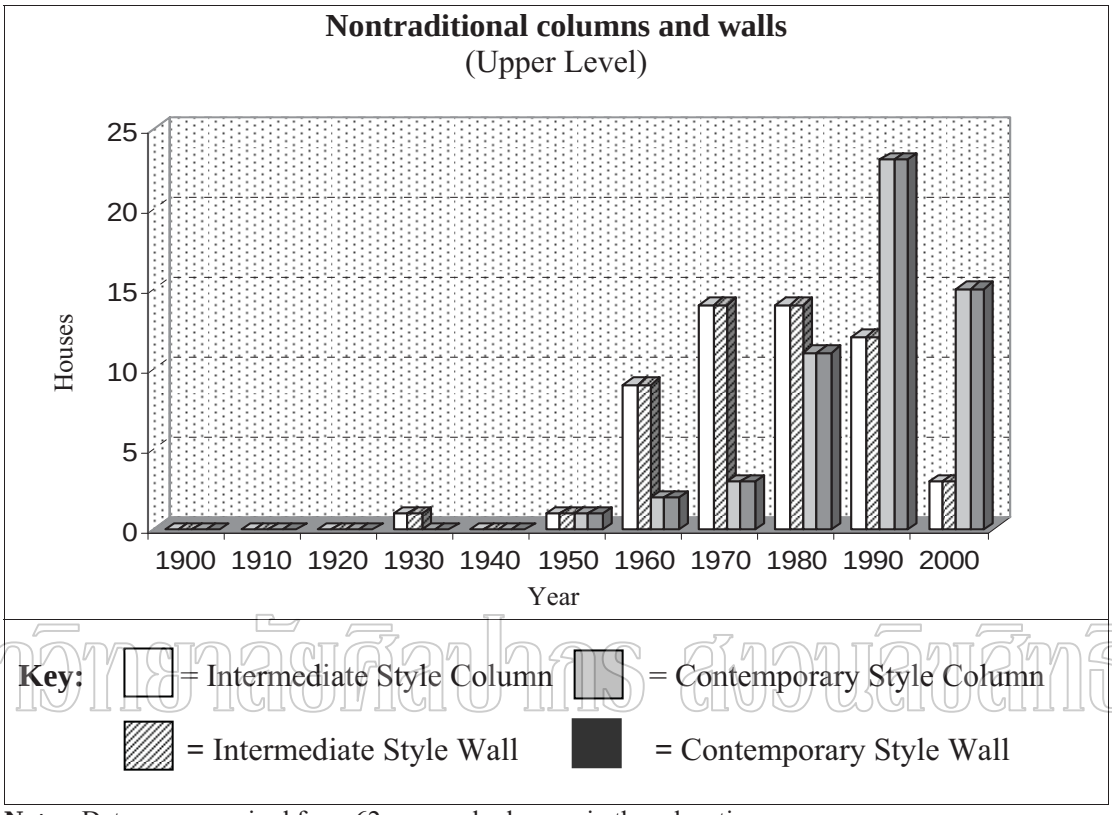
In Pakkran and Ladchado, the appearances of columns at the upper level are mostly similar. There is a slightly difference between these two locations. In traditional group, Teak is the most popular in uses and found much more than other timbers in Pakkran. Teng is the most typical timber in Ladchado, but found a bit more than the uses of Teak. Rung and Makha are found only in Ladchado while Daeng are found only in Pakkran.

In the intermediate group, Teng is the most used timber. There are no uses of Teak in both locations and no uses of Eucalyptus and pine in Ladchado. Steel columns are found only a few in Pakkran. In the contemporary group, only in-situ cast concrete are found in similar amount in both villages.

Traditional wall is used for almost every part at the upper level in Bangpahun (96.5%). However, some walls are constructed with the concrete structures inside, which are mainly built for a bathroom. Builders in Bangpahun seem to keep the appearance of the upper level construction in traditional style.

At the upper level, the appearances of walls in Pakkran and Ladchado are mostly similar. There is a few differences between these two locations. In the early intermediate group, there is only the use of corrugated metal sheet in Pakkran. In the contemporary group, there is also only the use of concrete block with plaster in Pakkran.

In the intermediate and contemporary groups, the characteristics of columns and walls in the *transformed Thai house* are found in similar proportion. The results of this study show the close relation of these two elements.



Note: -Data were acquired from 62 vernacular houses in three locations

Figure 104 The beginning of nontraditional characteristics (columns and walls at the upper level)

From timescale chart in Figure 104, the data of columns and walls acquired from the survey are not different. This chart shows the timescale of both elements. It also supports that columns and walls have been built from the same process. The last period of traditional construction occurred in the 1980s (see Appendix D).

The intermediate group shows the transformation of walls from traditional timber to timber weatherboards or corrugated metal sheets with bolted columns starting in the 1930s. They became popular in the *transformed Thai houses* during from the 1960s to the 1990s. Many residents (31 residents in 54 houses) stated that the simplicity of the construction process in the intermediate period reduced the cost of any expansion or modification.

The appearance of the contemporary group shows the change, which started later than the intermediate group. However, the uses are found in very high numbers of houses after the 1980s, because of the demand of brick-concrete bathrooms. These are found in both the *transformed Thai houses* and the *reproduced Thai houses*. The residents said that the need for solid brick walls and durable concrete columns started at bathroom. Although construction styles of the intermediate group were commonly used in the 1960s, bathrooms began to be built with contemporary appearance since the 1950s. The contemporary appearance has been widely used since the 1990s. The other spaces in some *transformed Thai house*, particularly kitchens, have also been built with contemporary appearance. In the *reproduced Thai houses*, the contemporary appearance has also been limited to bathrooms at the upper floor level even though the whole construction at the ground floor level is in the contemporary group.

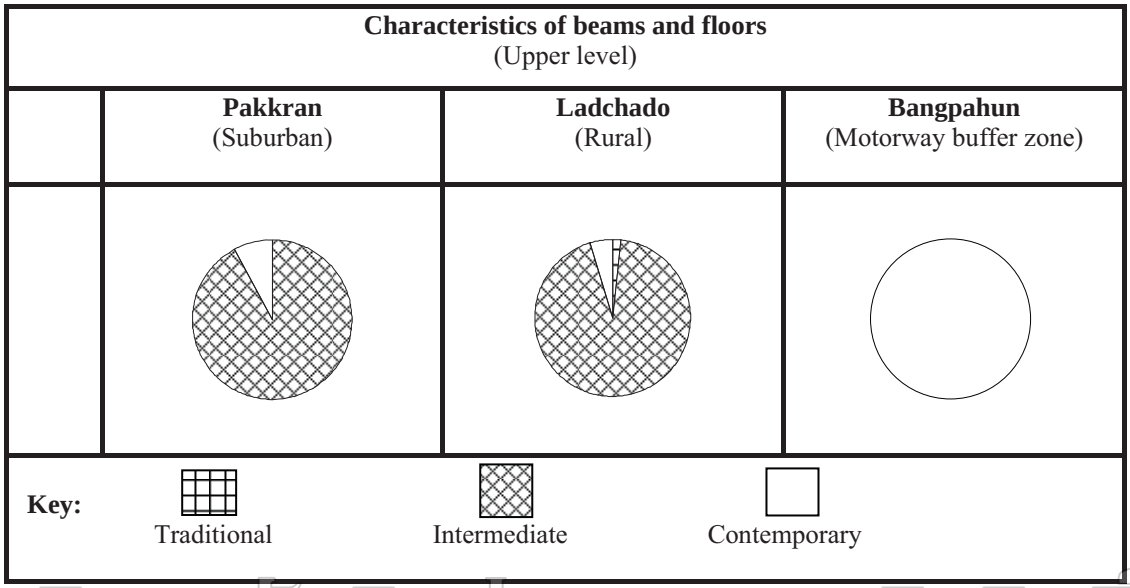
6.6.2 Upper level beams and floors

From pie charts in Figure 105, the appearances of beam and floor surface in each group are the same. At the present time, traditional beam and floor is rarely found in the transforming houses (1.7% in Ladchado). This happened after the 1930s when joists were introduced during the intermediate period. At that time, floors of the *traditional Thai houses* were often modified to be supported by additional joists. Moreover, the *traditional Thai houses* were sometimes built with joist-and-beam system from the beginning.

As a result, beams and floors in both traditional and nontraditional parts of the transforming houses can be categorized into the intermediate group (92.2% and 93.7%). Only contemporary beams and floors are used in Bangpahun. The timber boards are extensively used in Bangpahun. Those boards are laid on timber joists supported with concrete beams, or laid directly on a solid concrete wall. These can be categorized into the contemporary group.

The appearances of these elements in Pakkran and Ladchado are mostly similar. There are few differences between these two locations. In the intermediate group, Teng is the most used materials for the upper level beams both in Pakkran and Ladchado. However, Teak is used for beams a few less than Teng in Ladchado. The

popular imported timbers, Mahogany, are found in Pakkran more than in Ladchado. There are no uses of other imported hardwoods (Makha and Eucalyptus*)* and softwoods (pine) in Ladchado.

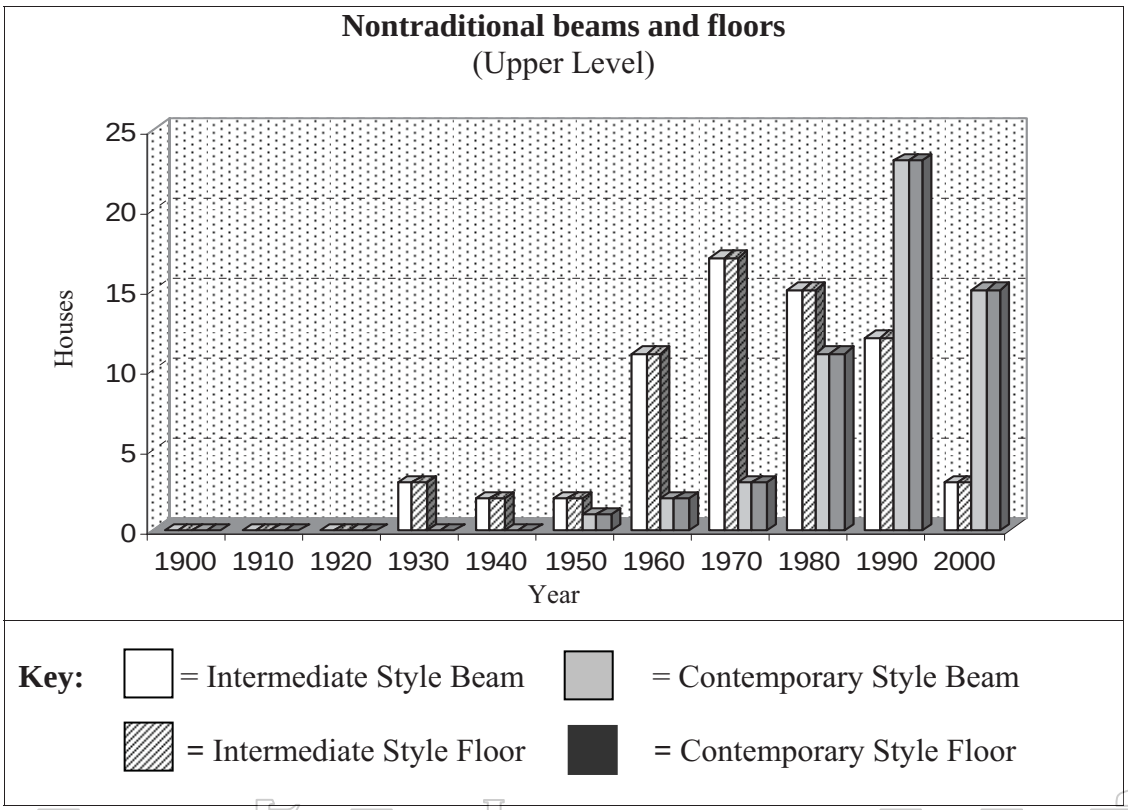


Note: The data are the averaged area or amount of samples.

Figure 105 Characteristics of the upper floor level beams and floors in three surveyed locations

Time-scale chart in Figure 106 shows that changes of beams and floors were before the 1980s, and this began earlier than changes of columns and walls. From the surveys, the traditional characteristics have declined and disappeared since the 1940s. Most of the residents stated that original beam and floor system required thick timber floorboards; which were rare, expensive, and suitable for a house without heavy furniture.

The changes of beams and floors in the intermediate group started in the 1930s, which was the same period in the 1930s as the changes of columns and walls. This characteristic had been well accepted from the 1930s to 1980s. The local builders commented that the uses of joist reduced sag of floorboard and became popular for expanding the *transformed Thai house*, which included any modification of the traditional construction.



Note: -Data were acquired from 62 vernacular houses in three locations

Figure 106 The beginning of nontraditional characteristics (beams and floors at the upper level)

In the contemporary group, the period of beams and floors is similar to the period of columns and beams because of the integral process of construction at the same time. The change started later than the intermediate group for three decades and has been very popular until now. However, the contemporary characteristic has been found in the small parts of the samples in Pakkran and Ladchado. Similar to columns and walls, the contemporary appearance occurred in both the *transformed Thai houses* and the *reproduced Thai houses*. In the transforming houses, the uses have been typically found at bathrooms and kitchens. In the reproduction houses, all constructions of beams and floors at the upper floor level are built with contemporary style.

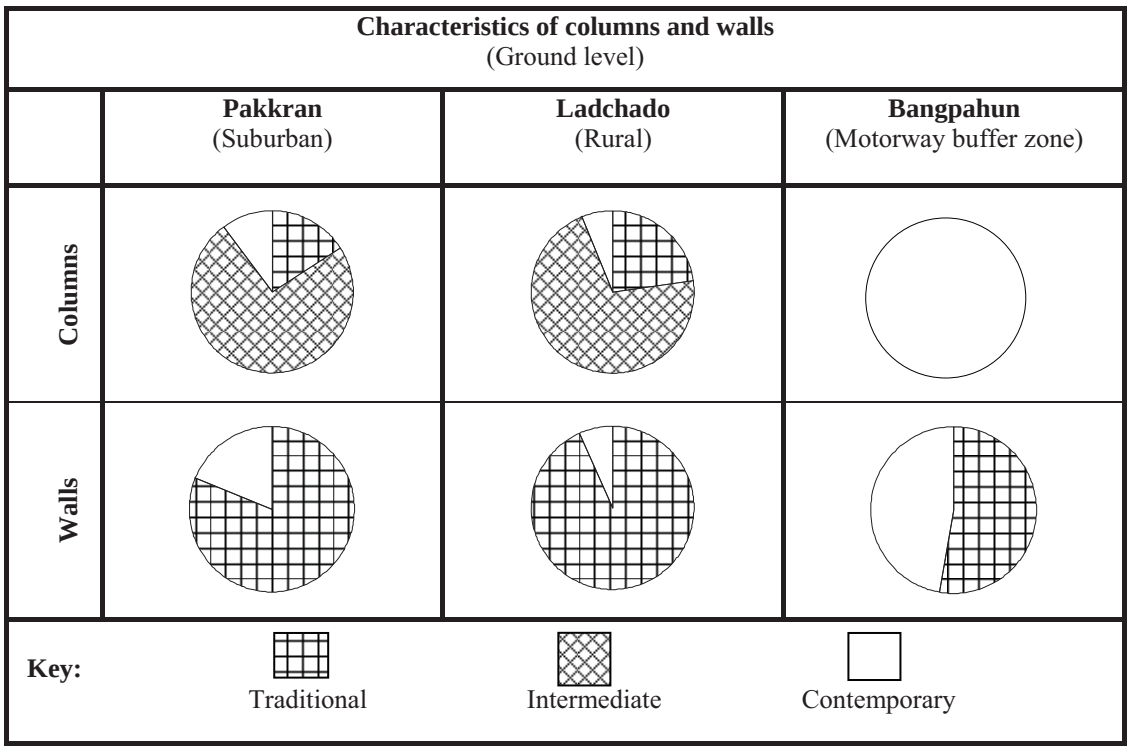
6.6.3 Ground level columns and walls

From the pie charts in Figure 107, the traditional columns are mostly found in Ladchado (22.5%). The intermediate columns are found in a high percentage in both Pakkran and Ladchado (74% and 69.8%). The contemporary columns are wholly used in Bangpahun. The uses of contemporary column and wall are found in bathrooms and kitchens in Pakkran and Ladchado.

The characteristics of the ground level columns in Pakkran and Ladchado are similar. A few differences occur between these two locations. Teng is the most used materials for the ground level columns in both villages. Teak is used only in the traditional group and found a few less than Teng in Ladchado). There are more uses of various timbers in Pakkran than in Ladchado. The uses of Makha, Eucalyptus, and pine are found in Pakkran. In-situ cast concrete is the only material in the contemporary group and found in Pakkran more than in Ladchado.

The data of the traditional wall do not mean that many traditional walls are used at the ground level. In fact, there is no wall at the ground level in the traditional group but an open space. In the *transformed Thai houses* in both villages, open spaces under a raised house are at a high percentage (81% and 93.2%). However, many residents (37 residents in 54 houses) stated that they will build more enclosed space in the future if they have funds. In Bangpahun, enclosed spaces are about half of the ground level area and the other half is open spaces. There is no use of intermediate wall at the ground level in all surveyed locations.

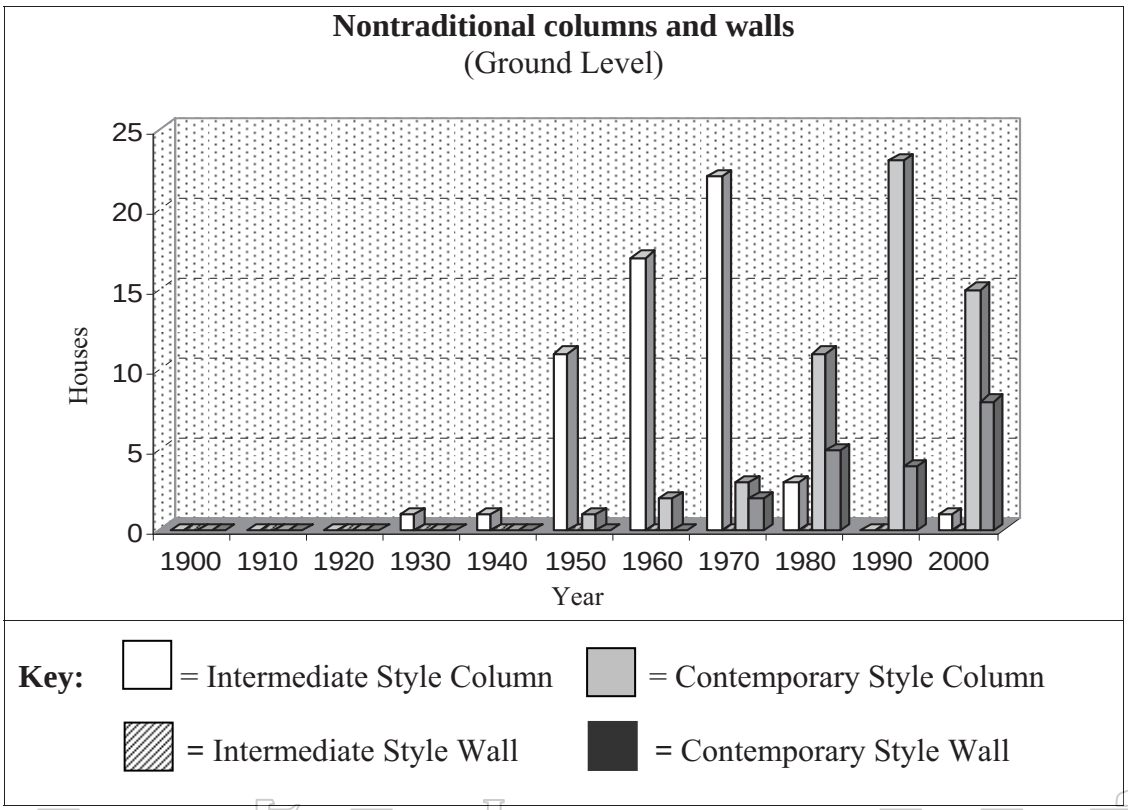
The characteristics at the ground level walls in Pakkran and Ladchado show similarities and differences. Most of the areas underneath the houses have no wall, which are categorized in the tradition group, and the uses of the manufacturing walls are not found. The uses of contemporary walls are found in Pakkran more than in Ladchado. There are uses of concrete blocks only in Pakkran.



Note: The data are the averaged area or amount of samples.

Figure 107 Characteristics of the ground floor level columns and walls in the three surveyed locations

From the time-scale charts in Figure 108, the intermediate columns are still used currently. As discussed previously, there is no use of the early manufacturing walls at the ground level. The last traditional columns were found in the 1980s (see Appendix D). In the contemporary group, the uses of columns and walls are found in both the *transformed Thai houses* and the *reproduced Thai houses.* The uses of contemporary walls at the ground level for creating an enclosed space started later than the contemporary columns for three decades. The masonry walls become common at the current and are used for all ground level walls, constructed recently, in the samples.



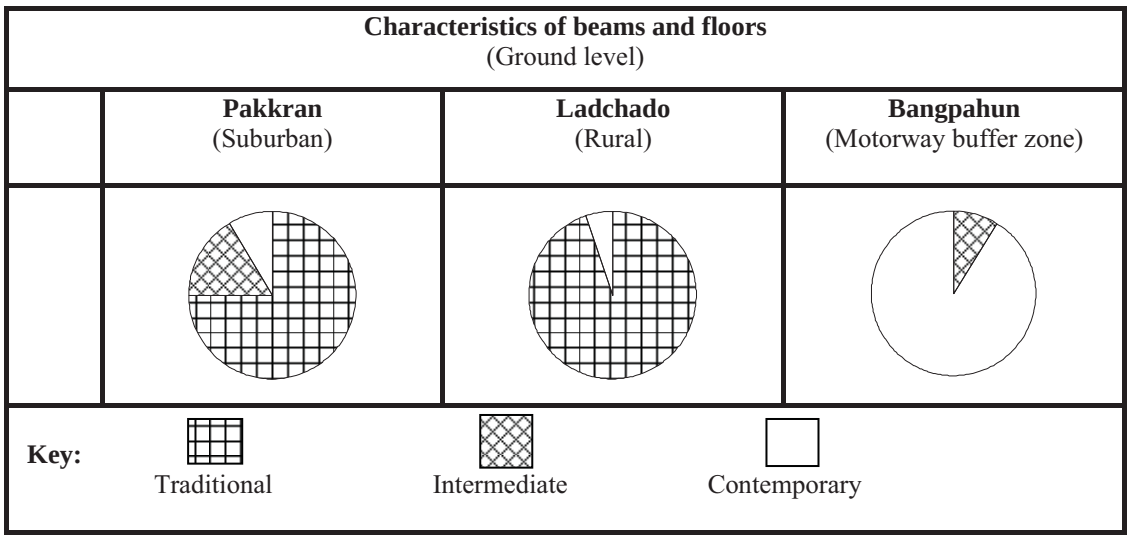
Note: The data are the averaged area or amount of samples.

Figure 108 The beginning of nontraditional characteristics (columns and walls at the ground level)

6.6.4 Ground level beams and floors

From Figure 109, the data of the traditional beam and floor show that there are no beams and floors at the ground level. Most of the areas under raised floor are still open spaces in Pakkran and Ladchado. The uses of the contemporary beams and floors in these two villages (7.8% and 6.8%) show a few enclosed spaces at the ground level. The enclosed spaces are typically built with contemporary beams and floors.

The characteristics the ground level beams and floors in Pakkran and Ladchado are differences in the intermediate group. There are uses of the slab-on-ground concrete only in Pakkran. The in-situ cast concrete is found in Pakkran more than in Ladchado.

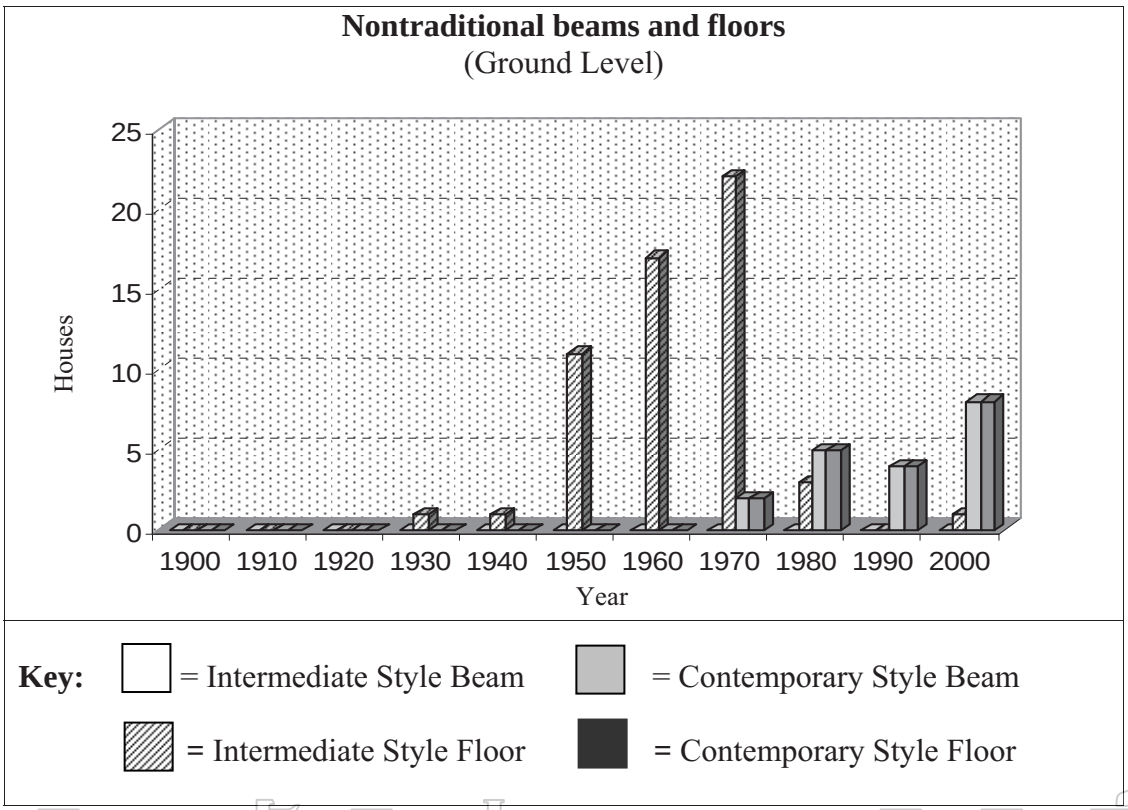


Note: The data are the averaged area or amount of samples.

Figure 109 Characteristics of the ground level beams and floors in three surveyed locations

From Figure 110, the use of ground level beams in the contemporary group started in the 1970s. These concrete beams are usually constructed with the same process as for columns and foundations. The contemporary beams are found in all *reproduced Thai houses* and some *transformed Thai houses*. There is no ground level beam in the traditional and the intermediate groups (see Figure 40, 41, and 92).

The uses of floors in the intermediate group, a slab-on-ground concrete floor, started in the 1930s and have become common for the *transformed Thai houses*. The number of houses constructed with this type of floor was high in the 1970s. In the contemporary group, the uses of in-situ cast concrete floors started in the 1970s and have been used both in the *transformed Thai houses* and the *reproduced Thai houses*.



Note: -Data were acquired from 62 vernacular houses in three locations

Figure 110 The beginning of nontraditional characteristics (columns and walls at the ground level)

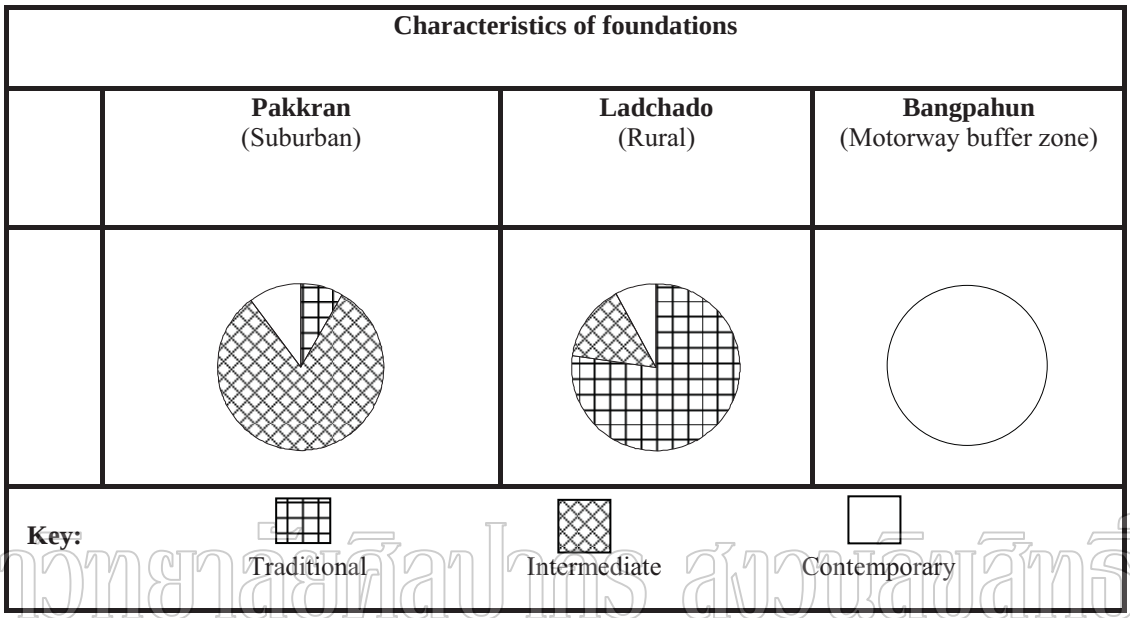
6.6.5 Foundations

The traditional foundation is still found in Ladchado (77.1%). From the survey in Ladchado, decayed timber footings have regularly been replaced with the same traditional type. Although the footing replacements in Pakkran comprise both concrete and timbers, concrete footings have been mainly found.

From Figure 111, the early manufacturing foundations are found in the highest percentage in Pakkran (81.4%). These foundations can be used in both the traditional and non-traditional parts of the *transformed Thai houses*. They are used for expansions or replacements.

The contemporary foundations, concrete footings with shallow piles, are found in the bathroom or kitchen constructions of the *transformed Thai houses*. The houses in Pakkran show the uses of these foundations more than in Ladchado (10.3% and 7.7%). All foundations in Bangpahun are a footing with deep piles.

The uses of each material at the foundations in Pakkran and Ladchado show significant difference. In the traditional group, most of the timber foundations are found in Ladchado and made of Thonglang and Teng. The intermediate and contemporary concrete foundations are found in Pakkran more than in Ladchado.



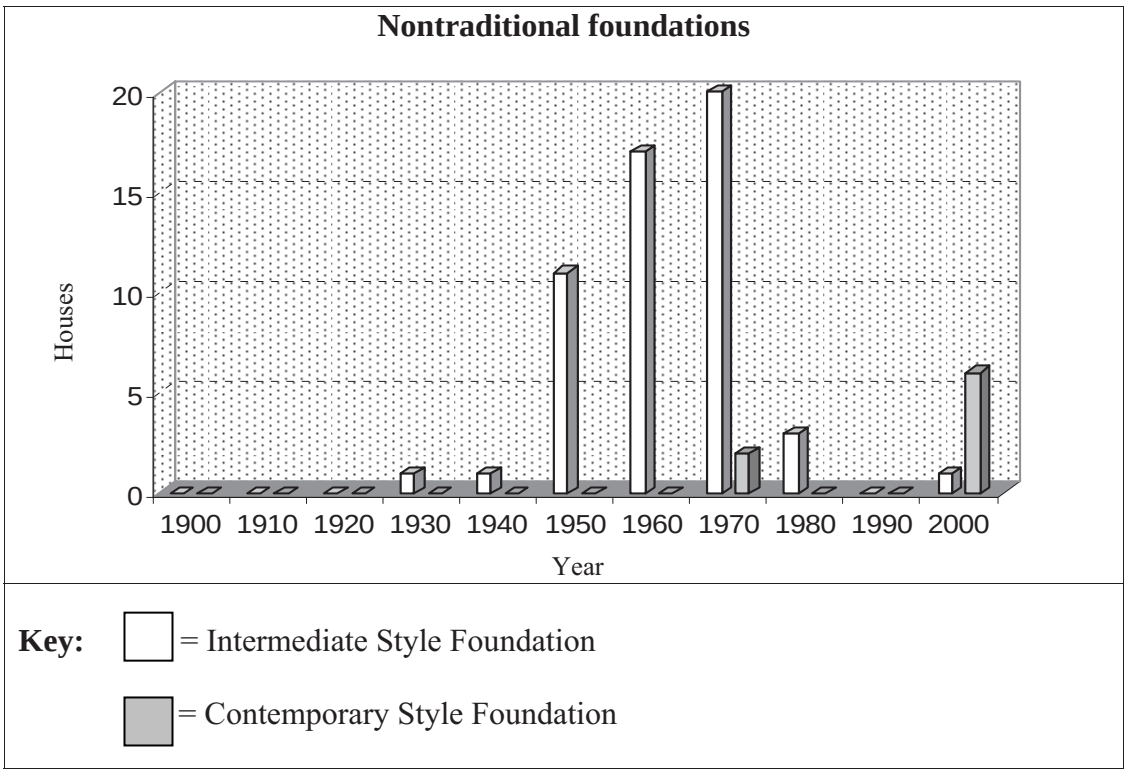
Note: The data are the averaged area or amount of samples.

Figure 111 Characteristics at the foundations in three surveyed locations

From Figure 112, the traditional group relates to the original traditional house and the non-traditional part of the *transformed Thai houses*. The popular of traditional footing declined after the 1980s. Most of the traditional foundations have been damaged and replaced by timber footings or concrete footings.

The intermediate group shows the change of uses from timber to concrete, beginning in the 1930s and which became widespread during the 1960s to 1970s. The style of foundation in this group is still found at present. From Figures 107 and 108, the data show that the development period of foundation and ground level columns are similar.

The contemporary group shows the use of concrete footing with deep piles, which are limited only in Bangpahun. These contemporary footings were initially used with brick-concrete houses in the 1970s.



Note: Data were acquired from 62 vernacular houses in three locations

Figure 112 The beginning of nontraditional characteristics (foundations)

6.7 Comparison of transformed and reproduced houses

In this section, the characteristics in the 11 main architectural elements are studied and compared within three main groups: traditional, intermediate, and contemporary. As the previous sections, these elements are discussed in pairs of structure and cladding. The most typical characteristics in each element and location are highlighted. The reason of use of the style will be discussed in Section 6.8.

The result from previous sections indicates that the uses of nontraditional style in the vernacular Thai houses began with early manufacturing materials in the 1930s. Intermediate characteristics became common for most of the architectural elements in the ordinary developing locations: Pakkran and Ladchado. In these locations, the changes from intermediate to contemporary style have occurred for two decades but are found in a small proportion of the surveyed houses. The contemporary characteristics are found only at the bathrooms and ground level constructions in the *transformed Thai houses*.

The popular of non-traditional style in the fast developing location show the changing idea of construction from the local builders in the motorway buffer area. The constructions are built with present-day materials instead of the early manufacturing materials. Traditional characteristics are still used at the upper level while contemporary characteristics are found at the ground level. The *reproduced Thai houses* are built not only for the local people living in the surveyed areas but also for clients who live outside the builder's village.

In Table 16, the traditional characteristics are still found at the roof and the upper level construction elements of the *reproduced Thai houses*. However, the floors and the beams are built with the contemporary style. The traditional characteristics are also found at the foundations and ground floor columns of the *transformed Thai house*s in the rural areas. These two elements are the main elements at the ground level of the *traditional Thai house*.

The intermediate characteristics are typically used in the roof and the upper level construction elements of the *transformed Thai houses* in both the urban and the rural areas. Only in the urban area, these characteristics are found at the foundations and the ground level columns.

The contemporary characteristics are commonly found at the ground level and some construction elements at the upper level of the *reproduced Thai houses*. At the ground level of the *transformed Thai houses*, these styles are usually found at the enclosed spaces.

The results suggest that the residents and the local builders in the ordinary developing locations prefer to use the intermediate characteristics for most of the constructions. The traditional appearances have been maintained and are found at the small parts that were the *traditional Thai houses*. In contrast, the traditional characteristics are widely applied in the fast developing location. Upper level part of the houses is made with the traditional style while the ground level part is made with the contemporary style. This combination is used to build the new form including the lay-out plan of the *reproduced Thai house*.

Table 16 A summary of the characteristics (11 architectural elements in three studied locations**)**

Characteristics									
	Traditional			**Intermediate**			**Contemporary**		
	SUrban	**Rural**	**Buffer**	**SUrban**	**Rural**	**Buffer**	**SUrban**	**Rural**	**Buffer**
1. R. Cladding	4.9%	1.5%	83.7%	94.8%	91.1%	16.3%	0.3%	7.4%	-
2. R. Structure	26.0%	23.2%	52.1%	73.7%	75.0%	15.2%	0.3%	1.8%	32.7%
3. UL. Column	22.8%	24%	85.7%	70%	70.6%	-	7.2%	5.4%	14.3%
4. UL. Wall	25.3%	24%	96.5%	67.9%	73.1%	-	6.8%	2.9%	3.5%
5. U. Beam	-	1.7%	-	92.2%	93.7%	-	7.8%	4.6%	100%
6. U. Floor	-	1.7%	-	92.2%	93.7%	-	7.8%	4.6%	100%
7. Foundation	8.3%	92.3%	-	70.2%	-	-	21.5%	7.7%	100%
8. G. Column	8.3%	82.5%	-	70.2%	9.8%	-	21.5%	7.7%	100%
9. G. wall	81% (NC)	93.2% (NC)	52.7% (NC)	-	-	-	19%	6.8%	47.3%
10. G. Beam	81% (NC)	93.2% (NC)	-	-	-	-	19%	6.8%	100%
11. G. Floor	79% (NC)	93.2% (NC)	-	2%	-	9%	19%	6.8%	91%

Keys and abbreviations:

-NC = No construction, Highlighted data = The most dominating characteristic

-R=Roof, U=Upper level, G=Ground level

-SUrban=Suburban area or Pakkran village, Rural=Rural area or Ladchado village, Buffer=Motorway buffer area or Bangpahun area

6.8 Reasons of change from traditional to nontraditional characteristics

In addition to the discussions about the physical surveyed data, the information of the resident's opinion about the changing characteristics is derived from the third phase of the interview. Because of limit on survey time, the residents firstly gave their overview opinions about the characteristics in three main parts of the building: roof, upper level construction and ground level construction. After that, only the architectural elements, which were significantly changed, were considered in detail. The residents sometimes provided more than one reason for each characteristic. Their reasons could be categorized into four groups: 1. Functionality; 2. Economy; 3. Aesthetic; and 4. Modernized appearance.

In Table 17, the most typical characteristic found in each element (drawn from Section 6.5 and 6.6) are presented together with the residents' explanations. The result from the suburban area, Pakkran village, shows that the nontraditional characteristics have been mainly applied because of theirs functionality, durability, and safety. Most of the nontraditional characteristics, found in Pakkran village, are in the intermediate group with early manufacturing materials. The contemporary characteristics are used at bathrooms and enclosed spaces at ground level. The results show that some residents (9 from 23 households) changed from the traditional style to the intermediate style because of an economic reason. A few residents (3 from 23 households) considered that the intermediate style was applied because of their modern appearance when the constructions were built in the past. The aesthetic was not a reason chosen from the resident.

The results in the rural area, Ladchado village, are similar to those in the suburban area. Durability, safety and functionality are the main reasons for application of an intermediate style. A few residents (4 from 31 households) mentioned the reason about modern appearance (when the construction was new) and none said about aesthetic. However, the remaining uses of a traditional style at the foundations in the rural area show a significant difference from the urban area. Additionally, most of the intermediate style columns at the ground level are still timber columns. The residents explained that they have been familiar with repairing or replacing the house elements with timbers. They also stated that these timbers had been available and inexpensive for longer period than timbers in urban areas. Some

Table 17 The reasons of change from traditional to nontraditional characteristics

Reasons of change from the residents															
	Suburban (Pakkran)					Rural (Ladchado)					Buffer (Bangpahun)				
	Character	Reasons from 23 households				Character	Reasons from 31 households				Character	Reasons from 8 households			
		FD	E	A	M		FD	E	A	M		FD	E	A	M
1. Roof Cladding	**IT**	● 23			● 3	**IT**	● 31			● 5	**T**			● 7	
2. Roof Structure	**IT**	● 23	● 9		● 3	**IT**	● 31	● 16		● 5	**T**			● 8	
3. UL. Column	**IT**	● 23	● 9		● 3	**IT**	● 31	● 16		● 5	**T**			● 8	
4. UL. Wall	**IT**	● 23	● 9		● 3	**IT**	● 31	● 16		● 5	**T**			● 8	
5. UL. Beam	**IT**	● 23	● 9		● 3	**IT**	● 31	● 16		● 5	**C**	● 8	● 1		● 8
6. UL. Floor	**IT**	● 23	● 9		● 3	**IT**	● 31	● 16		● 5	**C**	● 8	● 1		● 8
7. Foundation	**IT**	● 23				**T**		● 31			**C**	● 8			
8. G. Column	**IT**	● 23	● 9		● 3	**IT**		● 31			**C**	● 8	● 1		● 8
9. G. wall	**C**	● 10			● 2	**C**	● 1				**C**	● 8	● 1		● 8
10. G. Beam	**C**	● 10			● 2	**C**	● 1				**C**	● 8	● 1		● 8
11. G. Floor	**C**	● 10			● 2	**C**	● 1				**C**	● 8	● 1		● 8

Keys and abbreviations:

-Reasons of use: FD= Functionality or Durability or Safety, E=Economic, A=Aesthetic, M=Modernized appearance

-Highlighted cells show the most typical reason.

-Characteristic columns show the most dominating characteristics in each element.

-U=Upper level, G=Ground level

-T=Traditional group, IT=Intermediate group, C=Contemporary group

-One resident can tell more than one reason

residents (6 from 31 households) revealed that they concern the constructions at the roof and the upper level more than those at the ground level. They explained about the long period living at the upper level construction and muddy condition of the ground after seasonal flood.

The results from the motorway buffer area, Bangpahun, show two main groups of reasons. First, the application of the traditional style relates to the aesthetic reason. Second, the various reasons for the application of the contemporary style are functionality and durability, as well as a modernized appearance. Most residents or builders agreed that high cost of building a house with a contemporary style can be accepted. The local builders stated that the residents or their clients could afford the all-timber house. However, they prefer to live in the half-timber house with some style of a modern house. Nevertheless, a few residents argued that the contemporary constructions were cheap and used because of economic reason.

All residents in Bangpahun wanted their houses to combine both traditional and modern appearances. They agreed that only timbers built with traditional techniques are proper to be used at the upper level. They also believed that the roof and the upper level construction are more important than the ground level construction. Therefore, the construction at the ground level including beams and floors of the upper level were built with a contemporary style. The construction at the ground level was intended to have modern appearance and meet functional requirements of the present life.

In summary, the rural and suburban areas, which have been generally developed, show that functionality, durability and safety are widely accepted from the residents. These reasons have been supported the change from the traditional to the intermediate characteristics. Some differences occur because of the dissimilarity of the suburban and rural locations. The information from the motorway buffer area, which has been developed more than the suburban and rural areas, shows that aesthetic is the reason for continuation of the traditional style. Meanwhile, modernized appearance and durability are the reasons for accepting the contemporary characteristic.

6.9 Conclusions

To recognize the Thai vernacular houses, the procedure of the transformations are revealed. The findings are to confirm that the Thai vernacular houses are recalibrated and shifted from the popular image, which is narrowed in some period only. The comparison of the *traditional Thai houses* and the contemporary Thai vernacular houses shows some issues that have never been addressed. The analysis shows the dynamic nature of vernacular houses which were instigated by various causes.

The archetype is selected from one of the typical *vernacular Thai house* with popular image. It provides measurement of the change from tradition to contemporary. The settlement information clearly shows two types of the beginning of the samples: the relocated construction; and the construction at building site. The *transformed Thai houses* are composed of the traditional construction and the nontraditional construction. The proportion of merging these two constructions in both study areas is similar and shows some arrangements of the architectural form. Another type of a contemporary vernacular house is a newly-built house with the style of the *transformed Thai houses*. Although this kind of house in the study area is rare, it proves that the villagers prefer the modernized form to traditional form.

The reproduced house is the vernacular house with modern facility and popular image. Some of these houses are used to claim the high status of the house owner. The shape, form, scale and space of the *reproduced Thai house* have been developed by the local traditional builders and are very different from the *traditional Thai houses.* However, the houses are usually misinterpreted as a *traditional Thai house*.

The period of the modification and the extension in Pakkran and Ladchado related to the construction of roads. The roads, initiated in Pakkran, means lots of modification with new materials started in Pakkran earlier than in Ladchado. However, the occurrence of the big fire caused some constructions in Ladchado change before the beginning of the roads. The damaged houses had to be modified, extended, or reconstructed. The villagers chose to combine the remaining traditional construction with modernized form. From these factors, both actions (the modification and the extension) began in Ladchado earlier than in Pakkran for decades because of

the incidents of fire in the 1930s. Although the actions in Pakkran began late, the number of them had strongly increased from the 1970s to the 1980s.

The process of transformation is usually composed of both modification and extension. The period of the major transformations uncomplicatedly relate to the period of these actions. In most of the samples, the transformation has been occurred many times. The data, which are mostly drawn from the residents, reveal the important events in the timeline and history of the villages. These events are the construction of roads and a walking bridges, the absence of flood, and the damage of big fire. The causes, which are given from the interviewing, are the shortage of land, the increasing of the family size, the control of hygienic, privacy and security, and the change of lifestyle.

Consequently, the appearances of the vernacular houses are complicated and sometimes hidden because of the transformations in various periods. To understand the appearances of the vernacular houses, the dominant characteristics in the main transformations are presented including the comparison between samples in suburban and rural areas. The results suggest that the intermediate style in the enclosed hall controls most of the style in the whole construction. This confirms the importance of the hall where the residents spend plenty of their time.

The intermediate style, which has been used in the transforming houses, was selected from elements of bungalow-influential houses. However, the local builders and the residents could change many characteristics of a bungalow to combine with their traditional house harmoniously. Although the residents stated about the proud of the remaining of the *traditional Thai house* as a part of their house, the traditional style does not show any domination in the main transformations. The contemporary style strongly dominates the characteristics of bathrooms at the upper level. This style causes an awkward appearance when it was put together with the other styles. Durability and functionality of brick and concrete construction is the explanation of choosing.

At the roof, the intermediate style significantly dominates the *transformed Thai houses* in both villages. The contemporary characteristic is rarely found in the study areas. This proves that there are a few changes in roofing after the popular of the intermediate style. The characteristics of the roof structures in both villages are

mostly belonging to the intermediate group. The residents and local builders are very conservative in choosing characteristics for a pitch roof but more flexible for a new roof form.

At the upper level, there are greater numbers of traditional columns in the *reproduced Thai house* than in the *transformed Thai house*. In Pakkran and Ladchado, the residents restrict the use of the traditional column only at the traditional part. The intermediate characteristics are mostly found. The traditional wall is used for almost the whole part at the upper level in Bangpahun. Builders in Bangpahun control the appearance of the upper level construction in traditional style. The appearances of intermediate-style walls in Pakkran and Ladchado are similarly found.

The traditional beam and floor is rarely found in the study areas. These beam and floor systems required thick timber floorboards, which were rare, expensive and suitable for a house without heavy furniture. The beams and floors in the intermediate group started at the same period. This characteristic had been well accepted from the local builders.

At the ground level, the intermediate columns are typically found in both Pakkran and Ladchado. The contemporary columns are used in Bangpahun. The uses of contemporary columns and walls are found in bathrooms and kitchens in Pakkran and Ladchado. In the *transformed Thai houses* in both villages, open spaces without a wall under a raised house are still found. In Bangpahun, enclosed spaces with the contemporary walls are about half of the ground level area and the other half is open spaces. The masonry walls become common at the current and are used for all ground level walls.

There are no beams and floors at the ground level in the traditional group. The contemporary beams are found in all *reproduced Thai houses* and some *transformed Thai houses*. The traditional foundations are still found in Ladchado and have regularly been replaced. Intermediate-style footings, made from concrete, have been found in Pakkran as a replacement.

Because this study focuses on the dynamic way in which vernacular and modern traditions merge, the comparison of transformed and reproduced houses helps to widen the vernacular concept. The building tradition of both new vernacular forms confirms that the static idea of a backward past has faded away.

Intermediate characteristics became common for most of the architectural elements in the ordinary developing locations: Pakkran, and Ladchado. One of the factors involved to match the nontraditional style with the vernacular Thai houses is the materials and techniques from the early manufactures. The non-traditional style in the fast developing location shows the changing idea of construction from the local builders. The constructions are built with the contemporary materials instead of the early manufacturing materials.

In the ordinary developing locations, the traditional appearances have been maintained and are found at the important segment of the house. The small traditional segment, surrounded with different-style constructions, was a unit of the cluster of the *traditional Thai houses*. In contrast, the traditional characteristics are widely applied in the fast developing location. The upper level part of the houses is made with traditional style while the ground level part is made with contemporary style. The combination of styles including new form and lay-out plans is the intelligence of the local builders. Therefore, the *transformed Thai house* is the innovation of the 20th century while the *reproduced Thai house* is the innovation emerging during the late 20th century and the beginning of the 21st century.

The results of the interview in the villages show that the traditional style was changed to the intermediate style because of functionality, durability, and safety. An economic issue and aesthetic are the minor reasons of the change. The traditional style is continued at the recent footings in Ladchado because of availability of timbers. In Bangpahun, the modernized appearance and durability are the reasons for merging the contemporary characteristic with the traditional constructions. All of the residents in three locations still believe that the traditional style is their graceful heritage and more stylish than the contemporary style.

Chapter 7
Conclusions

7.1 Introduction

This study aims at the recognition of vernacular architectural forms that have evolved or developed for ordinary people. The term “recognition” in this study relates to an understanding about the adaptability and the transmission of knowledge in an era of technological advancement and cultural change. The need of recalibration of attitudes towards vernacular architecture has been a key element of analysis throughout the work. This approach has tried to break from an “antiquarian” stereotype towards an understanding of living traditions.

Some vital clues from the findings will encourage greater understanding of non-monumental architecture possessing cultural significance in order to continue the vernacular tradition. The study raises an academic issue that there are the new types of Thai vernacular houses developed for many decades and still unrecorded and uncelebrated. These contemporary vernacular architectures, this work argues, may serve as a starting-point for future research and education. The investigation of the transformation and the reproduction processes provide strong support to the idea of vernacular villages as a source of local wisdom.

In Section 7.2, the research focuses on two issues: new definitions of the Thai contemporary vernacular architecture; and circumstance of change. Further research is recommended in Section 7.3. Considerations for supporting Thai vernacular houses are presented in the last section.

7.2 Summary of the findings

Two main issues of the findings are summarized as follows:

7.2.1 New definitions of the Thai contemporary vernacular architecture

The dynamic and change of vernacular building traditions in this study is emphasized because of many back-leaning conceptions. Vernacular building

traditions have been often viewed with ideas of a romantic past, picturesque poverty and underdevelopment. However, vernacular buildings have responded and reacted to technological and culture changes as well. Their adaptability has been created many appropriate responses and solutions reflected in the contemporary vernacular houses.

The study findings indicate that the recent development of the Thai vernacular houses follow two main paths: 1. Transformation of the *traditional Thai house*; and 2. Emergence of new house types, which aim to have an image of the *traditional Thai house*. In the surveyed locations, many *traditional Thai houses* have been in continuous use since the late 19th century, adapting to changes in use and demands of modern and contemporary living, by integrating modern forms and technologies of construction. Extensions, built in what might be considered a "bungalow style," were one of the early construction changes applied to the traditional house. Modifications of architectural elements began, and have continued to take place among traditional houses or extended construction. Traditional houses that have undergone such changes are defined as the *transformed Thai house*.

While the bungalow style has been continuously used in many vernacular houses, the more recently built vernacular typology, the *reproduced Thai house*, has emerged in the zone along the motorways close to the vernacular village. The new vernaculars were not only built for reproducing the popular image of the traditional Thai house but also were redesigned to merge with the contemporary construction, found in the typical urban housing development in Thailand. As a result, these houses conformed to modern demands, using a variety of materials and techniques.

Therefore, two types of the vernacular house, the *transformed Thai house* and the *reproduced Thai house*, was defined in this research. These vernacular houses consecutively showed strong evolution of the traditional Thai houses and revival of the traditional Thai style in newly constructed houses. Therefore, "the new Thai vernacular houses" were separated into evolved and revival groups. The evolved group relates to conservation and continuation, while the revival group relates to the adaptation of tradition and new contexts. Both types have been transmitting the vernacular heritage to a new generation of Thai.

7.2.2 Circumstances of change

The findings indicate the process of transformation and change in the architectural elements. These indicate the direction of development of Thai vernacular houses. The findings suggest that the developments have been influenced by the non-traditional characteristics. The continuation of the transformation was still manipulated by the style in the early period of the modernization.

There was no strong evidence of the application of contemporary characteristics to the form and shape of the *transformed Thai houses*. The intermediate characteristics are still the popular choice for the villagers who live in suburban or urban areas. Although many modern methods were used to build the *reproduced Thai house* in the motorway buffer areas, the traditional techniques were still those of highly skilled builders.

The analysis of styles demonstrates that there were typical patterns of change occurring in each architectural element. There was no transfer of the traditional shape and form to the nontraditional parts of the house. In the suburban and rural areas, the intermediate style was found most commonly. However, foundations were the only architectural elements in the rural area retaining the use of traditional style. In the motorway buffer area, contemporary style was typically found but traditional style was also found in an important part at the upper level.

The residents began to replace the traditional style with the intermediate style in the 1930s. In most architectural elements, constructions with intermediate style were obviously found in the 1960s and declined after the 1990s. This information shows the period that there were many house transformations in the villages. However, the intermediate style is still used in recent constructions of the vernacular Thai houses. The contemporary style began to be used later than the intermediate style for two decades. This style has been found to be popular in some parts of the houses during the 1980s to the current time.

The residents' opinions suggested that there were three main reasons that encouraged the residents to adjust their choice of style. In typically developing locations, the most popular reasons were durability and function. In the fast-developing locations, the reasons were the same, but the residents added more reasons about the modernized appearance and traditional aesthetic.

The process of transformation was usually composed of both modification and extension. In each extension or modification, the different in style reflected the careful selection by the residents. The finding showed that the intermediate style is typically chosen for the halls, the porches and the cooking spaces. The contemporary style was preferred for the enclosed spaces at ground level and the bathrooms. The styles between urban and rural areas were different because of the availability of materials and labor costs. The early manufacturing materials, which began with the intermediate style, continued to be used because the transformation with bungalow-style construction was still applied to the recent vernacular Thai houses.

Consequently, the appearances of the vernacular houses were complicated and sometimes hidden because of the transformations in many periods. The finding suggested that the intermediate style controlled most of the characteristics in the whole construction. The results of the interview in the villages indicated that the traditional style was changed to the intermediate style because of functionality, durability, and safety. An economic issue and aesthetic were the minor reasons of the change.

In an era of technological advancement and increasing communication, vernacular Thai builders have transmitted building traditions in various ways. From the findings in this study, scholars should no longer assume that vernacular builders are unskilled, technological ignorant or isolated from global communication. The emergence of new vernaculars confirms the continuity of local knowledge.

7.3 Recommendation for further research

This study shows that more research needs to be continued in the field of the vernacular tradition. Some recommendations for future research as followings:

1. Study ways to interpret the hidden heritage such as the *transformed Thai house* in this research. This is to provide the information to both the households of vernacular house, public and tourists.
2. Study ways to create public participation. This is to encourage and support the householders to sustain their vernacular heritage. It also includes the participation relating to cultures, traditions and lifestyles.

3. Study the comparison of traditional technique of construction and alternative techniques invented by the local builders. The goal is to maintain the characteristics of the vernacular tradition and pass it on to the next generation and public.

4. Study vision, policy and strategy of the conservation organization in order to recommend the efficient and effective cultural heritage management for non-monumental architectures.

5. Study the ways to solve the problems of low-income communities or urban slums. The connection between the vernaculars and squatters is not yet well established. The forms of squatting as a new vernacular can be guided by the knowledge of the transformation in this study.

7.4 Consideration for supporting Thai vernacular heritage

In the present, some settings with vernacular architectures may be identified as a conservation zone, which is normally controlled by the conservation act or the guideline. From the results in this study, it is not necessary to prepare an act or a guideline for conserving the vernacular heritage because of the dynamic nature. A usual conservation plan may incorrectly control evolution or development of vernacular tradition. In many occurrences, conservation methods freeze many cultural heritages at the nostalgic period, which is popular to tourists or scholars. This control interrupts not only the process of evolution but provides new difficulties to householder of a vernacular houses as well.

Provision of incentives or positive information should be considered to encourage the traditional builders and the villagers to sustain their heritage in their own way. Therefore, this contemporary concept is needed to be addressed to scholars, architects and planners who take a responsibility for a master plan of conservation and development. Because Thai government rarely has a budget for heritage that is not monumental architecture or a tourist destination, raising an awareness of the owner of a vernacular house is important with the support of the information from institutional efforts. The issue of vernacular heritage should be promoted to the general public beyond the territory of a small group of professionals and practitioners. This

information needs to be properly managed by scholars, builders, and key persons of the villagers.

All the villagers should understand the value of their vernacular architecture so that they will agree to protect, conserve, or change it. Moreover, the villagers need local authorities to support their plans and to protect the village from any undesirable impacts. The most important factor in the existence of vernacular architecture is the power of the community to raise understanding and awareness regarding the value of its tradition and culture. As a result, the villagers can appreciate and keep their heritage for successors.

To support vernacular heritage, tourism development is considered to be one of the most suitable and relevant starting point. The most important aspect of this approach is that the villagers should have the capability of recognizing this phenomenon in an appropriate manner. This can be achieved if the villagers are able to set up rules and regulation for tourism without destroying the culture and architecture within the community. For this reason, the villagers should select the kind of tourists they want to attract without changing the nature of transformation and reproduction of their vernacular houses. This will utilize local resources to gain benefits from various local wisdom and their evolution. Cultural reproductions, such as products relating to a *traditional Thai house*, can be promoted both in the villages and the area along motor way.

The other concepts regarding the resolution of recognition problems include providing education and setting up a self-help organization. Providing education to the villagers involves promoting the dissemination of villagers' local wisdom to their children. Institutions may help by funding children or key persons in the villages for relevant courses. A village organization should be set up to be a center for people to congregate, to exchange knowledge, to transfer knowledge, and to generally help each other. This organization can guide the villagers in terms of their adaptation to tourism and new development. It can also function as an interpretation center, providing a rich, accurate, and entertaining understanding of various forms of vernacular architecture and its context for visitors.

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Appendix A

Thailand Profile

In roughly 3000 BCE, people cultivated rice within the boundaries of modern Thailand, but the ancestors of the Thai people began to move into modern Thailand from southern China, arriving between the 7th to 13th centuries CE. In 1351, a unified Thai kingdom known as Ayutthaya, was created by a Thai kingdom. Despite intermittent warfare with the Cambodians and the Burmese, Ayutthaya flourished for more than four hundred years. In 1767, Burmese troops sacked Ayutthaya and annexed the kingdom, but two years later, the Burmese were expelled when General Pya Taksin proclaimed himself king. After Taksin was executed by his ministers, the crown passed to General Pya Chakri, who went on to found the present Chakri dynasty of Thai kings and who ruled from 1782 to 1809 as Rama I. Under his reign, the country's name was changed from Ayutthaya to Siam, and the capital was moved to Bangkok.

Over the course of the 19th century, Siam was threatened by Western imperialism. Unlike Siam's Southeast Asian neighbours, the Siamese kingdom managed to remain independent thanks to the efforts at modernization begun in the reign of King Mongkut (1851-1868) and Mongkut's son King Chulalongkorn (1868-1920) and a policy of playing the major imperialist powers of Britain and France against each other. Although Siam was forced to cede Cambodia and Laos to French Indochina and north Malaya to Britain, Siam survived as a prosperous and rapidly modernizing state. In July of 1916, Siam entered the First World War on the side of the Allies, and it subsequently became a founding member of the League of Nations. After a revolt by Western-educated Thai military and political leaders in 1932, Siam became a constitutional monarchy. In November of 1936, Siam invalidated its treaties with foreign nations; and under the provisions of new treaties negotiated in the following years, the Siamese government obtained complete autonomy over its internal and external affairs. Siam was officially renamed Thailand in keeping with a new sense of Thai nationalism.

Source: http://www.ahtg.net/TpA/thai2001.html

Appendix B

Regulation to Support Conservation and Development in Ayutthaya

The Enhancement and Conservation of National Enhancement Quality (Part 3): **Conservation and Environmentally Protected Areas**

Section 42 Protection and management of areas within the limits of national parks and wildlife reserves shall be in accordance with the Environmental Quality Management Plan effective by virtue of section 35.

Section 43 In case it appears that any area is characterized as watershed area, or characterized by unique natural ecosystems which are different from other areas in general, or naturally composed of fragile ecosystems which are sensitive and vulnerable to destruction or impacts of human activities, or worthy of being conserved due to its natural or aesthetic values or amenities, and such area is yet to be designated as a conservation area, the Minister shall, with the advice of the National Environment Board, be empowered to issue ministerial regulation designating such area as an environmentally protected area.

Section 44 In issuing the ministerial regulation pursuant to section 43, any one or more of the following protective measures shall be prescribed there under

(1) Land use prescriptions for preserving the natural conditions of such area or for preventing its natural ecosystems or its aesthetic values or amenities from being adversely impacted.

(2) Prohibition of any acts or activities that may be harmful or adversely affect or change the pristine state of the ecosystems of such area.

(3) Specifying types and sizes of projects or activities undertaken by government agencies, state enterprises or private entities, to be constructed or operated in such area, which shall have the legal duty to submit reports of environmental impact assessment.

(4) Determination of management approach and method specific to the management of such area including the scope of functions and responsibilities of relevant government agencies for the purpose of co-operation and co-ordination that are conducive to efficient performance of work towards the preservation of natural conditions or ecosystems or aesthetic values and amenities in such area.

(5) Prescriptions of any other protective measures which are deemed proper and suitable to the conditions of such area.

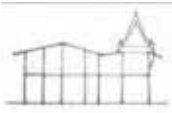
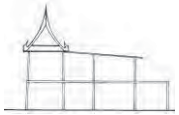
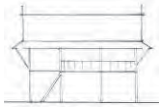
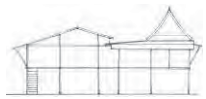
Section 45 In any area, despite having been designated as a conservation area, a master town and country plan area, a specific town and country plan area, a building control area, an industrial estate area pursuant to the governing laws related thereto, or designated as a pollution control area pursuant to this Act, but which nevertheless appears to have been adversely affected by environmental problems which assume a critical proportion to such an extent that an immediate action has become imperative and yet no action is taken by government agencies concerned to rectify the situation due to a lack of clear legal authorization or otherwise failure to do so, the Minister shall, with the approval of the National Environment Board, propose for a cabinet authorization to take any one or several protective measures provided by section 44, as necessary and appropriate, in order to control and solve the problems in such area.

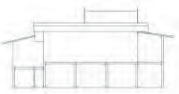
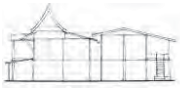
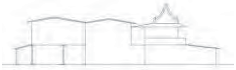
When cabinet authorization is obtained as provided in the first paragraph, the Minister shall, by notification published in the Government Gazette, determine the limits of such area and prescribe in detail the protective measures and the duration for which such measures shall be effectively taken therein.

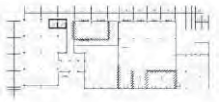
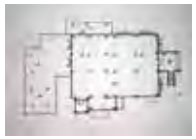
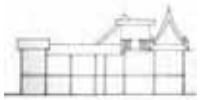
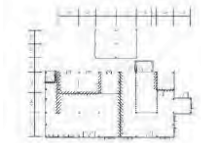
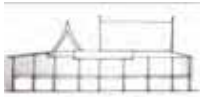
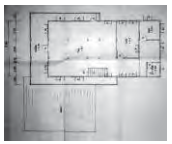
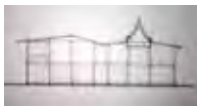
With the approval of the National Environment Board and the cabinet, the duration of effectiveness specified according to the second paragraph may be extended by notification published in the Government Gazette.

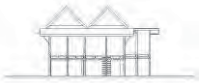
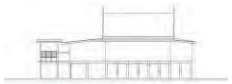
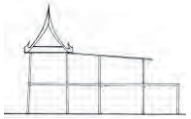
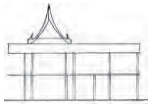
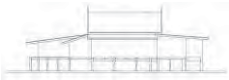
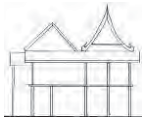
Appendix C

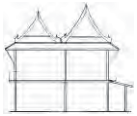
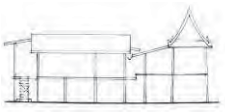
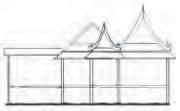
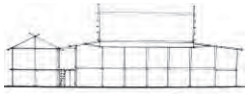
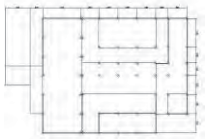
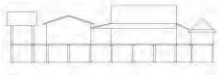
Address, plan and elevation of the house samples

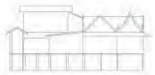
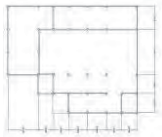
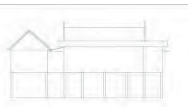
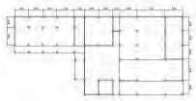
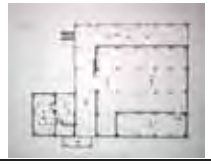
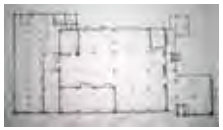
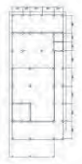
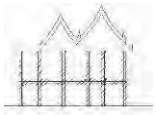
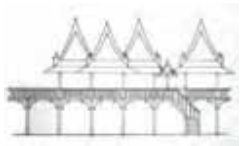
No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
01/ D-PK-01	Yong Ponpikul/ 29 Mu 3 Pakkran District			06/ E-PK-02	Pensri Jaitawin/ 64 Mu 3 Pakkran District		
02/ D-PK-03	Dumrong Sunktong/ 20 Mu 8 Pakkran District			07/ E-PK-04	Mon Pantong/ 14 Mu 5 Pakkran District		
03/ D-PK-04	Pan Wadjarean/ 28 Mu 7 Pakkran District			08/ U-PK-02	Ngen Suksomboon 17 Mu 3 Pakkran District		
04/ D-PK-05	Pachani Jitrathai 41 Mu 5 Pakkran District			09/ U-PK-04	Pring Haprot 4 Mu 9 Pakkran District		
05/ E-PK-01	Pean Taiprayoon/ 18 Mu 8 Pakkran District			10/ U-PK-05	Klong Mahawai 15 Mu 5 Pakkran District		

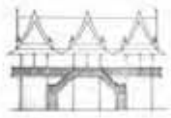
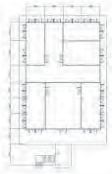
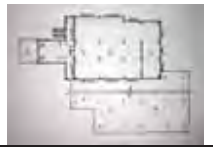
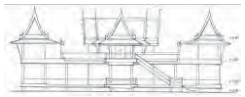
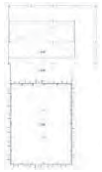
No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
11/ T-PK-03	Saink Supeedan/ 27 Mu 3 Pakkran District			16/ CH-PK-04	-/ - Pakkran District		
12/ T-PK-05	Sureeyon Reangsub 7/1 Mu 8 Pakkran District			17/ CH-PK-05	Chom Kunnon/ 14/1 Mu5 Pakkran District		
13/ T-PK-06	Rose Kaysornsri/ 4 Mu 5 Pakkran District			18/ P-PK-01	Sudjai Sangyaimanee/ 16 Mu 8 Pakkran District		
14/ CH-PK-01	Reangdej Keansakul/ 63 Mu 3 Pakkran District	-	-	19/ P-PK-02	Samran Patanajun/ 15 Mu 8 Pakkran District		
15/ CH-PK-03	Boontoop Kong-sangchat/ 25/1 Mu3 Pakkran District			20/ P-PK-03	Sangwan Rummasin/ 33 Mu 3 Pakkran District		

No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
21/ P-PK-04	- (Malee Nephew)/ - Mu 3 Pakkran District			26/ D-LD-02	Sangad Klongklaew/ 41 Mu 3 Pakkran District		
22/ P-PK-05	San Tudtrongkool/ 34/1 Mu 3 Pakkran District			27/ D-LD-06	Jumpee Juteepong/ 43 Mu 4 Nongnamyai, Pakhai District		
23/ P-PK-06	Somjit Kumnerdpet/ 31/1 Mu 3 Pakkran District			28/ D-LD-07	Sangad Kumpon/ 100 Mu 2 Pakhai District		
24/ P-PK-07	Namcheam Rumsak 34/1 Mu 3 Pakkran District			29/ D-LD-08	Somjai Kkongjit/ 49/3 Mu 1 Pakhai District		
25/ P-PK-08	Nopporn Rummayan 15/1 Mu 7 Pakkran District			30/ D-LD-09	Fun Klomsuntorn/ 37/2 Mu5 Jakkaraj, Pakhai District		

No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
31/ E-LD-03	Payao Klomosot/ 1 Mu 5 Nongnamyai, Pakhai District			36/ E-LD-09	Jaroon Pingjakkaraj/ 8 Mu 1 Nongnamyai, Pakhai District		
32/ E-LD-05	Jongdee Suksawad/ 30 Mu 5 Nongnamyai, Pakhai District			37/ E-LD-10	-/ - Pakhai District		
33/ E-LD-06	Malee Kunpaksri/ 31 Mu5 Nongnamyai, Pakhai District			38/ U-LD-01	Saeim/ 4 Jakkaraj, Pakhai District		
34/ E-LD-07	Prakong Rajreatai/ 21 Mu 5 Nongnamyai, Pakhai District			39/ U-LD-03	Jarean Binglom/ 5 Mu 3 Nongnamyai, Pakhai District		
35/ E-LD-08	Somjit chatweeratum/ 83 Mu 2 Nongnamyai, Pakhai District			40/ U-LD-06	Chan Cholatan/ 66 Mu 6 Nongnamyai, Pakhai District		

No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
41/ U-LD-08	Mara Sukkymee/ 11 Mu 10 Nongnamyai, Pakhai District			46/ T-LD-04	Somchai Tubtimbua/ 19 Mu 3 Nongnamyai, Pakhai District		
42/ U-LD-09	Chun Taopoop/ 117 Mu 2, Nongnamyai, Pakhai District			47/ T-LD-08	-/ - Pakhai District		
43/ U-LD-10	Rum Kumsut/ 118 Mu 2, Nongnamyai, Pakhai District			48/ T-LD-09	Somsak Yampomma/ 67 Mu 6 Nongnamyai, Pakhai District		
44/ U-LD-11	Sompong Kumlungdee/ 4 Mu 3 Jakkaraj, Pakhai District			49/ T-LD-10	-/ - Pakhai District		
45/ T-LD-01	Decha Klomreak/ 38/1 Jakkaraj, Pakhai District			50/ CH-LD-02	Wing Pasuk 47 Mu 3 Nongnamyai, Pakhai District		

No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
51/ CH-LD-06	Suchin Kosiyakul/ 39 Mu 5 Nongnamyai, Pakhai District			56/ CH-LD-11	Sawean Tanaruk/ 45/1 Mu 5 Jakkaraj, Pakhai District		
52/ CH-LD-07	Sajuan Chalotorn/ 32 Mu 5 Jakkaraj, Pakhai District			57/ P-LD-09	Boonshoe Chaichana/ 2 Mu 5 Nongnamyai, Pakhai District		
53/ CH-LD-08	Sutee Jareansuk/ 32 Mu 4 Nongnamyai, Pakhai District			58/ P-LD-11	Sumran Klomreak 45 Mu 3 Nongnamyai, Pakhai District		
54/ CH-LD-09	Sumlee Sara/ 99 Mu 2 Jakkaraj, Pakhai District			59/ P-LD-12	Tiang Puangvanyen 86/1 Mu2 Nongnamyai, Pakhai District		
55/ CH-LD-10	Wasana Kongsatorn/ 112/2 Mu 2 Jakkaraj, Pakhai District			60/ D-BH-10	-/ - Bangpahun district	-	

No./ Code	Owner name/ Address	Upper FL. plan	Elevation	No./ Code	Owner name/ Address	Upper FL. plan	Elevation
61/ D-BH-11	-/ - Bangpahun district			66/ CH-BH-12	-/ - Bangpahun district		
62/ E-BH-11	Chat Boriboon/ 83 Mu 8 Posamton, Bangpahun district	-	-	67/ P-BH-10	Somsak Kianroopkruit/ 3 Mu 8 Po-Samton, Bangpahun district		
63 T-BH-02	Somjit tungnamo/ 8 Mu 3 Bangpahun district						
64/ T-BH-12	Somjit tungnamo/ Mu 3 Bangpahun district						
65/ T-BH-13	Somjit tungnamo/ - Bangpahun district						

Appendix D

Pattern of Change and Period

No.	House Name	Period by Interview								Appearances by Survey																		
										Part 1 Original Thai House							Part2 Modified Thai House							Part3 Expansion						
										Structure			Roof				Structure			Roof				Structure			Roof			
		House Age	Thai House Age	Year of Thai House Moving	Times of Moving	Years of Modification at Part of Thai House	Times of Modification	Year of Expanding from Thai House	Times of Expanding	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall
01	D-PK-01	60, 1945	60, 1945	-	-	1980	1	1980, 01	2	T2	T1,T2, M1	M1	T1	M1	T2	T1	T1	T1	M1	M1	M2	T2	M1	M1	T1, M1	M1	M1	M2	T2, M2	M1, M2
	D-PK-03	120, 1885	120, 1885	-	-	1980	1	1985	1	T1	T1	T2	T1	M1	T2	T1	T2	T2	M1	M1	M2	M1	M1	M1, M2	M1, M2	M1, M2	M1	M2	M1, M2	M1, M2,C2
	D-PK-04	120, 1885	170, 1835	1885	1	1965	1	1994, 96	2	T1	T1	T1, T2	T1	M1	T2	T1	M1	M1	M1	M2	M2	M1	M1	M1	M1, M2	M1	M1	M2	M1, M2	M1, M2,C2
	D-PK-05	105, 1900	105, 1900	-	-	1979	1	1979, 02	2	T2	T1	T2	T1	M1	T2	T1	T2, M1	T2, M1	T2, M1	M1	M2	M1	M1	M1	M1	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
05	E-PK-01	51, 1954	~100	1954	1	1980	1	1980, 99	2	T1	T1	T2	T1	M1	T2	T1	T1	T1	T2	M1	M1	T2	M1	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	E-PK-02	11, 1994	~100	1994	1	-	-	1994	1	M1	T1, M1	T2	T1	M1	T2	T2	-	-	-	-	-	-	-	M1	M1	T2	M1, M2	M2	M1, M2	M1, M2,C2
	E-PK-04	150, 1855	150, 1855	-	-	1975	1	1975, 82, 97	3	T1, T2	T1	T1	T1	M1	T2	T1	T1,T2, M1	T1, M1	T2	M1, M2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1	M2	M1, M2	M1, M2,C2
	U-PK-02	51, 1954	120, 1885	1954	1	1957	1	1964, 90, 92, 95	4	T1	T1	T2	T1	T2	T2	T1	T2	T2	T2	T2	T2	T2	T2, M1	M2	M2	M1	T1, M2	M2	M1	M1
	U-PK-04	5, 2000	~100	NA	1	2000	1	2000	1	M1	T2, M1	M1, M2	T1	M1	T2, M2	M1, M2	-	-	-	-	-	-	-	M1	M1	M1, M2	M1	M2	M1, M2	M1, M2,C2
10	U-PK-05	23, 1982	23, 1982	-	-	-	-	1983, 89, 92, 97, 03	5	M1	T2, M1	T2	T1	M1	T2	T2	M1	M1	T2	M1	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1	M2	M1, M2	M1
	T-PK-03	120, 1855	120, 1855	-	-	1980	1	2004, 05	2	M2	T1, M2	T2	T1	M1	T2	T1	M2	T2, M2	T2	M2	M2	T2	M1	M2	M1, M2	M1, M2	M1	M2	M1	M1, M2,C2
	T-PK-05	30, 1975	150, 1855	1975	1	1975	1	1985, 90, 00, 03	5	T1	T1	T1, T2	T1	M1	T2	T1, T2	T1	T1	T2	M2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	T-PK-06	82, 1923	~100	1923, 57	2	1975	1	1982, 90, 96, 02	4	T1	T1	T2	T1	M1	T2	T2	M1	T2, M1	M1	M2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1	M2	M1, M2	M1, M2,C2
	CH-PK-01	20, 1985	~100	-	-	-	-	1985	1	M1	M1	M1	T1	M1	M1	T2	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2
15	CH-PK-03	35, 1970	35, 1970	-	-	-	-	1993	1	M2	M2	M2	T1	M1	M1	M1	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	CH-PK-04	100, 1905	~100	-	-	1965	1	1997, 02	2	T2	T2, M1	M1	T1	M1	M1	T2	T2	M1	M1	T1	M1	M1	T2	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	CH-PK-05	40, 1965	<100	1975	1	-	-	1996	1	M1	T2, M1	M1	T1	M1	M1	M1	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	P-PK-01	50, 1955	>100	1955	1	1983	1	1985, 98	2	T2, M1	T1	T2	T1	M1	T2	T1	M1	M1, T2	M1	M2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	P-PK-02	50, 1955	>100	1955	1	1970	1	1998, 03	2	T2	T1, T2	T2	T1, T2	M1	T2	T1	T1, M1	M1, T2	M1	M2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
20	P-PK-03	60, 1945	105,75 1900,30	1945	1	-	-	1945,47 ,50,01, 03	5	T1	T1	T2	T1	T2, M1	T2	T1	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2, C2	M1, M2	M1, M2,C2
	P-PK-04	10, 1995	~100	1995	1	-	-	-	-	T1	T1	T2	T1	M1	T2	T1	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
22	P-PK-05	20, 1985	70	1985	1	-	-	-	-	M1	M1	T2	T1	M1	T2	T2	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2

Pattern of Change and Period (Continue)

No.	House Name	By Interview								Appearances by Survey																	
										Part 1 Original Thai House							Part2 Modified Thai House							Part3 Expansion						
										Structure			Roof				Structure			Roof				Structure			Roof			
		House Age	Thai House Age	Year of Thai House Moving	Times of Moving	Years of Modification at Part of Thai House	Times of Modification	Year of Expanding from Thai House	Times of Expanding	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall
	P-PK-06	40, 1965	70, 1935	1965	1	-	-	1983,87 ,95,01	4	T1	T1	T2	T1	M1	T2	M1	-	-	-	-	-	-	-	M1, M2	M1, M2	M1, M2	M1, M2	M2	M1, M2	M1, M2,C2
	P-PK-07	~175, 1805	~175, 1805	-	-	1975	1	1935,75 ,95	3	M1	M1, T2	T2	T1	M1	T2	T2	M1	T2, M1	T2	M2	M2	T2	M1	M1, M2	M1, M2	T2, M2	M1, M2	M2	T2, M2	M1, M2,C2
25	P-PK-08	10, 1995	~100	1995	1	1995	1	1995	1	M2	T1, M2	T2, M2	T1	M1	T2	T1, T2	M1	T2	M2	M2	M2	M1	M1	M2	M2	M2	M1, M2	M2	M1, M2	M1, M2,C2
	D-LD-02	103, 1902	103, 1902	-	-	1965	1	1970,95 ,96-01	3	T1	T1	T1, T2	T1	T2	T2	T1	T2	T2	T2	T2	M2	T2	M1	T1, T2,M1	T1, T2,M1	T2, M2	M1, M2	M2	M1, M2	M1, M2,C2
	D-LD-06	98, 1907	98, 1907	-	-	1955	1	1955, 65	2	T1, T2	T1, T2	T2	T1	T2	T2	T1	T1	T1, T2	T2	T2	M1	T2	M1	T1, M1	T1, M1	T2, M1	M1, M2	M2	M1, M2	M1, M2,C2
	D-LD-07	200, 1805	200, 1805	-	-	1985	1	1985, 92	2	T1	T1	T2	T1	M1	T2	T1	T1	T1	T2	T1, T2	M1	T2	M1	M1, M2	M1, M2	M1, M2	M1, M2,C2	M1, M2,C2	C2, M2	M1, M2,C2
	D-LD-08	55, 1950	~100	1950	-	1990	1	1990, 95	2	T1	T1	T2	T1	M1	T2	T1	T1	T1	T2	T1, T2	M1	T2	M1	T1	T1	M1	T2, M1	M2	M1, M2	M1, C1
30	D-LD-09	90, 1915	110, 1895	1915	-	1973	1	1983, 95,96	3	T1	T1	T2	T1, T2	M1	T2	T1, T2	T1	T1, T2	T2	T2, M1	M1	T2	M1	M1, T1	M1,T1, T2	T2, M1	T2, M1	M2	M1	M1
	E-LD-03	69, 1936	~100	1936	1	1974, 94	2	1974,82 ,94,00	4	T1	T1	T2	T1, T2	M1	T2	T1	T1	T1	T2, M1	M1	M2	T2	M1	T2	M1	T2	M1	M2	M1	M1
	E-LD-05	65, 1940	65, 1940	-	-	1985	1	1985, 93	2	T1	T1	T1	T2	T2	T2	T1, T2	T1	T1, T2	T2	T2	M2	T2	M1	T1, T2,M2	T1,T2, M2	T2, M2	M1	M2	M1, M2	M1, M2,C2
	E-LD-06	170, 1835	170, 1835	-	-	2004	1	1941, 01,04	3	T1	T1	T1	T1	M1	T2	T1	T1	T1	T1	M1	M2	T2	M1	T1, T2	T1, M1	T2, M1	T2, M1	M2	M1	M1
	E-LD-07	60, 1945	~100	1945	1	-	-	1968, 80	2	T1	T1	T2	T1	M1	T2	T1	-	-	-	-	-	-	-	T1, T2	T1, T2	T2, M1	T2, M1	M2	T2, M1	M1
35	E-LD-08	70, 1935	70, 1935	-	-	-	-	1975, 85,94	3	T1	T1	T1	T1	M1	T2	T1	-	-	-	-	-	-	-	T1, M2	T1, M2	T2	T2, M2	T2, M2	T2,M1, M2	M1, M2,C2
	E-LD-09	140, 1865	140, 1865	-	-	1942	1	1935, 45,55	3	T1	T1	T2	T1	M1	T2	T1, M1	T1	T1	T2	M2	M2	T2	M1	T1	T1	T2	M2	M2	T2	M1
	E-LD-10	150, 1855	150, 1855	-	-	1994	1	1974, 82,00	3	T1	T1	T2	T1, T2	C1	T2	T1, M1	T1	T1	T1	M1	M2	T2	M1	T1, T2	T1, T2	T2, M1	M1	M2	T2, M1	M1
	U-LD-01	120, 1885	120, 1885	-	-	1998	1	1998	1	T1	T1	T2	T1	T2	T2	T1	-	-	-	-	-	-	-	T1	T1, M1	T2	M1	M2	T2	M1
	U-LD-03	120, 1885	120, 1885	-	-	1991	1	1991, 02	2	T1	T1	T2	T1	M1	T2	T2	-	-	-	-	-	-	-	T1,M1, M2	T1,M1, M2	T2,M1, M2	M2	M2	M1, C2	M1,M2 ,C2
40	U-LD-06	120, 1885	120, 1885	-	-	1980	1	1985, 90,03	3	T1	T1	T1	T1	T2	T2	T1	T1	T2	T2	M1	M2	T2	M1	T1	T2	T2	T2	M2	T2	M1
	U-LD-08	100, 1905	~150	1905	1	1965	1	98,03	2	T1	T1	T1	T1	T2	T2	T1	T1, T2	T1, T2	T2	M1	M2	T2	M1	T2, M2	T2, M2	T2, M2	T2, M2	M2	T2, M2	M1,M2 ,C2
	U-LD-09	30, 1975	30, 1975	-	-	-	-	1995, 97,04	3	M2	T1, M2	M1, M2	T1, T2	M1	M1	T1,T2, M1	-	-	-	-	-	-	-	T2,M1, M2	T2,M1, M2	M1, M2	M1, M2	M2	M1, C2	M1,M2 ,C2
	U-LD-10	59, 1946	~100	1946	1	1956	1	1994, 03	2	T1	T1	T2	T1	M1	T2	T1	T1	T1	T2	T2	M2	M1	M1	T2, M2	T2, M2	T2, M2	M1, M2	M2	M1, C2	M1,M2 ,C2
44	U-LD-11	120, 1885	120, 1885	-	-	-	-	1985, 92,99	3	T1	T1	T2	T1	M1	T2	T1	T1	T2	M1	M1	M2	M1	M1	M1	T2, M2	M1	M1	M2	M1	M1

Pattern of Change and Period (Continue)

No.	House Name	By Interview								Appearances by Survey																				
										Part 1 Original Thai House							Part2 Modified Thai House							Part3 Expansion						
										Structure			Roof				Structure			Roof				Structure			Roof			
		House Age	Thai House Age	Year of Thai House Moving	Times of Moving	Years of Modification at Part of Thai House	Times of Modification	Year of Expanding from Thai House	Times of Expanding	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall	Foundation	Column	Beam	Structure	Covering	Floor	Wall
45	T-LD-01	120, 1885	120, 1885	-	-	1985	1	1990, 00,02	3	T1	T1	T1	T1	M1	T2	T1	T1	T1	T1	T2	M2	T2	M1	M1, M2	M1, M2	M1, M2	M1	M2	M1, M2	M1, M2,C2
	T-LD-04	120, 1885	120, 1885	-	-	-	-	1970, 85,90	3	T1	T1	T1	T1	T2	T2	T1	T1	T1	T2	T2	T2	T2	M1	T1, M1	T1, M1	M1	M1, M2	M2	M1	M1
	T-LD-08	120, 1885	120, 1885	-	-	1975	1	1975, 94	2	T1	T1	T1	T1	M1	T2	T1	T1	T1	T2	M1	M2	T2	M1	M1	M1	M1	M2	M2	M1	M1
	T-LD-09	120, 1885	120, 1885	-	-	1951	1	1947,65 ,85,95, 98	5	T1	T1	T1	T1, T2	T2	T2	T1	T1	T1	T2	T2	T2	T2	T2, M1	T1	T1, T2	M1	M1	M2	M1	M1
	T-LD-10	140, 1865	140, 1865	-	-	1995	1	1985, 00	2	T1	T1	T2	T1	M1	T2	M1	T1	T1	T2	M1	M2	T2	M1	T1	T2, M1	T2, M1	T2, M1	M2	T2, M1	M1
50	CH-LD-02	100+ ,1905	100+ ,1905	-	-	1987	1	1999	1	T1	T1	T2	T1	T2	T2	T2, M1	T1	T1, T2	T2	M2	M2	T2	M1	T1, T2,M2	T1, M2	T2,M1, M2	M1, M2		M1, M2	M1
	CH-LD-06	100+ ,1905	100+ ,1905	-	-	1965	1	1995, 97,02	3	T1	T1	T2	T1	M1	T2	T1	T1	T1, T2	T2	T2	M2	T2	M1	T1	T1,T2 M2	T2, M2	M1, M2	M2	M1, M2	M1, M2,C2
	CH-LD-07	80, 1925	80, 1925	-	-	1985	1	2000	1	T1	T1	T2	T1	T2	T2	T1	T1	T1, T2	T2	M1	M2	T2	M1	T1, T2	T1, T2	T2	T2, M1	M2	M2	M1, M2,C2
	CH-LD-08	80+ ,1925	80+ ,1925	-	-	1965	1	1965, 75	2	T1	T1, T2	T2	T1, T2	M1	T2	T1	T1	T1, T2	T2	M1	M2	T2	M1	T1	T1, T2	T2	M2	M2	T2	M1, M2
	CH-LD-09	100+ ,1905	100+ ,1905	-	-	2000	1	1995, 2000	2	T1	T1	T2	T1	M1	T2	T1	T1	T1, T2	T2	T2	M2	T2	M1	T1	T1, T2	M1	M1	M2	M1, M2	M1, M2,C2
55	CH-LD-10	40, 1965	100+ ,1905	1965	1	1995	1	1995, 03	2	T1	T1	T2	T1	M1	T2	T1	T1	T1	T2	T2	M2	T2	M1	T1	T1	T2	M1	M2	T2	M1
	CH-LD-11	30, 1975	100+ ,1905	1975	1	-	-	1975, 99,02	3	T1	T1	T1	T1	M1	T2	T1	-	-	-	-	-	-	-	T1	T1	T2	M1	M2	T2	T2, M1
	P-LD-09	68 ,1937	150+ ,1855	-	-	1995	1	1995, 02	2	T1	T1	T2	T1	T2	T2	T2	T1	T1	T2	M2	M2	T2	M1	T1	T1	T2	T2	M2	T2	M1
	P-LD-11	60, 1945	60, 1945	-	-	-	-	-	-	T1	T1	T2	T2	M2	T2	M1	-	-	-	-	-	-	-	T1	T1	T2, M1	M1	M2	T2, M1	M1
	P-LD-12	50, 1955	50, 1955	-	-	-	-	1995, 97	2	T1, T2	T1, T2	T2	T2	M2	T2	M1	-	-	-	-	-	-	-	T2	T1,T2, M2	T2, M2	M1, M2	M2	T2,M1, M2	M1, M2,C2
60	D-BH-10	1, 2004	1, 2004	-	-	-	-	-	-	M2	T2, M2	M2	T2	T3	M1, M2,C2	T2, C2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	D-BH-11	1, 2004	1, 2004	-	-	-	-	-	-	M2	T2, M2	M2	T1	T3	M1, M2,C2	T2, M2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E-BH-11	30, 1975	30, 1975	-	-	-	-	2004	1	M2	T2, M2	M2	T2	T3	M1, M2	T2,C2, M2	-	-	-	-	-	-	-	M2	M2	M2	T1	T3	M1, M2,C2	T2, M2,C2
	T-BH-12	4, 2001	4, 2001	-	-	-	-	-	-	M2	T2, M2	M2	T2	T3	M1, M2,C2	T2,C2, M2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	T-BH-13	1, 2004	1, 2004	-	-	-	-	-	-	M2	T2, M2	M2	T2	T3	M1, M2,C2	T2,C2, M2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	P-BH-10	40, 1965	30, 1970	-	-	-	-	-	-	M2	T2, M2	M2	T1	M2	M1, M2	T2, M2	-	-	-	-	-	-	-	M2	M2	M2	M1, M2	M2	M1, M2	M1, M2,C2

Key

D,E,U,T,CH and **P**=Names of surveyor

PK=Pakkran villag **LD**=Ladchado village **BH**=Bangpahun area

T1=Tradition with archetype parts **T2=**Tradition with developed parts

T3=Tradition with new construction or production methods

M1=Intermediate with related parts to tradition **M2=** Intermediate without related parts to tradition

C1=Contemporary with related parts to tradition **C2=** Contemporary without related parts to tradition

Appendix E

Percentage of characteristics appearing in the three settings

Remark: The data are the proportion of used in samples,
T=Traditional, **I**=Intermediate, **C**=Contemporary

Table A Percentage of characteristics appearing in the three period groups (At the roof cladding and roof structures in three study areas)

Roof Cladding and Roof Structures				
Period Group		**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T 	**CL**	4.9%	1.5%	83.7%
	ST	26.0%	23.2%	52.1%
I 	**CL**	94.8%	91.1%	16.3%
	ST	73.7%	75.0%	15.2%
C 	**CL**	0.3%	7.4%	0%
	ST	0.3%	1.8%	32.7%

Note: CL=Cladding, **ST**=Structure

Table B Percentage of characteristics appearing in the three period groups (At the upper level columns and walls in three study areas)

Columns and walls (Upper level)				
Period Group		**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T 	**C**	22.8%	24%	85.7%
	W	25.3%	24%	96.5%
I 	**C**	70%	70.6%	0%
	W	67.9%	73.1%	0%
C 	**C**	7.2%	5.4%	14.3%
	W	6.8%	2.9%	3.5%

Note: C=Column, **W**=Wall

Table C Percentage of characteristics appearing in the three period groups (At the upper floor level beam and floor in three study areas**)**

Beams and floors (Upper level)			
Period Group	**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T 	0%	1.7%	0%
I 	92.2%	93.7%	0%
C 	7.8%	4.6%	100%

Table D Percentage of characteristics appearing in the three period groups (At the ground level columns and walls in the three study areas)

Columns and walls (Ground level)				
Period Group		**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T 	**C**	15.7%	22.5%	0%
	W	81%	93.2%	52.7%
I 	**C**	74%	69.8%	0%
	W	0%	0%	0%
C 	**C**	10.3%	7.7%	100%
	W	19%	6.8%	47.3%

Note: C=Column, **W**=Wall

Table E Percentage of characteristics appearing in the three period groups (At the ground level beam and floor in the three study areas)

Beams and floors (Ground level)			
Period Group	**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T	75% (NC)	93.2% (NC)	0% (NC)
I	16.4%	0%	9%
C	7.8%	6.8%	91%

Note: B=Beam, **F=**Floor, **NC**=No construction

Table F Percentage of characteristics appearing in the three period groups (At the foundation in the three study areas)

Foundation			
Period Group	**Pakkran** (Suburban)	**Ladchado** (Rural)	**Bangpahun** (Motorway buffer zone)
T	8.3%	77.1%	0%
I	81.4%	15.2%	0%
C	10.3%	7.7%	100%

Appendix F

Example of photographs
used for supporting survey form

House No. 01 Pictures
Survey on 27.02.09 and 20.03.09


Key Informant: House owner parent

1. Site

1.1
Canal behind the house

2. Elevation

2.1
Front elevation

2.2

2.3

2.4

2.2-2.4 Right Elevation

2.5

2.6

2.7

2.5-2.7 Back Elevation

2.8

2.9

2.10

2.8-2.10 Left Elevation

3. Foundation

3.1

3.2

Wood columns (100 years old) were put in concrete foundation.

4. Column

4.1

Pre-cast concrete columns connect with traditional style wood beams.

4.2
Steel column (2floors height) at roof corner

4.3

4.4

4.5

4.6

4.7

4.8

5.Beam

5.1 Traditional style beam and joists **5.2 Traditional king post column**

5.3 **5.4**

5.5 **5.6**

6. Roof

6.1 **6.2**

Traditional roof structure with flat tied beam

6.3 **6.4**

3.5 meters width room

6.5

Truss style roof (4 meters) on used-to-be-middle terrace area

6.6

Eave bracket

6.7

Rafter on front terrace

6.8

Gutter and connection between old and new roof.

7. Floor

7.1

7.2

0.4-0.6 meters width hard wood plank

7.3

New front terrace

7.4

Right side corridor

8. Wall

8.1

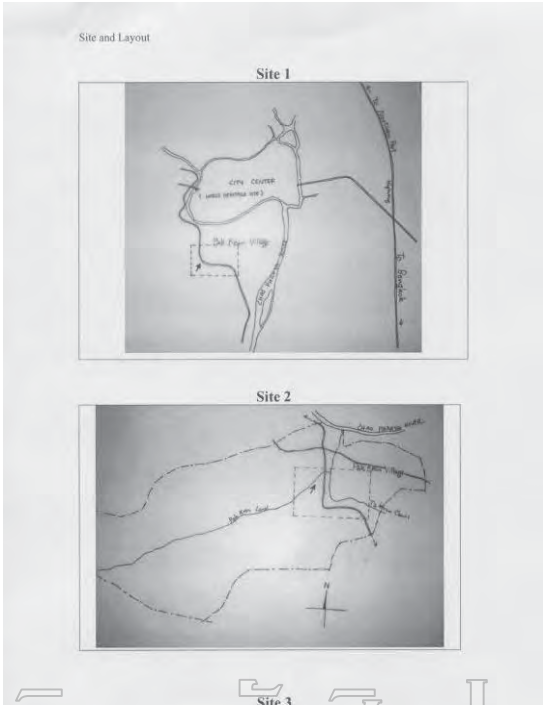
Wall, roof, gutter and down spout

8.2

Left side facade

Appendix G

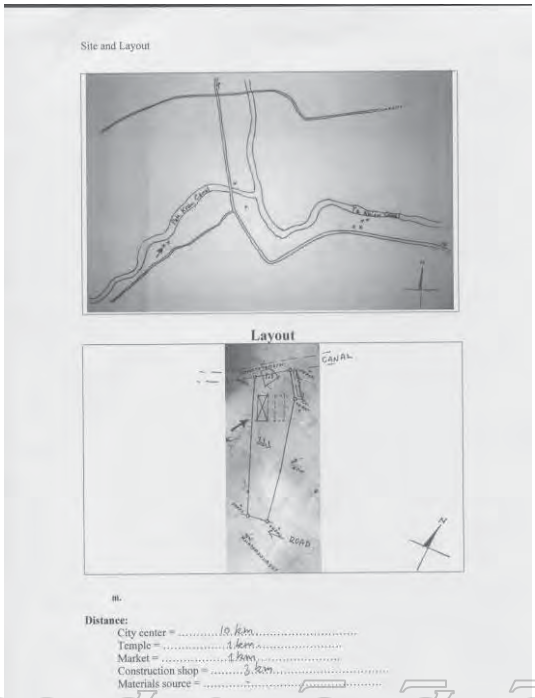
Example of Survey Form
House No. P-PK-01


Site and Layout

Site 1

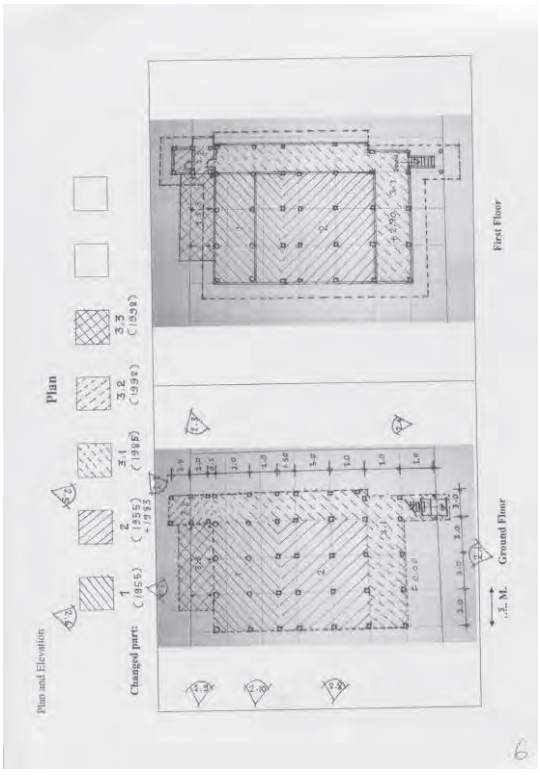
Site 2

Site 3


Site and Layout

Layout

Distance:
City center = 10 km
Temple = 1 km
Market = 1 km
Construction shop = 3 km
Materials source = ...

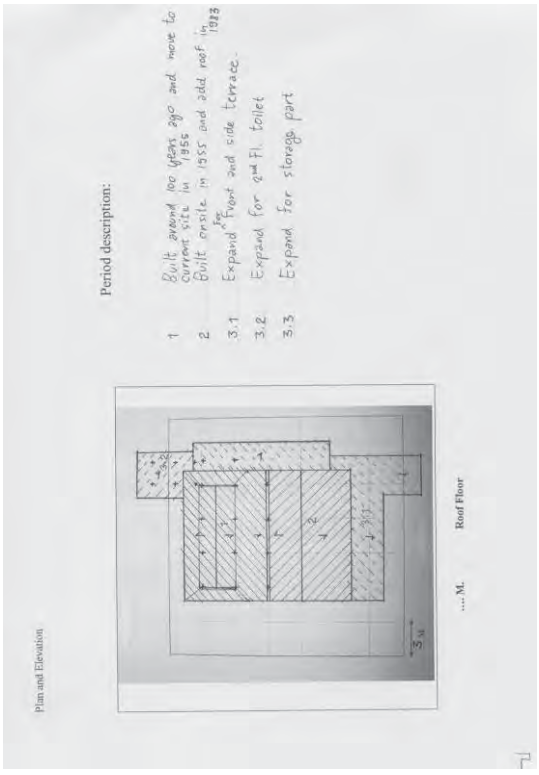

Plan and Elevation

Plan

First Floor

Ground Floor

Changed part:


Plan and Elevation

Period description:

1 Built around 100 years ago and move to current site in 1955

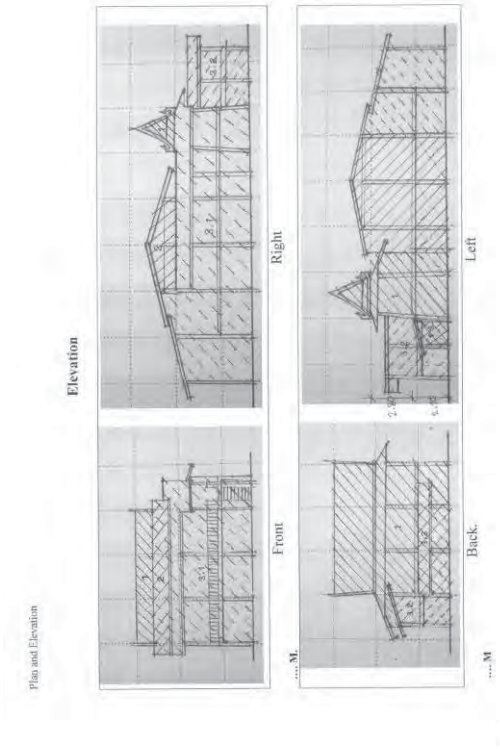
2 Built onsite in 1955 and add roof in 1983

3.1 Expand for front and side terrace

3.2 Expand for 2nd Fl. toilet

3.3 Expand for storage part

Roof Floor



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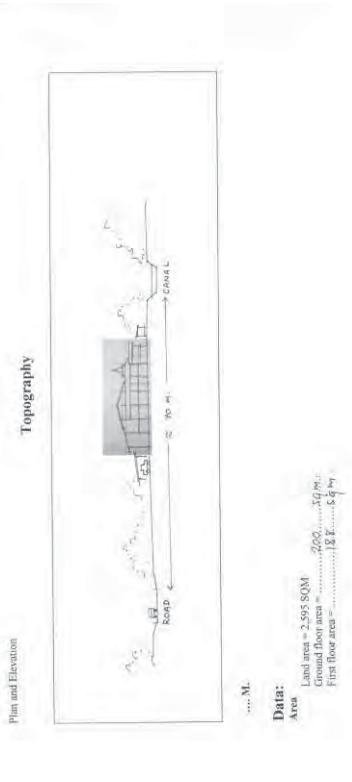

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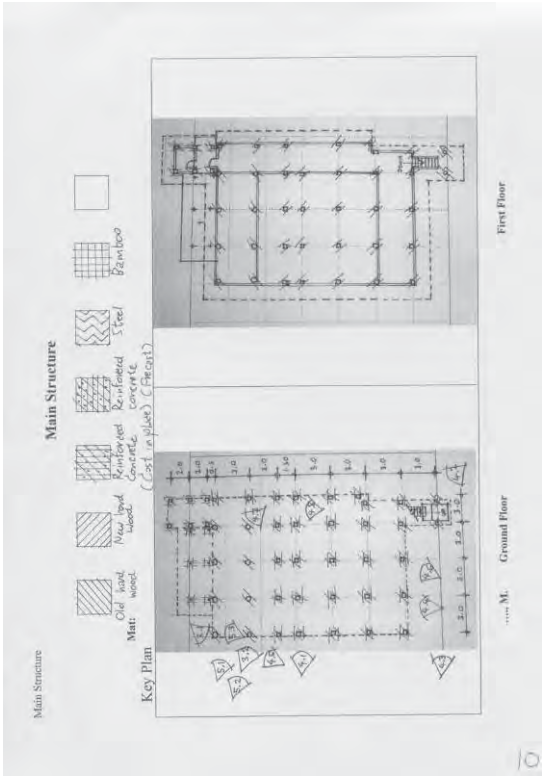

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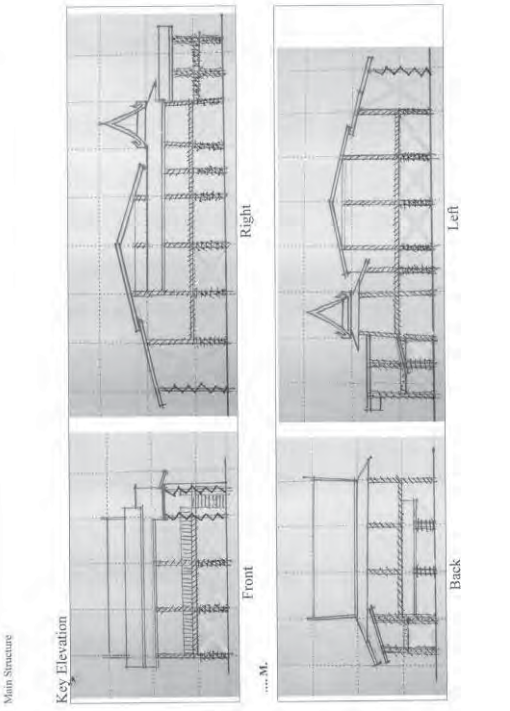


11

Main Structure

First Floor Column

Data					
	Original (At the beginning)	1. Original with minor change (At the present)	2. Original with major change (At the present)	3. Expansion	
		Part No.	Part No.	Part No.	
		1	2	3.1	3.2
Materials	Hard Wood	Old Hard Wood	New Hard Wood		R. Concrete
Age/Year	–	Before 1955	1983	1985	1998
Condition	–	B	B		B
Amount	–	B	16	12	6

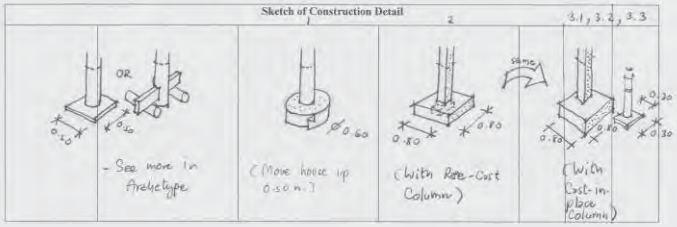
Sketch of Construction Detail

Main Structure

Foundation

Data						
	Original (At the beginning)	1. Original with minor change (At the present)	2. Original with major change (At the present)	3. Expansion		
		Part No.	Part No.	Part No.		
		1	2	3.1	3.2	3.3
Materials	Hard Wood	Concrete	Concrete			
Age/Year	------	1983 (1955)	1983	1985	1998	1998
Condition	------	C+	B	B	B+	C
Amount	–	8	16	12	6	6

Sketch of Construction Detail

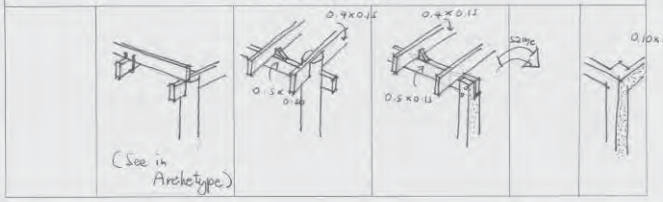


Main Structure

First Floor Beam

Data					
	Original (At the beginning)	1. Original with minor change (At the present)	2. Original with major change (At the present)	3. Expansion	
		Part No.	Part No.	Part No.	
		1	2	3.1	3.2
Materials	Hard Wood	Old Hard Wood	New Hard Wood		R. Concrete
Age/Year	–	Before 1955	1983	1985	1998
Condition	–	B	B	B	B
Amount	–	–	–	–	–

Sketch of Construction Detail

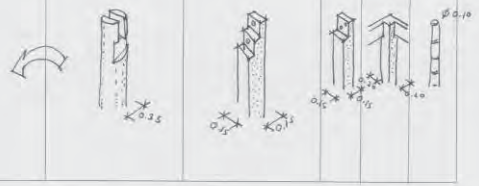


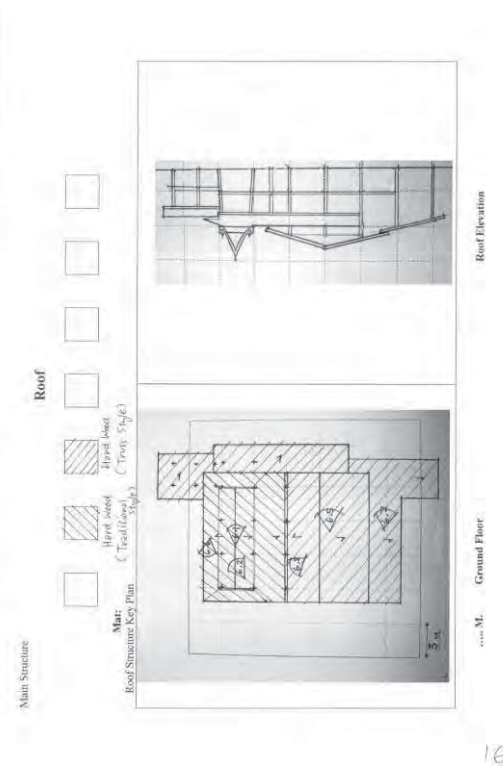
Main Structure

Ground Floor Column

Data						
	Original (At the beginning)	1. Original with minor change or no change (At the present)	2. Original with major change (At the present)	3. Expansion		
		Part No.	Part No.	Part No.		
		1	2	3.1	3.2	3.3
Materials	Hard Wood	Old Hard Wood	Concrete (Pre-Cast)	Concrete steel	Concrete (Cast-in-place)	Bamboo
Age/Year	------	Before 1955	1983	1985	1998	1998
Condition	------	C	B	B/B	B+	C
Amount	–	8	16	12/2	6	6

Sketch of Construction Detail





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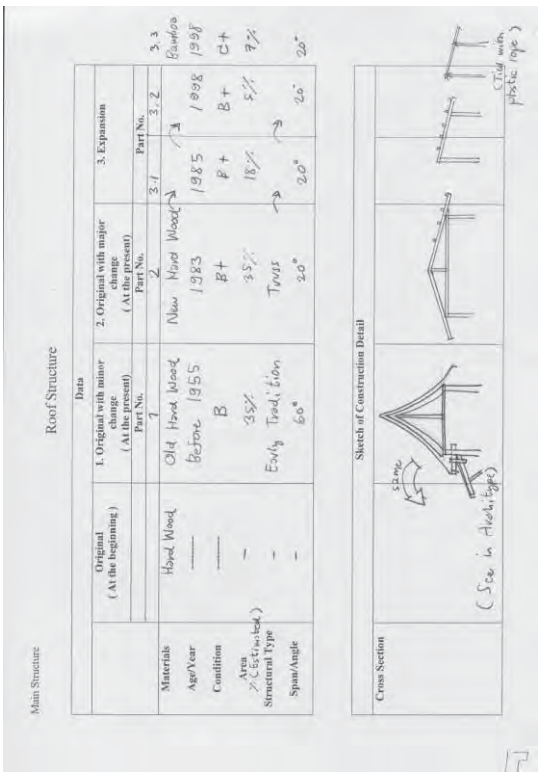

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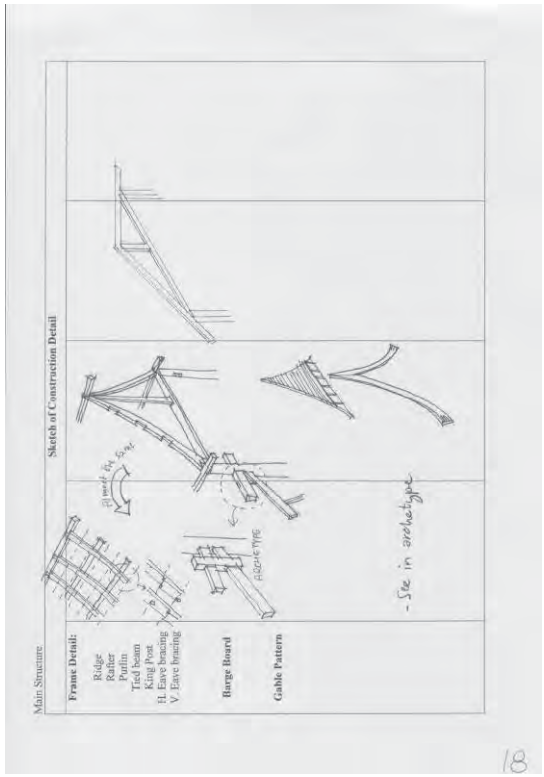


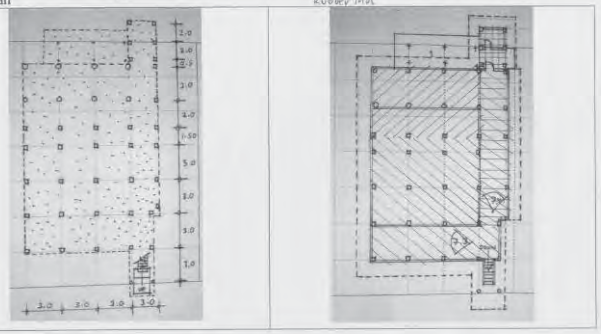
18

Main Structure

Floor

Mat: Compacted Soil; Old Hard Wood; New Hard Wood; New Hard Wood with Rubber Mat; R/C with Ceramic Tile

Key Plan



..... M. Ground Floor

First Floor

Main Structure

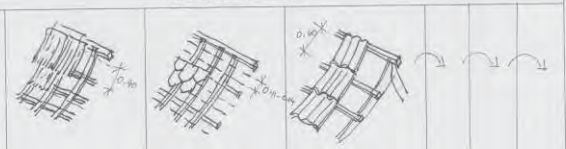
Roof Covering

Data	Original (At the beginning)	1. Original with minor change (At the present) Part No.	2. Original with major change (At the present) Part No.	3. Expansion Part No. 3.1	3.2	3.3
Materials	Thatch or Clay Tile	Cement Tile / C. Metal Sheet	Corrugated Cement Tile	↘	↘	Corrugated Metal Sheet
Age/Year	———	Before 1955	1985	1985	1998	1998
Condition	———	C- / C+	C+	B	B	D
Area	–	15% / 20%	35%	18%	5%	7%

Sketch of Construction Detail

Pattern

Covering Structure



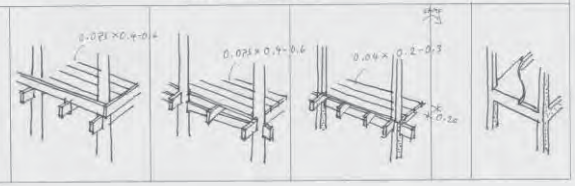
Main Structure

First Floor

Data	Original (At the beginning)	1. Original with minor change (At the present) Part No. 1	2. Original with major change (At the present) Part No. 2	3. Expansion Part No. 3.1	3.2
Materials	Hard Wood	Old Hard Wood Before 1955	New Hard Wood 1983	New Hard Wood 1985	R. Concrete with ceramic tile topping 1998
Age/Year	———				
Condition	———	B+	B	B	B+
Area		35%	35%	22%	8%

(Grid with laminated mat topping)

Sketch of Construction Detail

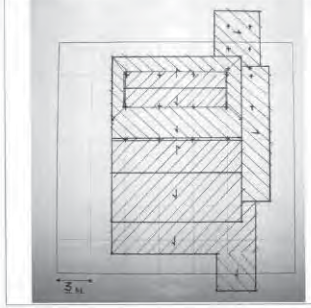


Main Structure

Roof

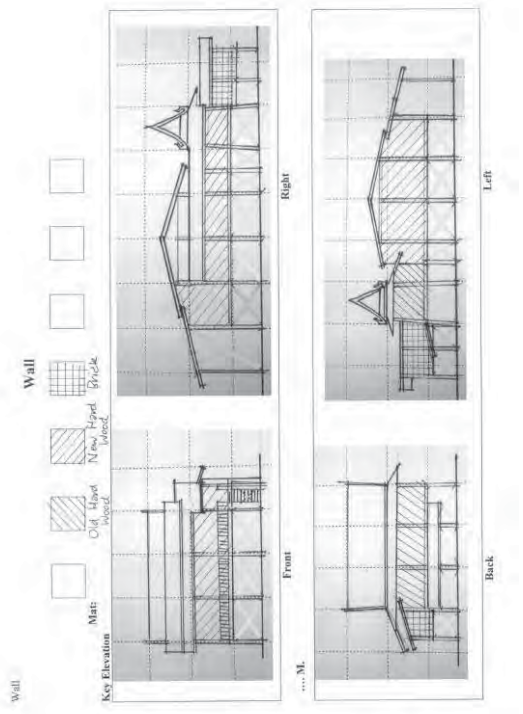
Mat: Corrugated Cement Tile; Corrugated Metal Sheet (Zinc Coated)

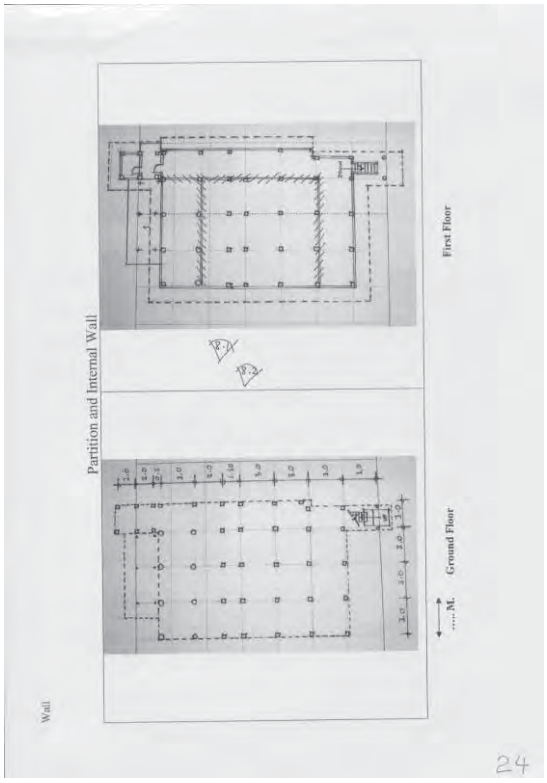
Covering Key Plan

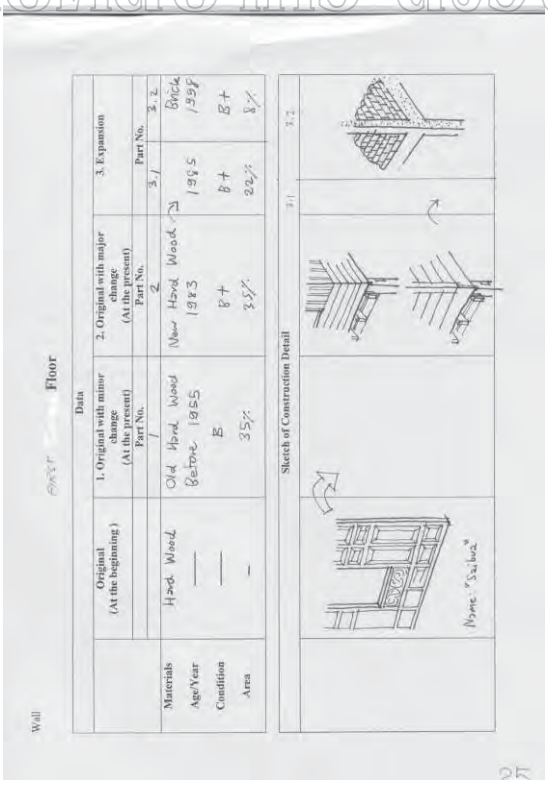


..... M. Ground Floor

Roof Elevation







Autobiography

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