A SYNTACTIC ANALYSIS OF SPATIAL CONFIGURATION TOWARDS
THE UNDERSTANDING OF CONTINUITY AND CHANGE
IN VERNACULAR LIVING SPACE:
A CASE STUDY IN THE UPPER NORTHEAST OF THAILAND

By

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I dedicate this study to my family with love and gratitude and to my professors with profound respect. Completing this dissertation is truly beneficial to me, and I feel privileged to have been given this opportunity.

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In the last few decades vernacular houses in Thailand have changed as people are

becoming physically and socially more integrated with the outside world. Vernacular

houses being built now differ radically from traditional houses in many aspects, from

their material and structure to style and appearance. Because of foreign influences from

global modernization, vernacular houses being built in most areas of Thailand are

becoming less influenced by existing traditions and more influenced by popular trends.

This study aims to examine spatial patterns modified by the design of vernacular houses.

It is hypothesized that while newer houses are more modern looking than those built in

the past, the internal organization of both house types remains similar. The main

questions for the investigation are how vernacular houses have developed their patterns to

support the change of lifestyle, and how these patterns have been carried on.

Syntactical studies were used to investigate changes regarding the spatial and functional organization of house samples. Forty-one houses were selected chronologically. The analysis of spatial configuration was based on two procedures: space syntax and cognitive research methods. Space syntax was applied to examine patterns established among samples through diagrams of house floor plans. Cognitive research methods revealed patterns of domestic experience regarding space-use patterns categorized by inhabitants. Data were grouped into nine primary spaces and analyzed for change: under floor, outdoor yard, toilet and bathing, food preparation, multiple uses, verandah, sleeping, eating and household services. The changes over time in spatial configuration and underlying functional structures were identified.

The analysis of spatial configuration indicates a continuous transition of space-use pattern in accordance with the change of lifestyle, while the information from cultural content suggests the shift from familism to individualism. Spatial patterns from various house types not only illustrate different domestic experience but also identify the impact of physical transformation by the process of urbanization. Several suggestions for spatial alteration are given based on the examination of spatial patterns and domestic experience in order to develop design guidelines for a supportive housing design in the study area.

CHAPTER 1
INTRODUCTION

Vernacular houses customarily derive pattern and style from many factors, such as physical setting, topological climate, social, culture, symbolic meaning and lifestyles. Found in areas around the world, most of vernacular houses reflect the basic needs in a particular locality. Both physical and socio-cultural factors that shape vernacular houses have been changed and modified over time. In recent years, a global phenomenon has overwhelmingly influenced the transition of local contexts from traditional vernacular to modern housing by introducing new processes of construction and technology. The houses that once were built by their occupants have recently been created by teams of professional designers. Factors that determine cultural change in vernacular houses become more complex since there are various ways to explore the relationship between cultural content and the design of built spaces, as in technology, economics, symbolism and sociopolitical aspects, and they are based on different value systems.

The design of vernacular houses is a direct expression of changing values, images, perceptions and ways of life. This study focuses on the physical transformation of vernacular living spaces as a way to define the connection and the understanding of the relations between built spaces and culture. The investigation of architectural evolution by tracing the development of spatial pattern over time indicates culturally linked phenomena among the housing patterns and helps to identify the problems of consistency and transformation of pattern. The change of house style may influence the arrangement of space and, consequently, may affect social and cultural content. The main intent of

this research is to investigate the change of physical alterations in vernacular houses in

Thailand.

Purpose of Study

The primary goal of this study is to examine whether the change of physical

features resulting different house styles influences spatial arrangement and patterns of

daily activity. Objectives of the study are as follows:

1. To reveal the underlying patterns of vernacular living spaces that have been

    changed over periods of time.

2. To identify the similarity and the difference of spatial configuration according

    to an examination of the house floor plans from various construction dates.

3. To examine how existing spatial patterns embedded in various house styles

    and appearances are different from those categorized by users according to

    their viewpoints and experience regarding the use of domestic space.

The interdisciplinary approach from architectural theory and anthropological

research applies as theoretical concept and methodology for the analysis of vernacular

design and its spatial configuration. The analysis is based on theory and applications

from two procedures—space syntax methodology and cognitive research. Regardless of

any changes in house appearance, two spatial patterns were examined, from the physical

organization established among the sample of vernacular houses and from the pattern of

domestic experience perceived by the house's inhabitants. The recent changes seen in

new environments, which are now partly traditional and partly modern in character, may

involve various aspects from physical and socio-cultural factors. This research focuses

on the arrangement of physical characteristics by considering the transformation of

spatial pattern across time. The intent of this study was to examine the transition of spatial configuration from traditional patterns to popular houses and to define how spatial layout is shaped by the local way of life.

<div align="center">Vernacular in Transition</div>

Vernacular[1] and Modern Design

The study of vernacular architecture not only provides information and understanding of how built form and its settings interrelate, but also enhances the meaning of how people see themselves through built form. Many research projects investigating the relation between built environment and culture have been conducted by researchers from different disciplines with various perspectives, looking at how housing meeting social, psychological and functional needs. Vernacular architecture, which is designed and built by people who live in it, has been referred to as the design archetype that responds properly to basic needs (Rapoport 1999, Turan 1990, Oliver 1987 and Rudofsky 1964).

Since the design profession was established, most buildings have been designed and built for customers. The role traditionally played by the building user has shifted from being a creator to a client who lives in the building. Such adoption of the design approach became the culture of the modern movement, which ultimately has influenced worldwide architecture. As part of the modernization process, most houses that recently have been built are architect-designed; while some are designed and built locally. Both design processes are evidently different in terms of construction system, variety of uses,

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[1] Paul Oliver defines vernacular as local or regional dialect, which is the common speech of building. Vernacular architecture is defined as owner or community-built, utilizing traditional technologies, while the formal architect-designed architecture is termed as popular architecture (Oliver 1997: xxi-xxii). This dissertation also uses the mentioned and related terms as working definition throughout the manuscript.

layers of meaning and cultural complexity. However, the majority of people still live, work and worship in vernacular buildings. In such diverse conditions, it is possible to question whether there is a trend toward consideration of vernacular design. Some argue that the new patterns will eventually replace traditional patterns, while others say that the new and the traditional will blend together (Choi 1999).

In addition, from a preservation viewpoint, the adoption of popular house styles in specified areas is regarded as one of the most important factors in the diminution of traditional houses. New materials and appearances have changed people's attitudes, because they represent the look of modern lifestyles that reflect a new way of living and symbolize a higher social status and quality of life. In recent situations, from urban to local environments, there is no sign of awareness in the value of local heritage (Eiam-Anan 1997). On the contrary, those changes incline toward an acceptance and appreciation of popular taste. Overwhelmed by such development, only a small number of vernacular houses survive to stand as models for the purposes of architectural education. As a result, the study of vernacular design in Thailand is critical in order that the information can be available as a fundamental basis for future research approaches and architectural design. Thai vernacular houses have been studied extensively; however, research is recently beginning only about ten years ago. Most studies attempt to document existing conditions such as proportion and style, but none examines the domestic level of spatial organization. Spatial analysis is an approach beyond building materials, structure, style and meaning; it is an important contribution to our understanding of architectural evolution.

Consequences of Universal Design Concept

In the past, the fundamental principle of vernacular architectural design was the houses were not part of fashion cycles but were built to serve only their functional purposes. The worldwide development of economic and social structure is leading the process of architectural design to change in accordance with modern society. The universal approach that represents the new ideology of design through the communication world is widely becoming a main driving force. Influenced by the attitudes of those in worldwide development, the Third World countries have accepted the modern approach to housing design as a model applying to their societies (Kalia 1987). The adoption of modernization becomes an important paradigm of development. People shift to modern aspect, and they abandon the traditions expressed an achievement and model of the past. The new Western style, with physical and spatial arrangements that are different from the indigenous, is applied globally and then becomes the main approach for today's architectural trend for local contexts.

Some researchers state that the universal concept of architecture, which does not derive design ideas from its physical and cultural settings, is an inappropriate and irrelevant model to domestic habits (Abel 1996, Theoharris 1983 and Brolin 1976). Many structures are designed following models developed to express aspects of the accepted worldview, which suggests that most living spaces would look alike because they respond to basic needs arising the functional purpose. This idea has been applied to house design in different places even though the environmental settings and users' habits are not the same. Because meanings and cultural norms are different, design from a universal approach, by professionals, does not work as expected in local contexts. In places where people choose to accept architectural design as what they visually prefer

rather than what they need for living, a misconception of applying universal approach to local contexts by an imitation of style is a simple way that people easily perceive as a new way of life. As a result, the conflict between the need for appearance and lifestyle has become obvious, because a designed space may not well accommodate the requirement for domestic activity. Designers need to know how people utilize space in built form and how the design of space influences people's behavior.

In the context of transition from the traditional to the popular style, the response of the user to existing environments can vary depending on what people already own and how they actually occupy those spaces. The acquisition of new houses does not imply that existing spaces among these houses appropriately accommodate the user's daily activities, since new spatial patterns are not necessarily based on the users' values nor were they created to meet the needs of local lifestyle. Studies that address the effectiveness of user-environment interaction support creating a desirable built environment for occupants (Sanoff 1992, Lang1987, Sommer 1983 and Zeisel 1981). Lifestyle, cultural values and norms influence the use of space and reinforce each other if properly addressed. Therefore, the interrelation between physical conditions and domestic experience of people who occupy the building plays an important role in the study of vernacular living spaces.

Vernacular houses serve various daily routines. When the way of life changes, a vernacular house is inevitably adapted to a new set of requirements, or in reverse, when the house style has changed, people adapt their lifestyle responding to a new pattern of design. The change of architectural style affects the arrangement of space and this change influences daily activity; therefore, the inhabitant's behavior may be influenced

by the design of spatial arrangement. Activity and physical settings interrelate with each other and either can modify the other (Rapoport 1990). Rapoport suggests that the interpretation of the activity setting helps to predict behavioral and social patterns.

This study focuses on the arrangement of architectural space as a main feature to examine vernacular living spaces from the existing physical features and from inhabitant's experience. Different patterns of domestic spaces that have been built and occupied over time are expected to reveal how traditional patterns move towards new forms of popular taste; the patterns may be accepted, blended or rejected.

The Impacts of Urbanization Process

The design of vernacular space is created basically to accommodate people's needs; it changes from time to time in order to correspond with a new lifestyle and contextual settings. Indigenous design judged as being the best and the most efficient response to topographic, climatic and economic constraints has been influenced by a global phenomenon. Because the urbanization process affects traditional culture, the impact of these changes becomes physically evident, particularly in most rural settlements and vernacular houses in Thailand. The new design of vernacular houses influenced by the architecture of urban areas has been adopted by the new generation of local inhabitants. A new appearance has been introduced, and a new spatial pattern results from the new architectural style being used by local inhabitants.

As in many Third World countries, the transition of house styles in Thailand from traditional patterns to what is considered as essentially different from existing local patterns is a significant turning point in the development of living pattern. Without any adaptations to local ways, new house styles and spatial patterns that have originally been

developed and designed by professionals to accommodate the urban lifestyle, following the same principles around the world, have been widely duplicated in many regions in Thailand. Such transitions have been mentioned by many scholars as unsuccessful and responsible for shortcomings (Brolin 1976 and Lang 1987). It is argued that the transition is not smooth and successful because both house patterns do not support the same lifestyle and cultural content. As indicated in many housing studies, Le Corbusier's design of Chandigarh in India (Kalia 1987), the resettlement of Cappadocia cave dwellers in Turkey to subsidized housing provided by the government (Emge 1992) and the urban housing projects in African countries (Potash 1985) are a few among a large number of examples that point out the problems of transitional process resulting from the differences in spatial design. Following the same path of architectural evolution, significant alteration in vernacular living space in Thailand creates a wide gap between those designed by outsiders and those built and lived in by insiders or its occupants.

There are many external factors driving regional development, such as modern culture, political systems, social and family structure corresponding with global phenomena. Architectural evolution has also reflected these trends. In Thailand, the transition has been causing a discrepancy between the traditional lifestyle and modern housing design. Along with the new appearance of popular house styles, a concurrent attitude towards the urban lifestyle has developed in local places. The transition from the traditional house form and space is a sudden shift, including the adoption of new style and materials that appear to transform spatial and cultural aspects of houses. Newly acquired house styles, associated with patterns unfamiliar in local contexts, reveal a profound adaptation of the interior arrangement and user's domestic routines.

This study seeks to understand the role of domestic spaces in shaping the house design as it underlies spatial organization. The relation between house spaces and activity pattern evolving over time is a significant acknowledgment of how people create or constantly modify existing environments. The unique characteristics of the case study are undertaken from the investigation established through perceivable language and methods. The study of house design from the organization of space aims for a better understanding of large and complex cultural phenomena and discusses the relationship between built spaces and social life. Since there are numerous variables that influence house design and its spatial pattern, this study has an integral part in creating a more complete understanding of domestic structure as it appears among vernacular living spaces.

Research Questions

The study involves questions concerning spatial and domestic activity patterns in vernacular houses. Different dates of construction not only result in difference of styles but also influence house design at the level of spatial configuration. It is hypothesized that spatial configurations in older houses are different from newer ones. The following questions are starting points for the examination of spatial patterns according to syntactic properties and the use of domestic spaces.

- Is there any change during the transition from traditional to popular houses in terms of spatial configuration? If there is a difference, can spatial types underlying those arrangements be identified?

- How do different spatial configurations influence the distribution of domestic activity among vernacular houses in study area?

- Does variation in existing patterns correspond to the morphology of domestic experience regarding inhabitants' perceptions?

The study concerns daily activities occurring in and among domestic spaces and adjacent activity areas within the household property rather than in other settings such as workplace, agricultural fields and public places. The design of architectural partition and furniture arrangement, which separates each space and influences the inhabitant's activity, is included in the analysis. In order to verify the existence of underlying principles of spatial patterns, syntactic properties from space syntax methodology and domestic experience of inhabitants are applied as essential models of the analysis.

Significance of Research

This study intends to provide a way to trace the transition of spatial configuration and to reveal prototypes of vernacular houses built over periods of time. The analysis of a certain characteristic of vernacular design by focusing on features such as spatial pattern and domestic activities produces the knowledge that helps to understand the domestic experience of space in differing conditions and the development of social and functional logic through spatial configuration. The field research on building documentation and ethnographic data detailing the use of space is essential for an understanding of the relationship and the development of reliable, predictive models that help to adapt useful guidelines for practicing designers. Moreover, the results also provide baseline data that may be used for analysis from different perspectives in the same site.

From the methodological perspective, all information collected from this study can further be transformed into a relationship diagram of space and activity that may be

applied to the design process through a diagramming approach. Systematic approach and application not only enhance the advancement of architectural theory and practice by incorporating research methodology to the context of design process, but also contribute to the interest in vernacular design for contemporary building.

Beyond the findings from this study, it is worthwhile to adapt an approach that can be applied and developed for architectural design of similar context or conditions. This study benefits an approach to establish appropriate methods for producing a unique architecture for its particular environment, while acknowledging the idea of self-identity searching, particularly in the situation of a traditional-modern paradigm. The design of contemporary building based on vernacular design is now a critical issue in architectural design and education in many countries.

CHAPTER 2
LITERATURE REVIEW

This chapter reviews previous studies that provide background for the study of spatial organization. The review emphasizes the relation of architectural space, its patterning and domestic spatial uses. This study aims to comprehend spatial configuration through architectural evolution according to the theoretical understanding that there is a series of underlying principles governing the arrangement of spaces and the use of spaces.

Consideration of the Idea of Culture in Built Form

Rapoport states that culture has two main characteristics, one as an abstract theory and the other as a global set of ideational concepts. An approach to understanding the notion of culture is to consider a concrete component of culture, including worldviews, values, lifestyle and activity systems (Rapoport 1969). Kent agrees that culture is ambiguous and includes many aspects. She suggests that parts of culture influence architecture and the use of space (Kent 1990). Edward T. Hall sees culture as a series of activities that are interrelated in many ways (Hall 1981), while Low and Chambers (1989) argue that culture can be defined as a cognitive structure which is a set of rules that are in the mind, encoded in language, serving as a template of cultural ideas. Different cultures structure the hierarchy of values through specific design in people's minds. However, most scholars agree that culture is influenced by social factors and human relations.

Because culture is a broad and vague domain, in order to make an interpretation of culture in built form, it is necessary to limit the focal point by emphasizing one attribute over another. Although there are several ways to explore culture, it becomes more understandable when the study focuses on the interpretation of the relationship between built form and human relations. Since both attributes are considered as an expression of culture, the study of housing design is a direct way to explore cultural contexts that influence built form and its occupants.

Several studies on the topic of space and its relation to social contexts suggest that pattern in built environments is a reflection of the social and cultural order of a certain society. In order to understand the connection between architectural space and society, the investigation needs to focus on a culture-specific study. The study of domestic spatial use and its physical setting is an approach that directly addresses the impacts of social phenomena in built form. In fact, the change of social structure is a reflection of cultural change that may lead to the compromise of behavioral pattern and the transformation of spatial pattern. Meanwhile, many scholars have considered spatial pattern as an account of cultural attributes that reflects social norms.

In general, house styles and arrangements have developed across time in order to accommodate new requirements based on the change of lifestyle and attitudes. The new house style design and spatial arrangement influence physical alterations, which consequently affect the interactions among occupants and their daily routines. The way domestic space organizes in built form is the way in which people manipulate spaces, select their choices and adapt an existing design to support personal preference and their behavior. This study intends to examine how the change of spatial organization accounts

for the way it is used, particularly in the place where both traditional and popular patterns are merging.

<div align="center">Spatial Study</div>

Space has meaning (Rapoport 1982). Built form is created through a sequence of design decisions, whether made by a professional or a builder. The arrangement of space associates with a logical process because it must at least serve the functional objective (Sander 1990 and Hillier and Hanson 1984). The pattern of space in built forms is explored in order to understand the link between the design of built spaces and its cultural consequences. Many studies illustrate the complexity of built forms by interpreting the messages from the spatial structure.

In general, spatial study can be conducted in two ways, from the observation of buildings tracing back to the experience of users or builders, or from the living experience of built space followed by speculation about how spaces are created (Cuisenier 1997). Cuisenier defines the first type of spatial approach as morphological, focusing on the arrangement of spaces, and the other approach as phenomenological, referring to the actual experience of people living in that space. The recent study of vernacular architecture from a spatial viewpoint has focused on an approach to describing spatial experience and movement by its users. The analysis concerns the interpretation of architectural space from different patterns of interior circulation that are formed regarding daily life experience. In order to create a supportive built space, the arrangement of space depends on the nature of activity, users, cultural values and norms. Such a range of physical conditions is not randomly structured; therefore, spatial study from a configurational aspect relies on assumptions from both functional and social logic.

The configurational approach of spatial arrangement is based on the theoretical concept that if built space is composed of organizational units, it is because they are responding to precise living patterns. The way space is organized by its inhabitants gives a deeper understanding of experience taking into account a social system. It is therefore necessary to examine those patterns in order to understand the organizational principles underlying the built spaces.

The development of a methodological approach to exploring spatial configuration is continuously established. The publications of *Architectural Morphology* by Steadman (1983) and *The Social Logic of Space* by Hillier and Hanson (1984) have introduced the analyses of domestic space configuration through architectural morphology. It has since become a tool applied around the world in a variety of research disciplines and design applications. According to Steadman spatial study begins with the investigation of a morphological diagram that is based on the building floor plan. Shape and the arrangement of spaces provide information for an explanation of spatial relations in a systematic manner. Hillier and Hanson's approach acknowledges spatial study by developing the analysis method from configurational measurements that later are known as the *space syntax* approach. Spatial layout is used as an architectural variable to reveal social and behavioral patterns.

Spatial organization interrelates with the concept of social pattern such as gender, family structure and mode of privacy. Moreover it can identify more abstract meanings including values and belief systems. Spatial properties and their arrangements are culturally and behaviorally formulated. The study of spatial configuration is an approach that reveals the social order embedded in spatial pattern. An analysis of the house floor plans as artifacts and existing elements can identify social and cultural consequences

associated with the design of the house. Archaeologists, geographers and architects have

adopted spatial study to examine the logic of cultural attributes from the relationships

between spatial and social patterns. Several research studies have built a theoretical

understanding of spatial pattern, aiming both to establish a relationship between spatial

properties and functions and to explore design possibility and behavioral conditions.

Spatial studies by Lawrence and Boschetti reveal the different social and cultural

consequences from generation to generation. Boschetti concludes that personal values

and meanings are associated with the house spaces (Boschetti 1990), while Lawrence

concludes that the study of spatial transformation from house samples in the same

environmental setting is one way to explore cultural values and meaning with which

domestic space is endowed (Lawrence 1981). Focusing on the change through the

physical arrangement of household spaces contributes to and reinforces our

understanding of the phenomenon of how spatial pattern influences domestic activities,

social and cultural content.

<u>Space and Social Relations</u>

Many researchers have explored a specific characteristic of attributes in order to

get a more accurate explanation of culture. Hall's study provides a conceptual work on

the subject of space and social relations. He points out that every culture has its

definition of activities which vary depending on the way spaces are occupied (Hall 1981).

His cross-cultural observation on the distance between people while engaging in social

interaction, specified as *proxemics*, reveals a great variability. People's interaction

appears to interconnect with social meanings, which therefore influence spatial use and

its design. Based on the proxemics, the relation between architectural space and human

behavior has taken a psychological approach into account when conducting a built-environment and behavioral study. The design of built spaces must provide an appropriate distance for users in a particular culture. According to Hall's findings, spatial design directly influences people and their behavior. Therefore, properties of space not only describe behavioral conditions but also reflect cultural dimensions of social phenomena. From an anthropological perspective, architectural space is discussed in terms of material culture and artifacts, including cosmological and ritual beliefs. The study of the Lao house by Charpentier indicates that housing layout and settlement correspond to social structure and belief systems (Charpentier 1989). The similar results from Clement's study also suggest that the organization of space in the Lao house is structured from cultural orders such as orientation system, hierarchy of access and rules related to conceptual ideas (Clement 1982). Architectural researches have later introduced the research methodology applied in anthropological studies to spatial study in order to examine the mechanism that arranges and organizes space. By means of various theoretical approaches, some researches are specifically concerned with the relationship between built spaces and social structure. The studies of northern Indian housing by Sinha and the African house by Potash support ideas that the change of house form influences social structure, lifestyle and habit. The transition from the traditional dwelling to western style housing, which is provided by the government, has changed the mode of privacy, family structure and the role of women within the family (Potash 1985 and Sinha 1990). Both studies point out that spatial arrangement is culturally ordered and such ordering has meaning.

The use of space varies from culture to culture because each culture has different values and social norms. The spatial layout created by interior arrangement and a

partitioning system is an important factor that has control over the inhabitant's activity. It is a controlling factor that reflects social interaction between family members and the relations among domestic spaces in the household. In Boschetti's historical study of farmhouses in Kansas, the arrangement of the floor plan suggests that different patterns of interior spaces directly connect to social and personal values of house design across generations of family members. The transformation of interior space uses and their orientation involves the family's experience and corresponds to the change of technology and concurrent social impacts (Boschetti 1990). The cross-cultural study of domestic space by Kent reveals that architectural partitioning reflects some cultural aspects in terms of socio-cultural dimension. The use of walls, curtains and other partitions is based on the perceived gender, activity, function and lifestyle. These elements become important factors that predict the change occurring in spatial and social orders. A society with more political complexity tends to have the more segmented architectural spaces as well as the more complex use of space (Kent 1991). Hillier and Hanson note that socio-cultural factors influence the arrangement of building. Social orders exist and express themselves through architectural space following the same rules that govern the relations among its occupants. They suggest that to understand cultural orders it is necessary to examine how space configures in the design of spatial layout. Therefore, the examination of space by physical appearances such as shape, scale and proportion, may not be able to reveal underlying dimensions influenced by occupant's lifestyle and social norms.

Pader suggests that domestic spaces are fundamentally intertwined with the conception of ethnic identity. Her study of Mexican houses in Mexico and in the United States focuses on the use of domestic space occupied by the same ethnic group. The results indicate that the adaptation of living environments by users connects to the

relationships among the house design, domestic space use and social contents. By analyzing the socio-spatial relation of the house in both locations, it is apparent that the change of physical environment influences the social change of living pattern as well as reflects an attitude of Mexican owners which ultimately results in the alterations of their housing (Pader 1993). Domestic spaces in the Unites States appear to place an emphasis on privacy and the individual, while the Mexican spatial system emphasizes the sharing and close daily interconnection among occupants. The change of conception from familism to individualism affects the user's attitude, daily activities and the relation between guest and family member.

Another cross-cultural study of Turkish and Italian vernacular houses by Baskaya and Symes (1992) reveals the interrelationship between socio-cultural dimensions and spatial pattern. The open spaces of traditional houses in both cultures have been transformed into part of an enclosed interior space in order to satisfy the need for privacy and security as well as to accommodate the new functional need and social changes. Moreover, the differences and similarities between these cultures can be identified by studying their spatial organization. The impacts of spatial design not only physically correspond to global culture, but also reflect social conditions such as changes of religious aspects, gender relationships and family structure (Baskaya and Symes 1992). Later the study by Kirsan and Cagdas concerns a similar analysis of the change among spatial patterns, but their focus shifts to the relation between space and historical contents. They conclude that different spatial patterns show the diversity of the occupants. The arrangement of space reflects a specific group of users who played important roles during the period of construction and built a particular type of building pattern to accommodate their needs (Kirsan and Cagdas 1998). Their study supports the

idea that spatial form, process of construction and pattern of alteration are not only an indication of social changes that reflect in the house floor plans but also represent the identity of a subgroup in a particular culture.

The review of previous studies suggests that social contents associate closely with spatial organization. The study of the associations is one way to develop the understandable connection of culture, social relation and the expression of both patterns through the design and arrangement of spaces.

Architecture, Activity Systems and the Use of Space

The analysis spatial organization and the use of space has structured and developed over a number of years for both research and design. Architectural space-activity relation is associated with the disciplines of architecture and behavioral-environmental psychology and involves archaeological and anthropological research.

According to social scientists, the way space is used varies by culture. Many works related to this topic consider architectural space by applying different approaches to describe the concept and the direction of interests in their own terms. In recent studies environmental designers focused on the use of space by addressing the issue of how design is culturally responsive, while archaeologists discussed an extant interpretation of architectural space and artifacts in order to enhance an understanding of the past. In an ethnoarchaeological study architectural space and its patterning is interpreted by comparing contemporary building use with artifactual records and by interrelating the relationships among archaeological sites. Most implications and analysis methods fundamentally focus on the consideration of the relationship between spatial structure and

contextual setting as well as the meanings of these patterns (Fletcher 1977 and O'Connell, Hawkes, and Jones 1991).

Since built spaces directly influence behavior, in order to understand the interaction between people and environments, the design of spaces and user's occupancy are main factors to be concerned. Mercer supports an idea to study built spaces from their arrangements. He notes that spatial organization is an indicator of cultural background and identity. A certain type of behavior seems to occur in a certain type of space, therefore, a physical setting can identify a user's identity and social relations (Mercer 1975). According to Padar, Baskaya and Symes, spatial organization reflects and influences social structure. The study of spatial organization is recommended as an approach to identifying the conception and principle of how cultural order is constructed in house form. Despite many investigations of the relationship between culture and the use of space, Lawrence has argued that to focus only on the physical pattern of space may not be adequate for understanding how idea and meaning in specific socio-cultural context are employed. The cross-cultural study of English and Australian housing in terms of cultural meaning and the use of space indicates a significant difference for each country when considering domestic activities associated within a spatial system. Even though functional components are similar, the ways that people classify and organize spatial structure are different. The findings suggest that the organization of activities in house space, their use, and meaning are based on a complex system of social codes, rituals and controlling of roles rather than physical components (Lawrence 1981). His study shows that cultural meaning is embedded in the social and spatial dimension of built space. The relationship between space and activities is a mutual factor that provides an explanation of the properties and the use of domestic facilities. In order to develop the

understanding of the cultural context, it is important to employ the underlying

relationship between space and activities. An insightful framework that reveals the

interdependence of both attributes provides the means to discover associated solutions

from the design of domestic spaces and its diverse ways of organization.

As previously mentioned, built environment, activities and settings are

interrelated. An activity system is a form of cultural and social expression of each

society. It occurs in two types of space setting: fixed-feature elements (architectural

space and partitioning) and semi-fixed-feature elements (furniture and interior

arrangement). The organization of both elements influences activities and reflects the

meaning of socio-cultural activity. The way domestic spaces are organized and

structured has strong influences on social and functional conditions. In Rapoport's study,

the use of space is examined in terms of the relationship between architecture and

activity. He suggests that activity involves four components- activity itself, how it is

carried out, the associated activities and the meaning of activity (Rapoport 1990). Setting

is a milieu that defines a situation for occupants to act appropriately. Instead of looking

at a single activity, the relationship between activity and spatial setting must consider the

systems that are relevant to each other. Rapoport suggests that the physical elements

within space, such as walls or partitions, function as physical cues that express the

structure of spatial organization. He concludes that built form is the representation of the

use of space, which in turn is the direct expression of culture. Kent and Rapoport's

studies agree, to some extent, that to make an interpretation of cultural phenomena in

built space, the relation between design possibility of spatial arrangement and behavioral

conditions is an intrinsic tool for spatial analysis. While Hillier, Hanson and Lawrence

suggest that the investigation of a building's users reflected in the spatial layout expresses the relations among members of the household and visitors.

In order to expand the understanding of spatial organization, this study aims to establish the underlying principles within the spatial pattern and the use of space with regard to the relationship between spatial and functional properties. The impacts from the change of physical alteration among different spatial patterns, domestic activity and social order are explored. The analysis of physical pattern as reflected in the house floor plan and activity pattern as embedded in domestic experience concerns a set of systematic approaches from architectural theory utilizing the space syntax model and from cognitive research methods.

CHAPTER 3
RESEARCH SITE

Scope of Research

This investigation emphasizes the change of physical features and spatial

configuration resulting from the building's age. The study focuses on living spaces at the

domestic level in the northeast region of Thailand, a rural area, where various house

styles influenced by different groups of builder are available for investigation. The

conceptual approach is to examine spatial patterns of existing buildings and to analyze

patterns of domestic activity performed by inhabitants. The way that people use and

organize their house spaces developing through a period of time is a major feature of this

dissertation.

The study is involved with 2 sets of analyses, the physical arrangement of spaces

and domestic experience from the inhabitants' viewpoint. The first considers on the

relations among domestic spaces in which all other spaces are taken into account, and the

second deals with a group of activities that are performed in those spaces as perceived by

inhabitants. To identify the difference of spatial configuration, the analysis considers an

examination of arrangements of the house floor plan and the establishment of domestic

activity. In order to identify spatial patterns among the house samples from different

periods, 41 houses are selected by a variance of construction dates. Spatial organization

of vernacular houses that have been shaped by the results from the changes, alterations,

adaptation of lifestyle for more than a century may reveal how domestic spaces are

influenced and interpreted by occupants. Furthermore, observing the distribution of space and activities within different settings helps to identify the knowledge of how social life and cultural content have developed through the system of functional logic. The analysis includes a discussion of the findings and the suggestion of possible future studies that place the focus on different perspectives in order to obtain a completely fruitful knowledge about spatial study.

In order to achieve dissertation goals, field research was conducted at Ban Khwao village, part of Khon Kaen province, where unique characteristics of vernacular living space meet research requirements. Data of household, activities and artifacts were collected by interviews, photographs, observations and drawing using multiple sets of questionnaires.

The selection of Ban Khwao village as the main focus of the study follows these criteria:

- The area offers a representation of diverse types of house styles that have been created in different periods as the site development in occurred.

- The site must have an adequate number of both traditional and popular houses available for analysis.

- The area must present a uniform and homogeneous picture of how daily lifestyles are performed.

- Supporting data of study area must be accessible and available to the researcher.

Ban Khwao is currently mentioned by many scholars as a site that can still be referred to as one of a few in this region that has maintained examples of the best preserved traditional houses along with the changing conditions of existing environments

(Srisuro 1998 and Hengrasmee et al. 1992). Today the settlement pattern and living spaces in the village have consistently changed under a series of regional development programs. While some older houses have been destroyed, modified or rebuilt, others retain their unique styles from the past. With distinct characteristics that correspond with study purposes, Ban Khwao was selected as an area for the study.

<div align="center">Thailand Profile</div>

The kingdom of Thailand lies in the heart of Southeast Asia. It occupies an area of 514,000 square kilometers, about the size of the state of Texas, and shares borders with Myanmar (formerly the Union of Burma) to the west and north, the Laos People's Democratic Republic to the north and northeast, Cambodia to the east and Malaysia to the south. The capital of Thailand is Bangkok, a city with a population of about 7 million. Geographically, in the north there is a mountainous area, a semi-arid plateau in the northeast, a peninsula in the south and a lowland plain in the central part of the country.

Thailand has a population of about 60 million (Bureau of the Census of Population 1999). The majority are ethnic Thais and some may appear similar to Mon, Khmer, Burmese, Lao, Malay, Indian, Chinese and Vietnamese ancestors[1]. People culturally and socially share a rich ethnic diversity which has become the Thai way of life. Because of its geographical location among many Southeast Asian countries,

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[1] In Thai history there are various ethnic Thai migrated from different areas, Thai Yai from Burma, Thai Lue from Yunnan and Thai Song Dam from Vietnam (Tourism Authority of Thailand –TAT 2000). For more details on vernacular designs from diverse ethnic Thai groups- styles and living spaces including a brief background of each ethnic consults Oliver (1997).

Thailand is regarded as a cultural melting pot. Buddhism plays an important role in building and melding Thai society. With the exception of hilltribe groups, all speak the same Thai language with regional dialects.

The national religion is Thevarada Buddhism. More than 90 percent of Thais practice Buddhism. The remainder of the population adheres to Islam, Christianity and Hinduism. Buddhism has a strong influence on the Thai's daily life. Temple or Wat is not only a center of local social and religious life, but also a place for spiritual relief and molding morality. In small communities temples have served as a village hostelry, information center, a school, a hospital and a community center.

<div align="center">The Case Study</div>

Khon Kaen: The Province and Its Region

The northeast of Thailand, known in Thai as Isan, comprises nineteen provinces. Bordered on the north and east by the Mekong river and Laos and on the south by Cambodia, Isan is the largest of the country's five major topological regions. It is largely a semi-arid plateau with forested mountains in the northwest. The economy in this region is based almost entirely on agriculture. People pursue an agrarian lifestyle, which changes with the seasons according to the annual cycle of farming. Most people in Isan speak local dialects with various accents from region to region. Because the area has great interests in rural customs, and its history dates back to the prehistoric period, Isan is regarded as having a better-preserved cultural tradition than anywhere else in Thailand.

Located in the heart of Isan, Khon Kaen is the third largest province in the northeast plateau. The provincial capital is 449 kilometers northeast of Bangkok (Figure 3-1). The province covers an area of 10,886 square kilometers, parts of which contain
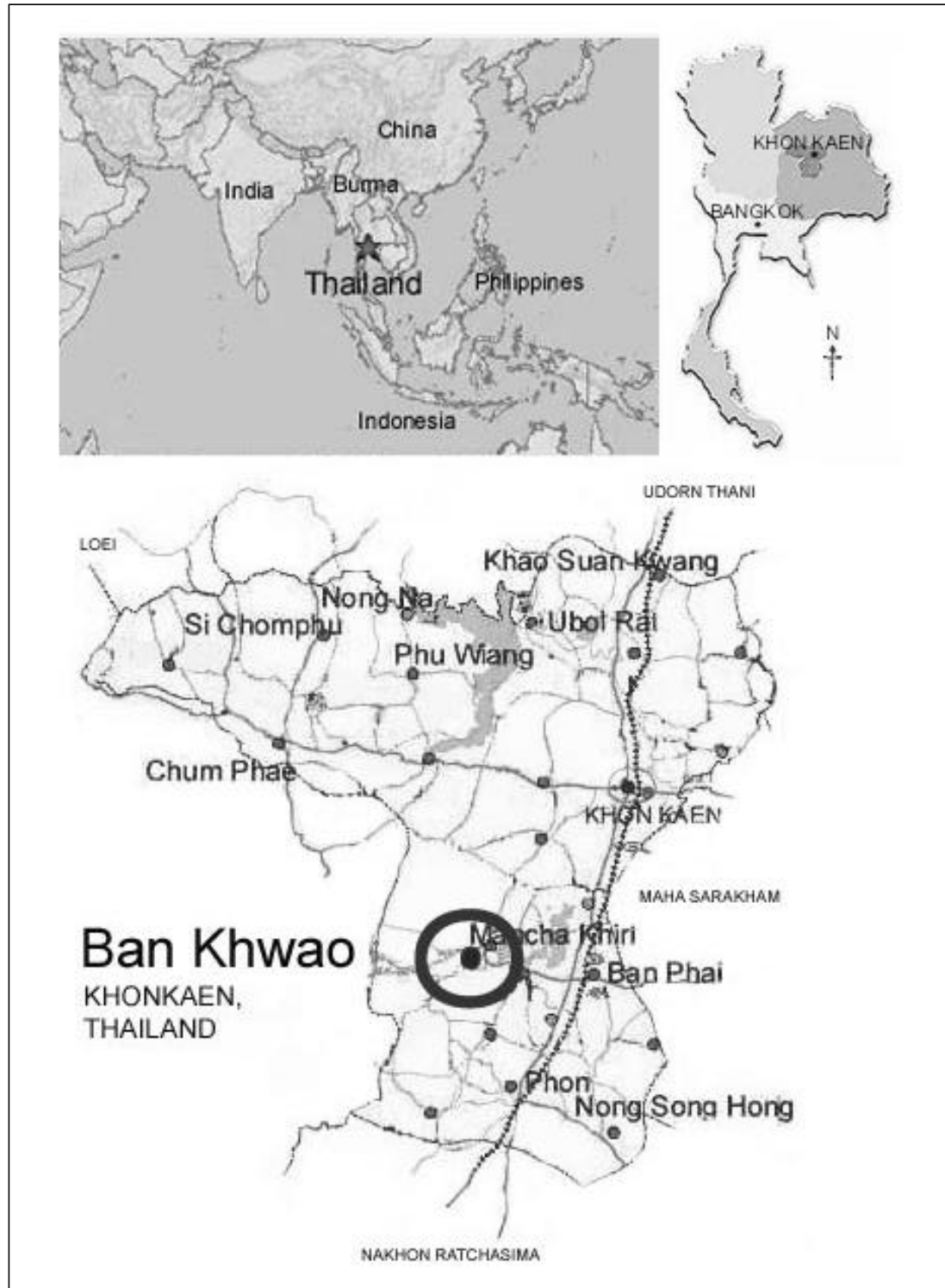
Source: Mapquest Home Page and Report of Tourism Authority of Thailand for Northeastern Region.

Figure 3-1. Map of study location.

national and forest parks. Khon Kaen was officially established in 1783. The majority of

population is Lao-Isan descendants. Various ethnic groups, indigenous Isan people and

those who migrated from neighboring countries, including Lao, Khmer and Yao, have

influenced the traditional culture of the region. Khon Kaen today, with a population of

nearly 2 million, is not only a center of commerce and government of the northeast, but

also hosts the largest university in the region, Khon Kaen University. As a major

regional development center, it has experienced one of the fastest growth rates in

Thailand until the countrywide economic crisis in 1997. However, it has continued to

develop, following the government plans as the export center for trading among Indo-

China countries. Khon Kaen has expanded economically, but most traditional crafts have

largely flourished and merged closely to preserve rural customs and lifestyles.

Ban Khwao: The Village

Ban Khwao is one of 105 villages in the Mancha Khiri district. It is located

approximately 58 kilometers southwest of Khon Kaen City and 1.5 kilometers from the

district center (Figure 3-2). The geography of Ban Khwao is mainly lowlands of the

central plain around Khon Kaen province. Most of the plain surrounds the village where

cultivated areas of orchards and rice fields are located. To the north is the district

highway which leads to Mancha Khiri's local administrative and market center and to the

southeast is the village reservoir which supplies most water for daily use.

The history of present Ban Khwao began with the arrival of the Lao immigrants.

Around 170 years ago, a group of settlers seems to have been exiled from Laos (Laos

People's Democratic Republic) to Thailand. These people settled in scattered

communities along the Mekong River. After a decade of trading around the region, the

site

Source: Department of National Development and Planning

Figure 3-2. The location of Mancha Khiri district and Ban Khwao village.

Source: The Military Department of Thai Army for the Interior Defense:
Division of Aerial Map Collection

Figure 3-3. Part of Ban Khwao from aerial photograph in 1976 shows a new grid
expansion and a spontaneous housing layout of older neighborhoods within the grid
block.

was selected by the first group of inhabitants to begin the settlement. A village has been established since 1849[2]. Before the program of national plans for economic and social development occurred in 1958 very little information had been documented about the site and its inhabitants. However, records of early explorers show that the discovery of this site began because it was situated on the trading route to and from Mekong settlements. In 1939 the first unpaved road was planned and used as a means for transporting people and merchandise. Since there was the development of a main access road joining the village to the nearby district center in 1940, easy access has brought new house types and social groups into the area.

Chinese and Vietnamese immigrants have always been an integral part of the history of the northeast region. Chinese from the central region and urban center have expanded shopping and trading activities in rural areas. Followed by the Chinese, Vietnamese migrated across the Mekong River leaving their home country during the period of French colonial rule. Both ethnic groups have played a major role in the development of national industry and commerce. In accordance with their economic orientation, their houses are mainly urban and located in the center of the settlement. From 1939 to 1969 the development of shop houses, adopted from Chinese culture, has largely become a part of village settlement and appears to blend with the local way of living. Since new living patterns have been introduced to the traditional lifestyle, they have had a great influence on the present architectural configuration of Thai form and spaces.

After the first national plan for economic and social development launched in 1978, most regions have continued to be developed in a similar pattern, emphasizing a

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[2] Information acquires from private interview with Mr. Guyn Pongsa, held at his home, June 16 1998.

technology-based and convenience-oriented community. The expansion of infrastructure to the northeast regions began to impact existing patterns of most village settlements. The scale of the community has been developed aiming for an adequate accessibility to nearby urban centers. Now that convenient transportation connects most parts of the country, new construction technology and materials have been introduced and used along with the traditional methods. Road construction and supply of electricity are often exogenous forces that result in the loss of vernacular houses (Eiam-Anan 1997: 294). During the past few decades, the area has changed significantly under the rapid growth policy encouraged by national development plans.

Ban Khwao today has convenient access to nearby districts. With various choices of local transportation: riding buffaloes, bicycles, carts, motorcycles or bus, people can reach the district center in only minutes. The village population is about 523. Around 95 percent of its population work in agriculture-based activities, while the rest work as employees in nearby towns or own craft shops and light industries, including cotton and silk weaving and cupboard making. Similar to people in Khon Kaen and other provinces in the northeast, Ban Khwao has diverse ethnicity with Isan descendants in the population. The majorities are the Lao-Isan and Lao. There are very few Chinese and Vietnamese living in the village. People mainly speak in the Isan dialect; however, the official language for communication is in what is termed the central Thai format.

Ban Khwao is divided into 2 sections. There are 225 households in 2 subdivisions with neighborhoods in each. Streets in the older neighborhoods are narrow, unpaved, and have a spontaneous layout, whereas the new expansions are structured in a grid pattern (Figure 3-3). The main street, where most local businesses and shop houses

are located, runs through the village center and directly links to the regional highway in

the north (Figure 3-4).

(a)

(b)

Figure 3-4 Overview of the village environments.
a) Along the main concrete paved street; b) Two house types from different period of
construction are juxtaposed to each other.

CHAPTER 4
RESEARCH DESIGN AND METHODOLOGY

As the research objectives indicate, this study aims to investigate the difference of

spatial configuration among vernacular houses built during various periods of

construction. Since the house floor plan is a key variable, most of the information about

the arrangement of physical conditions and the use of space relies was obtained from the

field research. There are several techniques used to obtain data concerning basic

information about a building, its inhabitants and domestic routines. This chapter presents

the research strategy used for this investigation, including a brief description of

procedures carried out during the field survey.

Study Area

In order to carry out the investigation it was necessary to locate an area which

would be experiencing development and yet still have enough traditional houses left to

provide needed design information. To study the continuity and change as design moved

from traditional to popular, there had to be a variety of patterns of spatial configurations

from different house styles. In order to obtain several house types as representative

samples, the selected area had to be physically under development and get an adequate

number of houses with different construction dates. Initial selections of study areas that

met the criteria were recommended by scholars involved in previous research on the

northeastern house in Thailand. After a visual survey of potential sites, Ban Khwao in

Khon Kaen province was selected as the area to study because quantity and variety of

village houses met requirements for the research established prior to collecting data.

Sampling Procedure

The study focuses on all the existing houses that were available during the field

research. In order to control variations of potential exaggeration among the samples,

only the houses that were inhabited as residential or residential-commercial occupancies

were selected from the population of households in the village. The main purpose of

sampling is to obtain a wide range of house types from different periods of construction.

Systematic random sampling[1] was conducted as a procedure to provide the best

representative households. Regardless of the physical appearance, all houses in the

village were placed in order according to construction dates, from the oldest to the newest

or the most recently built. The first house was selected to start the sampling, and then

every 5th house was chosen from the chronological list of houses in the sampling frame.

Forty-two houses were selected initially but one was dropped because the house was

demolished during the process of data collection. The final investigation of 41

households includes on-site observation and personal interviews (Figure 4-1).

Data Collection

Field Survey

Most information in this study was acquired through various types of household

data from field research. Different techniques for gathering data were used ranging from

direct documentation, socio-demographic information and observation of daily routines.

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[1] See Bernard (1995) for more details under the field condition.
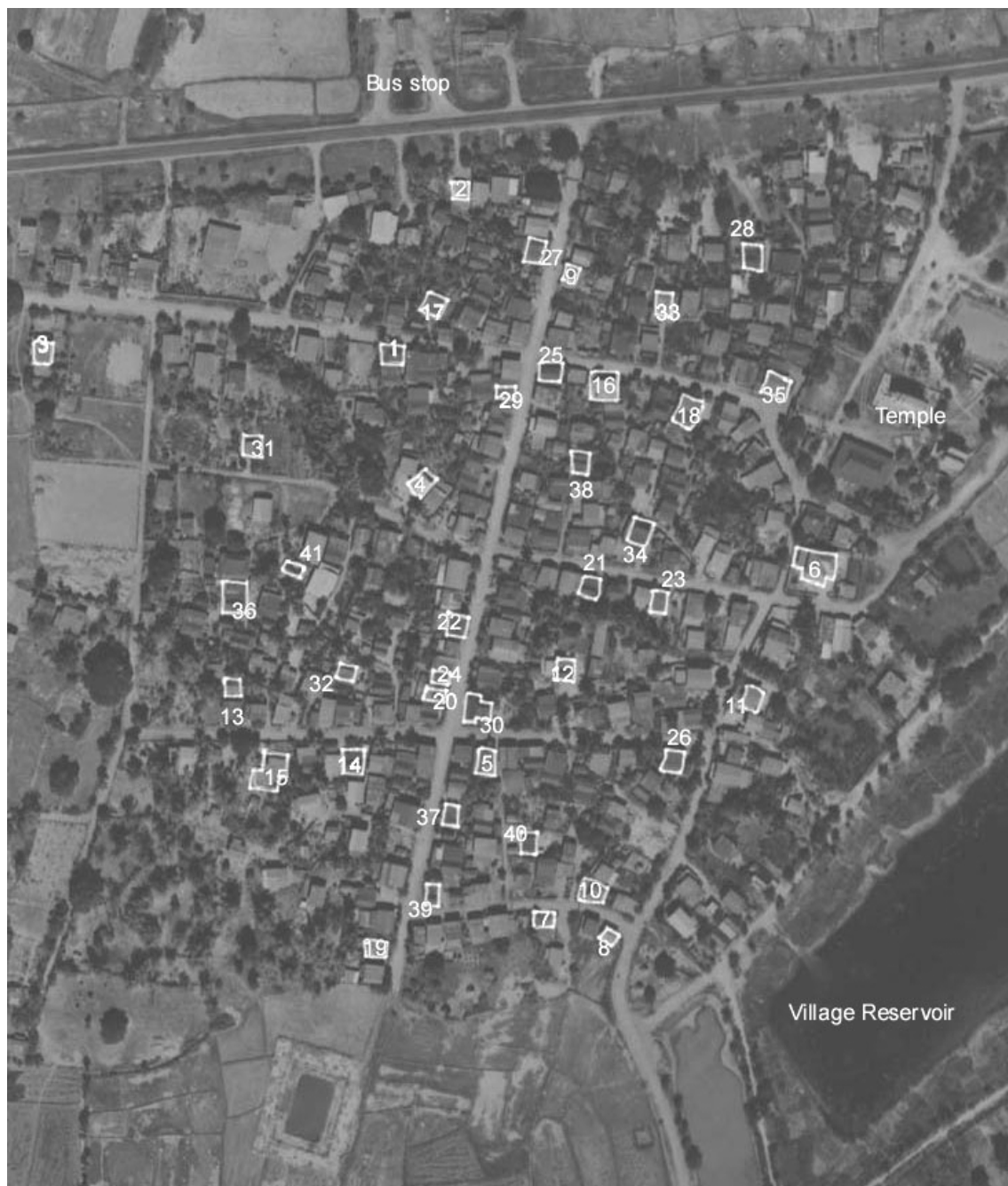
Source: Based map acquired from The Military Department of Thai Army for the Interior Defense: Division of Aerial Map Collection.

Figure 4-1. Aerial map of Ban Khwao showing the location of house samples.

The graphic data of physical features were acquired from the measurement and drawing of architectural floor plans, while socio-demographic data basically came from the interviews with household members. In addition to interviewing, observation during the house visit provided information on the use of domestic space and daily activities.

Survey team and field research administration

The survey team was composed of six members including the researcher. The members were recruited from the Faculty of Architecture, Khon Kaen University who were students and the researcher's colleagues, and consequently, were very familiar with the area of study. The team members were trained intensively and clearly instructed on the process of data collection prior to the field survey. In order to establish similar responses with questionnaires and to follow the instructions as given, the team members practiced with the researcher several times before visiting the respondents. Team members were divided into three groups. Each group contained an interviewer and an assistant. The interviewer asked respondents the questions in the questionnaires and wrote down the responses. During the interview in progress the assistant sketched the house floor plans and furniture arrangement in each room. After the interview was completed, both members measured the house plan and discussed the interview to correct any mistakes or supply missing answers.

The researcher assigned the house locations or addresses to the team members before they performed the tasks. After the survey was completed, team members turned in the completed questionnaires to the researcher, who then checked for any errors and misunderstanding of the questions. The survey team met and discussed any discrepancies at the end of the survey day.

Interviewing process

Two types of interviewing procedures were used in the process of data gathering: semi-structured and structured. The selection of the interview procedure depended on its potential and limitations. At the early stage of field research, the semi-structured interview was to collect overall information about daily routines of the village residents as well as a brief background of the house population. Subsequently, the structured interview was carried out to focus on details of the selected house samples. Household information on the use of domestic spaces and daily activities was provided by the household members. The respondents were asked to identify activities usually performed in a specific location in the house spaces.

The interviewing process was conducted in the home of selected households and carried out according to the instructions provided in the questionnaires. The survey team visited respondents at home and asked for permission to do the interview. If the team members met more than one person in the same household, the interviewer chose to interview a family member who had the most information about the building and its history. The interviews were conducted at different times of the day, from early morning to late evening, in order to include a variety of respondents. Every selected household was visited at least two times within a period of sixteen months. The interviewer asked the respondents questions and then wrote down the responses on the space provided in the questionnaires. The interview normally lasted about 30 to 45 minutes but the observation took a longer amount of time.

On-site observation

Since existing graphic resources were not available, most floor plans of the

houses were sketched and measured during the visit. The survey team recorded the

location of both architectural features and temporary partitions created by furniture

arrangement in each space, including leftover artifacts which might hold clues as to

where domestic activities were taking places. An annotated plan[2] (Zeisel 1981) was used

to describe the physical traces in words and a diagram in order to understand details in

the floor plan sketches. The interviewer also used the table of space-activity checklist

(see Appendix B) from part of the questionnaire to record how people occupied spaces.

Where it was possible, photographs of physical traces were taken to record the position of

furniture and the possible use of spaces. Photographs provide an intensive observation of

the inhabitant's activity in the house settings (Collier 1989).

Archival Research

In this study primary sources of information about the research site were obtained

from the municipal records and the annual report of provincial development plans

prepared by governmental institutions. Aerial photographs provided by The Military

Department of Thai Army for the Interior Defense, Division of Aerial Maps Collection in

Bangkok, were used as a reference for field research. An overall view of the research site

was obtained from topographical maps supplied by the Department of National

Development and Planning. In addition to archival research data, municipal officials and

Ban Khwao's villagers were interviewed for inquiries about the history and background

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[2] The annotated plan is a technique for presenting behavior information together with design drawings, written in words for an easy understanding of the relation between the planned environment and behavior. See Zeisel (1981: 42).

of the study area. Some of the socio-cultural information about Thailand was acquired from The Tourism Authority of Thailand documents.

After information from the techniques mentioned above was gathered, two groups of data were organized by the researcher, graphic information from house floor plans and responses from the interview questionnaires. There were two statistical packages used as tools for the analysis of data; otherwise, the responses were tabulated manually.

Questionnaire Design

The purpose of the questionnaires was to obtain data from various types of graphic documentation, the socio-demographic characteristics of the respondents and household information, including the use of domestic spaces and building backgrounds. Four different sets of questionnaires were used for data gathering. In this study questionnaires were designed to generate patterns for the investigation rather than to test the significance of the variables. A primary set of questionnaires was modified from questions previously developed in similar research studies.

Pilot study

At the early stage of field research, a pilot study was conducted to test the research plan and to get feedback from respondents regarding their understanding of the study. Five houses were selected for an overview observation of domestic activities and the design of spatial layouts. After interviewing the respondents, it appeared that there were a number of activities performed in outdoor spaces while others were carried out at the outside boundary of households. Women were house-caretakers during daytime. Therefore timing to conduct research would influence the information given by respondents. Additional observations obtained in interviews, the length and the

conclusiveness of the questionnaires were dominant factors during the discussion with respondents. In accordance with the sample respondent's comments, critiques and suggestions, the questions were revised for a final set of questionnaires. The questionnaires were written in Thai so as to communicate with the Thai respondents. However they were later translated to English for documentation of the research.

Since there were no records on the date of construction and the daily routine of inhabitants, it was necessary to rely on the respondent's interview for information. In the first questionnaire, a semi-structured interviewing was conducted in most households. A list of questions about vernacular houses and the occupant's daily activities was used as a guideline for discussion topics. Additional information about the background of the study area was noted. Data from the first questionnaire were used as information in order to specify a representative sample among the house population. The data were also used as guidelines to develop research instruments for the structured interviews and detailed observations.

Space-use grouping

In the preliminary trial of the questionnaire, researcher found that there were a large number of daily activities performed by household members. In order to obtain practical information for further field research and data analysis, domestic activities were classified following modified principles from the review of previous studies[3]. After the first questionnaire was conducted, fifty activities found in the household routine were grouped into nine primary functions of space-activity patterns in the following categories:

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[3] See Lawrence (1981), Amorim (1997) and Monteiro (1997) for more details about activity grouping.

1. Under floor space (UDF)

- Receiving guests and neighbors

- Daytime activities: caring for children, relaxing, making handicrafts

- Buying and selling goods

- Vehicle parking

2. House yard and outdoor space (YRD)

- Household gardening and planting

- Domestic animal keeping

- Agricultural-related activities

3. Verandah[4] (VD)

- Receiving guests

- Family living area

- Working and relaxing

4. Household service space (HSV)

- Laundering: washing, ironing, drying and folding clothes

- Storing

- Dishes washing

5. Food preparation (KIT)

- Cooking

6. Eating space (E)

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[4] Verandah is space with a roof along on outside wall of the house. Its size and location in the floor plan may vary but in general it locates next to an enclosed sleeping area. Verandah is one of the dominant elements of most of traditional houses in Thailand because the design appropriately responds with the tradition of Thai lifestyle and beliefs. Traditional houses contain a large area of verandah for various activities during daytime.

7. Toilet and bathing space (WC)

8. Multiple use area[5] (MU)

- Praying

- Studying

- Evening relaxing and watching television

9. Sleeping space (SLP)

- Sleeping

- Dressing

Space-activity grouping was done prior to the field research in order to avoid

some confusion in applying a primary function of activities found during the interview

and on-site observation. Some activities occurred in more than one space; therefore, the

same room may break into several convex spaces because of the overlapping of different

activities. Along with a set of questions, the sketch floor plan provides a description for

specific use of space (see Appendix D).

The second questionnaire was designed to obtain in-depth information on the

selected houses. The interviewer who administered the questionnaire asked the

respondents to identify the location and types of activities that they usually perform in the

household. A set of questions provided basic information about socio-demographic

status, domestic activities, primary use of house spaces as well as the history of the house

and its additions and renovations. A table of activities and primary spaces was prepared

as a checklist for both features in each household in order to locate specifically where the

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[5] Multiple use area is an enclosed space for family living and some household services. In most traditional
houses it serves only family members and uses as a place where both genders meet.

activities are performed. In addition to the questions, floor plans of each house were sketched and measured during the visit. Furniture arrangement and description of individual space uses were recorded.

The purpose of the third and fourth questionnaires was to obtain the occupant's responses on the primary function of domestic spaces. The main objective was to understand what the occupants think about those spaces and how they organize the patterns according to their views. Both questionnaires were developed from data gathering techniques derived from research in cognitive anthropology. The third questionnaire applied the triads[6] test technique, aiming to find the similarities among spaces. Nine primary spaces were randomly arranged into a group of three spaces for each triadic question. Each question asked respondents to choose one space that did not fit with the other two. The answers for all triadic questions identified which spaces in the household were more similar to each other than to others depending on the respondents' viewpoints. The fourth questionnaire specifically asked the same group of respondents to rate the degree to which household space must be located in the house. Each question contained a 5-point scale of front-back location for rating nine primary spaces: one is located to the back of the house and five is in the front.

The questionnaires were pre-tested on 5 colleagues of the researcher. Two of them were asked to examine the wording of the questions, while three reviewed the format of the instrument. The final questionnaires (Appendix B) were revised to incorporate comments and suggestions obtained from the pretest.

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[6] A triad questionnaire consists of a series of triples of items. For each triad or question, the respondent is asked to indicate which pair of items is most similar, or alternatively, which one item is the most different (Borgatti 1996: 13).

Method of Analysis

The study involves the methodology of two major procedures. The first

procedure aims to investigate the difference of spatial configuration among vernacular

houses across time, from the traditional to popular design. Traditional houses may have

been altered over time, while the new design of popular houses may indicate the different

types of spatial arrangements. The change of physical characteristics influences spatial

configuration and the use of domestic spaces. It is hypothesized that the houses built

from various periods are not only physically dissimilar but their spatial arrangements are

also different. Syntactic data from the space syntax model were applied as an effective

tool to study underlying patterns of the physical changes.

The second procedure concerns the pattern of domestic activities as perceived

through the inhabitant's experience. The investigation is based on cognitive research

methods. The analysis intends to discover the embedded relationship among household

spaces, which ultimately reveals a general tendency of space use among the vernacular

houses in the study area.

Space Syntax Methodology

Space syntax[7] was originally developed by Bill Hillier, Julienne Hanson and their

colleagues at The Bartlett School of Architecture, University College of London. This

technique is applied to the study of building and settlements in many disciplines. The

development of space syntax provides a new approach for the study of intellectual

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[7] Space syntax is a set of techniques for representation, quantification and interpretation of spatial configuration in building and settlements (Hillier, Hanson, and Graham 1987: 363). It has been used to treat spatial configuration as a variable in a variety of studies of the social functions, cultural significance and behavioral implications of layout (Peponis 2000: 1).

conceptions that underlie the creation of built forms. This idea is based on function and meaning in architecture and urban forms that seem to be a significant aspect of cultural and identity. Living spaces of houses across the world may serve similar purposes based on their functions, but it is possible that spatial arrangements are different (Oliver 1987). The arrangement of physical conditions combines to create supportive built spaces. The design of the spatial layout depends on the nature of the activity, users, cultural values and norms. This empirical finding identifies social patterns that are intimately linked to spatial parameters. Therefore, by analyzing spatial patterns one can answer the questions of how social and cultural content are embedded in spatial patterns as well as how built spaces shape social relations. Space-social relation is described by Hillier and Hanson in terms of the social logic of space. The way spaces organize social interaction, among inhabitants-visitors, male-female, family members and so forth, can be interpreted in many ways from an abstract to a systematic approach (Hillier and Hanson 1984). The analysis of spatial configuration is a systematic approach to understanding the relation between space and society.

In this study the applications from space syntax were used as a tool for the analysis of spatial configuration. An examination of the change in vernacular houses was based on syntactic properties that resulted from the relation among spaces in the household system.

Conceptual Approach of Space Syntax

Spatial layout has two kinds of property: intrinsic properties, such as shape, scale and proportion, and extrinsic properties, the relation of one space to other spaces and overall location in a layout (Wineman 1998). Intrinsic properties are perceived directly,

while extrinsic properties are perceived indirectly by the experience of moving through a design layout in a structure. The arrangement of each space is critically affected by its position and accessibility to other spaces. Space syntax fundamentally aims to reflect the functional logic of spatial system through configurational measures. According to Hillier and Hanson, the organization of space is arranged in response to precise living patterns for a specific society. In order to understand the organizational principles underlying built spaces it is necessary to analyze spatial structure, which in turn reflects social rational through spatial design.

Architectural language is an analogous to linguistics on dealing with two directions: syntax and semantics. Ferguson (1996) suggested that the syntax of architectural forms and arrangements can be read like text, and their contexts have meanings. The underlying message defined as a non-verbal communication from space is interpreted in terms of its characteristics. The basic theoretical concept of space syntax is space has a social logic, and the interpretation of spatial organization can reveal social messages (Veregge 1996).

Space syntax is used to describe the pattern of architectural space by embodying the variation that exists in spatial morphology: the closed /open pattern, hierarchical /non-hierarchical organization, and dispersed /aggregated forms. Each space is formed by architectural partitioning and interior elements. These features not only define the different functions and internal accessibility, but also identify the interface both between the inhabitants of the house and between the inhabitants and visitors. By using spatial separation to define a controlling system of social categories, a building's inhabitants are related to their neighbors both spatially and conceptually. Space and social contents are

both conceptualized languages from a set of entities ordered into different arrangements referred to as syntax. The physical features of architecture are conveyed through diagrams or patterns representing the inhabitants' interaction with spaces.

Syntactic Analysis of Spatial Configuration

Space syntax emphasizes the interpretation of spatial configuration, which is the primary principle in the analysis of the internal structure of a building. Spatial configuration is defined as the relations between two or more spaces that take into account all other spaces in the system (Hillier 1987: 363). The configurational analysis is based on architectural morphology which concerns every space and its accessibility.

There are two key elements of spatial layout, convex space[8] and its access. Convex space is a single space which corresponds to the experience of people in space, while access is a successful movement from one space to the other by its occupants. Both elements indicate the inhabitant's movement and interaction. The analysis of spatial configuration deals directly with building layout. Floor plans are transformed into morphological diagram in order to illustrate the relations among spaces. Every interior of cell or its subdivision is conceptualized as a point, and a line is a link from one cell to the other which represents the accessibility of each cell. Every space in the building is assigned a depth value according to the minimum number of movements that must be taken to get from one space into another space. A root space or original space is selected to represent the depth level of spaces in the system. All spaces and their accessibility in

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[8] The early analysis of space syntax uses partitions as divided factors to analyze the individual space. In recent studies, researchers have discovered that not only partitions influence the accessibility of each space but furniture arrangement also affects domestic activities in the household. It is possible that within the same room two types of activities are performed simultaneously or occur in different periods of time.

(a)

(b)

(c)

ext
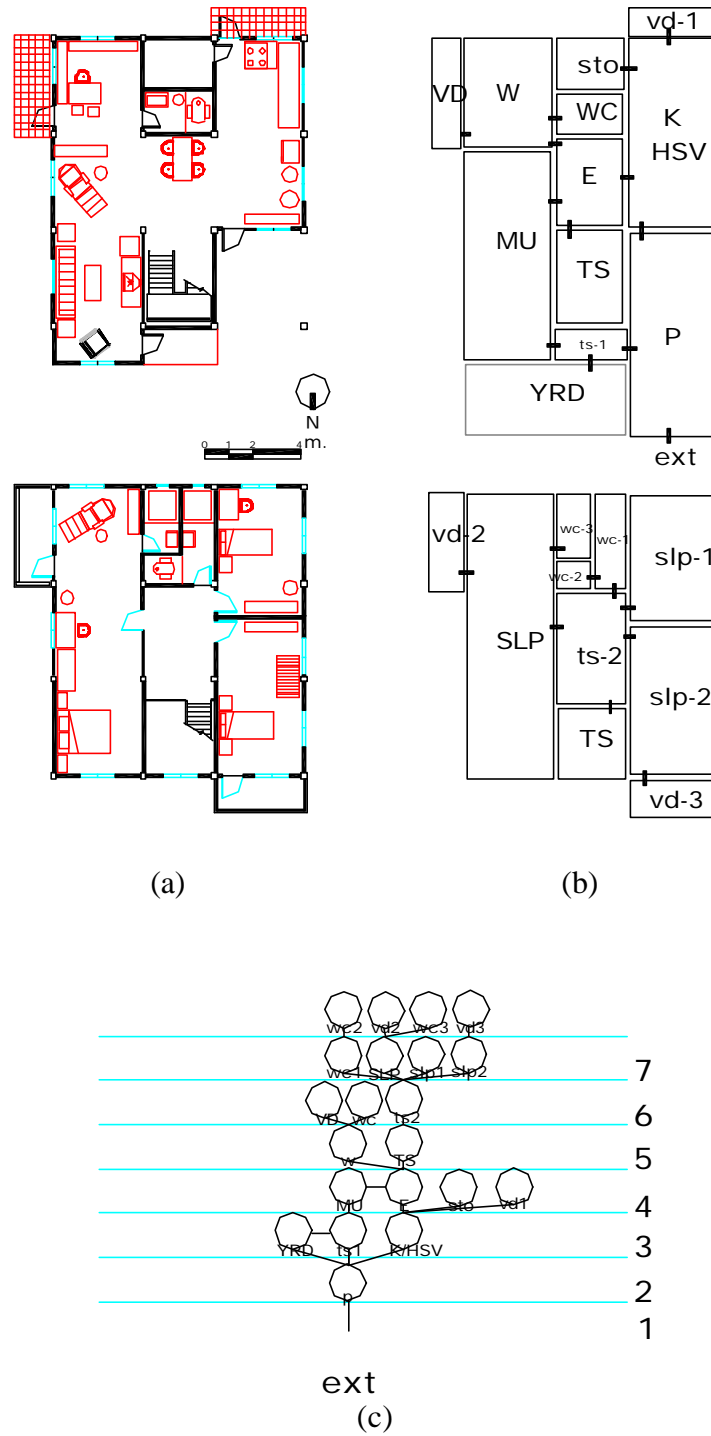
Figure 4-2. Illustration of the transformation from house floor plans to diagram of
architectural morphology.
a) House floor plan; b) Convex spaces; c) Accessibility diagram
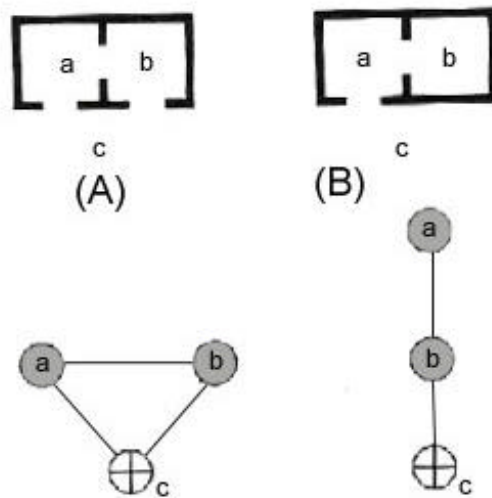
Source: Julienne Hanson, Decoding homes and houses
(Cambridge: Cambridge University Press, 1998 : 23).

Note: a, b = cell or convex space
c = root space

Figure 4-3. Conceptual approach for configurational relationship in an accessibility diagram.

the system are represented by circles and lines, respectively. All spaces at the same depth level are arranged horizontally (Figure 4-2).

Depth and accessibility from one space to another are basic properties for a calculation of syntactic values. In this study, the analysis of configuration applies two syntactic values provided by mathematical formulas, integration value and depth level, for the interpretation of spatial configuration.

Figure 4-3 illustrates the relation between internal space *a* and *b* and exterior space *c*. The gaps in floor plans represent access, allowing movement from one space to the other spaces. Figure 4-3 shows the different morphological diagrams even though their floor plans appear in similar spatial layouts. The relations among all spaces in the

system are a fundamental concept of space configuration. From this principle, by

providing empirically observable models, spatial configuration can be analyzed.

Figure 4-3 shows that an accessibility diagram graphically illustrates the types of

space. Depth and ring from the diagram indicate the configurational property of the

whole system. Depth is defined as the step or change of movement from one space to

any other space, whereas ring indicates the property of choice or alternative route to

move from one space to others. In an accessibility diagram, all spaces in the system are

represented by circles and the access between spaces is indicated by lines. A particular

space, which normally is an exterior space, will be selected as a root space and all other

spaces will be applied for the depth level from root space. Therefore the level of root is

defined as zero, while the depth level of each space in the diagram corresponds to the

steps taken to move from the root to that particular space. Figure 4-3 (A) and (B) are

accessibility diagrams that have *c* as the root space. Hence, in Figure 4-3 (A), *a* and *b* are

at level 1 since they can be directly accessed from space *c*. On the other hand, Figure 4-3

(B) shows that *b* is at level 1, while *a* is at depth level 2 since to move from *c* to *a*, it is

necessary to pass through *b*.

Depth is used to determine integration. The measure of mean depth (MD)[9] takes

into account the depth of all other spaces in the system. The transformation of MD by

measuring the relative depth of a particular space to all other spaces is defined as Relative

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[9] Depth level is designated by an access from building entrance to all other spaces in the accessibility
diagram. The value indicates structural property of space such as the flexibility and control of user's
movement. The mean depth can be calculated by

$$MD = \sum_i^n ni*di \, / \, k\text{-}1$$

When *n* is the number of spaces in the level *i*, *d* is the depth of the level, *i* and *k* is a total number
of spaces in the system

Asymmetry (RA)[10]. RA is the measure of spatial integration. If the analysis compares

systems that have a different number of spaces, the RA value must be adjusted in order to

control the effect of sizes. Hence, RA is transformed to Real Relative Asymmetry

(RRA)[11]. Integration values can be calculated from the reverse value of RRA or 1/RRA.

Integration zero is a maximum integration or no depth. The higher integration values

indicate the relatively deeper level of a particular space among all spaces (Figure 4-4).

The integration value of space measures how deep a space is from all other spaces within

the house. The deeper the space is, the less accessible it is and thus, the more isolated it

is with regard to other spaces within the house. The shallower the space is, the more

accessible it will be and thus, the more integrated it is, with regard to other spaces. The

numbers of integration values describe the location of the position of a space relative to

other spaces. In other words, it describes spatially-determined opportunities for social

encounters among residents and between residents and visitors. For example, Table 4-1

illustrates the syntactic values of external and transitional space. External space shows a

higher RRA value than transitional space or it means that external space has a lower

integration value, compared with transitional space. Therefore, occupants of H-03 are

likely to encounter each other and interact in transitional space rather than in external

space.

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[10] RA determines integration values. It is a relative depth of particular space to other spaces. RA indicates how deep or shallow the system is from a particular point. RA value is calculated by the following formula:

$$RA = 2 (MD-1) / (k-2)$$
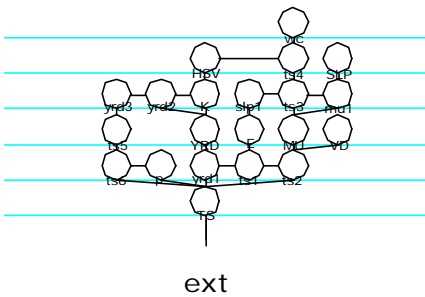
When *MD* is mean depth and *k* is the total number of spaces in the system. Relative asymmetry (RA) is the measurement of spatial integration.

[11] RRA is calculated by:

$$RRA = RA / Dk$$

When *Dk* is the D- value for *k* spaces.

Table 4-1. Example of the calculation of syntactic data from the accessibility diagram of
the house number H-03.

House Number: H-03	From	To Depth Level	Space Label	Sum of Depth
Number of Space (k) = 22	External	1	TS	1x1 = 1
Dk value for 22 spaces = 0.47		2	ts6, p, yrd1, ts2	2x4 = 8
MD = Sum/ (k-1)		3	ts5, YRD, ts1, MU, VD	3x5 = 15
RA = 2 (MD-1)/ (k-2)		4	yrd3, yrd2, K, E, ts3, mu1	4x6 = 24
RRA = RA/ Dk		5	HSV, ts4,slp1, SLP	5x4 = 20
		6	WC	6x1 = 6
			Sum	74
			Mean Depth	3.52
			RA	0.252
			RRA	0.533
	TS	1	EXT, ts6, p, yrd1, ts2	1x5 = 5
		2	Ts5, YRD, ts1, MU, VD	2x5 = 10
		3	Yrd3, yrd2, K, E, ts3, mu1	3x6 = 18
		4	Slp1, HSV, ts4, SLP	4x4 = 16
		5	WC	5x1 = 5
			Sum	54
			Mean Depth	2.57
			RA	0.157
			RRA	0.328

An accessibility diagram shows a visual difference, while the integration value of

each space numerically expresses a key characteristic of how space is embedded in the

system. The interpretation of configurational repetition from syntactic values expresses

cultural and social relations. As Hillier and Hanson describe,

> … different functions or activities in a dwelling are usually assigned to
> space which integrate the complex to differing degrees … If these
> numerical differences in functions are in a consistent order across a
> sample, then we can say that a cultural pattern exists, one which can be
> detected in things, rather than just in the way it is interpreted by minds
> (1984: 364).

Each space in each system has a different integration value. A mean integration
suggests a crucial difference among house spaces. Consequently, the order of the
integration value of different spaces is used to examine a certain pattern of function in the
selected samples. Different functions are systematically assigned to spaces, and
integrated with the house samples in different degrees. Where these numerical
differences are in a consistent order across the sample of the plan from a specified social
group, then a cultural pattern appears to exist. This type of consistency is a *genotype* of a
housing sample (Hanson 1994: 32). The measurement of some relevant dimensions from
the accessibility diagram, such as relative depth of spaces and the degree of integration/
segregation, is a possible way to classify type of spatial configuration. The results from
syntactic values will help to make statements about space and its relation according to
social and cultural contexts.

Previous Research Applied Space Syntax as Analysis Methodology

The space syntax technique has been used in fields as diverse as archaeology,
urban and human geography and anthropology. In architectural research, many scholars
apply space syntax to describe the use of space and meaning in built forms and human
settlements. In architecture, the analysis of configurational properties from a syntactic
approach supports spatial study to describe architectural space and its evolution in a
different way. The early approaches of space syntax address the issues of social structure
and cultural order in built spaces. In recent studies, researchers have searched for

characteristics of space that define the inherent meanings and domestic experience. The following are only a few selections of case studies that applied space syntax to the exploration of spatial properties embedded in built spaces.

In their study of Normandy vernacular farmhouses in France, Hillier and his colleagues applied syntactic values from space syntax methodology to investigate the underlying pattern regarding spatial-functional tendencies. They separated the house samples into two different groups, which corresponded to integration values. One group has living and communal space as a house center and the other has transitional space or hall space (Hillier, Hanson, and Graham 1987). The rank of integration from all spaces among the samples suggests that the two types of spatial configuration indicate different lifestyles and social relations, including gender role and family structure. The former pattern that organizes around the dominant function of the house, communal space, suggests a female-centered structure, while the latter associates with a male view. In this study, applications of space syntax provide access to significant information about social patterns that assist researchers in speculating on the contents of cultural ideas from the remains of archaeological records.

Kirsan and Cagdas (1998) investigated 19th century row houses in order to reveal the transformation of houses' layouts during the western movement in Istanbul, Turkey. They used both syntactic values and morphological diagrams to distinguish patterns among the spatial structures of the row houses. The different arrangements of layout and spatial pattern show a strong relationship between the development of floor plan and style of row houses in Istanbul history. Different morphologies of spatial structure reflect different influences from the varied occupants. The use of the diagram from an

abstraction of the floor plan represents social characteristics, which are readable from morphological examination. From the analysis of spatial pattern, it was found that some particular properties reflect the unique characteristics of a specific group of users, builders, ethnicity and land ownership (Kirsan and Cagdas 1998). This study distinguishes the identity of sub-groups in the same culture through the analysis of diagram and the interpretation of syntactic data.

The study of spatial types by Orhun applied space syntax to categorize genotypes in traditional Turkish houses. The main purpose was to identify the spatial characteristic of individual space by household activities. After the analysis of integration values among the main functions of the sample, two spatial genotypes were identified: one has the *sofa* or transitional space as the most integrated space, and the other is centered on the external courtyard. Two types of space support different living patterns for various groups of occupants and distinctively indicate the way of receiving a guest into the house. To this extent, the results reflect the openness of Turkish society to outside influence. The houses created during the period of western acculturation indicate a spatial configuration different from that of the traditional ones. The attitude of occupants is also suggested by the house pattern. The deep and shallow integration cores reflect centripetal and centrifugal social forces (Orhun, Hillier, and Hanson 1995).

Hanson (1994) studied four houses designed by architects Mario Botta, Richard Meier, John Hejduk and Adolf Loos. The study compared morphological properties of the house and revealed the relations between the basic composition of design and the configuration of domestic space. The results show that morphological properties of the houses are different even though they have similar simple cubic forms and a comparable

number of domestic spaces. Botta's design is shallow but tree-like; Meier's is shallow and ringy. Hejduk's house is deep and tree-like, while Loos's is deep and ringy (Hanson 1994). The integration values indicate the different design of functional organization. Syntactic data show that the house design is configured from different lifestyles and socially shaped by the experience of space for different occupants. Social interfaces between men and women, young and old, hosts and guests, owner and servants, are structured through the design of spatial layout. Four architects designed houses with a similar set of spaces, but the configuration of spatial design is different in each house. Architects may choose different design criteria for form-making to create the design following their own styles and approaches to decision making for the functional categorization of each space.

Luiz Amorim (1997) explored different approaches of spatial characteristics. The investigation focused on how the functional-oriented approach of the modern movement was established in architectural design. It was hypothesized that design and process should be based on concepts including the form of spatial systems. Functional characteristics of spaces among 140 modern houses in Recife were examined. Amorim divided household functions into four sectors; social, services, private and mediator or transitional sector. Groups of activities performed in the house were considered as basic elements to reveal how the spatial system is hierarchically structured.

The results from depth analysis indicate consistent pattern; social and service sectors are the shallowest functional sectors in every diagram, while the private sector is the deepest one. The mediator sector lies between either the social and private sector or service and private sector. It acts as transitional space that controls access between

sectors. The integration clearly suggests that the highly integrated groups are social and service sectors, whereas the highly segregated group is in the private sector. From integration values, genotypes of spatial pattern among the samples show that service and social sectors can interchange with each other. On the other hand, the private sector is the only function that is isolated. The results confirm that only some patterns found among a vast number of possible arrangements in floor plan are constantly reproduced (Amorim 1997). In conclusion, Amorim's study demonstrates that sectors are an idea that architects use as a paradigm of the design method to solve the function of spatial arrangement in modern Recife residences. Despite the variety of forms, spatial pattern seems to carry the information that not only reveals social dimension, but also shows how architectural ideas and design procedures are developed by architects.

This review of previous studies shows the possibilities for exploring cultural order in built spaces. Space syntax provides an approach to understanding the relationship between people and buildings by establishing the formal spatial properties of building. The analysis of internal structure can reflect social relations underlying the configuration of space. In this study, space syntax methodology was the first set of data used to identify spatial patterns and its consistency among the house samples across time so that the transition of internal structure could reveal the changes in housing design and in social and cultural orders. The second methodology is employed in this study which aims to explore spatial pattern from people's experience. The arrangement of domestic space perceived by the house's inhabitant provides an informative examination of configurational study from an insider's viewpoint.

This research explores spatially and behaviorally significant properties of space in order to investigate the change of spatial patterns among vernacular houses, how the patterns have been developed to support the change of lifestyle and carried on from the traditional to recent design.

Domestic Experience from Cognitive Research Methodology

In this study the analysis of spatial configuration deals with two different sets of data: one takes on spatial investigation from the relations among domestic spaces in the house floor plans, the other aims to reveal spatial pattern from the morphology of domestic experience. The latter set of data involves the analysis of spatial configuration as perceived by spatial occupants. By considering the analysis process from the user's view beyond the architectural morphology, additional information from the occupant can expand understanding of domestic experience from the human dimensions.

The analysis procedures are based on fundamental principles from cognitive research which is acknowledged within social sciences studies, such as anthropology, sociology and psychology. The main concept is to study the relation between human society and their thoughts. Cognitive study helps in understanding how people organize and use knowledge. This study explores cultural knowledge which is embedded in the arrangement of domestic spaces. In order to discover underlying pattern among household spaces, it is necessary to find which spaces could go together and which should be kept apart, or in other words, to define the pattern of *proximity*.

Basic information about domestic experiences is acquired from field research through the interviewing process. Four questionnaires were used for gathering data. Questionnaire-1 identifies people's pattern of daily activities. Nine primary activities

chose to label individual space in the floor plan of house samples. While conducting an interview at respondent's house, the use of each space was directly observed. All objects and furniture, which might hold clues as to where domestic activities perform, were recorded. To collect proximity data is to ask respondents which spaces are more similar to each other than to others. Questionnaire-3 was used to measure the perceived similarities among a set of primary spaces. A questionnaire contained a series of triple spaces (see Appendix B). For each question, a respondent was asked to choose which pair of spaces was most similar, or alternatively, which space was the most different. By choosing one space as the most different, the answer for each question is a vote for the similarity of the other two. A similar judgment by this technique is mentioned as a *Triads test.*[12] A similarity map of spatial pattern is produced according to the respondent's answers. The visual representation of a similarity pattern is a *Multidimensional scaling analysis* (MDS). The relationship among spaces obtained from respondents is grouped by various underlying dimensions, including front /back, clean/ dirty, private /public and so on. As mentioned earlier, the study of spatial configuration by space syntax considers the movement from the house entrance to all other space in the system as a fundamental approach for the analysis. Parallel to the space syntax technique, in questionnaire-4 the primary spaces were investigated in terms of front-back dimension. The questions basically asked respondents to rate the degree of location of each space in the household. Nine primary spaces were considered on the scale 1 to 5: 1 was the choice for the space which was most likely located to the back of the house,

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[12] For a full description of triads test and other techniques in cognitive anthropology see Bernard (1995), Borgatti (1996) and D'Andrade (1995). The random order of spaces in triads questions are created with ANTROPAC 4.0. The software assists the process of data input and produces a similarity map among spaces perceived by respondent's answers.

while 5 was most likely to group in the front. The answers, based on the respondent's judgment, were the basic information in the search for the front-back dimension in the similarity map produced earlier from the triads test responses. A method of testing a specific dimension which influences people's judgment of similarity among items is *Property Fitting* (PROFIT).

Multidimensional Scaling (MDS)

MDS is a multivariate analysis[13] that is used to find the similarities among items. In this study, MDS provides a visual representation of spatial patterns which indicate distances among spaces in the MDS map. The underlying relationships of spaces identify by distances from one space to others in the system or *dimensionality*.[14] The dimensionality in the MDS map is a device for scaling people's perception. The numbers are assigned to the respondent's attitude about domestic spaces in order to illustrate the similarity judgment. Therefore, the mental distances from cognitive data aim for a graphic display of the relations among spaces rather than a purpose of quantifiable numbers since they are non-metric data. The numbers of dimensionality among spaces in MDS map are the similarity of their relationship. The lower the correlation, the higher the distance, and consequently, a particular space is likely to appear far apart from others.

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[13] Multivariate analysis provides an explanation about the relationship among a set of items. The study of these items may generate by a large number of factors; therefore, analysis procedure involves a complex set of statistical methods.

[14] Dimensionality indicates mental distance that visualizes the relationship between one object to all others. In the MDS map, the similarities or the correlation among a set of items is converted into graphic distance. Between two items, there is one distance, or one dimension, and for three items, it is considered as two dimensions. For more than four items, the relations among items are more complex. The graphic representation of dimensionality becomes difficult since there is only 2 dimensions that can illustrate in paper space in order to get the correct proportion of similarity distances. This study chooses to illustrate the MDS of spaces in 2 dimensions.

Household data from field research

Physical preferences   Behavioral preferences

Houses basic information
Define the samples

Details of the sample with interior arrangements

Questionnaire-1
Semi-structured
(Freelisting)

Questionnaire-2
Structured-interview and
observation

Questionnaire-3
(Triads)

Questionnaire-4
(Ratings)

Houses floor plan

Accessibility Diagram

Syntactic analysis of spatial configuration from Depth / Integration Value

Spatial patterns of the house samples

Physical arrangements from floor plan
Space Syntax Model

List of daily activities

Activity & Space sorting

Similarities of spaces

Domestic Experience By Front-Back Location

Spatial pattern from inhabitant's view

Pattern of domestic experience
Cognitive Research Methods

Figure 4-4. The illustration of an overview of research methodology.

Property Fitting (PROFIT)

   Profit is a method used to reveal underlying dimensions of people's judgment of

similarities. The MDS map of similarities among items may be produced from a

different set of criteria. To search for a specific dimension used in making judgments, a

precise property of an item is assigned onto the MDS map. Profit helps to understand the criteria that respondents used to assess similarity. In this study, nine primary spaces were examined regarding the front-back dimension. A regression line for the front-back criterion was produced from the rating questionnaire or questionnaire-4. The direction of cosines identified the precise direction of front-back dimension increases and how a particular space is perceived as a front-back criterion. In other words, in order to interpret the results, the location of intersections between perpendicular lines from each space onto the front-back's regression line indicated the judgment of respondents.

The analysis of data from cognitive research procedures reveals the morphology of domestic experience underlying people's perception, including which spaces are perceived as compatible and which incompatible and how the patterns of domestic space are distributed within the house samples.

Classification of House Group by Age Category

Since the house samples were selected by the construction dates, the factors to identify and categorize the differences of house types vary, from appearances, materials and construction technology to social values and lifestyles. Some houses have been transformed by adding new spaces, while others adapted interior partitioning systems in order to create appropriate built spaces. Most traditional houses are altered over time and therefore, existing house plans may not represent the original design of the earliest characteristics. On the other hand, new houses may be built in contemporary forms and materials, but occupants do not use spaces as designed for the new lifestyle. Hence, instead of categorizing which house is traditional or popular from its appearance and spatial design, the house samples are grouped by period of construction. Grouping of

house samples is classified according to the history of housing development, which can help to identify the continuity and change in the study area. A significant development of the village environments from an early stage to recent contexts is regarded as a factor in determining a different type of house grouping.

As mentioned in chapters 3, Ban Khwao has developed under three distinct phases: 1) before the development of infrastructure (1939 or earlier), 2) the immigration of outsiders and industrialization movement (1940-1984) and 3) urbanization period (1985 to today). Vernacular houses of the first phase are locally built and mainly constructed of wood. The main floor is raised above the ground. In the second phase, most of the houses were influenced by various groups of designers and builders, and, at the same time, new materials and construction technology were introduced. New houses in the third phase resulted from the design of suburban housing projects and provincial government offices, which are normally designed and built by a construction company.

By following the criteria of construction dates, the house samples were categorized into three groups; they were specified as, traditional, intermediate and popular, from the earliest to the newest, respectively. A total of forty-two houses were selected from Ban Khwao. Of these nine houses were assigned to the traditional group 60 years or older. Eighteen houses, ranging in age from 16 to 59 years were categorized as the intermediate group, while fifteen houses of 15 years of age or less were designated as the popular group.

CHAPTER 5
RESULTS, DISCUSSION AND CONCLUSION

This chapter discusses the results of spatial configuration from syntactic properties of the house samples and from domestic experience by inhabitants. The investigation of both patterns was carried out in order to analyze the difference of spatial configurations and to establish the physical transformation of spatial arrangements over time found among a set of domestic spaces.

Domestic Space Use

Under Floor Space

Since daytime activities take place at the ground level, under floor space is one of the most important spaces for daily routines. More than 85% of vernacular houses in this study contain under floor space. All single story houses are from the popular group. Most activities of the day are usually performed by women, from late morning through early evening hours, including domestic chores, handicraft works, child care, food preparation, socializing with neighbors and receiving guests. Some houses may use under floor space for vehicle parking, selling goods, storing agricultural products and equipment. The area is commonly an open space with a raised-wooden platform used as workspace and as a relaxing area. The space could also be used to keep cattle, pigs and poultry.

In the shop house, a residential-commercial use structure, the entrance of the under floor space opens into the main room which serves both as a shop for commercial activities and for receiving guests (see floor plan on page 171).

Multipurpose Space

Multipurpose space is an enclosed space for family living. After children are back from school and men from work, the area is usually used for evening activities such as family socializing and entertaining, watching television, finishing schoolwork. It is also a sleeping space for relatives and very close friends of family members. In more than 93% of the house samples there is at least one space that is used for several activities.

Verandah Space

Most traditional houses have a large and open space for verandahs. The area normally is located between the sleeping space and the open terrace in the floor plan and acts as transitional space from the ground floor to the upper level. Many activities are performed in this space, including making artifacts and taking a rest or nap. It may be considered as an informal place for family living. Verandah space is sometimes used for receiving guests who have a very close relationship with family members.

More than 88% of the samples have at least one verandah. In traditional houses, 30% of verandah spaces contain a water booth (drinking-water jars covered with a small roof) located adjacent to the ladder or near the kitchen.

(a)

(b)

Figure 5-1. The use of under floor space.
a) Cooking and relaxing space; b) Socializing with neighbors and working on
handicrafts

Figure 5-2. Multipurpose space for family living.

Figure 5-3. Verandah space looking through the open terrace adjacent to a separate
kitchen with covered drinking-water jars.

Figure 5-4. Sleeping area in traditional house.

Figure 5-5. House yard and outdoor space.

Sleeping Space

The sleeping area is always located in the upper floor of two-storied houses. It is a closed space with a small number of windows and is not accessible to visitors. Sleeping quarters contain a prayer room, storage, and a small altar. In most houses people sleep on mattresses laid over mats and under mosquito nets. Mattresses, pillows and mosquito nets are rolled up along the wall during daytime. In a traditional house, all family members sleep in the same sleeping space, with the exception of a separate room provided for daughters who are old enough to be married. During summer, sleeping may sometimes take place in the verandah. Therefore, the term *sleeping space* is preferred rather than *bedroom* because the activity may occur in other spaces besides bedrooms.

Yard and Outdoor Space

Approximately 93% of the sample used outdoor space as an integral part of daily routines. The main use of the house yard is for drying clothes because of sufficient sunlight and ventilation. The area is a multifunctional space where various activities are performed, including washing clothes and dishes, storing agricultural tools, waste utensils and firewood, and children's playing. It is also occasionally used as a family ceremonial area. In 35% of the sample outdoor spaces contain a compound with outbuildings such as a granary, shelter for animals, storage containers for water supply, toilet and bathing area. Most houses are not connected to a water pipe; water tanks or big jars are typically seen in house yard.

Toilet and Bathing Space

The design of new houses includes a bathroom inside, but in some old houses toilet and bathing space are located outside the house as part of the outbuildings. The

area is always located on the ground floor at the back of the house or, rarely, in a new-house design it may be located on the second floor. Water jars are set on half of the area for storing the water supply.

Food Preparation Space

The main meal of the day is dinner. Women spend most of the afternoon preparing dinner. Breakfast and lunch are prepared in the kitchen, while dinner may be prepared in the under floor space or on the verandah. The kitchen normally is located at the rear of the house, at the furthermost corner of the open terrace or adjacent to the verandah; otherwise people use the designated space in the under floor area. Twenty percent of houses in study area have outdoor cooking space. The kitchen is spatially separated from other enclosed spaces because there is too much smoke and smell to cook inside.

Eating Space

Eating activity is flexible. Breakfast and dinner take place either on the verandah or in the open terrace space. In a new house eating space is designated for an area adjacent to the kitchen or near the living room. People normally have lunch outside the house, at work, in the field or in neighborhood food shops. If they eat lunch at home, a platform provided in the under floor space is an eating place. In more than 85% of the sample, there is no one area specified as an eating space.

Figure 5-6. House yard and outbuildings.

Figure 5-7. Kitchen located between open terrace and verandah space.

Figure 5-8. Household service quarters in popular house.

Household Service Space

People engaged in various types of domestic chores in different locations. House cleaning, dishwashing, clothes washing and ironing are among these chores. Clothes are either hand washed or machine washed. In both cases the activity most frequently takes place in the house yard, under floor space or near bathing space. Dishwashing is also located in the yard, verandah or adjacent to the kitchen. In most houses the only furniture is stools and cupboards where precious belongings are kept. Only a few houses contain Western style furniture such as beds, dining table and sofa. The main storage area for keeping agricultural tools is under floor space.

In addition to the interviewing process, the field observers noted that domestic activities are performed by housewives and elderly members. Younger males participate in activities that take place outside the house, particularly working in the field or as laborers in town. Only on weekends or national holidays are all household members potentially at home most of the day. On a special occasion with social ceremonies, the

house yard is a place to accommodate a large number of guests and neighbors. Sometimes spaces from neighboring houses and the street are used as location for temporary storage sheds for the events.

From their external appearances the house samples may have distinct architectural characteristics, but inhabitants' daily routines are alike. Eighty-five percent of the sample, houses have two stories. Outdoor space is a significant feature among houses in the study area. It usually serves for outdoor cooking, household services and for agricultural-related activities. Some spaces appear to be used for multiple types of household activities; typically various functions are performed at different times during the day. Figures 5-1 to 5-8 illustrate interior spaces of vernacular houses in the study area.

Syntactic Analysis of Samples

The first analysis investigates the difference of spatial configurations among vernacular houses across time. This section deals with the discussion and comparison of spatial patterns underlying each of the three categories of houses: traditional, intermediate and popular. The syntactic analysis of spaces suggests the way space is arranged in the house samples. The analysis is based on syntactic data generated by space syntax procedures. Two values—RRA or the syntactic measurements of integration and depth values are fundamental criteria taken into account when determining configurational relations among the domestic spaces.

Pattern of Integration

The analysis focuses on the relationship of domestic spaces according to the internal structure of the sample by spatial integration. Table 5-1 shows the mean integration values of houses for the different groups. The analysis of 41 vernacular houses indicates that most domestic spaces from three groups consistently tend to locate in different levels of integration.

The results from Table 5-3 show that the most segregated space is toilet and bathing space, at the mean RRA of 0.63, and the most integrated space is eating and transitional space with the RRA value of 0.48. Spaces that fall into the integrated domain are eating, transition, under floor space, house yard, while those in the segregated domain are toilets and bathing space, sleeping, household service, multipurpose and food preparation space. The former spaces are likely to be formed by communal needs. Most spaces in this group accommodate activities performed where house members can encounter their visitors such as socializing with neighbors and receiving guests. The latter group clearly indicates space for a family's daily life, including cooking, household chores and sleeping area. The sample has a mean RRA value of 0.528. The highest RRA at 1.04 is found in the exterior space of H-12, and the lowest at 0.19 is found in sleeping space of H-09 and multipurpose space of H-31 (see Appendix E). Maximum and minimum RRA indicate which spaces have a great differentiation. Sleeping and multipurpose spaces show a wide range of RRA values that appear in a distinct variation from one house to another, whereas transitional space indicates a consistency pattern among the sample.

RRA values of different house groups from Table 5-1 and Figure 5-9 (a) illustrate some consistencies among most house spaces. The parallel lines of each group indicate

that the distribution of RRA by spatial pattern is similar. Certain functions appear to

locate in a particular order. The popular group tends to have a more integrated system, or

Table 5-1. Syntactic values of mean RRA and integration values by age category and
domestic spaces.

Space - activity Pattern	Popular House (0-15 years)		Intermediate House (16-59 years)		Traditional House (More than 60 years)	
	RRA	Integration	RRA	Integration	RRA	Integration
Under floor Space (UDF)	0.48	2.08	0.49	2.04	0.49	2.04
Yard and Outdoor Space (YRD)	0.48	2.12	0.54	1.85	0.46	2.17
Toilet and Bathing Space (WC)	0.61	1.64	0.75	1.33	0.67	1.49
Food Preparation Space (K)	0.52	1.96	0.59	1.75	0.52	1.92
Multipurpose Space (MU)	0.51	1.96	0.59	1.69	0.52	1.92
Verandah Space (VD)	0.57	1.75	0.52	1.92	0.47	2.13
Sleeping Space (SLP)	0.59	1.69	0.71	1.43	0.66	1.52
Eating Space (E)	0.45	2.22	0.53	1.89	0.45	2.22
Household Service Space (HSV)	0.50	2.00	0.57	1.75	0.63	1.59
Transitional Space (TS)	0.48	2.13	0.49	2.08	0.47	2.13
External Space (EXT)	0.60	1.67	0.50	2.00	0.47	2.08

Table 5-2. Syntactic values of mean depth by age category and domestic spaces.

Space - activity Pattern	Popular House (0-15 years)	Intermediate House (16-59 years)	Traditional House (More than 60 years)
Under floor Space (UDF)	2.92	3.11	3.20
Yard and Outdoor Space (YRD)	3.16	3.37	3.06
Toilet and Bathing Space (WC)	3.74	4.36	4.44
Food Preparation Space (K)	2.97	3.54	2.22
Multipurpose Space (MU)	3.09	3.62	3.47
Verandah Space (VD)	3.67	3.72	3.63
Sleeping Space (SLP)	3.71	4.37	4.12
Eating Space (E)	2.62	3.24	2.99
Household Service Space (HSV)	2.94	3.57	3.51
Transitional Space (TS)	2.84	3.08	2.81
External Space (EXT)	3.62	3.57	3.17
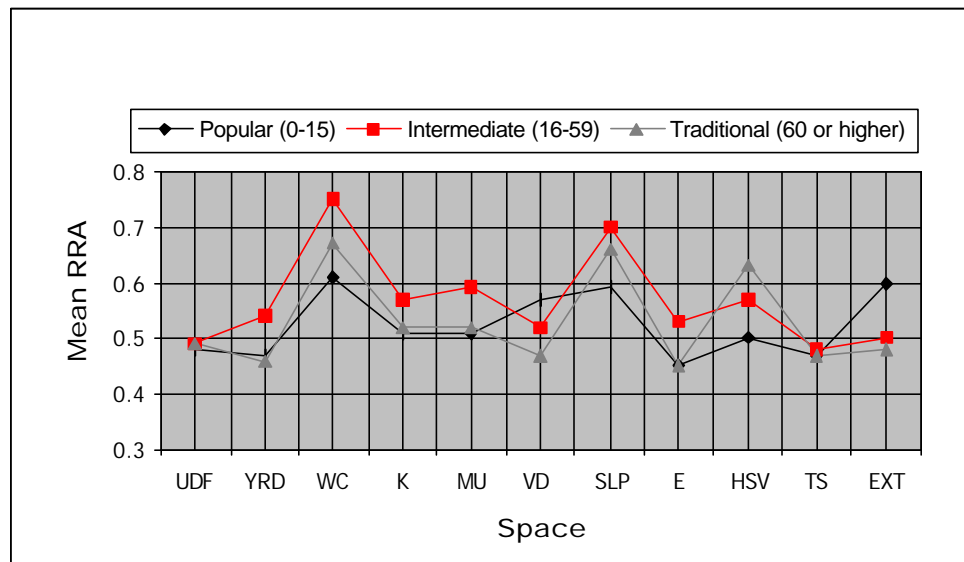
(a)
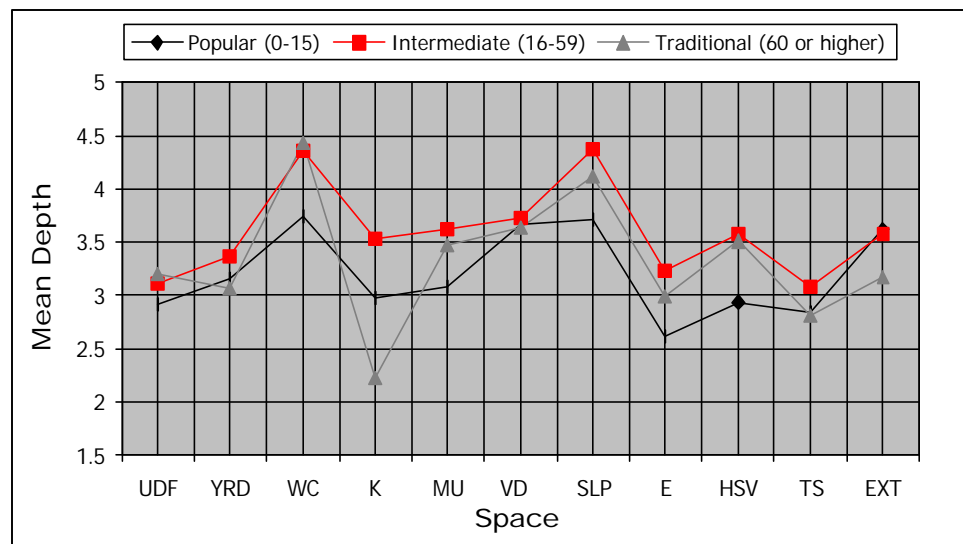
(b)

Figure 5-9. Comparison of syntactic values of space use pattern by age groups.
a) Mean RRA values; b) Mean depth values

lower RRA values, than those in the intermediate and traditional groups do. Among the three groups, the popular group has the lowest RRA values, while those from the intermediate group have the highest. The results from Figure 5-9 (a) also present some peculiarities that are not consistent across the three house groups. Unlike other spaces, the distribution of RRA values from the verandah and external spaces in the popular group indicates a different trend, both shifting the RRA line to the most segregated group. On the other hand, instead of being located between popular and intermediate groups, the RRA line of household service space in the traditional group moves to the highest RRA value among the three groups.

Pattern of Depth

Table 5-3 presents the mean depth level for each space. The shallowest is eating space, at the mean depth of 2.93, and the deepest space is toilet and bathing space at 4.10. The shallowest value of depth is 0.17 is found in the multipurpose space of H-08, and the deepest value at the level of 5.89 is found in the sleeping space of H-27 (see Appendix E). The minimum and maximum depth values in household service space, sleeping space and verandah show a great difference from all other spaces. The mean depth indicates that toilet, sleeping space and verandah are deeper when compared to external, under floor space and eating space. It suggests that domestic spaces involved with daytime activities have a shallower depth then those occupied by family members. Socializing with neighbors, receiving guests and sharing lunch at home are likely to locate adjacent to the house entrance, while sleeping, family living and entertaining are a few steps deeper.

Table 5-3. Summary of syntactic values by space-use pattern.

Space - activity Pattern	Number of Cases	Depth Level			RRA		
		Min	Mean	Max	Min	Mean	Max
Under floor Space (UDF)	35	2.06	3.08	4.39	0.30	0.49	0.70
Yard and Outdoor Space (YRD)	38	1.97	3.23	4.68	0.34	0.50	0.74
Toilet and Bathing Space (WC)	34	2.90	4.10	5.42	0.27	0.63	0.82
Food Preparation Space (K)	37	2.08	3.31	4.71	0.31	0.56	0.82
Multipurpose Space (MU)	38	1.70	3.40	4.63	0.19	0.56	0.91
Verandah Space (VD)	36	2.24	3.68	5.77	0.31	0.53	0.91
Sleeping Space (SLP)	41	2.30	4.08	5.89	0.19	0.57	0.98
Eating Space (E)	25	1.75	2.93	4.78	0.33	0.48	0.82
Household Service Space (HSV)	38	1.90	3.34	5.50	0.34	0.54	0.81
Transitional Space (TS)	39	1.90	2.94	4.25	0.31	0.48	0.61
External Space (EXT)	41	2.40	2.94	5.63	0.27	0.53	1.04

Table 5-2 and Figure 5-9 (b) show the depth level for each space across three

house groups. The intermediate group has a higher mean depth than those in the popular

and traditional groups. Among the three groups, mean depth is ranked, from the

shallowest to the deepest, popular, traditional and intermediate, respectively. The parallel

lines for all house groups indicate that the distribution of mean depth in most spaces is

similar. However, the pattern of mean depth for some spaces in a particular group does

not follow the trend. For house yard and food preparation spaces, the line of mean depth

from the traditional group shifts down to the lowest location, while in most other spaces

the line is located between the other two. The line of mean depth from the popular group

tends to locate at the bottom, but for the external space it moves up to the top.

The overall observation from the results suggests that RRA and depth values from

the three groups tend to locate in a constant order as well as the range of grouping among

domestic spaces. Spaces with high RRA values or low integration tend to occur in spaces

that have a high mean depth, whereas spaces with a low RRA values or high integration

occur in spaces with a low mean depth. In order to confirm that a decrease in depth level

means increasing integration, the correlation of integration and depth is examined.

The Correlation of Integration and Depth

The relationship between integration and depth presents the association of

domestic spaces in the house samples. A regression line for both features suggests how

the house structure determines spatial arrangements in different house groups.

The correlation for a whole sample in Figure 5-10 (a) indicates a negative

relationship. The more steps it takes to move from the exterior to a particular space, the

less integrated it is. In other words, shallow spaces can be conceivable as the integrated

spaces to the house. The correlation found in the sample is relatively high, at the level of

0.69. After the sample is divided into three groups, a clear contrast of the house structure

begins to exist. In Figure 5-15 (b) and (c), the correlation significantly improves to a
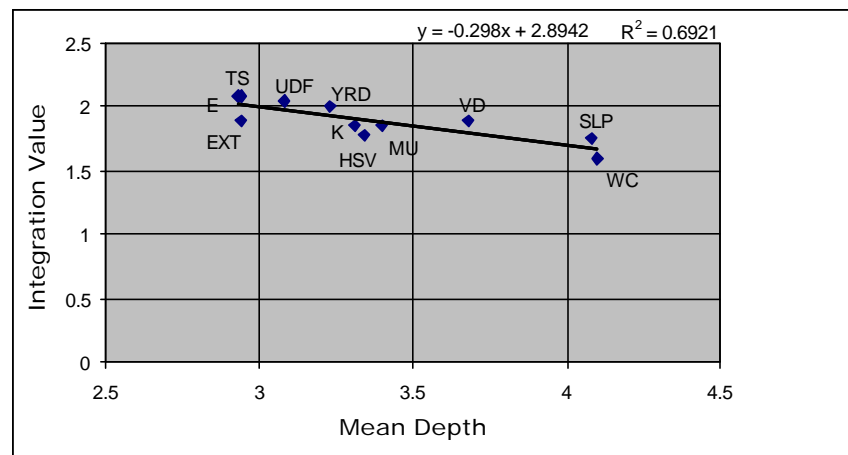
(a)

Figure 5-10. The correlation of integration and mean depth.
a) Overall samples; b) Popular houses; c) Intermediate houses; d) Traditional houses
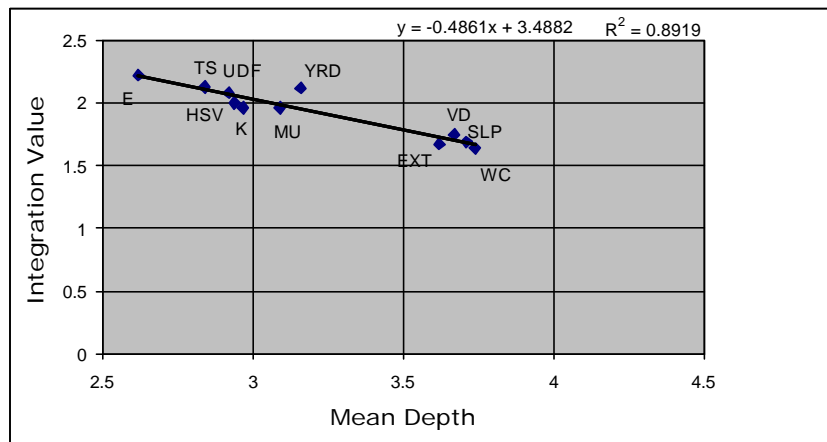
(b)
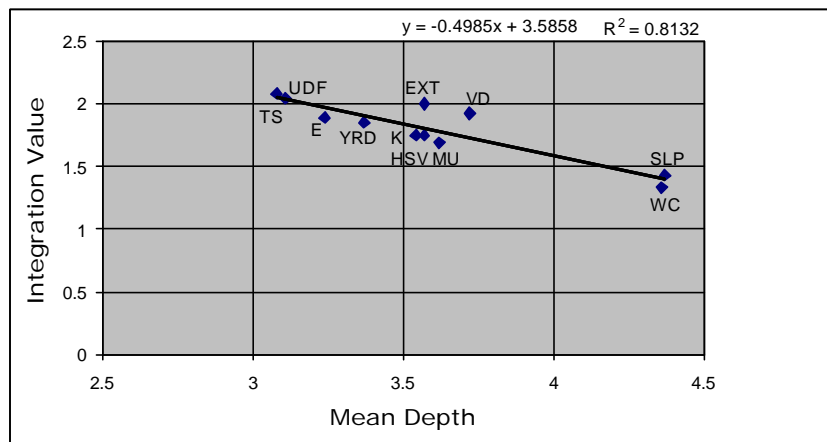
(c)
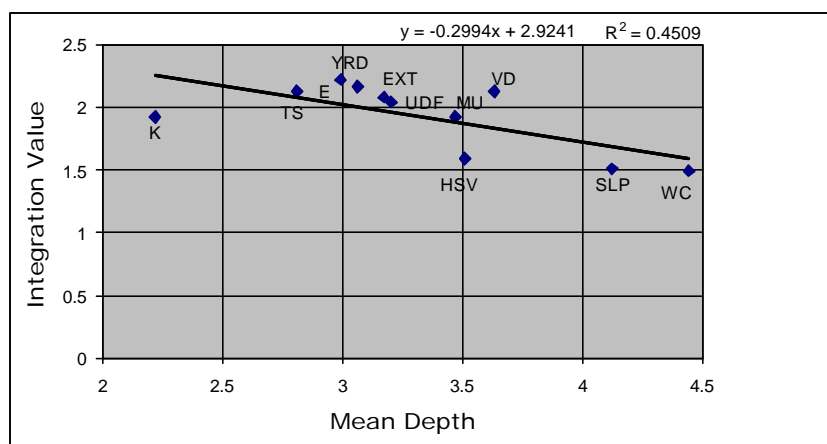
(d)

Figure 5-10.—Continued.

high value of 0.89 for the popular group and to 0.81 for the intermediate group. The

popular group shows the best correlation. The results indicate that the spatial structure of

popular houses strongly determines the spatial arrangement, and the cluster of correlation

is markedly well defined by the regression line. The cluster of the popular group locates

at higher values in the scatter plot compared to the other two. The cluster of the

traditional group in Figure 5-10 (d) appears to locate in a wide range. The correlation is

relatively weak at 0.45 level, the lowest among the three groups.

Table 5.4. Spearman correlations among spaces by pair of housing group.

Pair of House Group	Integration Value	Mean Depth
Popular / Intermediate	0.509	0.866
Intermediate / Traditional	0.729	0.816
Popular / Traditional	0.693	0.714

In addition to the results from the correlation of linear regression, the Spearman

rank-order correlation[1] also confirms strong findings on the correlation between

integration and depth among three house groups. The integration values of all spaces

among the pairs of house groups in Table 5.4 show that the traditional group correlates

most highly with all the other groups, the intermediate group correlates less highly, and

the popular group has the lowest correlation. The results indicate that the traditional

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[1] Spear rank-order correlation or Spearman rho is an alternative procedure to the correlation coefficient in order to test the correlation between the rankings of variables. This technique is used to rank the order of the observations for a pair of variables and then the difference between the two ranks makes up part of the test statistic. Spearman rho is used for small data sets. The rho is calculated by the following formula:

$$\rho = 1 - 6 \left(\sum d^2 \right) / n \, (n^2 - 1)$$

when d = the differences of ranked order between the variables and n = number of observations.

group has the best correlation with integration value, while the popular group shows the least. The results from the mean depth show an opposite trend. The traditional group indicates the weakest correlation to depth level whereas the popular group is the strongest among three house groups. Results from the Spearman correlation prove that an increasing integration value is a decreasing depth level. The spatial structure of the traditional group is clearly defined by integration value, while in the popular group the explicit character is determined by depth.

The results from the correlation of integration and depth show that shallow spaces are the most integrated ones, and the segregated ones occur spatially deeper in the houses. The cluster of spaces appears to divide into three different groups. Eating, transition, and under floor space are located three steps away from the front door. The second group, house yard, kitchen, household services, multipurpose space and verandah, present a similar depth level, at 3.5 steps from the entrance. Sleeping and toilet show very deep locations, and integration values are at the lowest level among all other spaces in the house structure. The first group is understood as socializing /communal space, the second is domestic chores /family living, and the third is personal space.

Spatial Pattern from Occupant's Experience

The second analysis reveals the underlying pattern of domestic experience. This section discusses spatial dimensions as perceived by the house's inhabitants. The analysis is based on data from triads and rating questionnaires. The primary goal is to find groups of space and to discover underlying dimensions that influence the inhabitant's judgment of similarities among a set of domestic spaces.

Stress in 2 dimensions is 0.095, calculated from ANTROPAC 4.94.
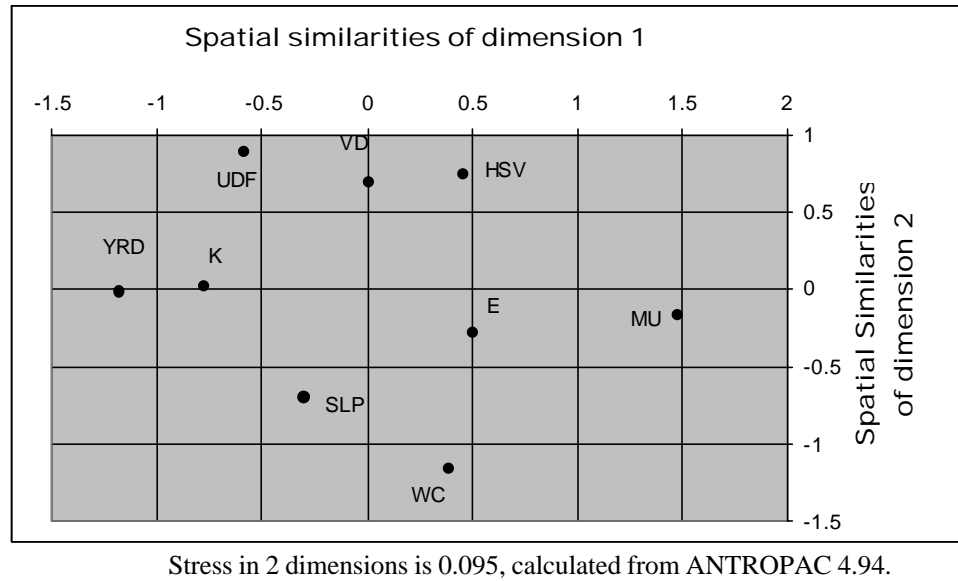
Figure 5-11. MDS map shows the similarities among nine primary spaces.

Regression results: Multiple Regression 0.498, R-Square 0.248, and Probability 0.437.
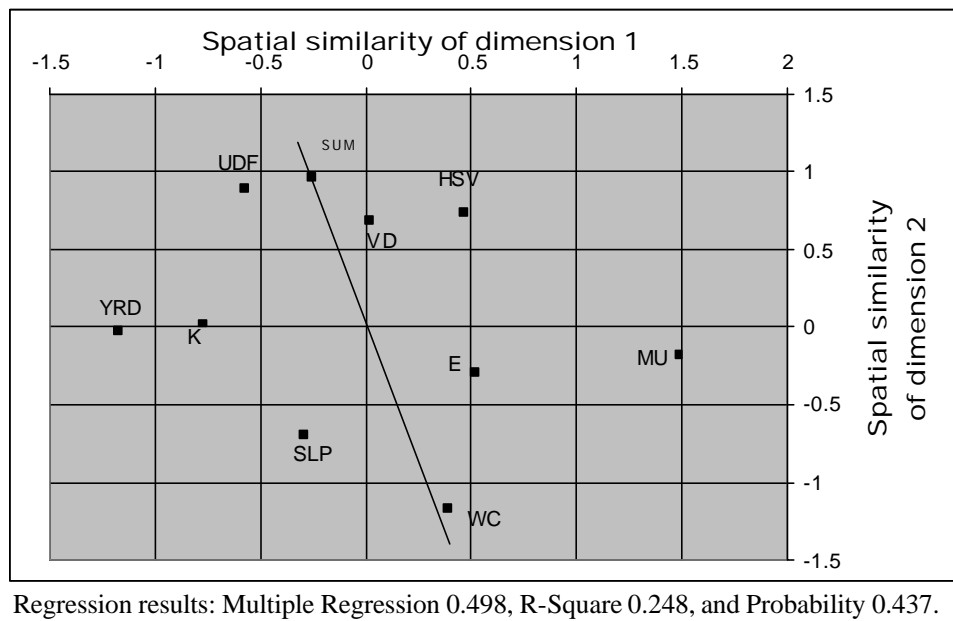
Figure 5-12. The judgment of similarities by front-back dimension.

Figure 5-11 shows the similarities among nine primary spaces in the household. The MDS map from the triads questionnaires indicates a clear pattern: as we move from the top to the bottom, space becomes increasingly located away from the house entrance. The results suggest the possibility that respondents may use the "location from the house entrance" as a dimension to distinguish one space from another. But as we move from the left to right, spaces are likely to increase the needs for a hygienic level. In this case, "clean-dirty" might possibly be the dimension. The yard space requires less hygiene than the toilet, eating and household service space. However, the pattern of clean-dirty dimension is not perfect when the location of multipurpose space is presented in the MDS map. Meanwhile, the pattern of similarities is much more significant when we move at the direction of up-down rather than left-right. It is possible that the house's inhabitants perceive similarity among domestic spaces regarding their locations.

Nonetheless, during the data gathering process, the respondents were asked to name the dimension as they answered the triads questions. Eighty-five percent of the respondents stated that they used the preference of location to select the degree of similarities among spaces. Ten percent were given their answers by using the hygienic level, while only 5% considered privacy as a reason to describe the similarities of spaces. The selection of front-back dimension is not only based on a majority of inhabitants' responses but also corresponds to the conceptual approach of space syntax methodology, with regard to the analysis of accessibility from the house entrance. As a result, the location of spaces was selected for a further analysis of spatial pattern. From the observation of Figure 5-11, under floor space, verandah and household services are

clustered in a similar group, and possibly placed to the front of the house, whereas toilet and sleeping understandably appear on the map as at the back of the house.

Beyond a visual representation of pattern of similarities among a set of spaces, the stress value in two dimensions map is 0.095 (Appendix F). With a stress under 0.1, the results indicate an excellent representation of correspondence between the distance in the MDS map and the respondent's answers.

In order to investigate the front-back dimension of domestic spaces, the PROFIT analysis was performed. The results from PROFIT between similarities of space and the judgment of front-back location are illustrated in Figure 5-12. The regression line of front-back indicates that the location of space increases along the line from top to bottom, as moving to the back of the house. The projections of the perpendicular line from each space to the regression line identify the location of space in the house, and consequently, those results reveal patterns of space regarding the front-back dimension. Under floor space is located most to the front, whereas multipurpose, sleeping and toilet spaces are located to the back of the house. The spatial pattern identified from the domestic experience of occupants on entering the house is as the following:

UDF => VD => HSV => YRD => K => E => MU => SLP => WC

Discussion of Spatial Configuration

The results from both physical arrangements of the house floor plans and user's experience of domestic spaces demonstrate different spatial properties among the house samples. The analysis of integration and depth describes spatial structure and the use of

space that occurs in the different house groups. The results also shed light on how spaces are being experienced.

Table 5-5. Grouping of domestic spaces by syntactic values.

Range of Syntactic Data	Overall Sample	Popular House (0-15 Years)	Intermediate House (16-59 Years)	Traditional House (More Than 60 Years
Mean RRA Values				
Low	E, UDF, YRD, TS	E, YRD, TS, UDF	TS, UDF, EXT, VD, E	E, YRD, VD, TS
Medium	VD, HSV, EXT, K	HSV, K, MU	YRD, HSV, K	EXT, UDF, K, MU
High	MU, SLP, WC	VD, EXT, SLP, WC	MU, SLP, WC	HSV, SLP, WC
Mean Depth				
Low	E, TS, EXT, UDF, YRD	E, TS, UDF, HSV	TS, UDF, E, YRD	K, TS, E, YRD
Medium	K, HSV	K, MU, HSV, EXT	K, HSV, EXT	EXT, UDF, MU
High	MU, VD, SLP, WC	VD, SLP, WC	MU, VD, WC, SLP	HSV, VD, SLP, WC

From the observation of the sample, spaces consistently tend to group regarding integration values. The more integrated spaces are the social ones, such as eating, under floor space and house yard (Table 5-5). These spaces accommodate activities that involve visitors and all family members. They are spaces where family members are likely to encounter each other as well as guests to the house. In contrast, the less integrated spaces need a high level of privacy such as toilet and sleeping space. These spaces tend to involve a specific user and are segregated from where most household activities are performed.

From the other perspective, the spatial pattern from depth level shows a distribution similar to what the integration does. Types of activity are directly affected

by depth. The shallowest group of spaces accommodates house chores or activities related to domestic tasks such as food preparation and household services. At the deepest group, the presence of space demanding privacy is dominant. It is likely that visitors may not be allowed to enter these spaces. Spaces for passive activities and personal needs, such as family living, sleeping and toilet space are included in this group.

Spatial Genotype

Spatial genotype is established by investigating the consistent distribution of RRA values. A tendency of a certain pattern occurring across the sample identifies patterns among domestic spaces. To obtain the genotype, the mean RRA values of each space-activity pattern are ordered from the most integrated to the most segregated, or in other words, from the lowest to the highest RRA value. Because some activities may occur in more than one space, such as eating or food preparation, this study uses the mean RRA value from the average RRA of all convex spaces where the same type of activity can be found in the house. Table 5-6 shows the order of RRA values for 41 houses in this study.

The RRA distribution suggests that there is more than one type of space occurring in the most integrated and the most segregated domains. The RRA order indicates that eating, under floor space, yard and verandah tend to fall into integrated domain, while the segregated domain includes toilet, sleeping and multipurpose space. Table 5-7 shows the general tendency of certain spaces that are likely to fall on either the integrated or segregated side. The RRA values of 41 houses show that toilet and bathing space never occurs as the most integrated space. Only in one case out of all the samples, sleeping and transitional space were shown to be the most integrated spaces, which are H-09 and H-22, respectively. The spaces that occur most frequently in the integration domain are eating,

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Table 5-6. Order of space-use pattern in 41 house samples.

House	1		2		3		4		5		6		7		8		9		10		11
H01	K	<	UDF	<	TS	=	MU	<	YRD	<	EXT	=	WC	<	HSV	<	SLP				
H02	K	=	HSV	<	TS	<	E	<	YRD	<	MU	=	SLP	<	VD	<	WC	<	EXT		
H03	E	=	K	<	MU	<	YRD	<	TS	<	HSV	=	VD	=	EXT	<	WC	=	SLP		
H04	E	<	K	=	HSV	<	MU	<	TS	<	EXT	<	VD	=	SLP	<	WC				
H05	YRD	<	K	<	UDF	<	MU	<	HSV	<	TS	<	EXT	<	SLP	<	WC				
H06	K	<	UDF	<	E	=	TS	<	EXT	=	VD	<	YRD	=	WC	<	SLP				
H07	K	<	YRD	<	UDF	<	TS	<	MU	<	VD	=	SLP	<	HSV	<	WC				
H08	E	=	HSV	=	MU	<	SLP	<	YRD	=	EXT	<	K	=	WC						
H09	SLP	<	WC	<	YRD	=	TS	<	EXT	<	MU	<	K								
H10	YRD	<	UDF	<	TS	<	MU	=	EXT	<	K	<	HSV	<	WC	<	SLP				
H11	EXT	<	E	<	K	<	TS	=	HSV	<	MU	<	UDF	=	WC	<	YRD	<	SLP	<	VD
H12	HSV	<	E	<	TS	<	K	<	MU	<	WC	<	YRD	<	UDF	<	SLP	<	VD	<	EXT
H13	HSV	<	E	<	UDF	<	TS	<	K	=	YRD	=	VD	=	MU	<	SLP	<	EXT	<	WC
H14	E	<	VD	<	TS	<	YRD	<	SLP	<	HSV	=	EXT	<	WC	<	K	=	MU		
H15	UDF	<	YRD	=	MU	<	WC	<	TS	<	EXT	=	HSV	=	SLP	<	VD	<	E	=	K
H16	K	<	UDF	=	TS	<	E	<	VD	<	EXT	<	YRD	<	HSV	<	SLP	<	MU	<	WC
H17	E	<	UDF	=	MU	<	YRD	<	TS	<	EXT	=	WC	<	HSV	<	VD	<	K	<	SLP
H18	YRD	<	VD	<	UDF	<	TS	<	WC	<	EXT	<	MU	<	HSV	<	SLP				
H19	VD	<	EXT	<	UDF	<	K	<	TS	<	YRD	<	WC	<	HSV	<	SLP	<	MU		
H20	VD	<	HSV	<	EXT	=	TS	<	UDF	<	K	<	SLP	<	E						
H21	UDF	<	TS	<	EXT	<	VD	<	YRD	<	WC	<	MU	=	HSV	<	SLP	<	K		
H22	TS	<	UDF	<	VD	<	E	=	WC	<	EXT	<	YRD	<	HSV	=	K	<	MU	<	SLP
H23	K	=	E	<	EXT	<	YRD	<	UDF	=	MU	<	HSV	<	VD	<	TS	<	SLP	<	WC
H24	MU	<	TS	<	K	=	HSV	<	EXT	<	VD	<	YRD	<	UDF	<	E	=	SLP	=	WC
H25	VD	<	EXT	<	HSV	<	K	<	YRD	<	TS	<	UDF	<	MU	<	SLP				
H26	UDF	<	YRD	<	VD	=	TS	<	EXT	<	E	=	HSV	<	K	<	SLP	<	MU		
H27	UDF	<	YRD	<	HSV	<	TS	<	VD	=	EXT	<	K	<	WC	<	SLP				
H28	VD	<	EXT	=	TS	<	YRD	<	HSV	<	UDF	=	E	<	K	=	MU	<	WC	<	SLP
H29	EXT	<	K	<	YRD	<	TS	<	MU	<	VD	=	SLP	<	HSV	<	UDF	<	WC		
H30	E	<	HSV	<	UDF	<	EXT	<	TS	<	MU	<	K	<	YRD	<	SLP				

Table 5-6.—Continued.

H31	MU	<	TS	<	K	=	EXT	=	WC	<	UDF	<	SLP	<	HSV	<	VD				
H32	UDF	<	VD	<	YRD	=	TS	<	HSV	<	EXT	<	K	<	SLP						
H33	VD	<	EXT	<	TS	<	UDF	=	YRD	<	HSV	<	WC	<	SLP		MU	<	K		
H34	MU	<	YRD	<	E	<	TS	=	EXT	<	SLP	=	HSV	<	UDF	=	VD	<	WC	<	K
H35	EXT	<	E	=	K	<	UDF	<	TS	<	VD	<	HSV	=	WC	<	YRD	=	MU	<	SLP
H36	EXT	<	MU	<	TS	<	YRD	<	UDF	<	E	<	WC	=	SLP	<	HSV				
H37	E	<	VD	<	UDF	<	YRD	<	MU	<	EXT	=	K	<	HSV	<	WC	<	SLP		
H38	K	<	VD	<	EXT	=	MU	<	YRD	<	WC	<	UDF	<	TS	<	HSV	=	SLP		
H39	VD	<	UDF	<	TS	=	YRD	=	EXT	=	MU	<	E	=	HSV	<	K	<	SLP		
H40	YRD	=	UDF	<	TS	<	VD	<	EXT	=	SLP	<	MU								
H41	YRD	<	E	=	HSV	=	VD	=	TS	<	UDF	<	MU	=	EXT	<	SLP				

Note: The darker areas show space-use patterns that fall into the integrated side of the houses, while the lighter areas show space-use patterns that fall into the segregated side.

Space abbreviations:
UDF = Under floor Space   SLP = Sleeping Space
YRD = Yard and Outdoor Space   E = Eating Space
WC = Toilet and Bathing Space   VD = Verandah Space
K = Food Preparation Space   HSV = Household Services Space
MU = Multipurpose Space   TS = Transitional Space
                                 EXT = External Space

verandah, yard, household services and food preparation space. On the other hand, under floor space, yard and transitional space never occur as the most segregated space. Toilet, sleeping and multipurpose most frequently fall in the segregated domain. At an intermediate domain, spaces that often fall into the range of mean RRA are transitional space, under floor, yard and household services.

With regard to the tendency of space-use pattern, the results from the integrated and segregated domains identify the association with other properties such as privacy need and the nature of activity performed within the space. The integration domain of the sample involves the encounters of users, between inhabitants and visitor or between

household members, and occurs among communal and interactive activities. Most spaces

providing for personal and passive activities are grouped in a segregated domain

according to the requirement for privacy needs. A group of spaces arranged for domestic

chores is located between integrated and segregated domains and acted as transitional

spaces where public and private areas in the house are separated.

By ordering the mean RRA values of each space, from Table 5-3 and Table 5-8

the consistent pattern of space is arranged as follow

Genotype of overall samples:

$E < UDF < YRD < VD < HSV < K = MU < SLP < WC$

Table 5-7. Number of cases found in the sample by mean RRA values.

Space -activity Pattern	Number of Case	Range of RRA Value		
		Most Integrate	Mean	Most Segregate
Under floor Space (UDF)	35	4	7	0
Yard and Outdoor Space (YRD)	38	6	7	0
Toilet and Bathing Space (WC)	34	0	5	11
Food Preparation Space (K)	37	6	6	6
Multipurpose Space (MU)	38	4	5	6
Verandah Space (VD)	36	8	5	3
Sleeping Space (SLP)	41	1	5	13
Eating Space (E)	25	8	2	2
Household Service Space (HSV)	38	6	6	2
Transitional Space (TS)	39	1	8	0
External Space (EXT)	41	4	12	1

Spatial Types by Age Category

Table 5-8 compares the spatial genotypes of each age category. The results for

most spaces indicate a similar tendency of spatial patterns. The integrated spaces are

eating, transition, under floor space and house yard, and the segregated spaces are toilet and sleeping space. These spaces only fall into either side of the domain. The consistency of certain functions suggests that domestic spaces from both domains strongly structure their configurational properties. The ordering and arrangement of different spatial properties that are related to specific functions in the household correspond to the results of the genotype from the overall sample. The main functional spaces in both integrated and segregated domains exist with a similar pattern across all house groups. Food preparation and multipurpose spaces are located in the intermediate domain. Their RRA values are not high or low enough to be included in either the integrated or segregated side of the house.

Table 5-8. Genotypes of house samples.

Age Category	Integration Domain						Segregation Domain				
Overall Samples	E	TS	UDF	YRD	VD	EXT	HSV	K	MU	SLP	WC
Popular House (0-15 years)	E	YRD	TS	UDF	HSV	K	MU	VD	SLP	EXT	WC
Intermediate House (16-59 years)	TS	UDF	EXT	VD	E	YRD	HSV	K	MU	SLP	WC
Traditional House (60 years or older)	E	YRD	VD	TS	EXT	UDF	K	MU	HSV	SLP	WC

Note: The darker areas show space-use patterns that fall into the integrated side of the houses, while the lighter areas show space-use patterns that fall into the segregated side.

Although in most cases spatial patterns are dominant, there are some functions that behave differently. The RRA values of these spaces occur in variation patterns among the three house groups. The different arrangements of verandah, household service and external spaces identify the significant changes in spatial patterns.

Verandah space in the traditional houses is highly integrated, whereas in popular

houses it falls into the segregated domain. RRA values tend to decrease for newer

houses. The results indicate the transition of spatial uses that are influenced by the house

design and physical arrangement. In traditional houses, verandah space is large and open

space where various domestic activities occur, but in newer houses the area becomes

smaller and serves as a private balcony, which is generally located adjacent to bedrooms.

Hence, the change of size and location influences spatial organization as well as the

domestic use pattern. Meanwhile, the household service space has an interesting

transition. In older houses service quarters are in the segregated domain, but they

become more integrated spaces in newer houses. The needs of privacy for women who

perform household chores tend to decrease. The change of pattern in household service

spaces reflects the change in women's roles. Women who are the primary users of space

are more exposed to society and tend to have closer and friendlier contacts with their

neighbors and strangers. External space also has a similar tendency. In older houses it

tends to integrate with all functions. RRA values of external space shift significantly to

the segregated domain in newer houses. Although in the intermediate houses external

space may slightly move to the integrated domain, it still is evident that the spatial pattern

in the popular house indicates the need for an extremely high degree of privacy. A

significant transition in the spatial pattern reveals the change of living spaces. Since the

design and spatial arrangements were based on housing in urban areas, newer houses

clearly reflect the pattern that is built to accommodate the urban lifestyle. Table 5-8

shows that the popular houses are isolated from the outside world. In contrast, the spatial

pattern of older houses evidently responds better to an agrarian society in which people have a close relationship with their neighbors.

Traditional house

A consideration of the results for each group indicates that traditional houses provide a deep integrated structure of spatial pattern. Most spaces are located in the integrated domain. Among all spaces in the household, only the household service, sleeping and toilet spaces are considered as segregated spaces. An extremely integrated pattern of domestic spaces reflects a cultural experience of an open and friendly society. The pattern of the traditional houses suggests a women-centered structure which reveals mainly around household tasks, especially cooking and taking care of children. Women who act as wives and mothers are the primary users of space, and therefore control most domestic chores. The deep structure of the integrated domain also reveals the nature of the lifestyle experienced by the house's inhabitants. People tend to relax and often socialize with their neighbors. Spatial pattern associates closely with agrarian society in which most neighbors are considered as relatives (Nardsupa and Lertwicha 1998). In traditional houses, family living space, multipurpose and kitchen act as the connectors and separators between the integrated and segregated domains. Only household members are allowed to occupy segregated spaces.

The mean depth shows a slightly different pattern from integration values. The kitchen becomes the shallowest space, while toilet and sleeping spaces consistently locate to the deepest side (Table 5-2). The significant changes in the depth level of the kitchen and house yard present a dominant transition of spatial pattern. Both spaces have a

strong association with traditional lifestyle. The results indicate that outdoor space is an integral part of village life in traditional houses.

The more integrated spaces tend to be in more shallow spaces in the house structure; there are eating, yard and transitional spaces, while segregated spaces are the deeper ones, including household services, sleeping and toilet space (Table 5-5). However, integration values in some spaces are not directly related to spatial depth. Food preparation space is considered relatively segregated space, but it occurs at the shallowest location in the house structure. Therefore, a decrease in depth does not always mean an increase in integration. The low level of correlation between integration and depth confirms that the spatial pattern of traditional houses is loosely structured. In this case, depth level that directly influences the number of spaces and separates space by a partitioning system has no significant impact on the integration. The structure of the house pattern indicates a flexible use of space. Traditional houses normally have a small number of spaces. It is possible that the same space accommodates different activities that occur in different time periods of the day. The privacy in traditional houses depends on timing rather than on the partitioning of spaces. The degree of flexibility provided by a spatial structure also reflects social orientations of domestic experience. The loosely defined structure of traditional houses indicates that they are social in character rather than private.

<u>Intermediate house</u>

The pattern of RRA values presents a distinctive difference from the other two. Domestic spaces of intermediate houses in Figure 5-9 (a) show the highest values of RRA. The integrated spaces accommodate communal and leisure spaces where various

types of daytime activities occur, such as transition, under floor space, verandah and house yard. These spaces function as mixed-use areas in the house. The results from RRA values reflect spatial patterns that are influenced by new types of houses built during this period, including shop houses and houses in the high style copied from other regions. The under floor space plays an important role as public and socializing space where the house's inhabitants encounter outsiders, particularly for buying and selling goods. Often the house owners spend a great deal of time in the shop space while performing other activities in the same area. Intermediary spaces where integrated spaces are separate from the segregated ones mainly accommodate domestic chores such as household services and kitchen. The segregated domain has a similar tendency as in traditional houses. Sleeping and toilet spaces are strongly structured in a spatial type of personal needs.

The deep integration demonstrates that the structure of intermediate houses is accessible to visitors. Spatial pattern reflects hospitality and invitations into the house because the integrated spaces serve multifunctional purposes and flexible use for different domestic activities. However, because the houses have the highest RRA values in most spaces among three house groups, the degree of accessibility for a visitor to enter spaces becomes more difficult. In fact, the house owners are likely to be aware of the privacy and security needs. Meanwhile, it is also possible that depth level directly affects the integration of the house. The correlation of integration and depth confirms that the shallow spaces are the most integrated ones, and the segregated spaces occur spatially deeper in the house. The structure of intermediate houses strongly determines spatial arrangements. In this case, a number of spaces play an important role in the house

structure in order to distinguish spaces by their requirement and nature of activities. The houses built in this period are more complex in terms of construction systems and the styles acquired from other social groups. Spatial pattern indicates that intermediate houses are built to serve private life rather than social life. The strong correlation suggests that spatial structures do not allow flexibility in their use because most spaces are confined by a partitioning system. Spaces may be divided within defined boundaries and need special furniture and equipment for people to perform activities such as shop space and kitchen. As a result, spatial pattern of intermediate houses is directly related to spatial depth.

By considering the results from depth level in Figure 5-10 (c), it is possible to determine that most spaces in intermediate houses present a higher level of integration and depth, compared with traditional and popular houses. The shallowest spaces that are the most integrated occur at more than 3 steps from the house entrance. At an intermediary depth, kitchen and service quarters are located at the level of 3.4 to 3.6 steps from the entrance. Spaces demanding privacy, including sleeping and toilet, have extreme location in the deepest areas where the most segregated spaces exist.

Popular house

The mean RRA and depth for most spaces in popular houses show the lowest values in the sample. The integrated spaces are eating, yard and under floor space, considered as communal and socializing spaces. On the other hand, the segregated spaces are provided for personal needs such as sleeping and toilet spaces. In Figure 5-9 (a) and Figure 5-10 (a), verandah and external spaces are shown to have an interesting common characteristic. Both spaces significantly fall into the segregated domain. This reflects

that impacts of the physical transformation are from a new design of the house. More than 85% of popular houses acquire their patterns from suburban housing which is designed and built by real estate companies. The style and spatial arrangements are based on an urban lifestyle which tends to need more privacy for special uses. As a result, the integration of external space presents an extremely high segregation from most spaces, which shows a completely different spatial experience from previous groups. Table 5-8 shows a shallow core of integration which means popular houses are deep structuring spaces. External space is ranked second among the most segregated spaces in the house. The placement of external space corresponds to the demand for privacy. The arrangements of domestic spaces confirm a design that responds strongly to urban living pattern. Meanwhile, the observation of integration values for verandah space also identifies the design implication of the physical arrangements. As mentioned earlier, verandah for traditional houses is a large and open space provided for multifunctional purpose, while in popular houses it is much smaller in size, and transforms to a balcony serving only a private bedrooms (Figure 5-13). The pattern of verandah space shows a significant transition from the traditional house as an integrated space to a segregated one in popular houses. Like other house groups, intermediary spaces are kitchen and multipurpose space used for domestic chores and family living spaces.

In popular houses, spatial depth directly correlates to integration values. Spaces that need a high degree of privacy such as toilet and sleeping space tend to have low integration and high mean depth. The depth level of the popular house shows a high consistency in which most spaces appear to create a similar pattern across the sample. Although the spatial pattern is dominant, external space is different from all other spaces.
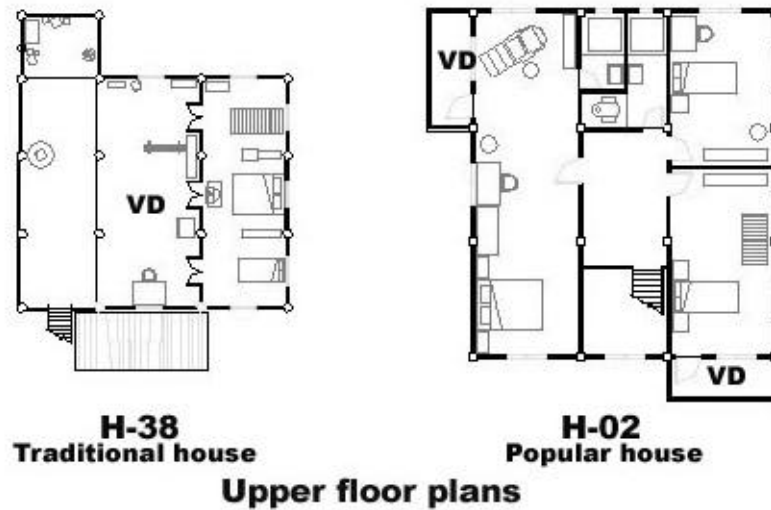
Figure 5-13. The comparison of verandah space in the floor plans of traditional and popular house.

In Figure 5-9 (b), the line of mean depth that normally locates to the bottom suddenly shifts to the top when it reads to identify for external space. The results indicate a strong relationship between depth and integration that the segregated spaces are the ones with a high value of depth. Among three house groups, external space in popular houses locates at the deepest position.

The strong correlation suggests that spatial structure has very little flexibility. In fact, it has the highest correlation among all house groups. The integration, depth and their correlation reflect the spatial pattern of popular houses. Because the design of the popular house provides for urban life, originally influenced by western culture, the need for privacy is a fundamental principle of newer house design. In order to achieve the goal of meeting needs for privacy, the house spaces must have a greater variety of spaces

for specific uses. Increasing the partitions directly affects the segregation of spaces and, consequently, both the number of spaces and depth levels are increased. As a result, the spatial structure of popular houses strongly determines functional arrangements.

<div align="center">Spatial Configuration and Social Change</div>

As discussed in the previous sections, the change of spatial configuration in the sample across time reflects social and cultural contexts that are influenced by physical arrangements. Integration is a key aspect of the syntactic parameter that indicates the social content of architecture and reveals the arrangement of domestic spaces. Although the genotypes from each house group exist with similar properties, there are some spaces that indicate a great variation among three groups.

The genotype of the traditional house shows a deep core integration that indicates a strong connection between the interior and the exterior. The houses are not isolated from the outside world. Spatial pattern offers a great flexibility for household activities. The privacy in these houses is a matter of timing, not a segmentation of spaces. The various activities occur in diverse locations. There is no specific boundary to divide them spatially. The results indicate that the spatial pattern of traditional houses corresponds highly with an agrarian way of life. An extroverted character presents a close connection with outdoor life and their neighbors. Among the three groups, the household service space in traditional houses indicates the highest level of privacy needs for women to perform their chores. Family living spaces such as multipurpose, service quarters and kitchen are the center of daily activities in the household. These spaces compose the place where all family members meet, including men, women and children. The spatial

pattern of the traditional houses presents a structure of "familism" emphasizing a sharing and close connection among house members.

In intermediate houses, the integration of the spatial genotype demonstrates the spatial configuration of the shallow node structure, or alternatively, a deep core of integration. The houses are characterized by a highly integrated interior. In this case, transition, under floor and external spaces act as a place where visitors and house members encounter. A very shallow node of structure among intermediate houses represents a strong extroverted pattern. This characteristic reflects the social aspects of the houses built in this period. After the first development of infrastructure in 1939, new social groups have migrated into the study area, including Chinese, Vietnamese and people from other regions. Different house styles as well as new materials and construction technology were introduced to the indigenous group. New styles[1] and designs, such as shop houses, high style and institutional style were built by different groups of immigrants. Despite the variations of house styles influenced by various groups of designer and builders, the integration shows that there are some consistencies among certain spaces that appear to create the spatial pattern of intermediate houses. A group of integrated spaces, such as transition, under floor and external space, structures the configuration regarding communal needs. The placement of external space in the genotype indicates a spatial type of the extremely shallow node structure. The house's inhabitants tend to have closer and friendlier contacts with their neighbors. Meanwhile, it is understandable that people from different regions were developing personal relationships between different social groups. An existence of weak bonding between

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[1] See more description of house styles in Appendix G.

homeowners and outsiders implies a high degree of social relations within the house structure. The integration of intermediate houses shows that spaces provided for household chores, eating, house yard, kitchen and service quarters are the center of the spatial pattern among intermediate houses. Moreover, the highest number of links to other spaces means the highest volume of spatial accessibility (Table 5-9). The house's inhabitants and their visitors often have an opportunity to encounter each other in intermediate houses. This type of spatial configuration suggests a strong correspondence of "socialism."

The spatial structure of popular houses presents a shallow core of integration, or a deep node structure. Despite a strong internal structure, the house creates a weak relation to the exterior. The placement of external space in the house genotype is relatively deep which represents its dominant segregation from the outside world. Most domestic spaces have lower integration than the external space. Therefore, spatial patterns of popular houses create a very strong boundary with the outside. The interfaces among family members and between inhabitants and visitors are very low. As mentioned earlier, most popular houses in the village were based on suburban housing projects and the standard design for public housing distributed by government agencies. The design of spatial arrangement is based on a dense and more populated house in urban areas. Consequently, the houses tend to demand more privacy and need a variety of spaces for specific uses. As a result, popular houses appear to have more partitioned spaces in order to increase the degree of privacy to a desired level (Table 5-9).

Table 5-9. The comparison of physical features among three house groups.

House Category	Physical Features			
	Age Range (Years)	Number of Rooms	Number of Spaces	Number of Link to Other Spaces
Popular House	4 months - 15	6.47	17.26	19.53
Intermediate House	18 – 58	4.60	17.17	21.39
Traditional House	60 - 100	4.50	15.75	19.25

The integration and the correlation indicate that the spatial pattern of popular houses strongly structures functional arrangements and disconnects the interior from the exterior. Spatial structure does not allow flexibility because it occurs in defined boundaries. This spatial type has a high segregation in order to keep internal relations from outsiders. People are spatially separated from each other. The results confirm that a high degree of spatial segregation found in the popular houses is a dominant pattern in urban societies. This spatial type emphasizes "individualism" and independence.

Parallel to the findings by Pader and Kent, the relationship between house design and social relations is fundamentally intertwined with the partitioning system and domestic space use. When people change the way in which they use and organize spaces, the social mechanics are affected by those alterations (Pader 1993 and Kent 1991). The findings from this study confirm that the physical transformation of vernacular houses over time influences the cultural behavior of the house's inhabitants.

Configurational Properties: The Relations of Physical and Behavioral Patterns

In this study, the spatial configuration of vernacular houses indicating both physical arrangements and domestic experience is investigated. Consideration of the

spatial patterns, those established physically and behaviorally in the house samples, can

expand the understanding of built spaces in a more practical way. The study of

functional logic beyond a morphological approach by asking the house's inhabitant who

is cultural insider provides critical information about the way that people live. It has been

shown that architecture is designed to serve people' needs and the arrangement of spatial

layout is ordered for supportive environments. Therefore, the house design which does

not respond to its occupant will eventually cause problems.

     The results from both analyses are presented in Table 5-10. Certain functions

tend to create a pattern and configurational properties. Spatial ordering and arrangement

are related to spatial requirements and the nature of activities performed in those spaces.

Activities that need a high degree of privacy tend to occur in segregated spaces and deep

Table 5-10. The summary of spatial configuration

User's Experience (Front-Back Location)		UDF	VD	HSV	YRD	K	E	MU	SLP	WC
Spatial Arrangements	Depth From the Entrance	E	UDF	K	YRD	HSV	MU	VD	SLP	WC
	Integration	E	UDF	YRD	VD	HSV	K	MU	SLP	WC

location. Active activities seem to take place in spaces with high integration and low

mean depth. Even though the arrangement of domestic spaces may have a similar

pattern, there are some differences between the placement of physical positions and

spatial experience. Sleeping and toilet are spaces with a strong correspondence in both

physical and behavioral preferences. Both spaces are highly segregated spaces,

physically located at the deepest side of the house structure, and perceived as being the

back of the house. The physical arrangement of space responds strongly to people's experience; therefore, the pattern of both spaces is satisfied by their users. For the house yard, under floor and multifunctional space, the locations of spatial configuration slightly change. For example, the location of yard space is physically and conceptually similar, but the integration creates a slightly higher degree of integration between the inside structure and the outside. In this case, it is conceivable that people are likely to accept or harmonize their lifestyle with the physical transformation of these spaces. Domestic spaces that shift their locations within the same side, either integrated or segregated domain, are considered as the ones that have potential for physical alterations during the occupancy of spaces. Household services and kitchen may need to modify the existing structures in order to reach the deserved level of privacy and location. Spaces with significant conflict between the physical structure and the use of space present a strong rejection by occupants because spatial arrangements do not accommodate both the need for privacy and the perception of users. This case includes eating and verandah spaces.

The correspondence of configurational properties from physical arrangement and domestic experience produces an empirical knowledge that helps in understanding the impacts of change influenced by design possibilities and behavioral conditions. Despite the great variations of physical arrangement among the house samples across time, the analysis of the effects of physical transformation shows that continuity and change of built spaces may acknowledge the social nature of space and its evolution. The study of configurational properties expands the use of spatial data in the interdisciplinary study, including social, psychological and behavioral research, and at the same time, assists the

selection of design choices by the speculated conclusions from practical information and a systematic approach.

Conclusions

In order to examine the change of spatial configuration from traditional to popular houses, the sample of 41 vernacular houses, selected from several construction dates, is analyzed in this study. The findings indicate that the change of physical features influences the configurational properties of the houses. The alterations of spatial arrangements from different sources of design reveal the change of spatial patterns among vernacular houses.

Although most spaces exist with similar pattern in the house, some peculiarities of the functions suggest the variations of different spatial properties. The size and location of the verandah directly influence the house characteristics and the configurational properties. The modification of household service space reveals the change in women's roles in the family. Traditionally the houses are structured around women' daily tasks but in recent years both men and women work outside their own home. Therefore, domestic spaces are designed to correspond with the change of lifestyle, and the analysis of spatial configuration in this study confirms those transitions.

The spatial structure of the sample is determined by domestic routines. In most cases the configurational pattern of space is arranged according to a basis of daily activities and their spatial requirements. Food preparation and household service spaces are the center quarters, while other activities spatially structure around. For public domain or the front of the house, functional spaces include under floor, house yard and eating space. These spaces accommodate daytime activities such as socializing,

receiving guests and working. These are flexible functions that can be performed in

diverse locations among public domain of adjacent spaces. Semi-private spaces are

located relative to the back, including verandah and multipurpose space. Both spaces

serve several functions for family living. The innermost structure is private space where

toilet and sleeping spaces are consistently located in all types of spatial configurations.

In addition, the examination of external space reveals a significant change of

spatial structure. The pattern of arrangements among different types of house design

reveals an underlying order that governs the way space is arranged. Spatial patterns in

older houses are more welcome and friendlier to visitors, whereas newer houses provide a

different experience of space. The analysis of configuration indicates that the

dissimilarities among spatial arrangements reveal different impacts from the house

design. Traditional houses are openly structured with high flexibility in their uses. The

house design closely corresponds to the agrarian lifestyle. In contrast, newer houses are

spatially isolated from the outside world. Their spatial structures are the direct result of

urbanization process; users are influenced by other society members rather than the house

owners.

With regard to physical transformation, the change of spatial configuration

directly reflects social and cultural changes. The results from this study acknowledge the

findings from previous research that architectural spaces and society intimately link to

each other. The study also suggests that the changes of physical arrangements occur in

order to create environments that support a new lifestyle and accommodate social

changes. The transformation of spaces over time establishes the relationship between

spatial properties and functions. A syntactic investigation of vernacular living spaces in

terms of spatial configuration not only addresses the behaviorally significant properties of

space, but also expands the understanding of social phenomena.

CHAPTER 6
CONSIDERATIONS BEYOND SYNTACTIC ANALYSIS

Although the previous chapters contain a discussion of spatial configuration that considers some physical aspects and domestic experience of vernacular houses, there is a variation of socio-cultural factors that may influence the change of spatial patterns in the sample. These refer to aspects of family and society, economic status, religious beliefs and value. In this chapter, the discussion explores the relationship among the spatial patterns of the three categories—traditional, intermediate and popular, and the socio-demographic characteristics of the sample. The analysis involves quantitative data from some subjective variables that potentially influence the physical transformation of domestic spaces. In addition, some objective approaches, including the expansion of space and house styles, are also included in this section.

Socio-demographic Characteristics

Household Income

The economic status of the house owner is one of the factors that contribute to modifying existing spaces and constructing the new ones. Figure 6-1 shows a great variety of household income levels. Among the three groups, the majority of traditional houses are the highest income level, while popular houses are the lowest. The household income in popular and intermediate houses shows a wide range. The majority of income level in popular houses is between 10,000-20,000 baht /year, while a few houses have an income at a level higher than 40,000. Most income levels of the intermediate house

range from 30,000-35,000 and a few houses have an income level much lower than

10,000 baht /year. The traditional house group is the highest income group, ranging from

35,000-45,000 or higher. The results indicate that households with good financial

resource own the traditional houses, whereas those with the lower income occupy the

newer houses. Therefore the level of household income is not the indicator for the

acquisition of new houses. The decision to construct a new house is likely to depend on

personal taste and attitude towards a new form of living spaces rather than a

consideration of the use of spaces.
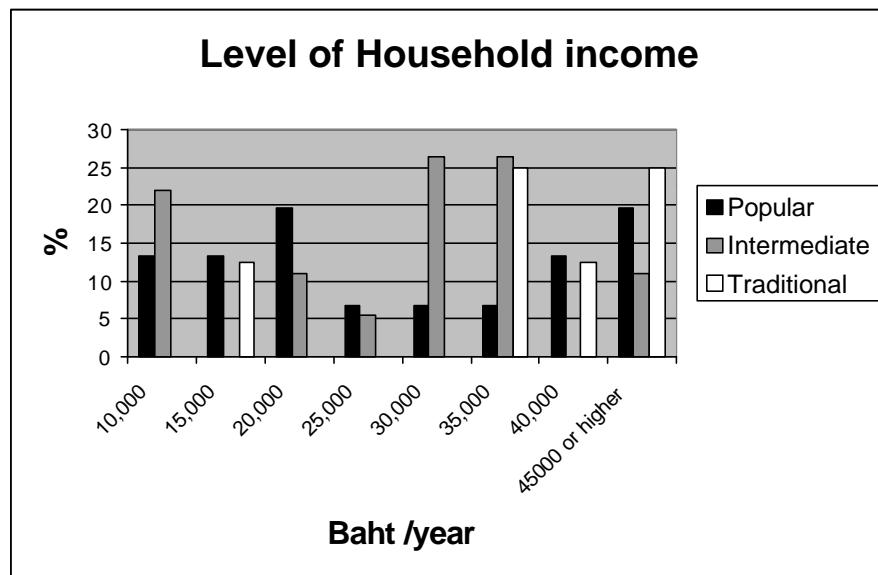
Figure 6-1. Household income of the sample in three age categories.

Educational Level

There are strong similarities in the educational level found across the sample.

More than 75% of inhabitants graduated at the elementary school level,[1] which is the

minimum level required by the government. It is quite usual that after people graduate

from elementary school they begin to work for a living, particularly for those who live in

an agrarian society. Among the three groups, the population of occupants in the popular

houses graduate at the highest level; 26.5% of them earn the Bachelor degree and 7%

earn a diploma from vocational schools. The educational level might relate to the change

of attitude about how people see themselves. People with a higher education tend to have

more opportunity to experience the urban lifestyle—during school years or while

working in neighboring districts. The opportunities for this experience occur because the

higher educational institutions are located in the city center, whereas local schools are

distributed near a smaller scale of settlements. Therefore it is possible to say that the

change in people's attitudes contributes greatly to their acquisition of a newer house.

Education is one of many factors that can relate to the change of living patterns and

physical characteristics.

Family Type

Although the results from family type are not quite significant, they present an

interesting transition among the three groups. Sixty-seven percent of popular houses are

single-family household. On the other hand, more than 60% of intermediate houses are

extended family households that have more than one generation of family members living

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[1] In Thailand, educational level is ranked from the lowest to the highest as following, kindergarten, elementary school, secondary school, junior high, high school, vocational school, four years collage and advance collage levels.

together in the same house. However, in the traditional houses the number is equally divided between the two family types. The findings demonstrate that, to some extent, the family type is moving towards being a nuclear family when the new house is occupied. When people decide to live in a new house, it appears that social and cultural values have changed. The design choices and physical arrangement of the house are influenced by those who have adopted a new way of living.

Type of Ownership

The acquisition of the house contributes to the change of kinship relations and the way people obtain their houses. Most traditional houses are inherited from the owner's predecessors who were the household head's parents or grandparents. Thirty-seven percent of all were built by the house owner (see Table 6-1). Intermediate houses are acquired in different ways, including built by owner or a construction company, by purchase and by inheritance. Most intermediate houses were built either by collective labor or professional builders. Sixty-seven percent of popular houses were built by construction companies. The percentage increases dramatically in newer houses. This indicates a significant change of cultural traits. The house once was an essential link from older to younger generations, but its symbolic value is now decreasing. Traditionally, people have a strong feeling for family belongings and high respect for their predecessors. When the house is built by a construction company, the sense of togetherness among neighbors and family members declines. It can also be explained that the process of house design is likely to shift away from the social life of local contexts. From rural to urban ways, the transmission of spatial pattern underlying the domestic structure of vernacular houses has been gradually altered by external forces.

Without the transference among family kinship, it appears that older houses tend to be
demolished and replaced by constructing newer houses on the same location.

Table 6-1. Comparison of number of occurrence among three house groups.

|	Popular House	Intermediate House	Traditional houses
Socio-demographic Characteristics			
Household Income (x 1,000 Baht per Year)	45K, 20K > 40K, 15K, 10K > 35K, 30K	30K, 35K > 10 K > 20K, 25K	45K >40K, 25K >10K
Educational Level	Elementary > Bachelor > Secondary > Vocational	Elementary > Secondary >Bachelor	Elementary > Bachelor
Family Type	Nuclear > Extended	Extended > Nuclear	Extended = Nuclear
Number of Occupant	4 > 2, 3, 6 > 1, 5	5 > 3, 4 > 6	5 > 2 > 7, 3
Occupation	Farmer > Officer > Laborer > Housewife > Retailer	Farmer > Retailer > Housewife > Laborer	Farmer, Laborer >Housewife, Officer
Type of Ownership	Built by company > Bought built	Built by owner > Built by company > Inheritance	Inheritance > Built by owner
Physical Characteristics			
Expansion of Spaces	No expansion > Kitchen > Garage > Living space	No expansion > Verandah > Toilet > Garage	Toilet > Kitchen, Verandah > Living space
House Style	Contemporary > Institutional	High style = Tradition > Shop house = Institutional	Traditional > High style
Outbuildings	Yard > Stable > Granary > Garage > Toilet	Granary = Yard > Toilet	Yard > Toilet > Granary
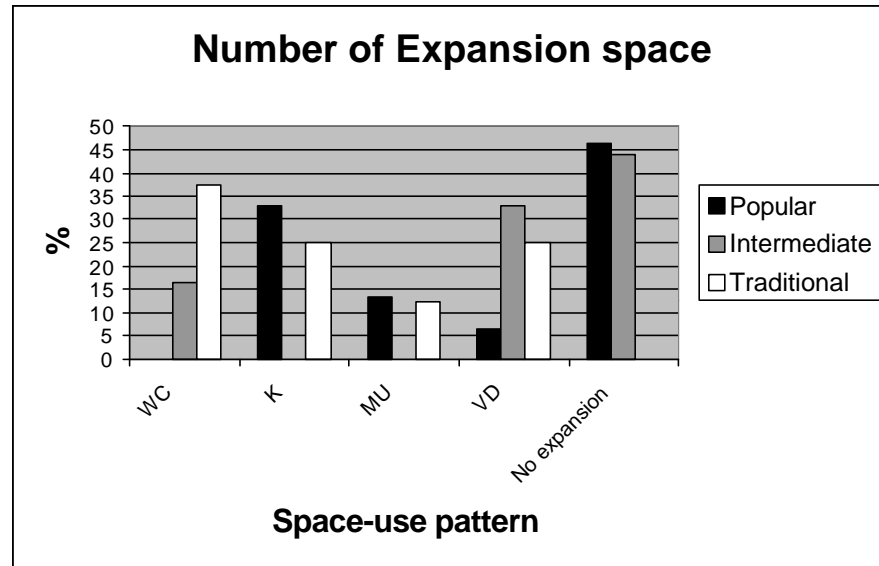
Figure 6-2. The expansion of domestic spaces in three house categories.

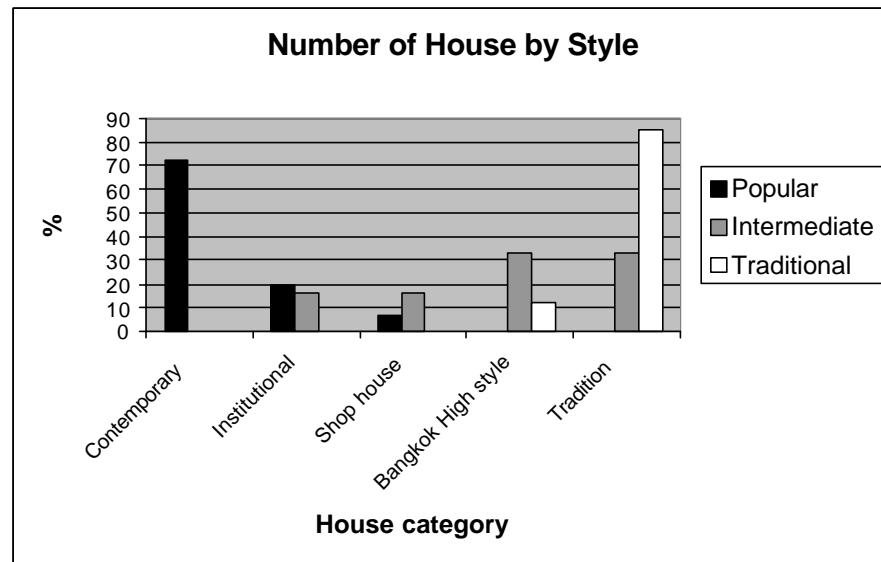
Figure 6-3. House styles associated with different construction dates.

Physical Characteristics of Spaces

Expansion of Domestic Spaces

Figure 6-2 demonstrates that all traditional houses were altered, whereas

approximately 50 % of both intermediate and popular houses were modified. Those

findings support the basic observation that domestic spaces in traditional houses older

than five decades need modification of their original design in order to accommodate the

change of lifestyle. Most alterations occur in toilet and bathing space, verandah, kitchen

and multiple-use space. Traditional houses need physical changes in all categories of

space. Toilet space is most often changed, because the houses were originally built

without toilet and bathing area. Verandah is the most modified space in intermediate

houses, while popular houses often need to adapt kitchen and multipurpose space. It is

obvious that the alteration of domestic space aims to provide supportive environments in

each house type. The physical transformation in older houses occurs because it involves

the change of cultural contexts and space-use patterns. Nevertheless, the expansion of

domestic space also relates to the economic factor which is a direct impact of physical

alteration.

Construction Dates and Categorization of Styles

As mentioned in previous chapters, the investigation of spatial configuration in

this study focuses on vernacular houses built in different periods. The analysis is based

on the physical arrangement of space rather than on the appearances of the houses.

Figure 6-3 demonstrates that different construction dates also influence house styles.

Five styles[2] are determined according to physical characteristics: contemporary,

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[2] See the description of house styles in Appendix- G.

Number of years built

Village establishment

150

Built the first road

60

Legend:

Traditional ●

Bangkok High Style (Hipped roof) ○

Shop House □

Institutional ▨

Contemporary ■

Began to separate the
house lots

15

The younger migrate to
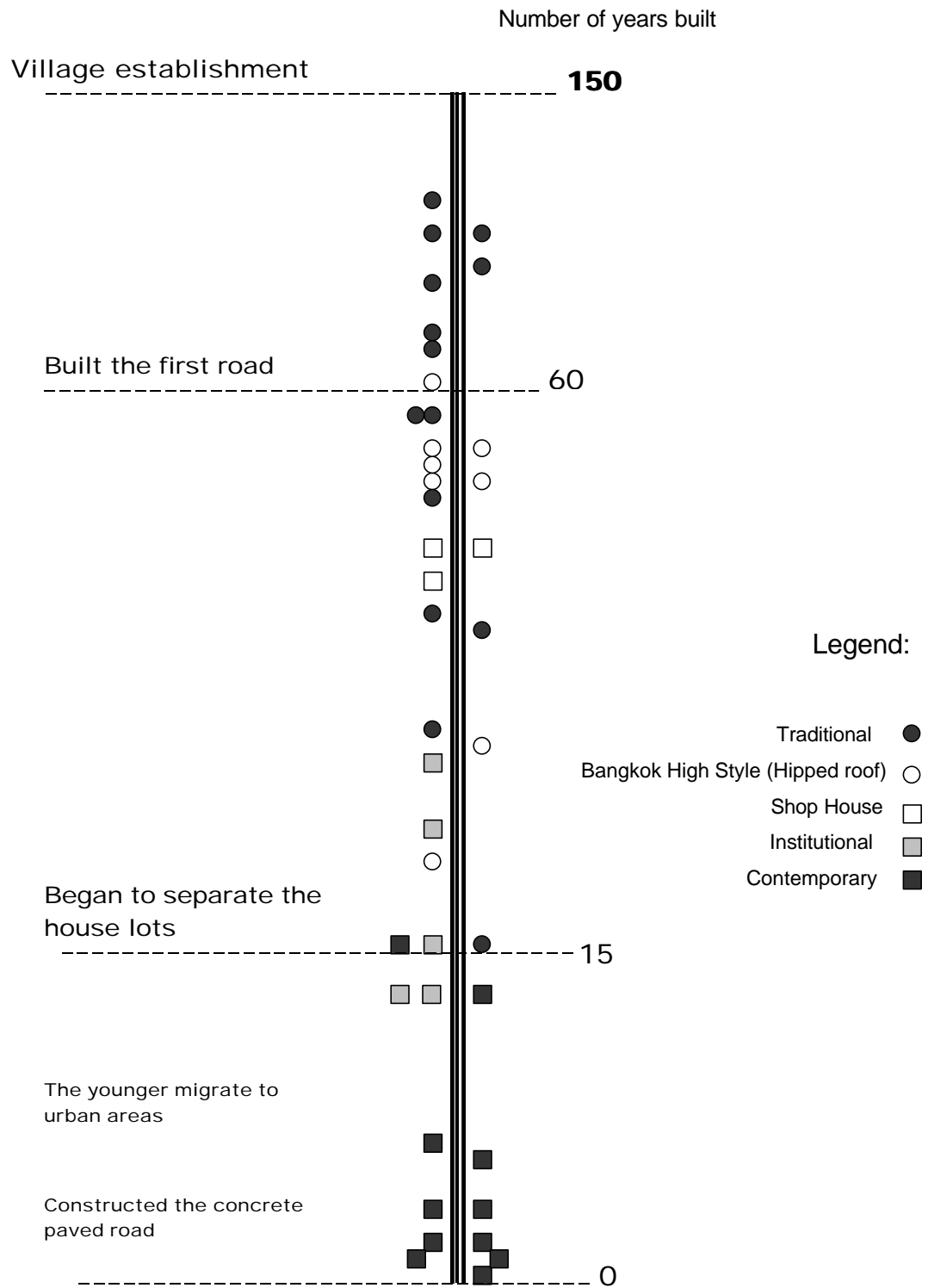urban areas

Constructed the concrete
paved road

0

Figure 6-4. Diagram of stylistic development through timeline.

institutional, shop house, Bangkok high style, and traditional. The results show a strong

relation between both variables. The traditional group is defined by the characteristics of

traditional and Bangkok high style, while the intermediate group produces a wide range

of styles. Traditional, high style, and shop house are the dominant characteristics. The

popular group contains examples of the contemporary and institutional style. Thus, the

period during which a house was built is a significant factor in its style and arrangement.

As to an overall observation in the study area, in recent years people have been

constructing their houses according to standards of appearance rather than in response to

basic needs. Since the transition of house styles responds closely to the trend of popular

taste in a particular time period and to the impact of external factors, the form and spatial

use of vernacular houses continues to be influenced by a rapid growth of global

modernization. The findings of this study show that the dynamic of housing transition

persistently involves the framework of style and design. Figure 6-4 confirms that the

change of house style strongly corresponds to the major development of the study area

and socio-economic impacts. Consequently, the physical transformation of domestic

spaces clearly follows the change of style influenced by these external factors.

<div align="center">Summary: Continuity and Change of Vernacular Living Spaces</div>

The transition of spatial configuration from traditional to popular houses

corresponds to many factors, including planning policies, income and social status of

household members. The main factor contributing to the process of urbanization in

northeast Thailand is the development of the economy and technology. Generally, this

occurs due to influence from the impact of the national development program proposed

by government agencies on local communities. The involvement in public planning

unintentionally introduces new attitudes and different types of housing. The expansion of

infrastructure constantly leads to changes in the community fabric. Most rural villages

have begun to transform their existing patterns, responding to the growth of a

transportation network and the supply of electricity and piped water. The improvement

of these necessities promotes the change of people's attitudes and lifestyle. People are

inclining towards a technology-based and convenience-oriented lifestyle. The perception

of a good life has turned to what already exists in urban areas, including the attitude to

develop their living environments.

The access of transportation makes the village life more convenient. Rural areas,

once remote and isolated from the outside world, are now joined to adjacent local

districts and towns where governmental centers, marketplaces and grocery stores are

located. People who used to go out seeking food in neighborhoods and eat what is

available in the village are now going to nearby towns where an abundance of supplies

sell in the market. Daily activity, such as leaving the house and walking to the village

square to buy daily supplies, exchange fresh food and chat with neighbors, has changed.

Most families own vehicles to accommodate the need for traveling. Meanwhile,

producing rice only for family consumption does not provide enough money for

increasing expenses and demands. The attitude toward working in the agricultural-

oriented environment as family industry has shifted to favoring industrial-based jobs,

working as a laborer in factories and business establishments that provide a monthly

salary, enough income for living expenses. In fact, getting a job in an urban area has

become an honored accomplishment by younger people. The older men who no longer

actively work often enjoy their days outside the house, perhaps in a village neighborhood,

spending time socializing. Women, in their roles as wives and mothers, are the primary

users of space both in their houses and in the community. Women's time is structured

around activities at home, including domestic tasks and loom weaving or handicrafts.

Girls are either at school or taking care of younger children and helping with chores.

Adult men might sleep and eat at home, but they usually work outside--in the field,

factory or local businesses.

In recent years, domestic routines of the family have changed. When the piped-in

water supply is available at home, it is no longer necessary for women, who once went

out to meet their neighbors at the community well, to fetch water for daily routines.

Some who went to the village reservoir for a bath and washing have now acquired a

washing machine and stay at home. Some may stop making homemade fabrics for

clothing because it is more convenient to buy clothes in the market than to weave them at

home. The use of a house yard containing many jars to collect rainwater for drinking and

cooking, and to conserve for use through the year, is no longer required. Younger

women increasingly work outside the home for pay. The amount of time spent at home,

engaging in daily routines and socializing with other women has dramatically decreased,

including time for cooking in the kitchen. The change of daily routines clearly is

reflected in the spatial configuration of newer housing. The younger people, who live

and work in urban areas, are normally responsible for the extra expenses of the

household. When they acquire enough savings, it is quite usual in the village community

that the first thing they do is to build a new house for their parents and for future use as

the home for their own family. The idea of possessing a house like those seen in urban

areas strongly influences the attitudes those constructing new habitation and living

facilities. The desire for modernity and an urban lifestyle becomes a new trend and preferred taste in the community. Village communities where people have already enjoyed the outcome of urbanization welcome the new attitudes. The change of traditional contexts to urban ones gradually transforms the meaning of "togetherness" in the community to "individualism."

Although the traditional house has long been shown to be an intelligent model in terms of environmentally responsive design to local climate, lifestyle and social norms, the change of economic conditions, materials and construction technology appear to transform spatial and social aspects of house design. These changes may not involve a strong linear process of transformation but rather gradually develop through people's attitudes. The development of globalization is a process of progressive penetration of new attitudes and conception of space in order to accommodate the change of basic needs and lifestyles. The change of Thai vernacular houses to houses that accommodate a living pattern similar to that found in western culture may be limited by many aspects such as value systems, religious beliefs and poverty. There is always the effort to maintain a traditional form of spatial configuration and cultural pattern among new house types. For instance, despite being a rapid growth area, some Bangkok housing in high-rise apartments still provides a spirit house as a place for guardian spirits for each unit. Without a doubt, it is understandable that despite the change of spatial configuration, cultural values are uniquely interconnected with local ways. Consequently, the physical characteristics of vernacular houses haves also changed. To achieve a successful transformation, the house should not only be designed to accommodate functional purposes but it should also satisfy the local way of life. The recommendation for a

design approach that reduces architectural problems is to "think globally, act (built) locally" (Koh 1985). Many architectural problems occur because people think locally and act globally, or think globally and act globally, such as the imitation of architectural style and design from a universal approach to local contexts. Therefore, the design and construction process must respond to particular cultures, specific conditions, local economy, technology and social content.

CHAPTER 7
RECOMMENDATION FOR FURTHER STUDY

This study emphasizes the analysis of spatial configuration based on syntactic properties and domestic experience. The findings from this study reveal the underlying relations among domestic spaces and their uses and indicate that physical alterations of vernacular houses correspond to the change of daily routines and cultural content.

Although the differences among patterns of spatial organization from various construction dates indicate the dominant transition within the house samples in the study area, the results may allow only a moderate generalization to housing within other areas of Thailand, since there is a wide variation among Thai vernacular houses from region to region. However, the approach taken in this study might be applied not only to other towns with similar characteristics, but also replicated in other settings with a variety of houses so as to examine their differences and similarities. Due to the interdisciplinary nature of the subject, such research requires architectural investigators to think in interdisciplinary teams. While architects may approach housing from aesthetic, technological and organizational properties, anthropologists and archeologists may investigate the house as a cultural artifact that is related to family and social structure. Further investigation of vernacular houses can take on various perspectives that may link the consequences of house form and design to social and cultural features of space. In the following paragraphs, potential areas of future research are discussed.

Comparative Spatial Study

As mentioned earlier, Thailand is comprised of people from diverse cultures and historical backgrounds, which results in various patterns of housing across the country. The replication of methods applied in this study to investigate other parts of the country is essential to an understanding of the transition of spatial patterns and cultural attributes that may reveal the ways that people live and shape their houses.

Inclusion of Environment-Behavioral Research

The study of spatial configuration from architectural layouts complements behavioral science research on the way in which space is used. The relationship between human behavior and the physical environment is widely acknowledged within the social sciences- psychology, sociology and anthropology, and in design disciplines- architecture, urban planning and interior design. Since spatial arrangements mainly depend on the nature of activities and users, the study of things people do, including thinking, feeling, seeing and moving in spaces contributes to the development of knowledge and better design decisions. The process of reconsideration of the house after it has been occupied provides useful information which takes into account the user's view. Patterns of occupancy and spatial uses suggest the involvement of activity and its settings, such as the impact of furniture and decoration arrangements. The alteration of house spaces represents the change in the spatial pattern as well as the progression in the use of space.

In addition, it is particularly important to acknowledge the social nature of space and its symbolism and meaning in relation to the study of physical characteristics. The abstract components associated with vernacular houses such as the attitudes of occupants

appear to influence how people perceive their dwellings and intervene in the physical

transformation, either modifying existing houses or constructing a newer one. If the

popular houses are preferred as a model for future housing design, the study of an

appropriate design of spatial pattern must be considered. The thorough investigation and

comparative analysis of traditional and popular houses may yield information about how

both housing types properly relate to local people and settings.

This study is only a small step to creating a more complete understanding of

spatial evolution from the interdisciplinary content. The relation between domestic

spaces and their users is undoubtedly a large and complex issue. In order to evaluate

factors that might influence the change in the spatial pattern and behavioral conditions,

further investigation with intensive analyses based on specific criteria beyond this study

is recommended.

<u>Meaning and Value</u>

The results of this study indicate that people have different ways of ordering

domestic spaces. The user's front-back notion is applied to mean the difference of spatial

arrangements, which is different from the classification of private-public by outsiders.

The study of ideas and meanings in specific socio-cultural contexts remedies an

inadequate means of explaining the appropriation and uses of domestic spaces by the

analysis of physical contents (Lawrence 1981). A set of social meanings associated with

space and activity such as public /private, clean /dirty, day /night, dry /wet, provides a

configurational meaning of spaces. In traditional houses, the meanings of spatial

sacredness influence its organization. The rules of orientation and hierarchy among

domestic spaces such as east /west, head /tail, high /low, upstairs /downstairs, male/

female, contribute to the separation of the sacred from the mundane spaces. In contrast, spatial meaning of the design of newer houses is based on function and privacy needs- the more enclosed and segregated the space is, the higher the privacy. The ordering of spaces influences and reinforces the social value system. For example, the extended family is tightly bounded by a sense of togetherness. The shifting of spatial conceptions is a significant aspect to search for the continuation of form and spatial arrangement in the house design. These transformations of schematics around the spatial configuration are related to the morphology and social meaning of the house.

<div align="center">Material and Building Resources</div>

The change of materials and construction technology influences the house appearance, its characteristic and values. Most rural houses are dependent upon the availability of materials. Timber and all parts of trees including trunks, branches, bark, leaves and roots were abundant materials and widely used for traditional house construction. Once natural timber became a scarce resource, the use of new materials increased because they are available everywhere and offer a more permanent structure. Concrete block, brick, reinforced concrete, steel and glass considerably extend the life of houses and expand the builder's ability to partition and change the structural system. The difference in material properties shapes the process of spatial segmentation that potentially influences the complexity of spatial form and its configuration. Moreover, the change of materials also modifies the effectiveness of space, and consequently, has an indirect impact on the inhabitant's behavior. The results always lead to the physical alteration of existing settings for a more compatible occupancy.

The implications mentioned above are recommendations for further investigation of vernacular houses beyond the configurational approach as discussed in this study. The main investigation in this study is based on space syntax technique, which is applied as a useful tool for investigating the fundamental principles of spatial organization in order to develop theoretical understanding of relationships between social and spatial patterns. Hopefully, the information obtained through the application of space syntax will be useful in the design of situations that can answer the deeply felt traditional ways of people and respond to their lifestyle. However, in order to speculate on conclusions drawn from use of this technique, researchers must consider the limitations of space syntax. First, the use of this methodology requires exhaustive knowledge of the study area's history and its cultural background. The findings from configurational analysis can be a pitfall if investigator does not have enough information for accurate interpretation. Second, the investigator must have adequate computer skills to be able to use software for the calculations and the management of a large amount of numbers from syntactic values.

Configurational analyses using space syntax recently have been applied by researchers to support a variety of research inquiries and design applications. Applications from the space syntax approach have become more widely accessible and better established in the international research community. Still, there are different viewpoints about the use of space syntax as a planning tool in the design profession. Care should be given to the proper use of this technique as an integral part of design application. Investigators must be aware that research results are not answers to design solutions but rather they illuminate the design of architecture through an elaboration of

the underlying knowledge-base and through describing fundamental design choices and predicting consequences of interaction between the configurational design of buildings and social constraints. The ultimate goals of this study are: 1) to encourage investigators to find an interface between theoretical ideas and research; and 2) to see a coherent framework of methodologies applied in this study emerge as further applications of a new approach to a variety of spatial design are made. Substantial discussions from research findings can contribute to a better understanding of design formulation and generate an extensive database for the evaluation and the development of design ideas. Often the interaction between design and analysis will suggest new design solutions and introduce a theory and practical application of design decisions. The integration between theory, practice, research and teaching will provide an opportunity among researchers, educators and professionals in architectural fields and related disciplines or areas of inquiry to explore spatial configuration in a more systematic manner.

In academic environments, methodologies from this study offer an interesting model for use in architectural research and in the creation of design approaches based on research knowledge. The study of vernacular design offers a useful body of evidence that helps to construct concepts and models, which can be the bases for informed and inspired design studios and lecture courses. The concepts and value systems can be transformed and configured for educational activities. To establish new attitudes for the next generation of architects requires educators to be concerned with a visually based design with accompanying verbal discourses. A variety of discourses provides a more comprehensive combination of skill, knowledge, technology and imagination that shapes new ways of expression in architectural design. The development of a curriculum should

present students with experience of architecture as an integrated knowledge that focuses on both research findings and the process of design. In addition, an analysis of spatial configuration obtained through the investigation of architectural morphology is a systematic approach that can be developed and applied for teaching process in design classes. The use of the morphology diagram in the design studio can help students to find appropriate applications of design.

The designs of vernacular houses are created from certain concepts, spatial patterns and functions generated through local process and rules. By using these houses as architectural exemplars, the instructor can put together an educational vehicle that can help students to assimilate the various kinds of knowledge and guiding principles. This gives students the opportunity to enter into the world of local community so that they will create designs with critical awareness of people and local architecture in their minds.

For professional designers, vernacular houses can be sources of information and inspiration in developing design attitudes in creative ways. This study not only has increased knowledge and understanding of the changes in vernacular living spaces, but also cultivates a deeper appreciation of design based on local values. Professional designers need to be trained with greater understanding and appreciation of local principles so that the achievements of vernacular design can consolidate design fundamental with modern times. Defining and refining new concepts as tools of design approaches can revolutionize housing design, and architects can benefit from this architectural evolution. The approach to searching for identity in contemporary design by blending the best of tradition with the new is an excellent way to explore different directions of vernacular houses in today's society. Results of the integration between the
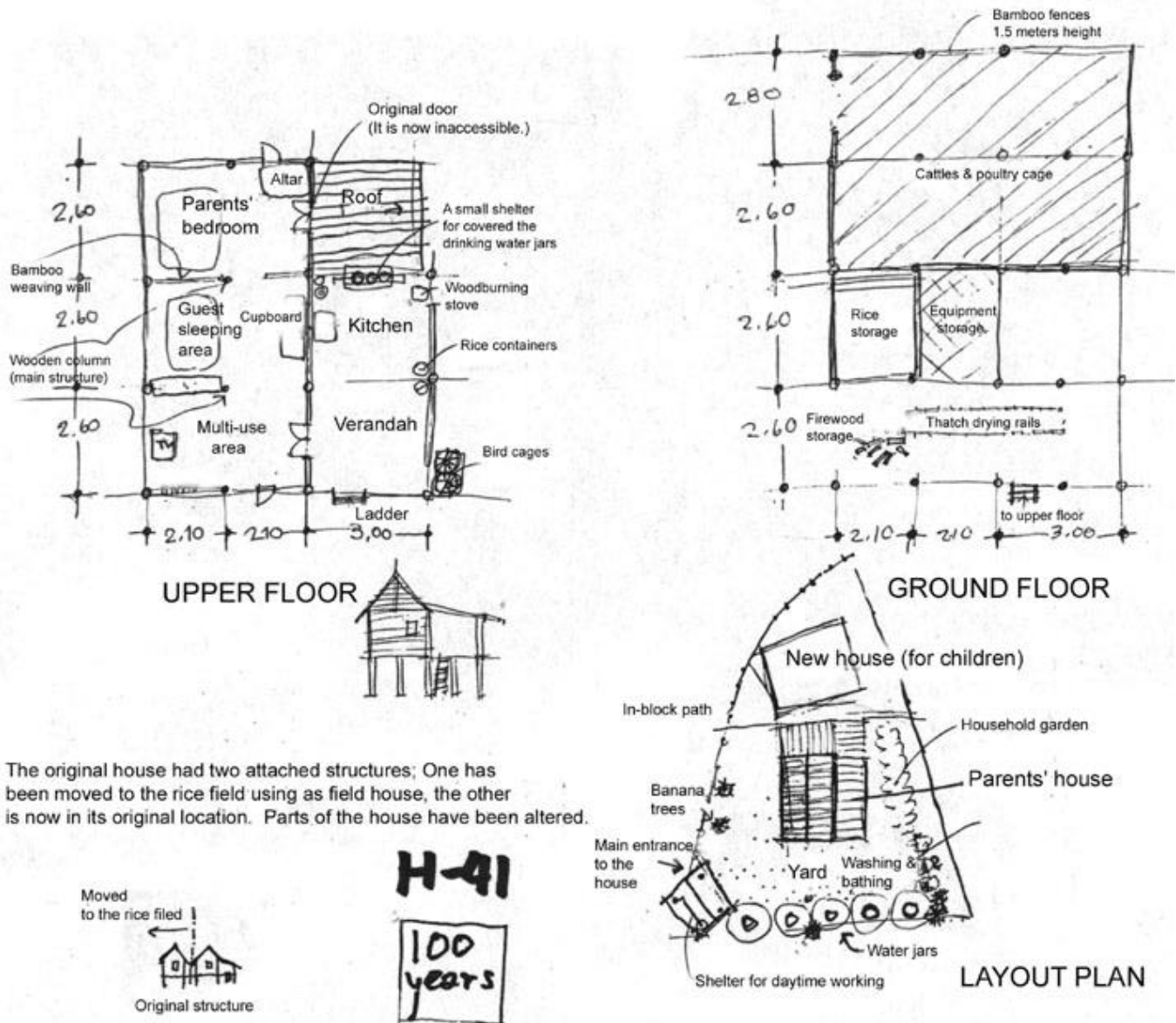
vernacular and architectural practices allow the transitions between the formal and informal practices so that "architectural heritage represents all living condition, enables the vernacular to keep abreast of the modern trends and the architects to benefit from the collective genius of vernacular" (Aysan & Teymur 1990: 297).

Focusing on the transition of configurational design of vernacular houses through a period of time can potentially help to bring about the emergence of a new order that is at least partially rooted in prevailing traditions. In fact, the most successful works in contemporary architecture are likely to be those that abstract from the past and project a vision of the future onto today's trend. Findings from this study will encourage professional designers to reconsider the design of architecture created in and belonging to its region. The regional approach not only brings back a new life of traditional knowledge and technique, but also narrows the gap between the new and the old in order to harmonize the elements with beneficial materials and design from other places and to prepare appropriate models for a new challenge which points toward global culture.

While vernacular houses architecturally and conceptually change, the transition of spatial configuration often acknowledges the cultural traits and the creative wisdom of occupants. The findings from this study suggest that the changes of living spaces are influenced by the development of infrastructure in rural communities. The impacts of these changes tend to associate with the change of attitudes towards social and cultural contexts and, consequently, lead to physical alterations. Changes have occurred not only in house form and spatial configuration, but also in their symbolic meanings. It is important that the provincial government needs to consider their planning policies in order to enhance appropriate developments to support basic needs and, at the same time,

allow local inhabitants to maintain their way of life without necessarily changing their livelihood. The use of results from this study and future research can influence the direction of public planning policy in trying to get the local administrative governmental units to recognize the value of vernacular houses. The continuous assessment of planning programs with regards to the consequences of changes in society and housing environments is recommended. Planning policies should strengthen local structures instead of attempting to assimilate them with the places in the rest of the country or in other parts of the world. Development should support economic independence and traditional values based on the availability of resources and local ways of life.

The original house had two attached structures; One has been moved to the rice field using as field house, the other is now in its original location. Parts of the house have been altered.

House Number: H-41

Note: All drawings were originally sketched with pencils and permanent markers. All descriptions in the house floor plans were written in Thai.

UNDER FLOOR SPACE

Washing
Toilet
Water jar
Raised wooden platform
Bathing area
Garden
Granary & chicken shed

UPPER FLOOR

Cupboard
Rice containers & cooking utilities on the floor
Kitchen
Wood burning stove
Dressing
Daughter's
Multi-use space
Area for watching TV
Parents'
Verandah
Ref.
Study area
Son's
Ladder
up
Outdoor terrace
Washing area
Screening door
Clothes hanging
Sleeping area
Step up 5 C.M. to veranda area

CROSS SECTION

H-38

72 years

House Number: H-38

DETAILS OF THE BACK TERRACE

SECTION

The house ENTRANCE

H-25

46 years

UPPER FLOOR PLAN

GROUND FLOOR PLAN

NOTE:
Toilet is in yard area, near neighbor's home.
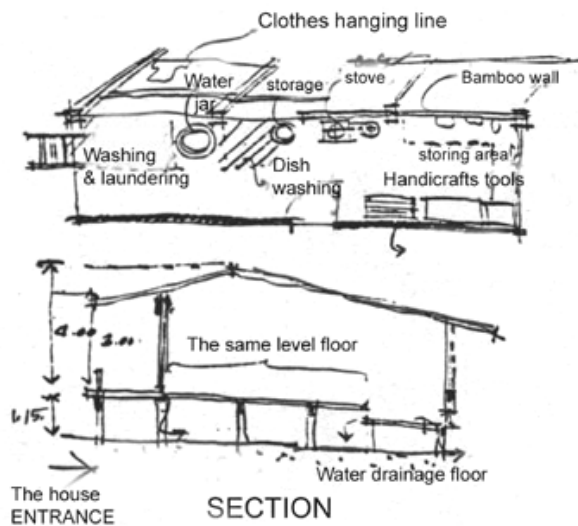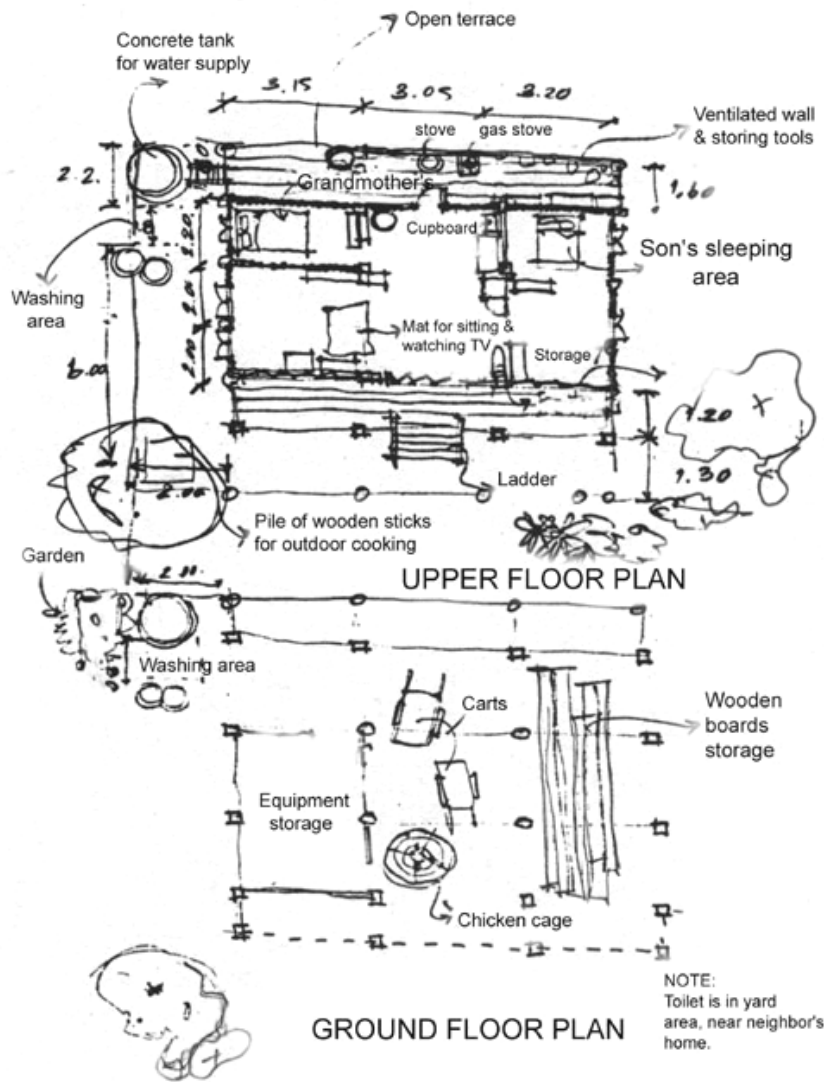
House Number: H-25

GROUND FLOOR

Concrete block walls

Bathing & Washing

Corrugated iron door

NOTE:
Most of the under floor space use for storage purpose

Cupboards

Raised wooden platform

Cooking

Water jar

Water jar

Platform to the upper floor

Wooden column

Water jars

UPPER FLOOR

H-22

40 years

Buddha altar

20 c.m. higher than the verandah

Sleeping space

Cupboard

Daughter's bedroom

Corrugated iron walls

Verandah

Mat

Wooden platform

The house's entrance

Open terrace

Bamboo weaving walls

House Number: H-22

10.00

6.00

Household garden

3.00

Concrete pave

Son's room

Bedroom

Granary

Washing area

Dishwashing

Banana trees

Dining

Living area

3.5

Ground for gardening

Car parking

Platform

Banana trees

Shoes rack

Sliding gate

Water tank

3.50 3.50 3.00 1.29

GROUND FLOOR PLAN 18.00

H-16

18 years

Daughter's bedroom

Roof

2.50

Parents' bedroom

3.50

Working space

1.50

UPPER FLOOR PLAN

Balcony for drying clothes

House Number: H-16

GROUND FLOOR

Wooden columns · Cupboard · Closet · Ref. · Gas stove · Laundry machine

Household garden

Kitchen · W.C

Storage

Cupboard

Piles of wooden boards

Raised wooden platforms

NOTE:
The house has no fence.

Cupboard

Rice granary

A layer of concrete block floor

Washing area

Pergola

Yard

UPPER FLOOR

Roof

Inaccessible door
(for future expansion)

Multi-use area

TV

Roof

Cupboard

Bedroom · Bedroom

H-01

4 Months

House Number: H-01

APPENDIX B
QUESTIONNAIRES

The following pages are the example of questionnaires used for data collection in the filed work.

```
┌─────────────────────────────────────────┐
│  Interviewer Name……………………..…..        │
│  Date……………………………………           │
│                                         │
└─────────────────────────────────────────┘
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PART 1
QUESTIONNAIRE 1
Brief Information of the Building and Occupants' Daily Activity List

Section 1: Building information

- Street Address……………………………………………………………………………
- Location of the building in the village (Interviewer marks or colors the building's location in the aerial map which is attached in the back of this questionnaire.) ………………………………….
- General description of building's existing condition (specify)…………………………………………………………………………………… …………………………………………………………………………………………..

- Building type and style (Check all that apply)

  ☐ **Traditional**
  ……A single story building
  ……A building with outbuildings (rice barn, animal shed, groundwater well,…)
  ……Group of buildings (Extended family with the additions)
  ☐ **Governmental-designed plan**
  ☐ **Contemporary or Popular style**
  ……with fence surrounded
  ……enclosed under floor space
  ☐ **Others**
  ……Temporary shed
  ……Field house
  ……Shop house or row house (Specify the present use)
  ……(Specify)……………………………………………….

- Date of construction……………………………………………….

Section 2: Informant's Information

      Name………..……………Last name…………………………….

      Sex   ……Male ……Female

      Age …………..yrs.   Occupation……………………………

Section 3: Daily Activity List

(Interviewer reads the following instruction to the informant.)

" Please list all activities that you participate in everyday or on a regular basis. You can mention as many as you like or can recall"

Interviewer marks those that apply in front of each activity provided in the table, or takes note on detail in the provided space below.

Types of activities perform in Domestic Space

Sleep	Chant	Drink water	Kids care
Wake up	Smoke	Drink	Feed animal(s)
Shower	Cook	Chat	Water plant s)
Brush teeth	Prepare food	Chore	Gardening
Toilet activity	Breakfast	Dish washing	Handicrafting
Dress	Lunch	Laundry	….
Stroll	Dinner	Ironing	….
Sex	Snack	House cleaning	….

Other Activity

Field work	Watch movie	Sport /Exercise (specify)	
Go to temple	Watch TV.	Read	Nap
Go to market	Listen to music	Talk on phone	Relax
Job-related work	Sing	Read letter	Other (specify)
Go downtown	Dance	Eating out	……………….
Drive car	Chat with neighbors		……………….

Remarks:

Note on the additional details

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

Thank you for participating in this study.

<div style="border: 1px solid black;">

Building Coded Number

………………………………..

</div>

PART 2
QUESTIONNAIRE 2
Building Information and the Use of Domestic Spaces

Section 1: Information about Informant

- Sex …….Male …….Female
- Age ……………years
- Marital status:
  …….Single ……Married ……Divorced ……Widow
  …….Other(specify)………….
- Educational level……………………………………………….
- Occupation…………………………………………………
- Income……………………Baht/year
- Religion……………………

Section 2: Informant's Socio-cultural Information

(Interviewer reads the questions and fills information in the blank, or takes note whichever is necessary.)

Total number of occupants …………..
Each occupant information (Not including the informant)

Number	Sex		Age	Occupation	Relation to the Informant	Marital Status
	Male	Female				
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

Section 3: Building information and Background

- Date of construction………………………………………………………………..
- Street address   number…..….district number………street………………….
- Length of time that the informant has occupied this building……………years
- Type of ownership:
………owned ……….rented   ……….other (specify)……………………

    (If the informant owns the building, he /she needs to answer the following question)
- How did the informant acquire this building?
………inherited   …….bought it built   ……built it on land
………other (specify) ……………….

- Who designed your house?……………………….
- Who constructed your house?…………………….
- Please specify the changes or additions that you made since you moved to this house.
………extensions of the building (specify which part)……………………………….
………reconstructed parts of the building (specify which part)……………………….
………redecorated finishing (specify)……………………………………………………
………no change
- Approximate area of the land lot………………………Square Warh.*
- Approximate area of household agricultural land………………Rai*
(*1 Square Warh is approximately equal to 44.36 Square feet and 1 Rai is around 0.4 Acres)

Section 4: The Use of Building Spaces

(Interviewer can also sketch or note the answer of the following questions in the sketch floor plan, if needed, then attach along with section 5 in this questionnaire.)

- Present use of this building:
……...Private residence   ……...Shop house   ……...Others (specify)………………
- Which part of the building is used for receiving guest or relatives?
(specify) …………………………………………………………
- Identify the space(s) that are used as eating areas for
    Breakfast ……………………………………………….
    Lunch …………………………………………………..
    Dinner …………………………………………………….
- Which part of the house has the size or area that is not enough to perform domestic activity?
(specify)………………………………………………………………………………
- Has the occupant ever borrowed space from neighboring house(s) to expand for a family occasion?
If the answer is yes, please identify which type of activity that space is normally borrowed …………………………………………………………………………….

- Identify outbuildings that have been used in the household. (E.g. granary, toilet, bathroom, animals' shed, ...) If the use of them is different from its original function, please specify any new function or an additional activity of each one in the list that follows.

1. Outbuilding function ………………….additional activity or function ………………...
2. Outbuilding function ………………….additional activity or function ………………...
3. Outbuilding function ………………….additional activity or function ………………...
4. Outbuilding function ………………….additional activity or function ………………...
5. Outbuilding function ………………….additional activity or function ………………...

- Specify the space where some or all of ceremonials or religious activities are normally performed during the special occasion.
  …………………………………………………………………………………………….
- Is there any space in the house that is individually separated or designated for each of the family members?
  If the answer is yes, please specify where, when and which type of activity that is performed in each space in the following list.
  1. area/space ………………activity performed ………………..when………………...
  2. area/space ………………activity performed ………………..when………………...
  3. area/space ………………activity performed ………………..when………………...

- Do the different seasons influence the space where the family stays in this house?
  If the answer is yes, please specify the length of time that your family stays in places other than this house.
  From (specify) month ………………………to (month) ……………………….
  And, where? (specify the place or location) …………………………………...

Section 5: Sketch Floor Plans and Lay Out of the Building

(Interviewer sketches floor plans of this building in a separate paper provided on next page, then takes notes from an observation describing written details on floor plans including making a checklist in section 6 table.)

Section 6: Occupant's Activity and the Use of Domestic Spaces Checklist
(Interviewer makes the appropriate marks in the blank space where the observation on the use of space and activity corresponds.)

Space in floor plan / Activity	Under floor space	Outdoor space	Eating space	Verandah	Toilet/Bathing space	Multiple use space	Kitchen	Sleeping space	Transition space (hall or corridor)	Space for specific activity (specify)	Additional details
Bath											
Dress											
Eat											
Prepare food											
Relax											
Read book											
Chat											
Receiving guest											
Watch television											
Nap											
Sleep											
Dishes washing											
Ironing											
Clothes washing											
Drying clothes											
Job-related work											
Kids care											
Pray/ Chant											
Storing activity											
Vehicle parking											

PART 3
QUESTIONNAIRE 3
Spatial grouping

Interviewer reads the following instruction to respondents and records answers in the attached paper.

> "Thank you for participating in this study. In the following instruction, you will listen to a set of three words on each line. For each set, please select the word that is MOST DIFFERENT in meaning from the other two. For example, for the set
>
> HOUSE   WOMAN   BUILDING
>
> You would pick WOMAN, since it is the word most different in meaning. Here is another example:
>
> DOG   CAT   ROCK
>
> In this case, you would select ROCK.
>
> Please give an answer for EVERY set of three, even if you are not sure of the answer.
> DO NOT SKIP ANY sets: if you don't know the answer, just guess.
> Thank you."

#			
1.	EATING SPACE	HOUSEHOLD SERVICE	SLEEPING SPACE
2.	YARD	MULTI-USEM AREA	HOUSEHOLD SERVICE
3.	MULTIUSE AREA	UNDERFLOOR SPACE	EATING SPACE
4.	TOILET BATHING	FOOD PREPARATION	UNDERFLOOR SPACE
5.	FOOD PREPARATION	VERANDAH	SLEEPING SPACE
6.	HOUSEHOLD SERVICE	FOOD PREPARATION	TOILET BATHING
7.	MULTI-USE AREA	TOILET BATHING	SLEEPING SPACE
8.	TOILET BATHING	MULTI-USE AREA	VERANDAH
9.	EATING SPACE	YARD	FOOD PREPARATION
10.	SLEEPING SPACE	UNDERFLOOR SPACE	FOOD PREPARATION
11.	MULTI-USE AREA	FOOD PREPARATION	VERANDAH
12.	YARD	EATING SPACE	TOILET BATHING
13.	YARD	VERANDAH	SLEEPING SPACE
14.	FOOD PREPARATION	YARD	MULTI-USE-AREA
15.	MULTI-USE AREA	UNDERFLOOR SPACE	HOUSEHOLD SERVICE
16.	YARD	UNDERFLOOR SPACE	SLEEPING SPACE
17.	TOILET BATHING	UNDERFLOOR SPACE	YARD
18.	VERANDAH	HOUSEHOLD SERVICE	YARD
19.	EATING SPACE	UNDERFLOOR SPACE	VERANDAH
20.	VERANDAH	EATING SPACE	TOILET BATHING
21.	HOUSEHOLD SERVICE	TOILET BATHING	SLEEPING SPACE
22.	MULTIUSE AREA	EATING SPACE	SLEEPING SPACE
23.	EATING SPACE	FOOD PREPARATION	HOUSEHOLD SERVICE
24.	VERANDAH	HOUSEHOLD SERVICE	UNDERFLOOR SPACE

Answer sheet for questionnaire 3

Question number	Respondant-1 Name Age Sex Education	Respondant-2 Name Age Sex Education	Respondant-3 Name Age Sex Education	Respondant-4 Name Age Sex Education	Respondant-5 Name Age Sex Education
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
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23					
24					

Additional notes:

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

PART 4
QUESTIONNAIRE 4
Location of domestic spaces

Interviewer reads the following instruction to participant and circles the choice of selection for each space.

> "Thank you for participating in this study. I will read the list of household domestic spaces. For each space, please rank its possible location in the house from
>
> Most in the BACK (1)   to   Most in the FRONT or ENTRANCE (5)."

- Respondent Name……………………………………..
- Sex …….Male …….Female
- Age ………….years
- Educational level……………………………………….

	BACK	1	2	3	4	5	FRONT
1. Under floor space		1	2	3	4	5	
2. Yard		1	2	3	4	5	
3. Toilet / Bathing space		1	2	3	4	5	
4. Food Preparation		1	2	3	4	5	
5. Multiple use area		1	2	3	4	5	
6. Verandah		1	2	3	4	5	
7. Sleeping space		1	2	3	4	5	
8. Eating space		1	2	3	4	5	
9. Household service space		1	2	3	4	5	

Questionnaire 1

ผู้สัมภาษณ์....................................
วันที่สัมภาษณ์...............................

แบบสอบถามชุดที่ 1

ข้อมูลอาคารอย่างย่อ และรายละเอียดของกิจกรรมประจำวันของผู้ใช้อาคาร

ส่วนที่ 1 ข้อมูลทั่วไปของอาคาร

- ที่อยู่...:....

- ที่ตั้งของอาคารในหมู่บ้าน (ผู้สัมภาษณ์ทำเครื่องหมายลงในแผนผังที่แนบด้านหลัง)
  ....

- ลักษณะทั่วไปและสภาพของอาคาร
  (ระบุ)..
  ....

- รูปแบบอาคาร
  - ☐ พื้นถิ่น
    ......บ้านเดี่ยวหลังเดียว
    ......บ้านเดี่ยว และอาคารประกอบ (ยุ้งข้าว, คอกสัตว์, บ่อน้ำ, ...)
    ......กลุ่มเรือนหลายหลัง (สำหรับครอบครัวขยาย)
  - ☐ แบบจากหน่วยราชการ/เทศบาล
  - ☐ ร่วมสมัย
    ......มีรั้วล้อมรอบแปลง
    ......ปิดล้อมใต้ถุน
  - ☐ อื่นๆ
    ......ตูบ / เหย้า
    ......เถียงนา
    ......อาคารพาณิชย์ หรือ ห้องแถว (ระบุประเภทการใช้งาน)...................................
    ......(ระบุ)..

- อายุอาคาร หรือ วันที่ก่อสร้าง...

ส่วนที่ 2 ข้อมูลผู้ตอบแบบสอบถาม

ชื่อ...

เพศ ....ชาย ....หญิง

อายุ................................. อาชีพ...

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ส่วนที่ 3 ระบุกิจกรรมที่ทำในแต่ละวันที่บ้าน

(ผู้สัมภาษณ์ อ่านคำแนะนำผู้ให้สัมภาษณ์ปฏิบัติ ความดังต่อไปนี้)

" ขอให้ผู้ถูกสัมภาษณ์ (ระบุชื่อ) บอกกิจกรรมที่ทำในแต่ละวัน โดยที่ผู้ถูกสัมภาษณ์สามารถบอกผู้ให้สัมภาษณ์
มากที่สุดเท่าที่จะมากได้ "

ผู้สัมภาษณ์ทำเครื่องหมายด้านหน้ากิจกรรมที่ระบุ หรือบันทึกรายละเอียดลงในแบบสอบถามตามความเหมาะ
สม

กิจกรรมภายในบ้าน

นอน	สวดมนต์	ดื่มน้ำ	เลี้ยงลูก
ตื่นนอน	สูบบุหรี่	ดื่มเหล้า	เลี้ยงสัตว์
อาบน้ำ	ทำอาหาร	ทานข้าวนอกบ้าน	รดน้ำต้นไม้
แปรงฟัน/ล้างหน้า	เตรียมอาหาร	ทำงานบ้านทั่วไป	ดูแลสวน
เข้าห้องน้ำ/ส้วม	ทานอาหารเช้า	ล้างจาน	ทำงานหัตถกรรม
แต่งตัว	ทานอาหารเที่ยง	ชักผ้า	…
เดินเล่น	ทานอาหารเย็น	รีดผ้า	…
ร่วมเพศ	ทานของว่าง	กวาดบ้าน	…

กิจกรรมอื่นๆ

ไปไร่/ทำนา	ดูหนัง	เล่นกีฬา (ระบุ)..	…
ไปวัด	ดูโทรทัศน์	อ่านหนังสือ	นอนกลางวัน
ไปตลาด	ฟังเพลง/เพลง	คุยโทรศัพท์	นั่งเล่น
ไปงานหมู่บ้าน/วัด	ร้องเพลง	อ่านจดหมาย	อื่นๆ ระบุ…
เข้าเมือง	เต้นรำ/ฟ้อน	คุยกับเพื่อนบ้าน	……
ขับรถ	ออกกำลังกาย(ระบุ)	…	

หมายเหตุ

บันทึกอื่นๆ เพิ่มเติม

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ขอขอบคุณที่ให้ความร่วมมือตอบแบบสอบถามการวิจัยมา ณ.โอกาสนี้.

FLOOR PLANS, SITE PLAN, CONVEX SPACES, AND ACCESSIBILITY
DIAGRAM OF HOUSE SAMPLES

Label in Floor Plan

UDF   Under floor space

YRD   Yard and outdoor space

WC   Toilet and bathing space

K   Food preparation space (indoor and outdoor kitchen)

MU   Multi-use space

VD   Verandah space

SLP   Sleeping space (bed room)

E   Eating space

HSV   Household services space

TS   Transitional space (corridor, stairs and hall)

EXT   External space

P, pk   Parking space

w   Working space

pr   Prayer room

(a)

(b)

(c)

(d)
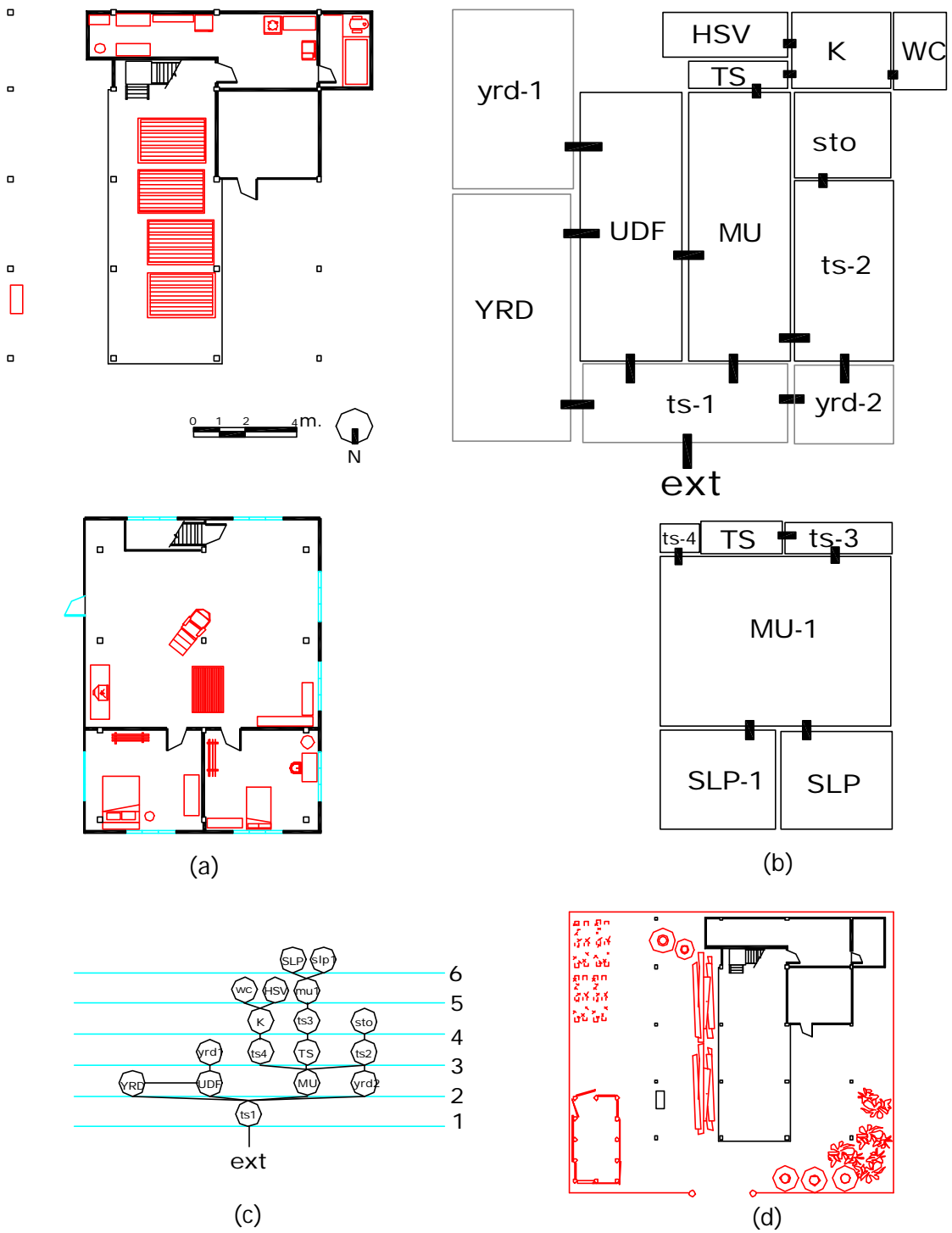
HOUSE 01

LEGEND:
UDF - Underfloor Space   YRD - Yard   WC - Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD - Veranda   SLP - Sleeping Space   HSV - Household Service Space
TS - Transition Space   ext - External Space   sto - Storage   pk - Parking Space   pr - Prayer Room
w - Working Space   ob - Outbuilding/ Barn   s - Social Space

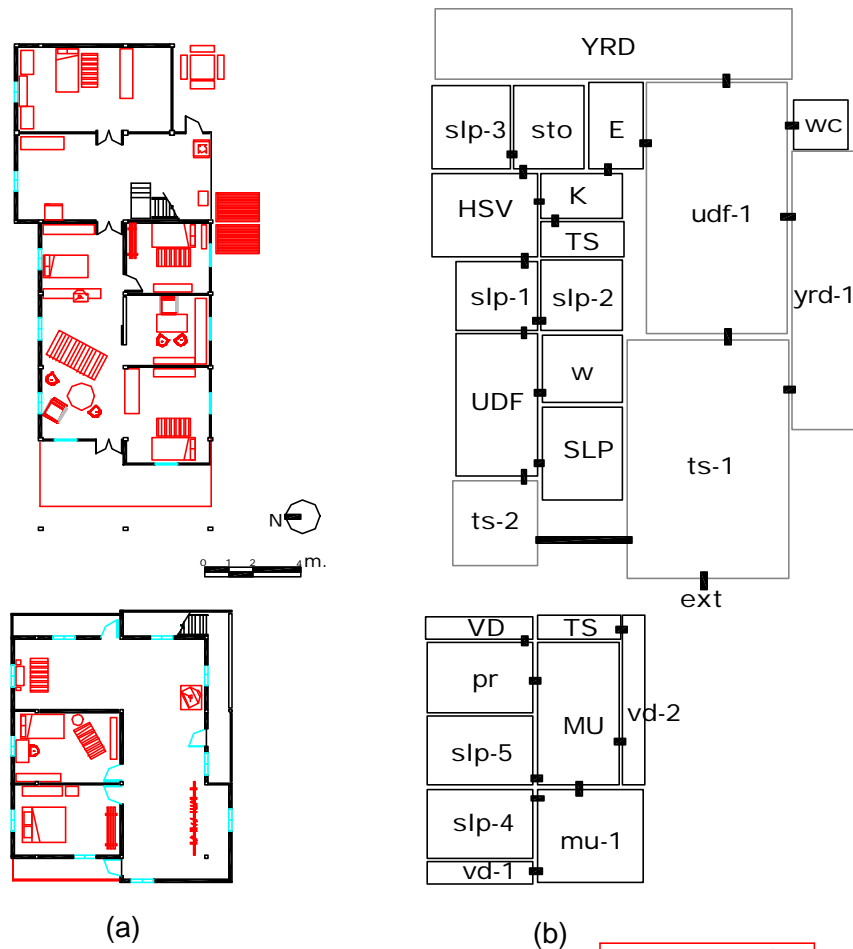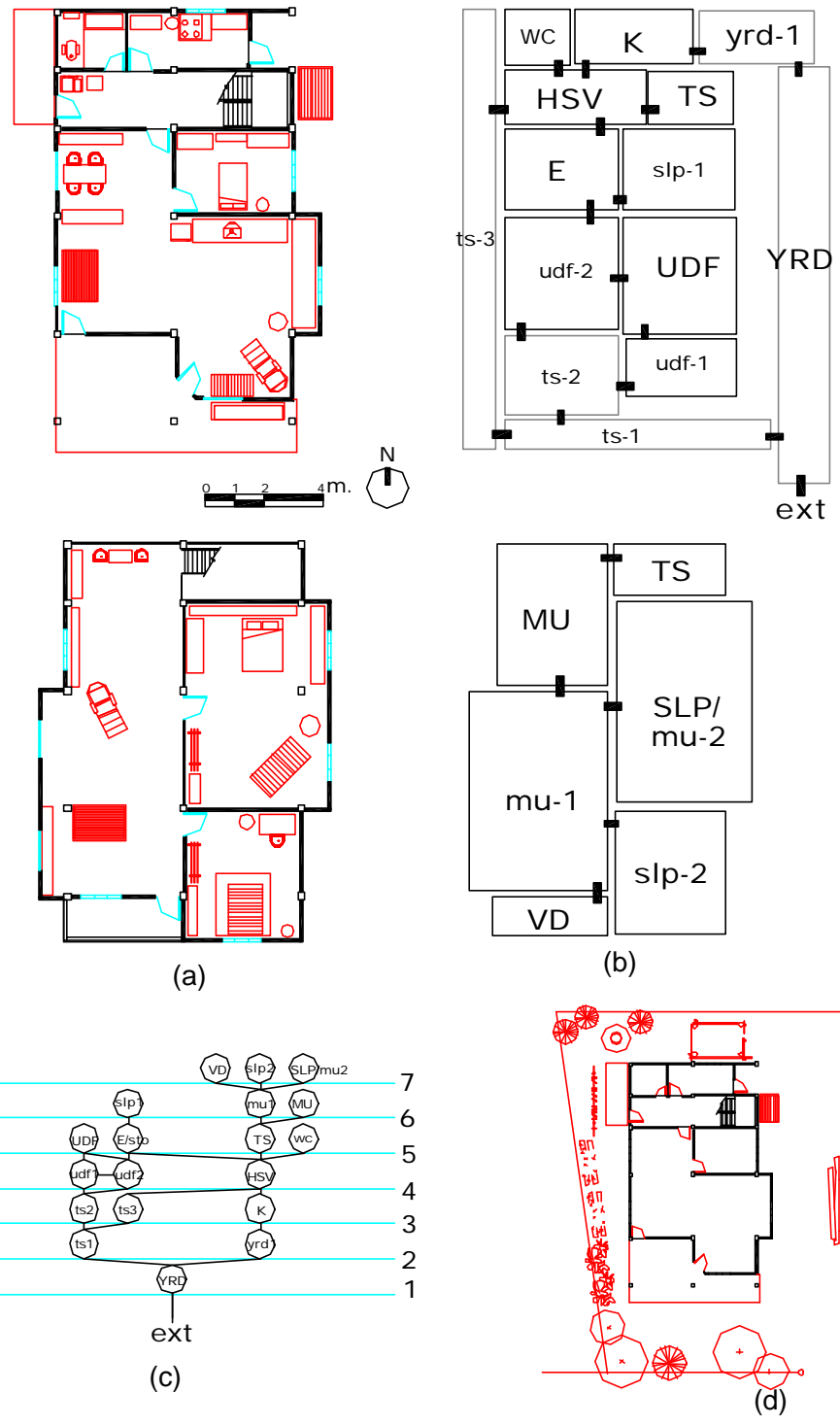a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
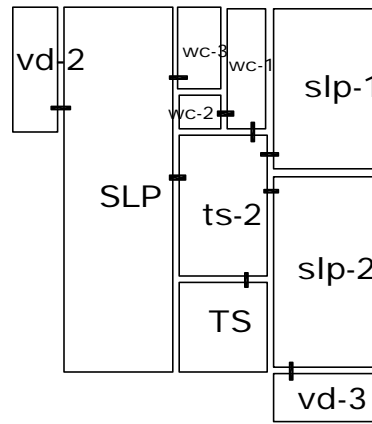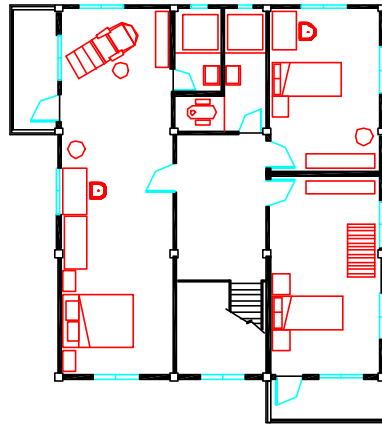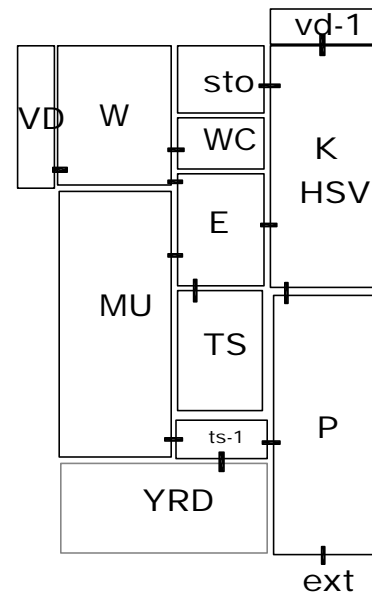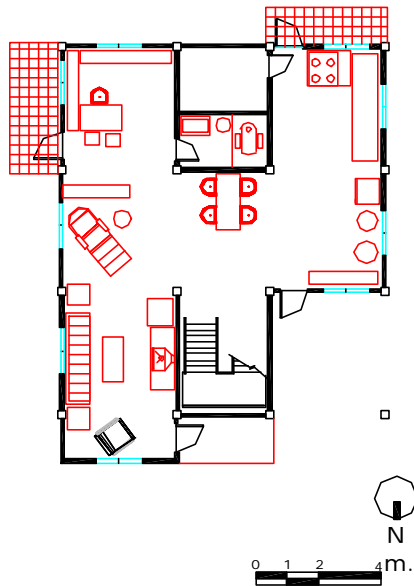
(a)

(b)
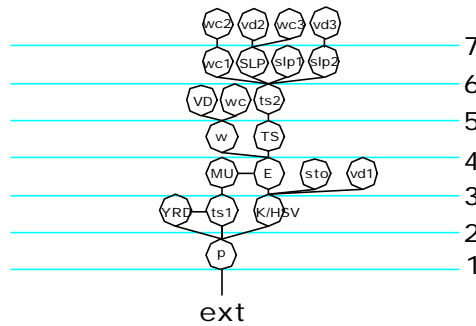
(c)
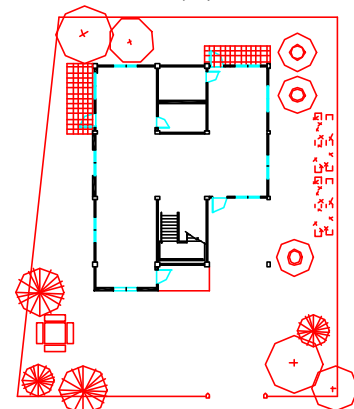
(d)

HOUSE

02

LEGEND:
UDF - Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext - External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

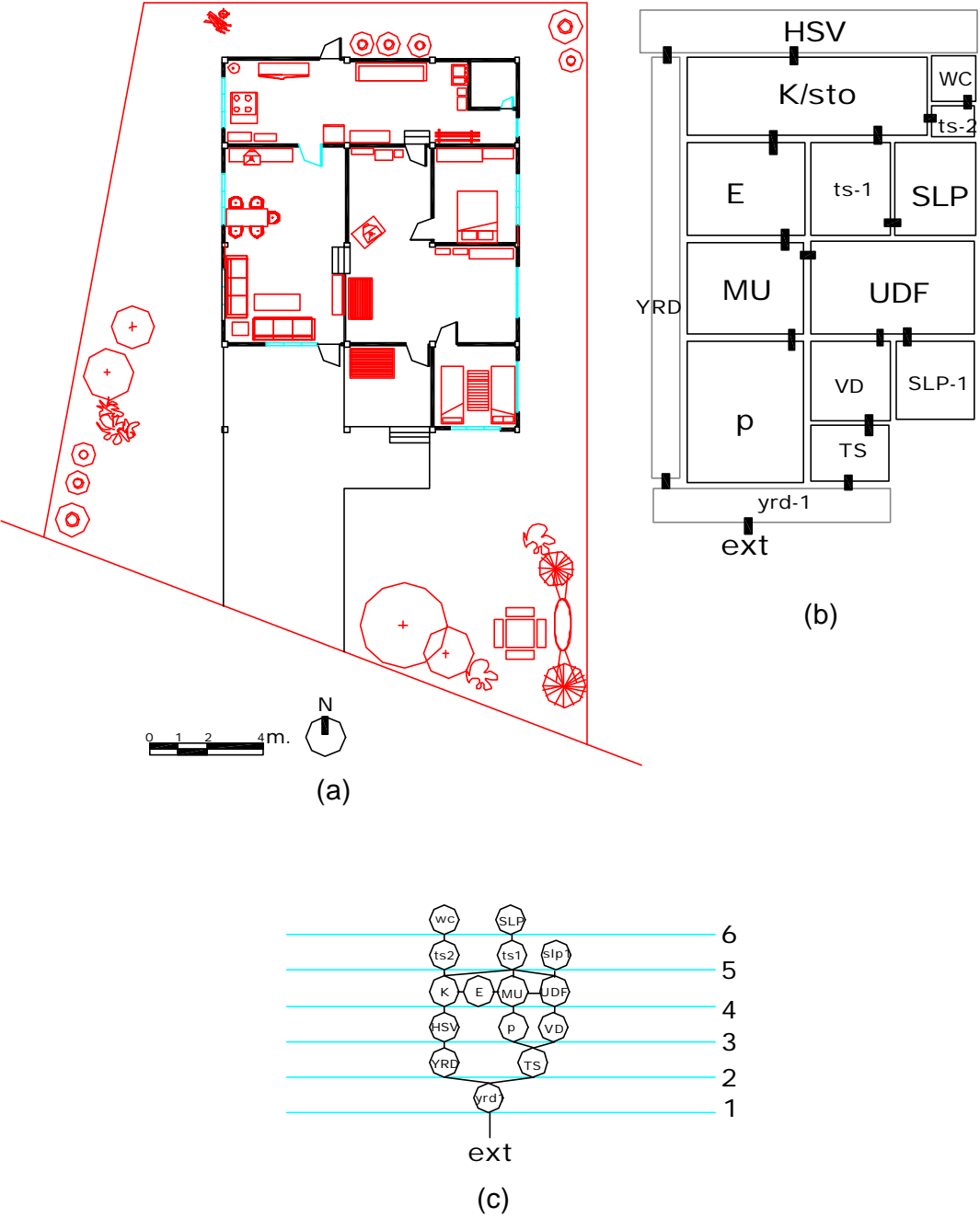a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

0 1 2 4 m. N

(b)

(c)

(d)

| yrd-2 | yrd-3 |

WC
K HSV ts-5
ts-4
slp-1
YRD ts-3 SLP
E ts-6
mu-1 MU
p
ts-1 ts-2 VD
yrd-1 TS
ext

6
wc
HSV ts4 SLP 5
yrd1 yrd2 K slp1 ts3 mu1 4
ts5 YRD E MU VD 3
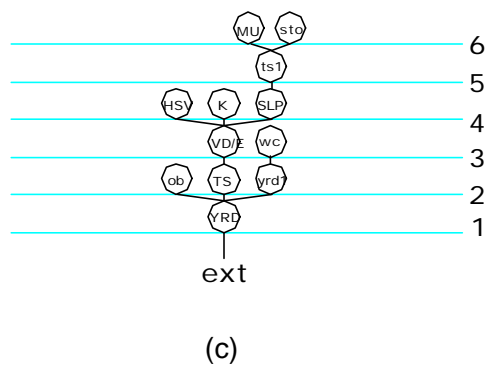ts6 p yrd ts1 ts2 2
TS 1
ext
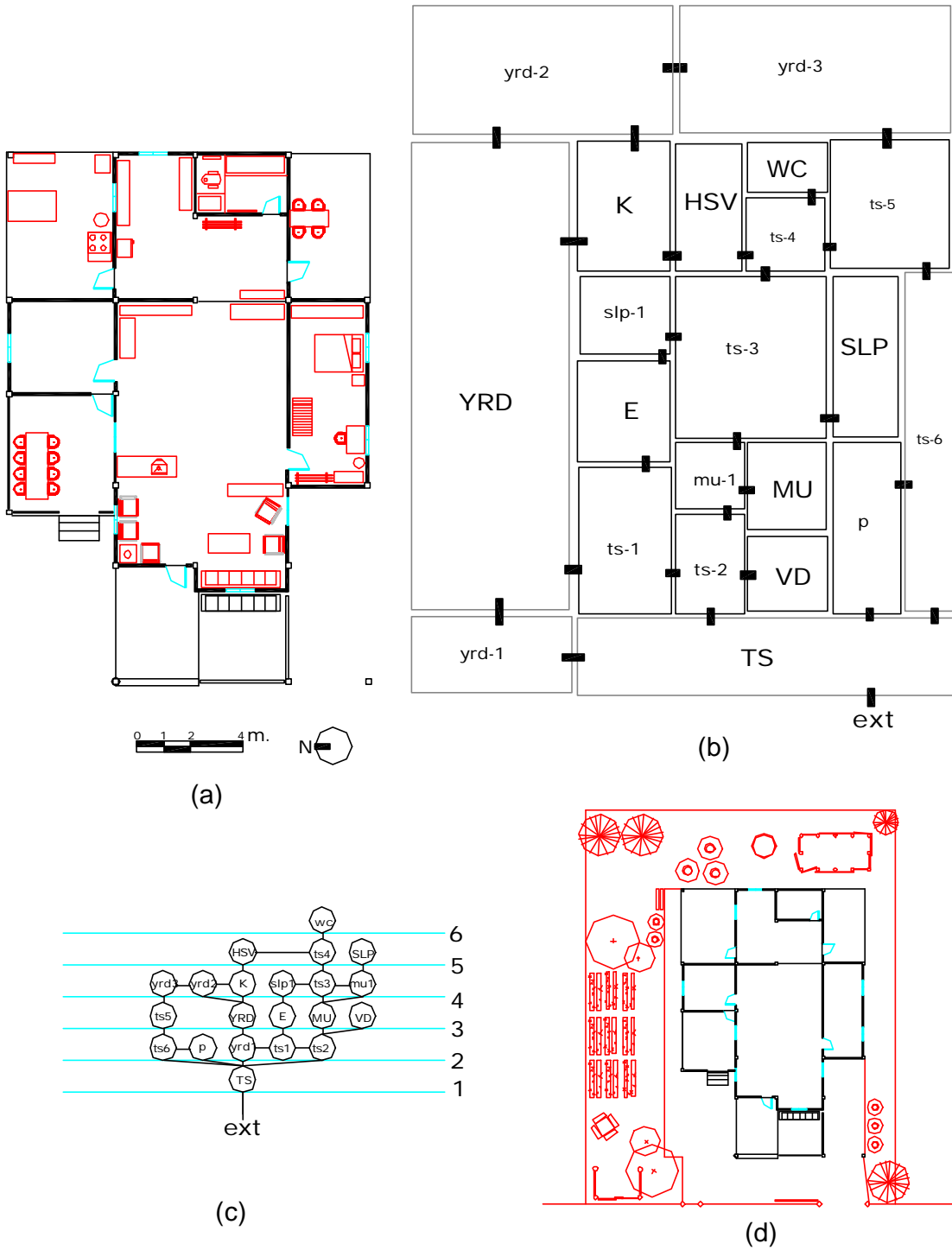
HOUSE 03

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
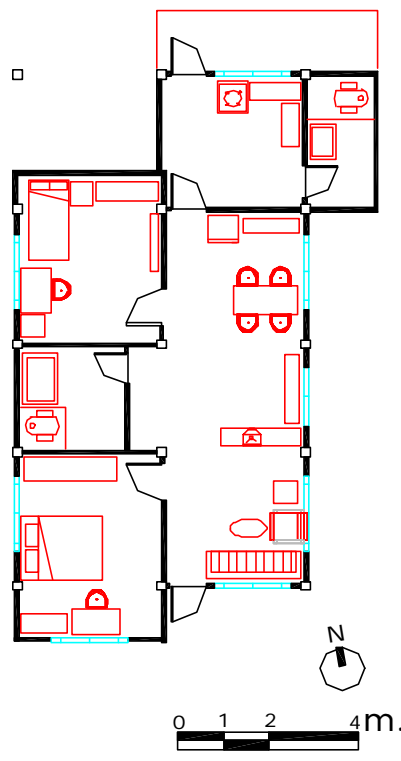
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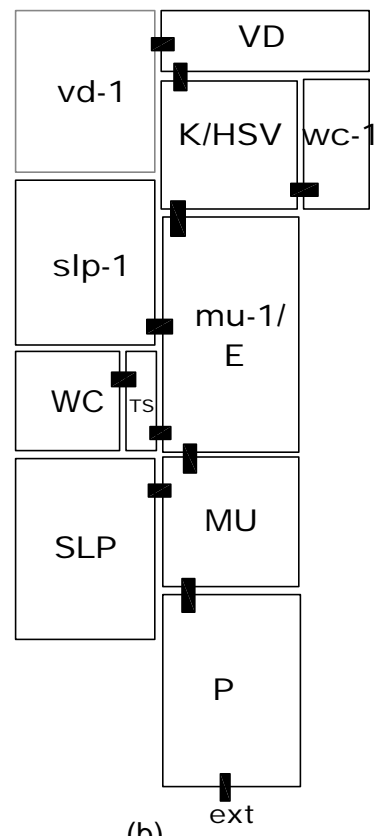
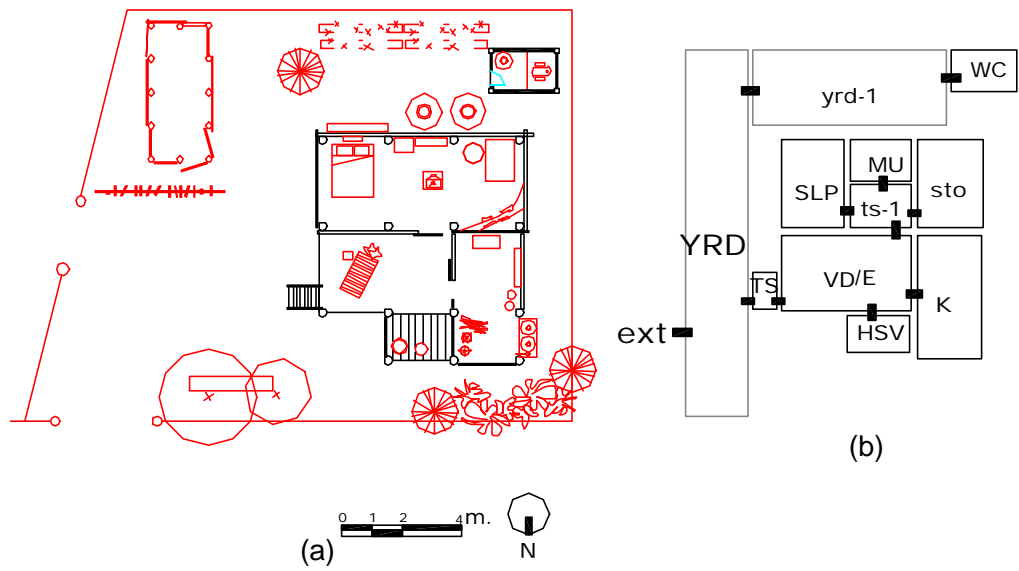(b)
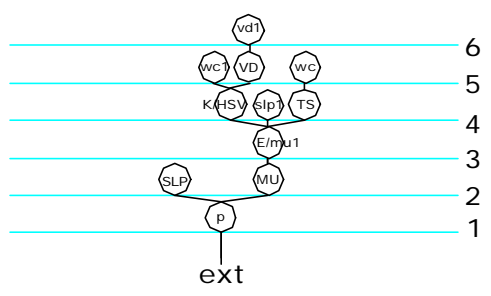
(c)
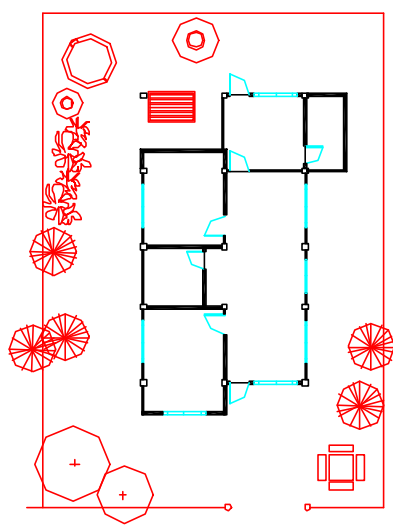
(d)

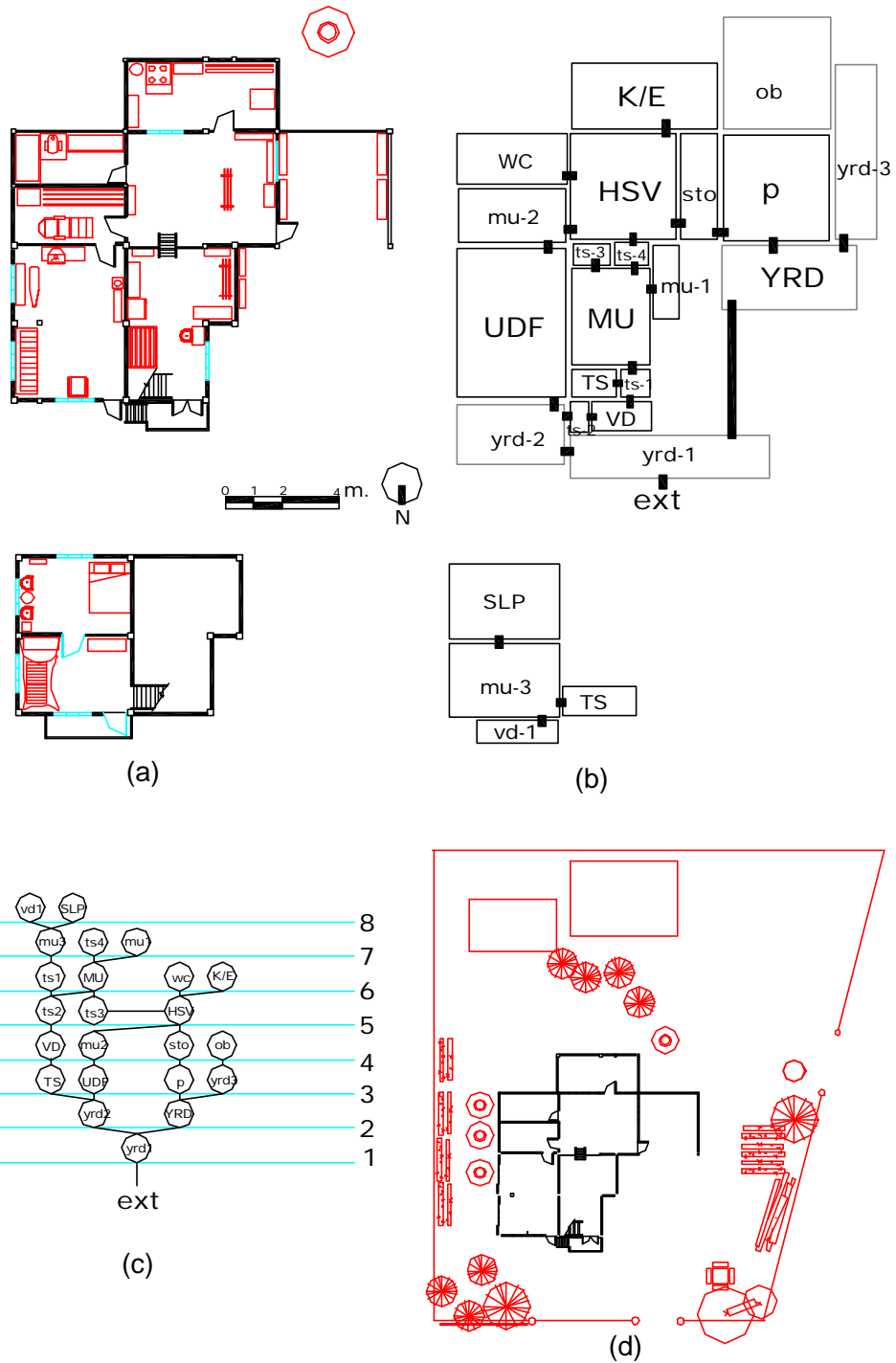| HOUSE 04	LEGEND: UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

ext

(d)
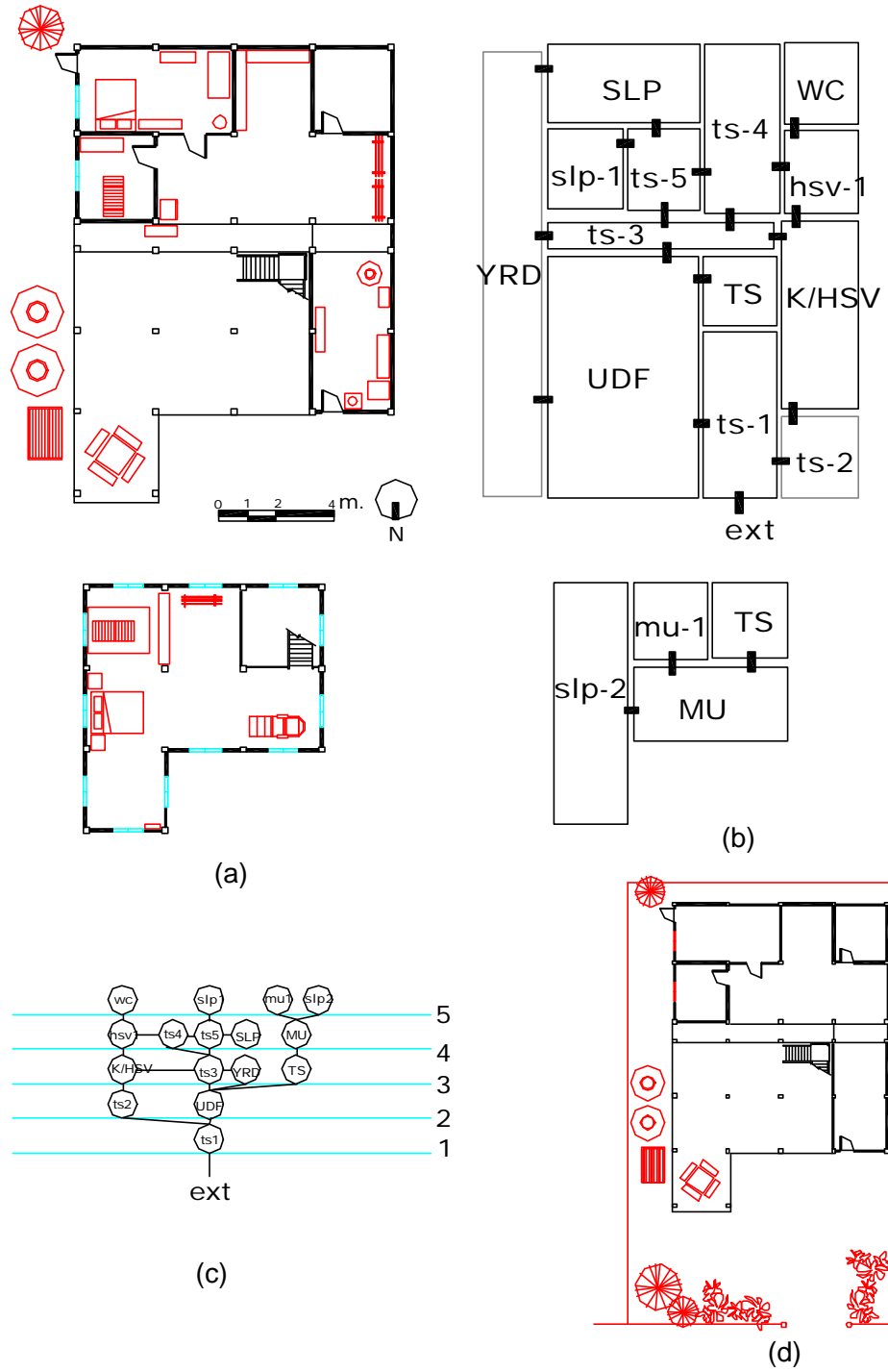
HOUSE

05

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

N
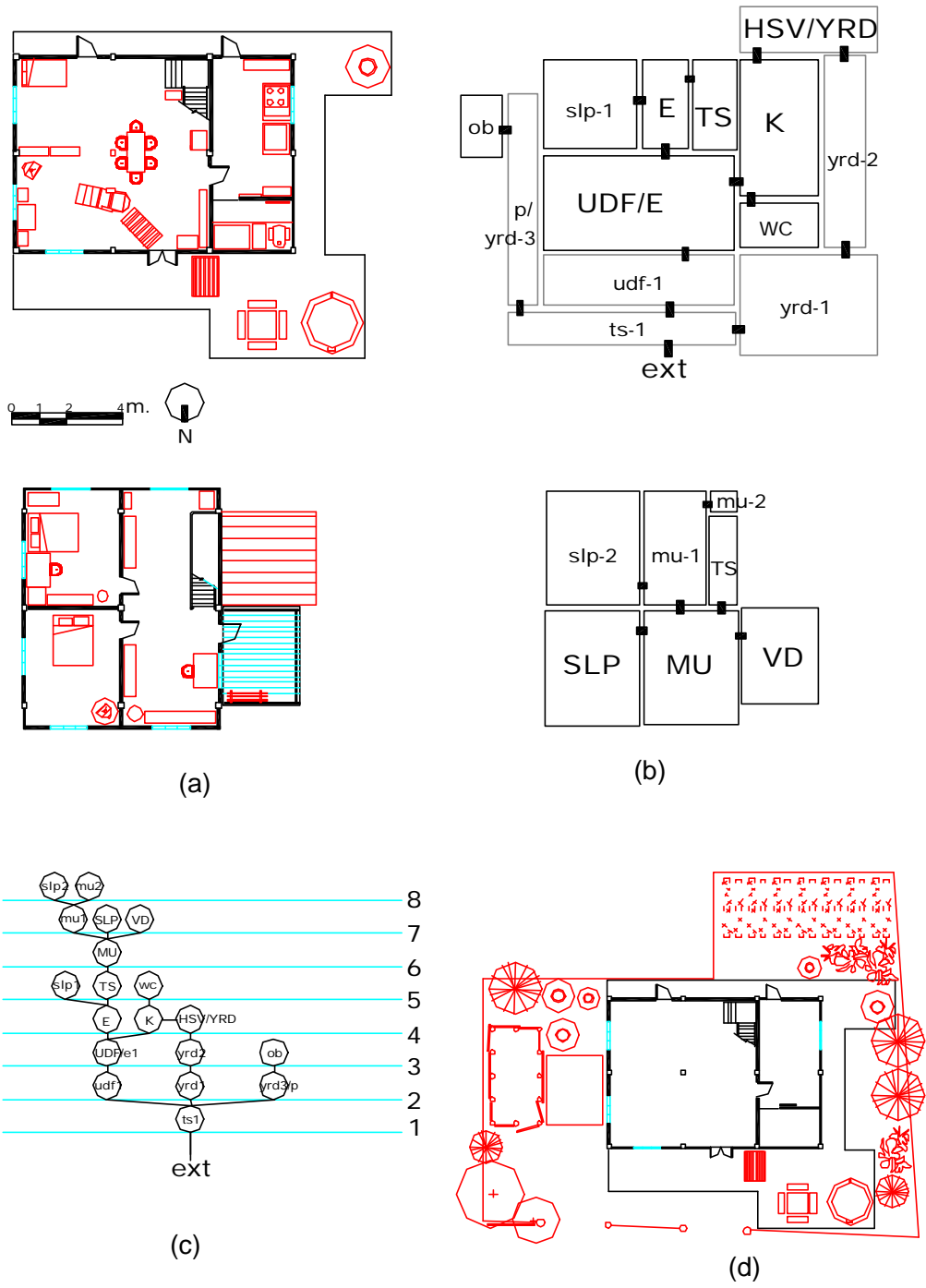
0 1 2 4 m.
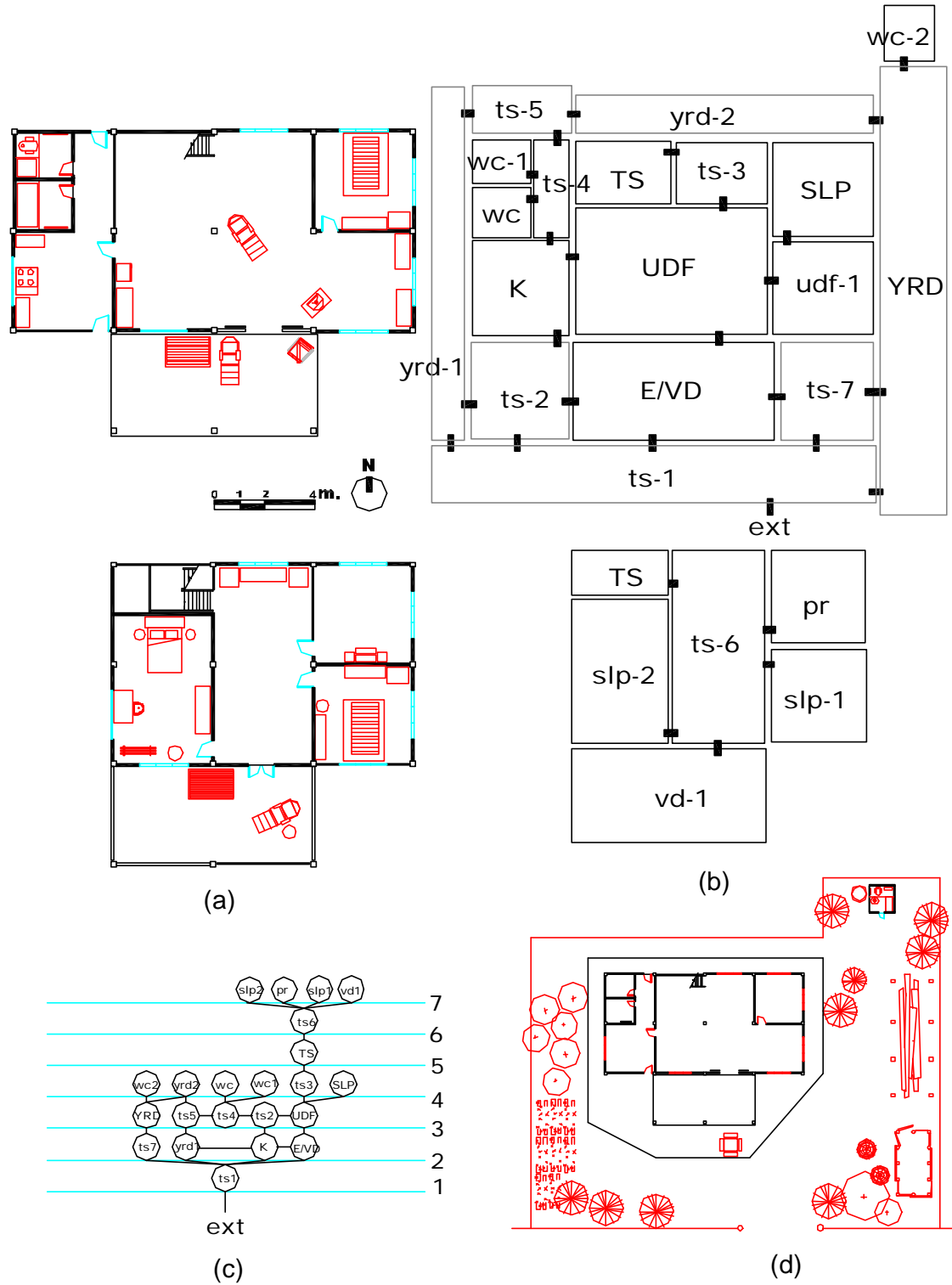
HOUSE 06	LEGEND: UDF - Underfloor Space YRD - Yard WC - Toilet & Bathing Space K - Food Preparation MU - Multi-use VD - Veranda SLP - Sleeping Space HSV - Household Service Space TS - Transition Space ext - External Space sto - Storage pk - Parking Space pr - Prayer Room w - Working Space ob - Outbuilding/ Barn s - Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)
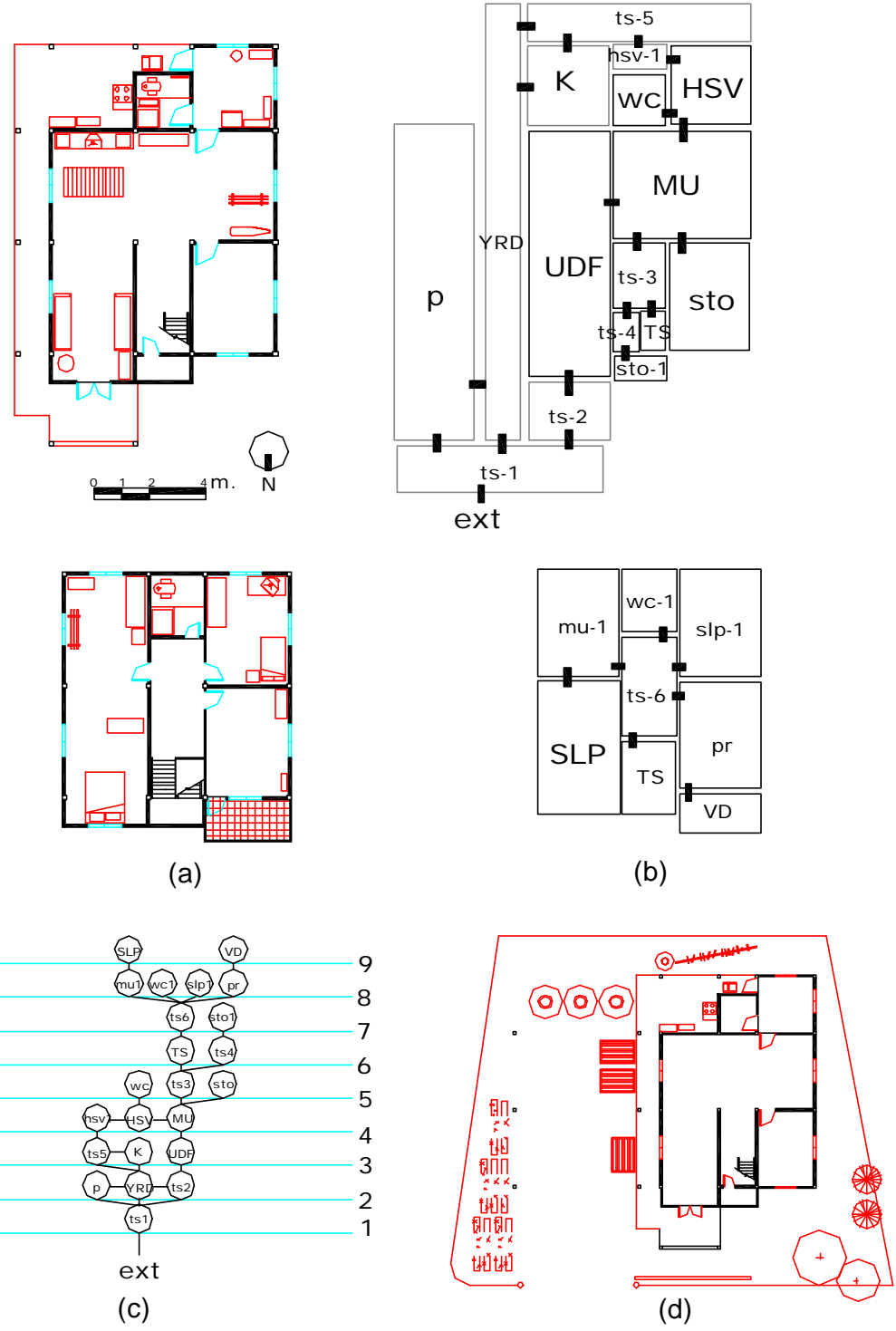
HOUSE 07

LEGEND:
UDF - Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w– Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

0 1 2   4 m.

N

(b)

HSV   K   WC

MU/p   sto   SLP

ext   E/mu-1   yrd-1

YRD

(c)

wc

K   sto   SLP   yrd   4

HSV   E/mu1   YRD   3

MU/p   2

ext   1
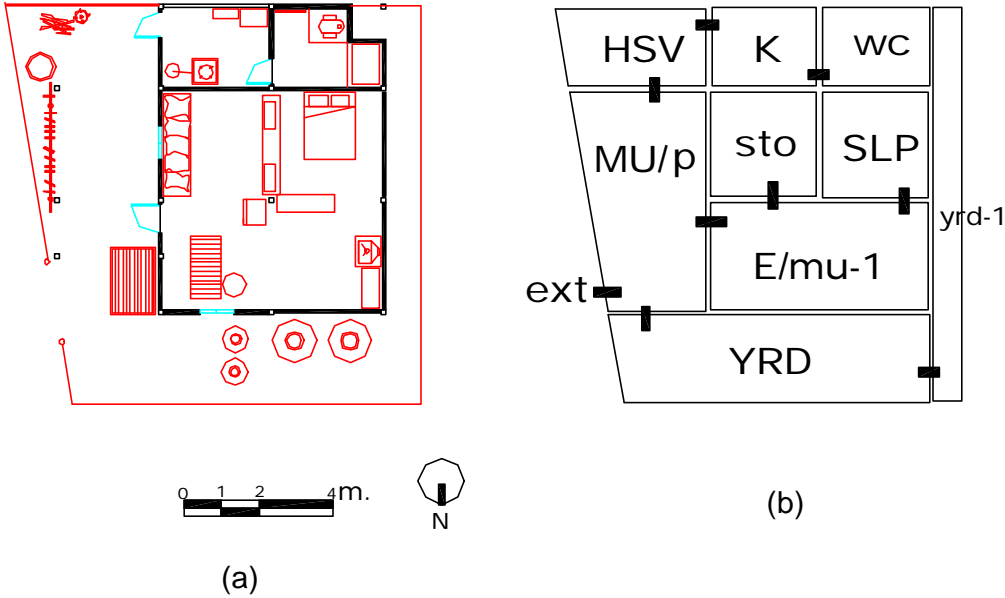
HOUSE 08	LEGEND:
	UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation
	MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space
	TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room
	w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram
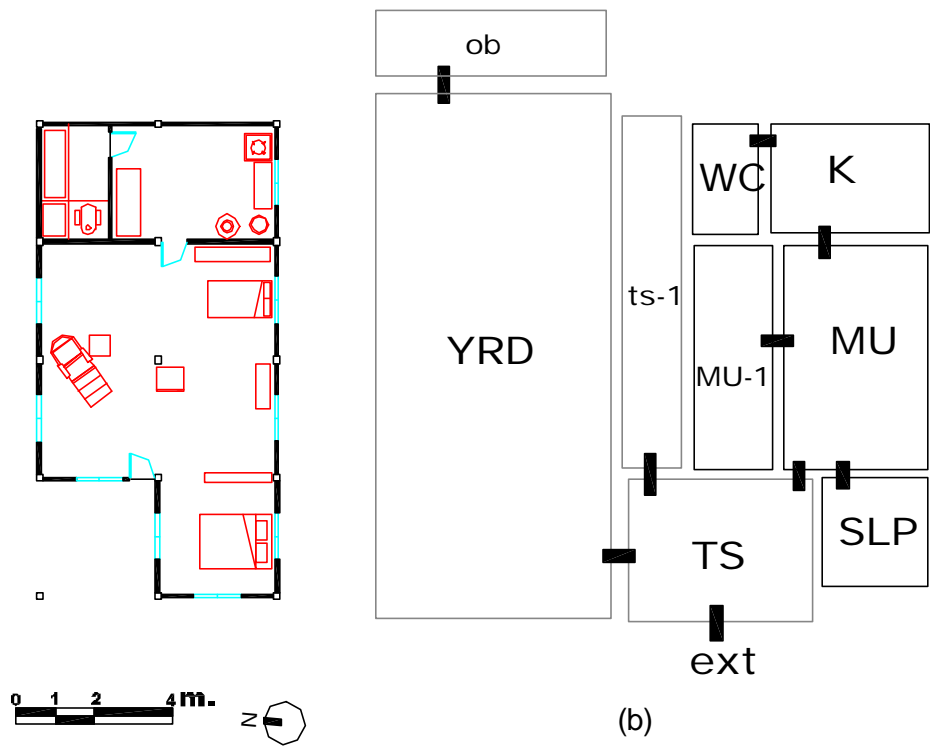
(a)

(b)
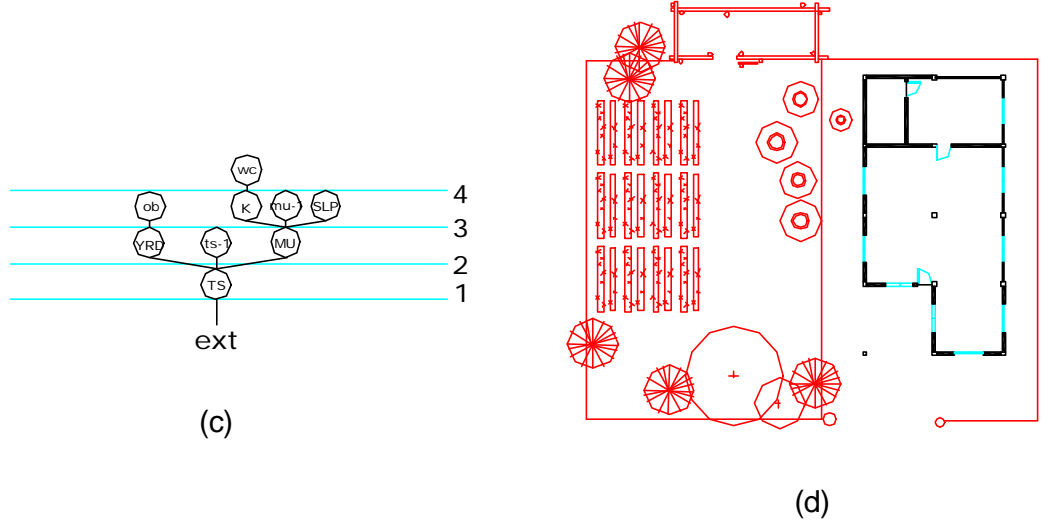
(c)

(d)

HOUSE 09	LEGEND:
	UDF - Underfloor Space YRD - Yard WC - Toilet & Bathing Space K - Food Preparation
	MU - Multi-use VD - Veranda SLP - Sleeping Space HSV - Household Service Space
	TS - Transition Space ext - External Space sto - Storage pk - Parking Space pr - Prayer Room
	w - Working Space ob - Outbuilding/ Barn s - Social Space

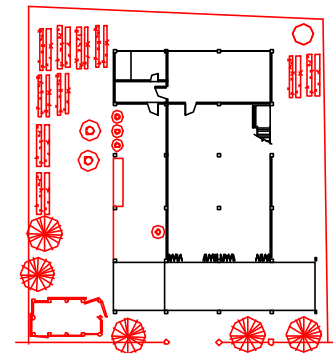a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
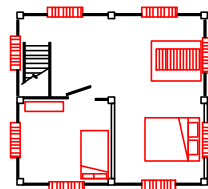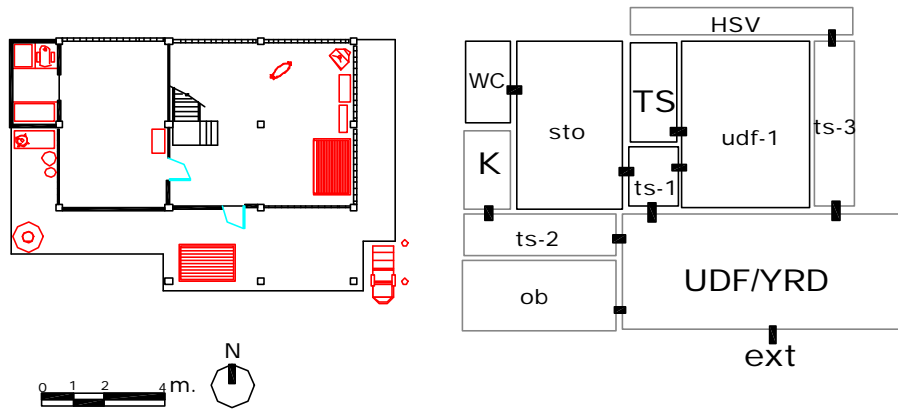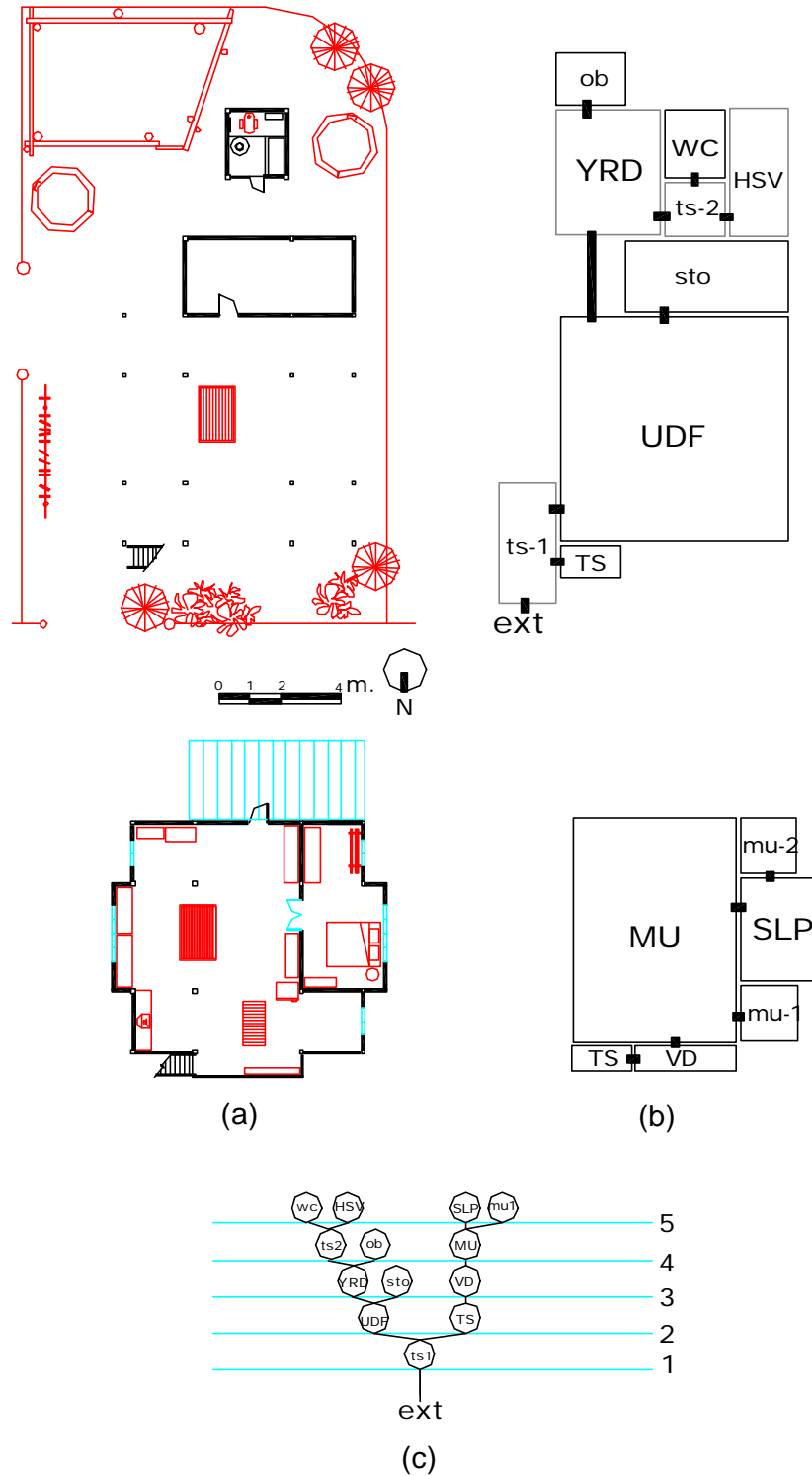
(a)
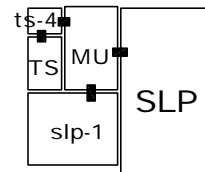
(b)
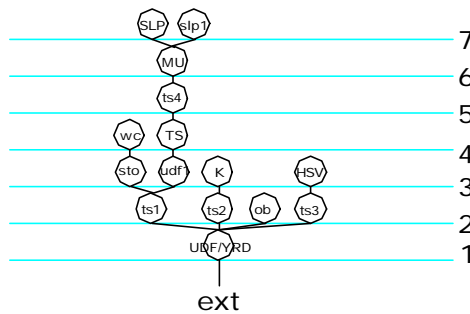
(c)
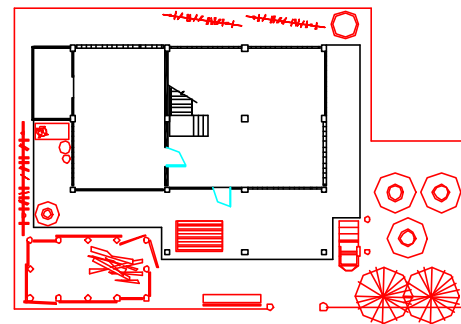
(d)

HOUSE	10	LEGEND: UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

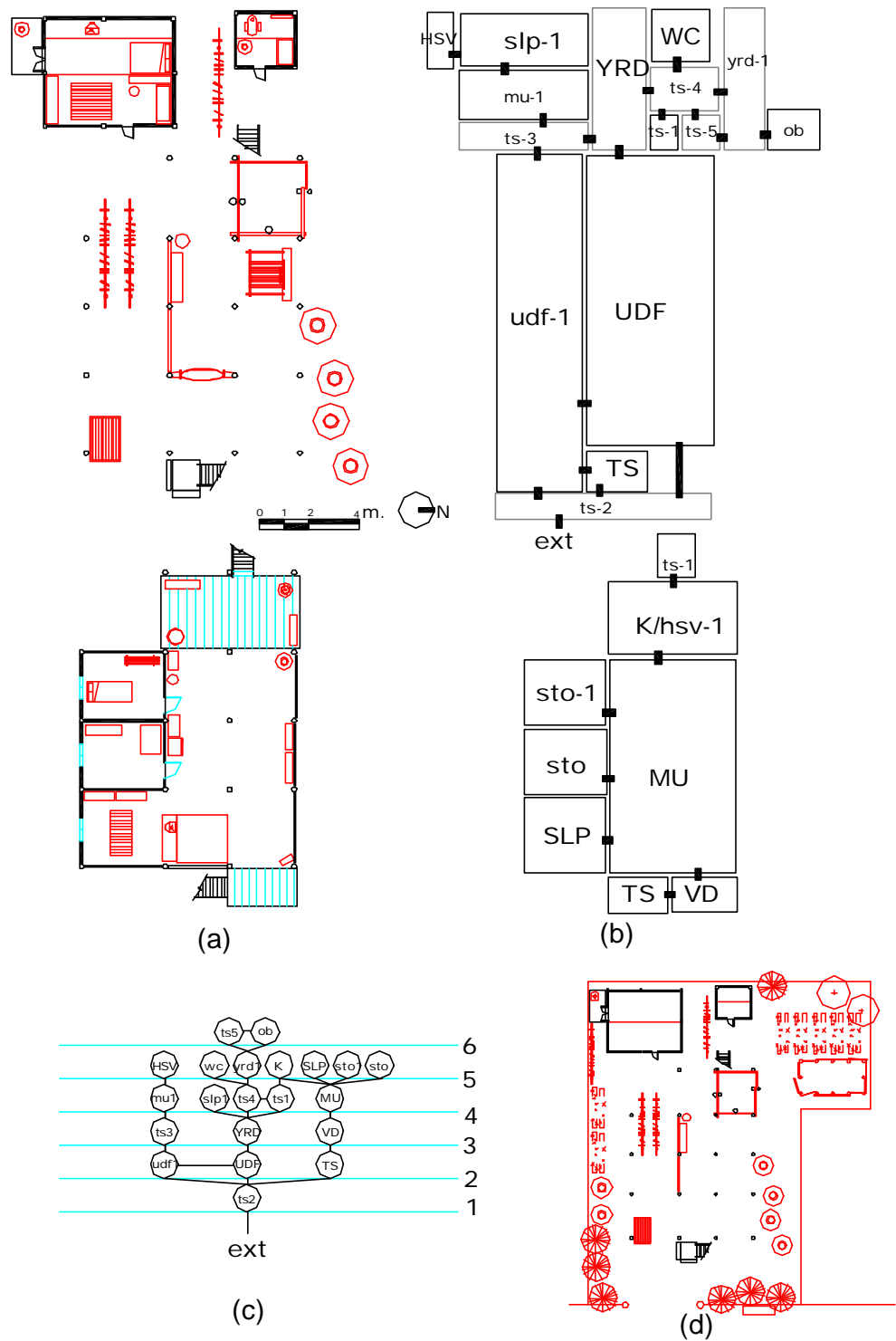a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
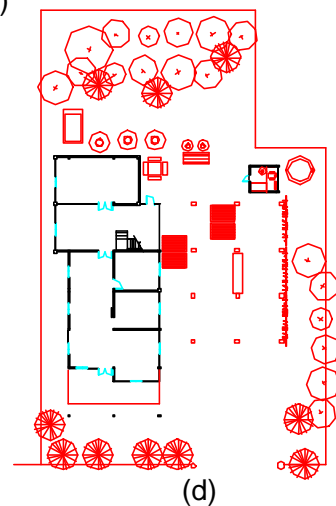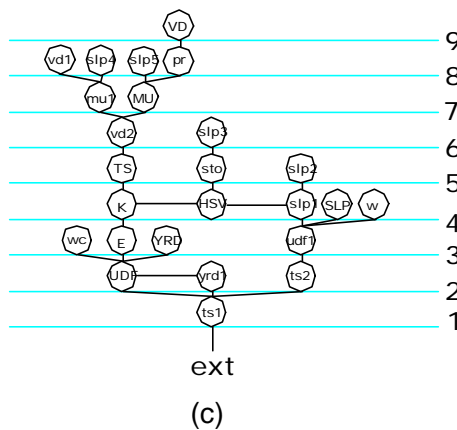
HOUSE 11

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

(a)

(b)

(c)

(d)

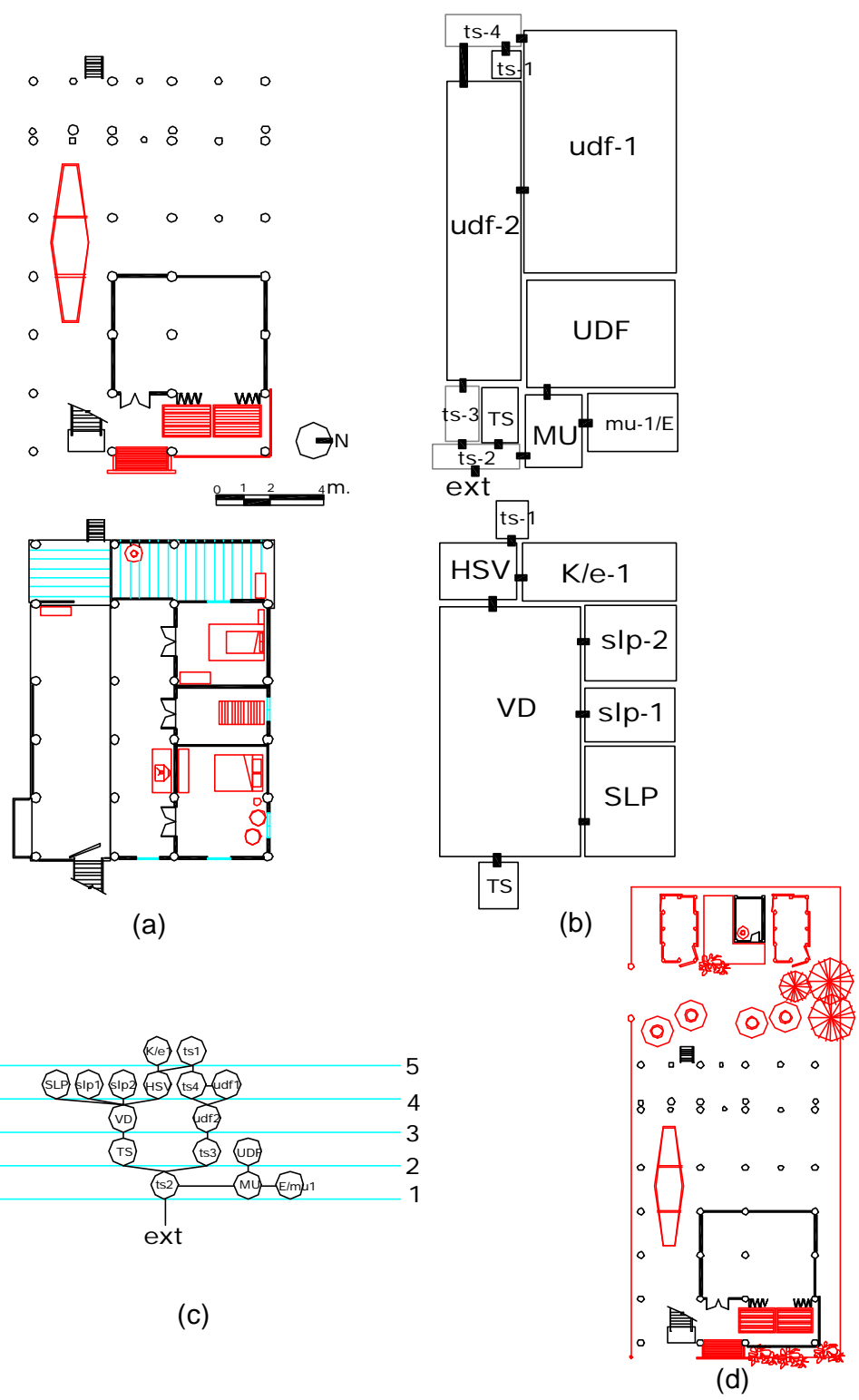WC- Toilet & Bathing Space   K- Food Preparation

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

HOUSE 12

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

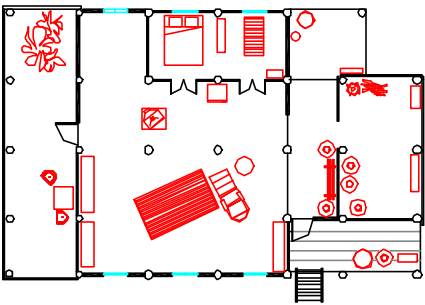a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram

HOUSE 13

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

(a)

(b)

(c)

HOUSE **14**
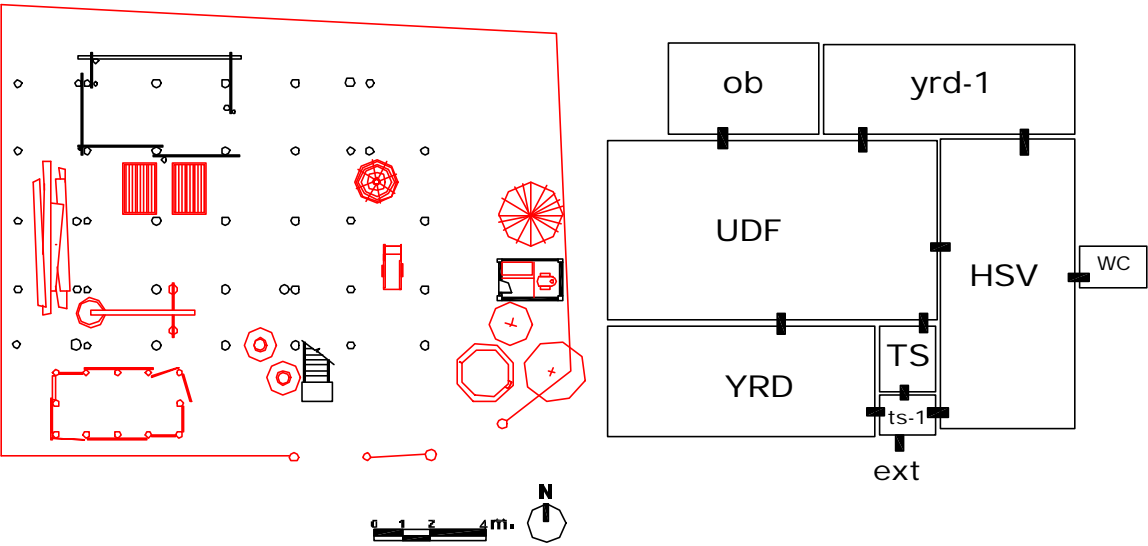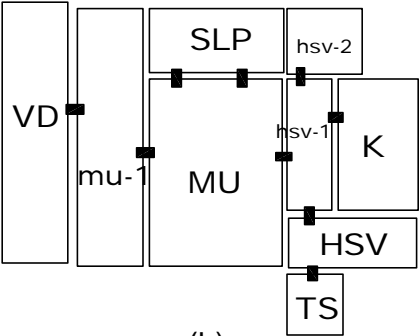
LEGEND:
UDF - Underfloor Space   YRD - Yard   WC - Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD - Veranda   SLP - Sleeping Space   HSV - Household Service Space
TS - Transition Space   ext - External Space   sto - Storage   pk - Parking Space   pr - Prayer Room
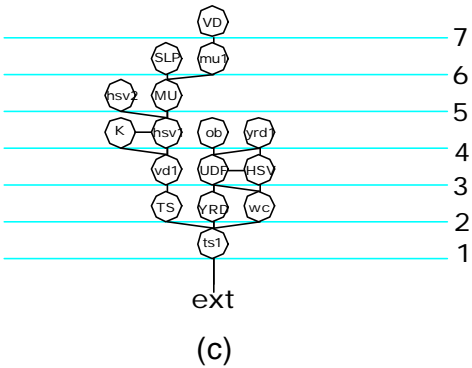w - Working Space   ob - Outbuilding/ Barn   s - Social Space

a) Floor Plan; b) Convex Spaces; c) Accessibility Diagram

(a)

(b)

(c)

(d)

0 1 2 4 m.

N

K/E

ob

WC

HSV

sto

p

yrd-3

mu-2

ts-3 ts-4

mu-1

YRD

UDF

MU

TS ts-1

VD

yrd-2

yrd-1

ext

SLP

mu-3

TS

vd-1

vd1 SLP

mu2 ts4 mu

ts1 MU wc K/E

ts2 ts3 HSV

VD mu2 sto ob

TS UDF p yrd3

yrd2 YRD

yrd1

ext

8
7
6
5
4
3
2
1

HOUSE **15**

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/Barn   s- Social Space

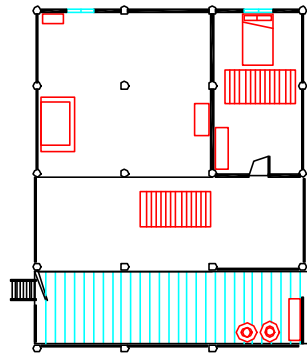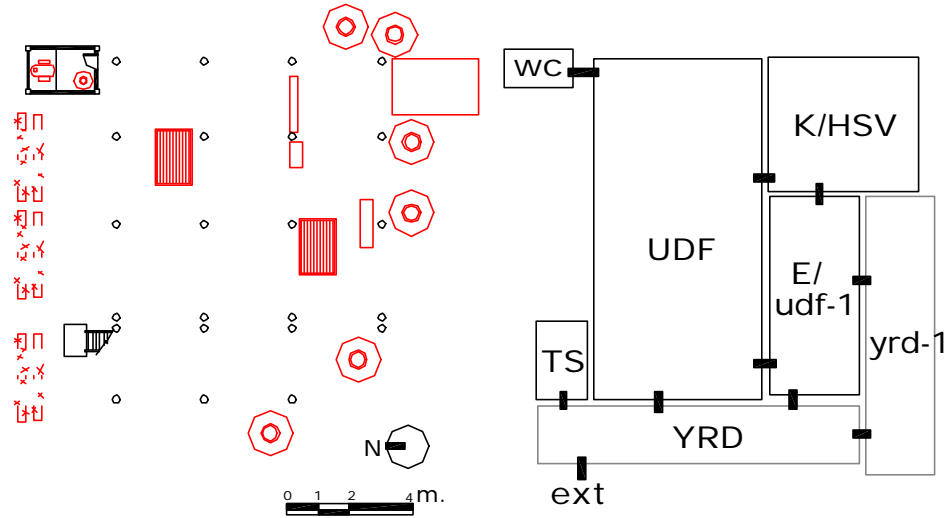a)   Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
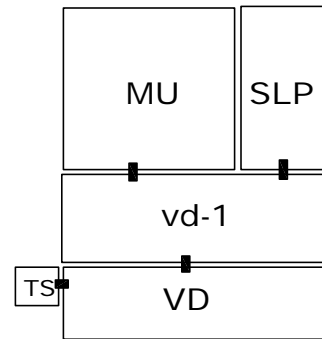
HOUSE 16

LEGEND:
UDF - Underfloor Space   YRD - Yard   WC - Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD - Veranda   SLP - Sleeping Space   HSV - Household Service Space
TS - Transition Space   ext - External Space   sto - Storage   pk - Parking Space   pr - Prayer Room
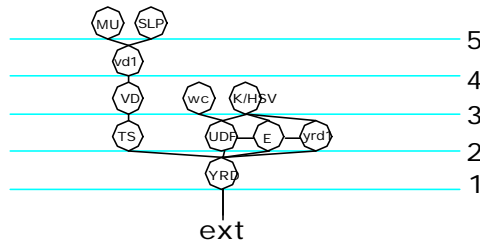w - Working Space   ob - Outbuilding/ Barn   s - Social Space

(a)

(b)

(c)

(d)

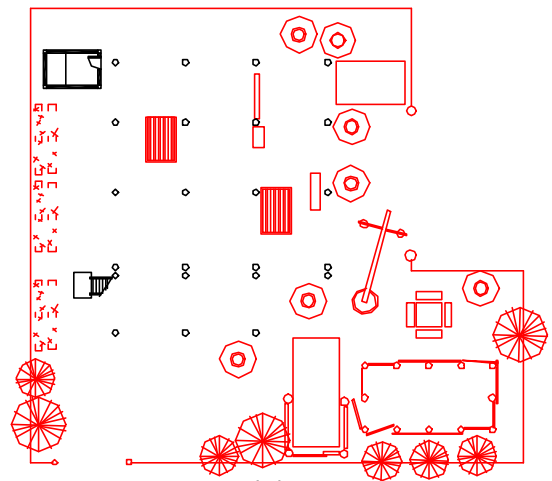a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
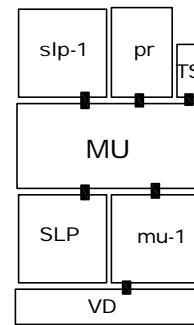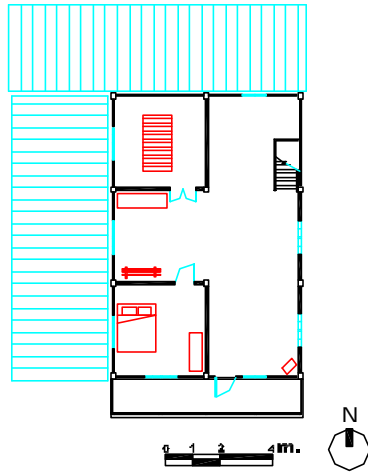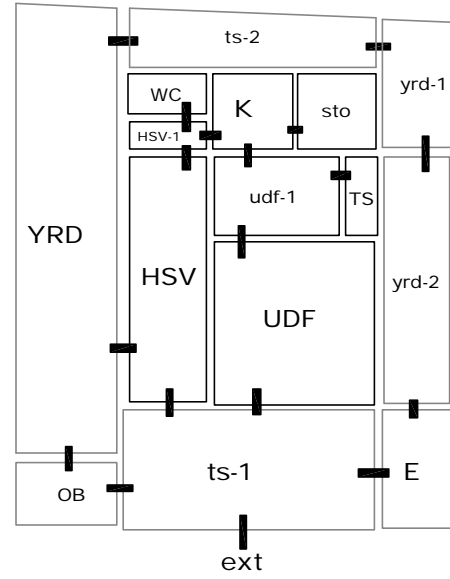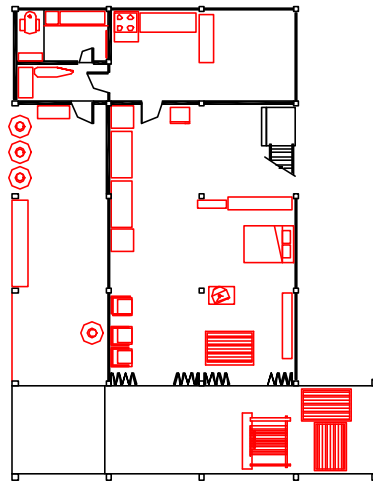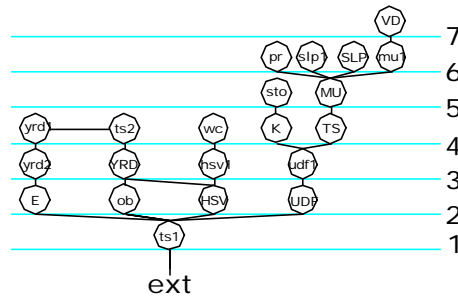
HOUSE 17

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

(a)

(b)

(c)

0 1 2   4 m.

N

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram
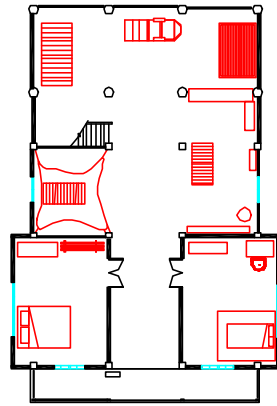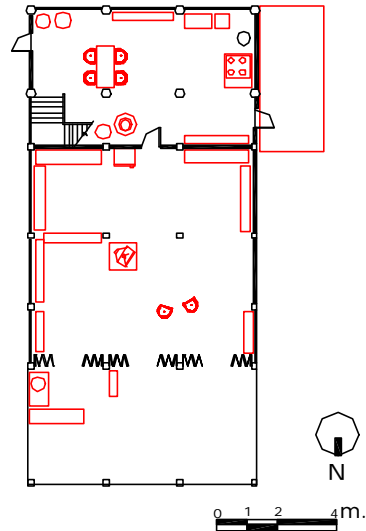
(a)

(b)

(c)

ext

(d)

HOUSE 19

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

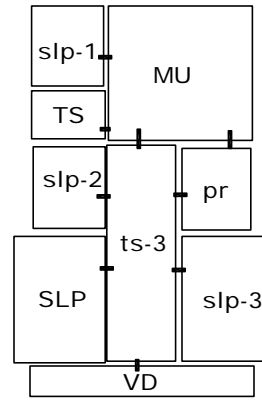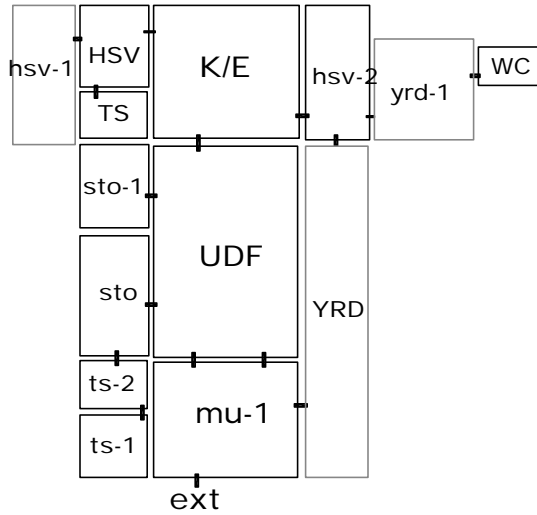| HOUSE 20	LEGEND: UDF - Underfloor Space YRD - Yard WC - Toilet & Bathing Space K - Food Preparation MU - Multi-use VD - Veranda SLP - Sleeping Space HSV - Household Service Space TS - Transition Space ext - External Space sto - Storage pk - Parking Space pr - Prayer Room w - Working Space ob - Outbuilding/ Barn s - Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

ob

yrd-1

UDF

HSV

WC

YRD

TS

ts-1

ext

N

(a)

SLP

hsv-2

VD

hsv-1

K

mu-1

MU

HSV

TS

(b)

VD

SLP

mu1

hsv2

MU

K

hsv

ob

yrd1

vd1

UDF

HSV

TS

YRD

wc

ts1

ext

7
6
5
4
3
2
1

(c)

HOUSE 21

LEGEND:
UDF - Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
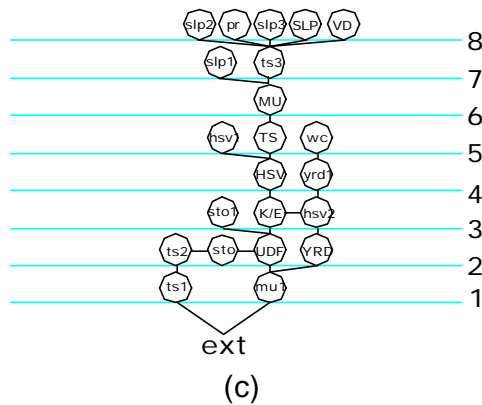w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram

(a)

(b)

(c)

(d)

HOUSE 22

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

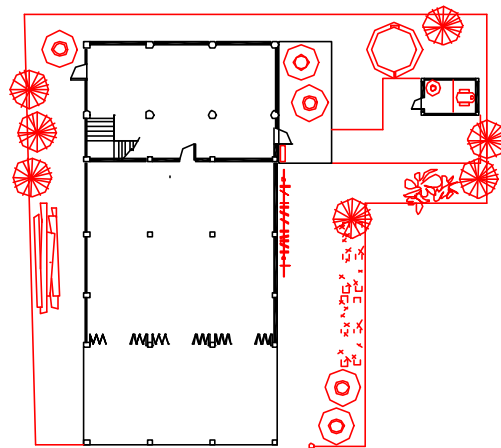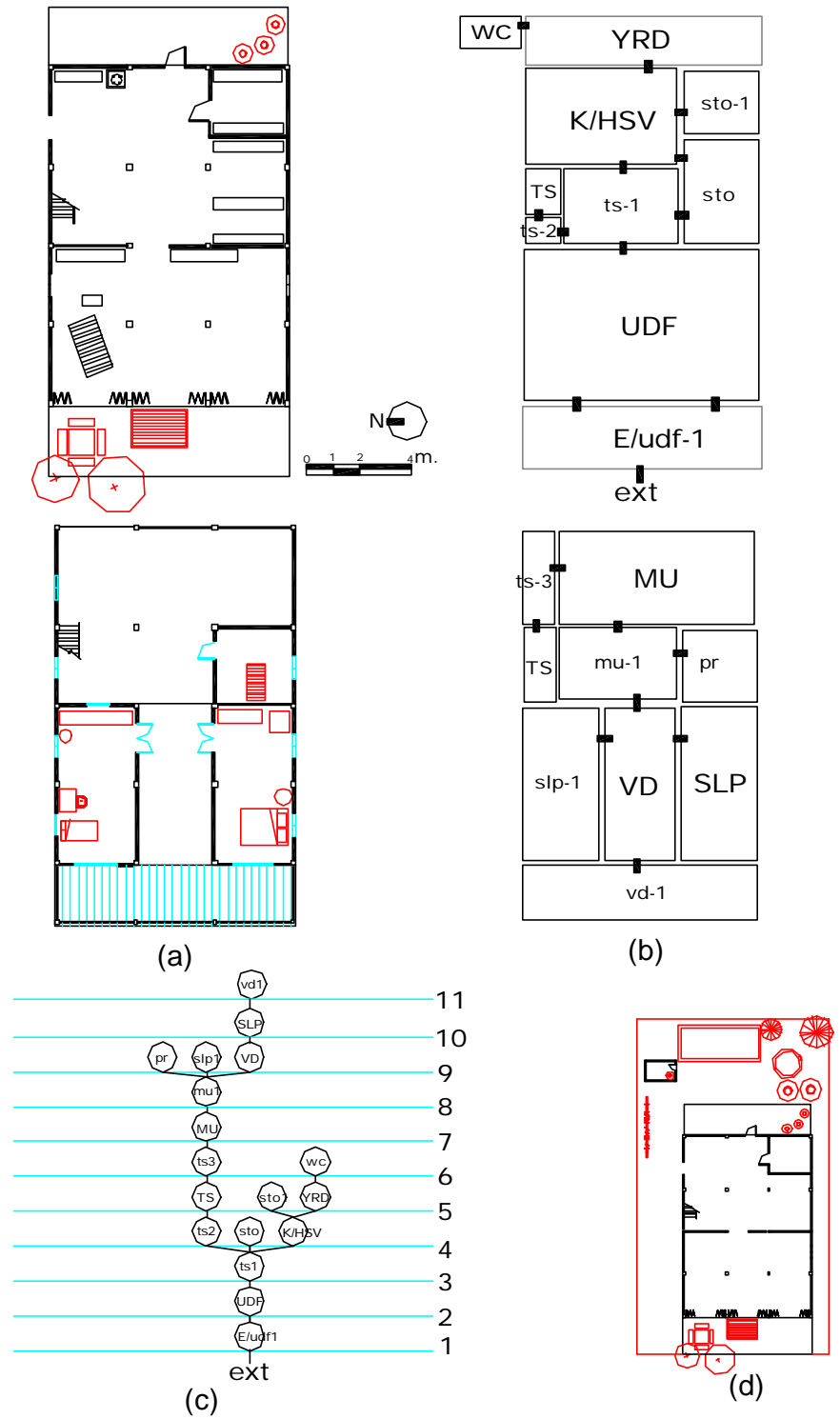a)   Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
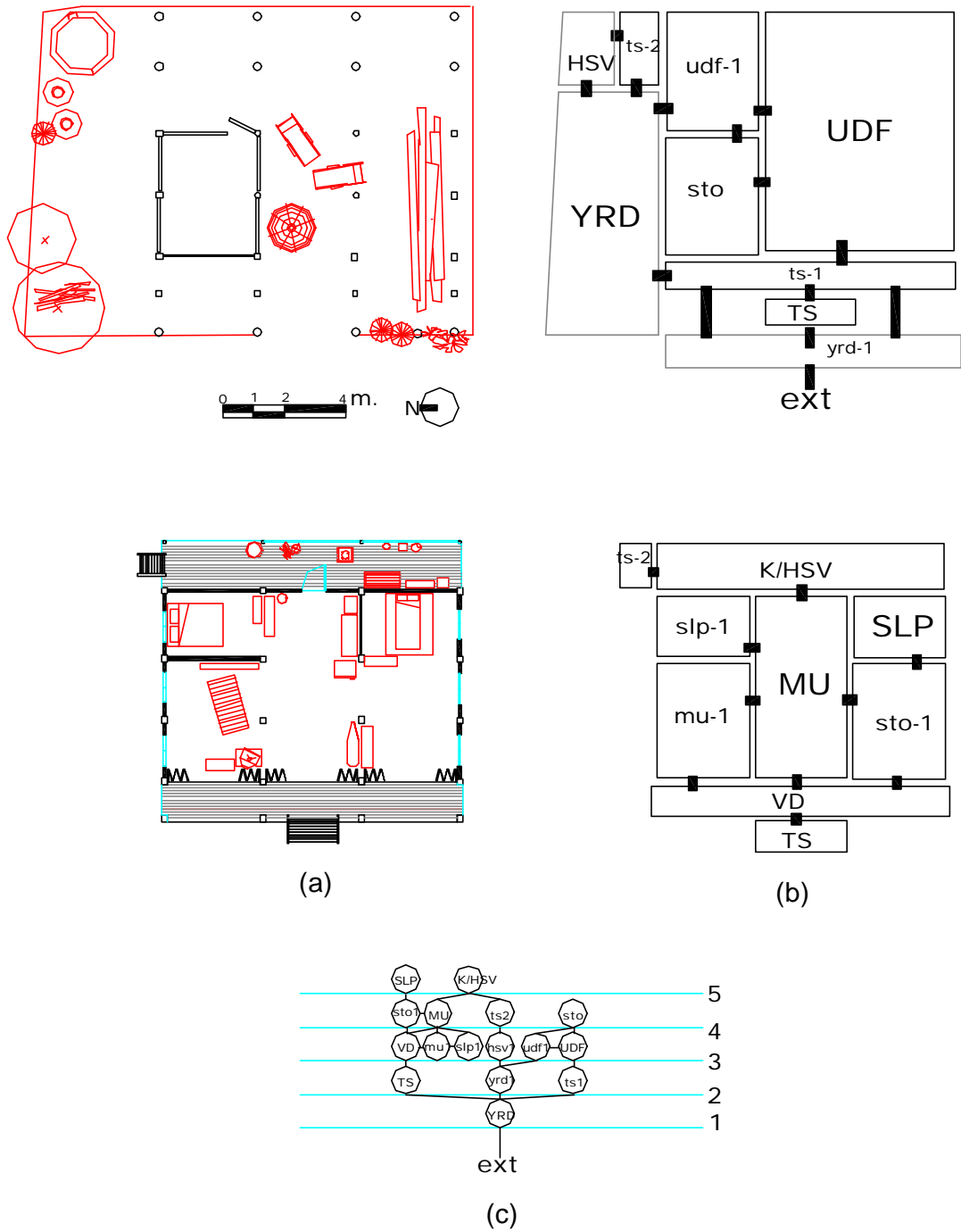
HOUSE

23

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

(a)

(b)

(c)

(d)

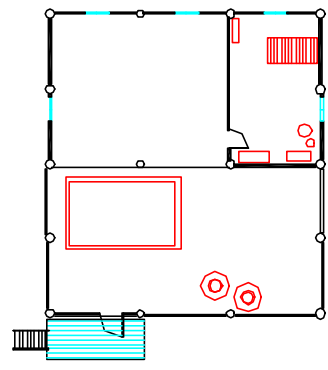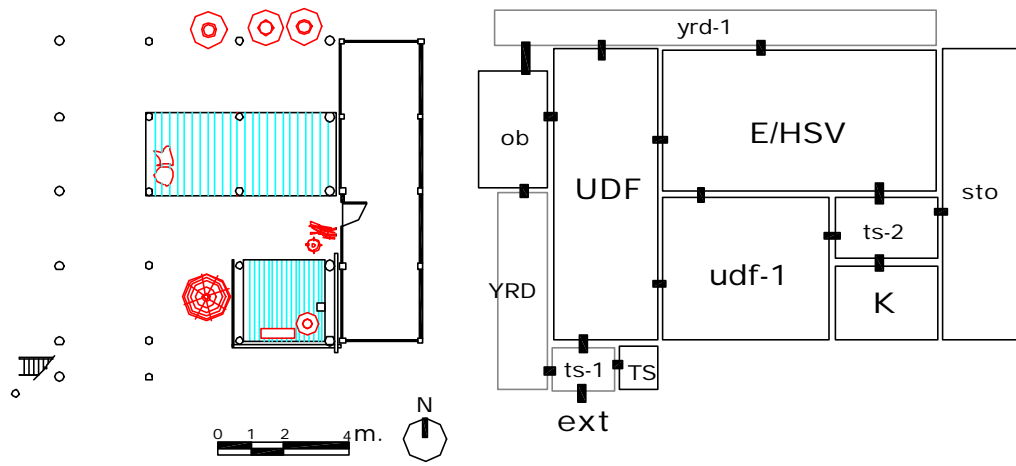**HOUSE 24**

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

ts-2 | **HSV** | **udf-1**
UDF
YRD | **sto**
ts-1
TS
yrd-1
ext

0 1 2 4 m. N

(b)

ts-2 | **K/HSV**
slp-1 | **SLP**
MU
mu-1 | **sto-1**
VD
TS

(c)

SLP K/HSV
sto1 MU ts2 sto — 5
VD mu slp1 hsv udf UDF — 4
TS yrd ts1 — 3
— 2
YRD — 1

ext

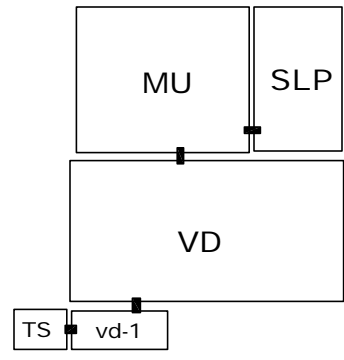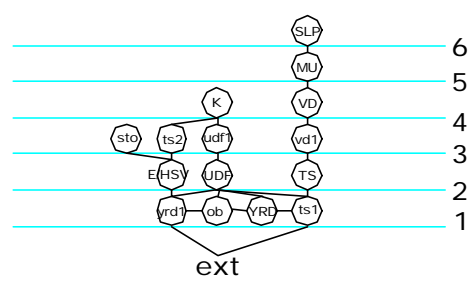| HOUSE 25	LEGEND: UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram

yrd-1

ob

E/HSV

UDF

sto

udf-1

ts-2

YRD

K

ts-1　TS

ext

N

0　1　2　4 m.

MU　SLP

VD

TS　vd-1

(a)

(b)

SLP — 6

MU — 5

K　VD — 4

sto　ts2　udf1　vd1 — 3

E/HSV　UDF　TS — 2

yrd1　ob　YRD　ts1 — 1

ext

(c)

(d)

HOUSE 26

LEGEND:
UDF- Underfloor Space　YRD- Yard　WC- Toilet & Bathing Space　K- Food Preparation
MU- Multi-use　VD- Veranda　SLP- Sleeping Space　HSV- Household Service Space
TS- Transition Space　ext- External Space　sto- Storage　pk- Parking Space　pr- Prayer Room
w- Working Space　ob- Outbuilding/ Barn　s- Social Space

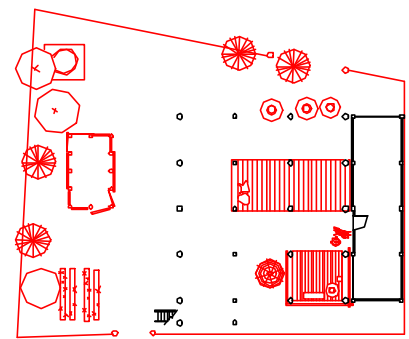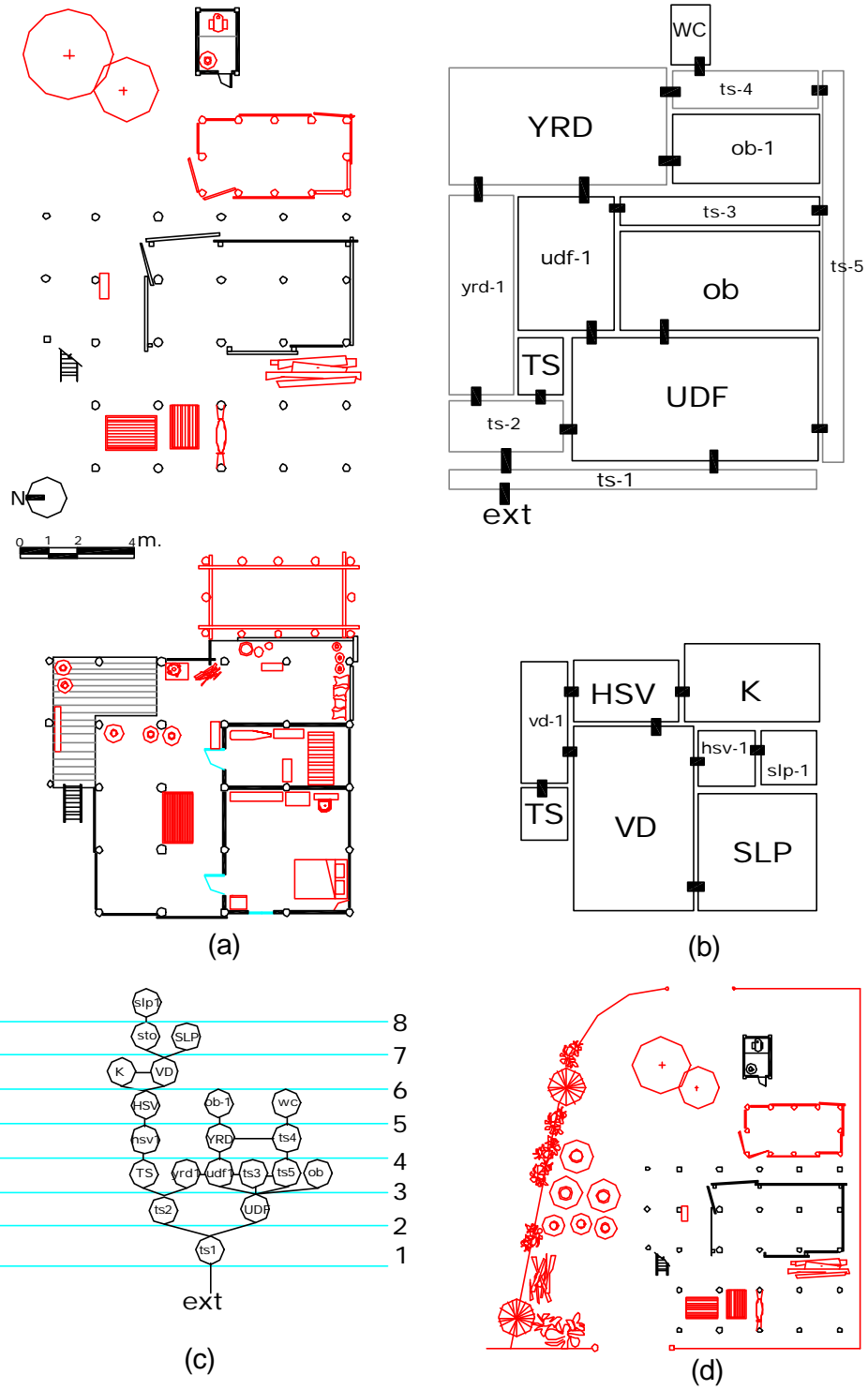a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

HOUSE	27	LEGEND:

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

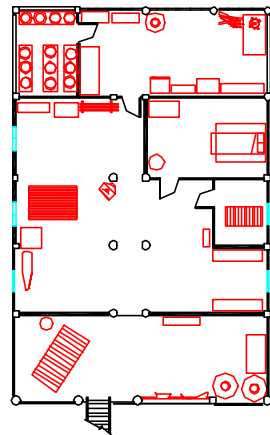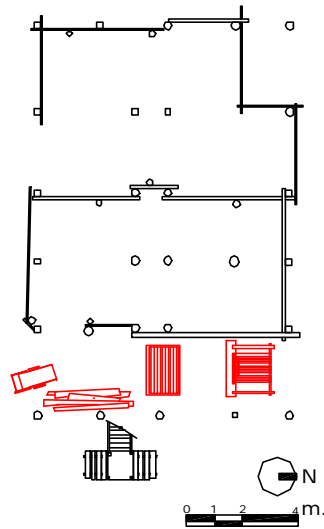a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

ext

ob-1

ts-4

ob

UDF/E

TS

ts-3

ext   ts-2   YRD

ts-1   WC

ext

sto   K/HSV

mu-2   SLP

MU   slp-1

mu-1

VD/hsv-1

TS

(c)

7
6
5
4
3
2
1

sto
K/HSV
mu-1 slp1 SLP mu2
wc MU
ob ts3 VD
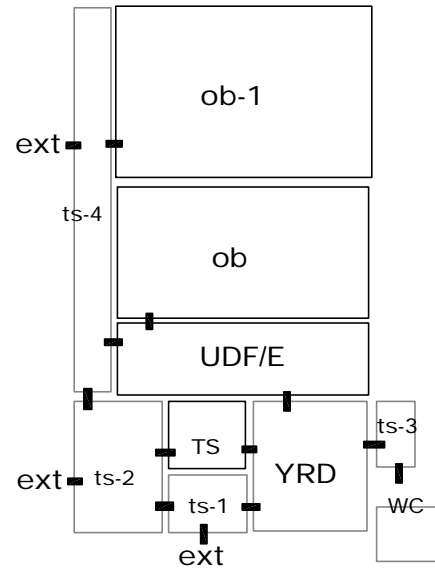ob-1 UDF/E YRD TS
ts4 ts2 ts1
ext

(d)

HOUSE 28	LEGEND: UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation MU - Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room W– Working Space ob- Outbuilding/ Barn s- Social Space

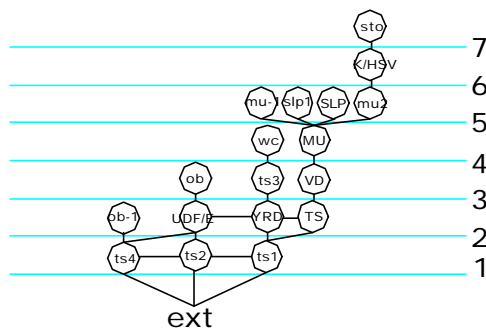a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

HOUSE
29

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
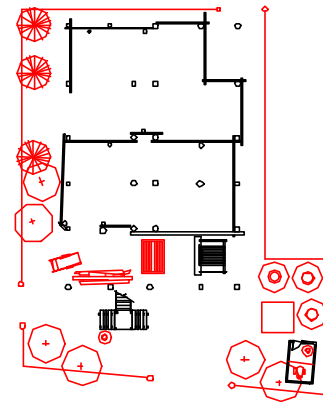w- Working Space   ob- Outbuilding/ Barn   s- Social Space

(a)

(b)

(c)
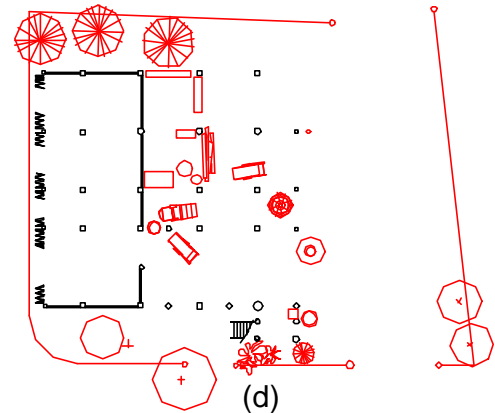
(d)

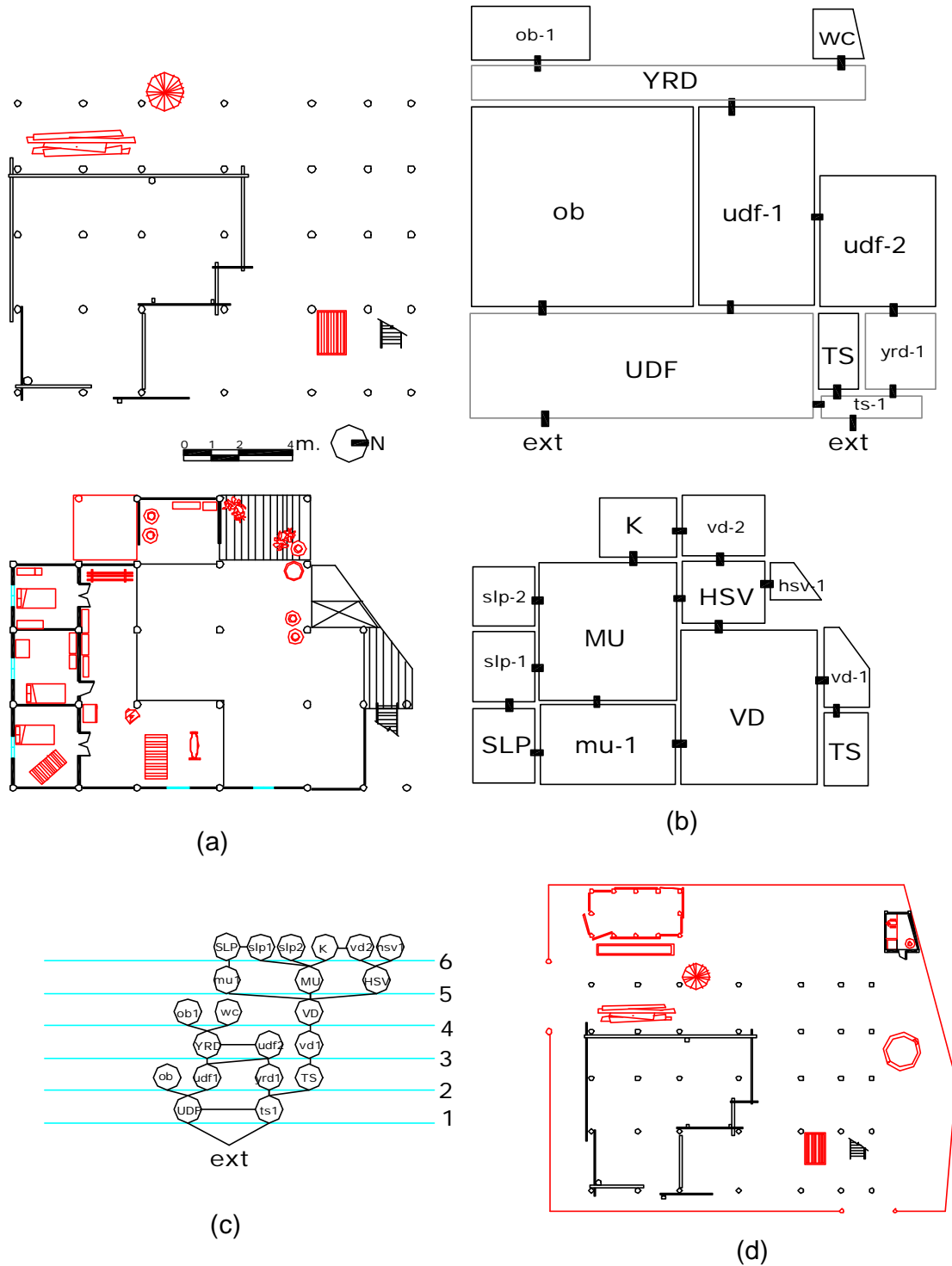| HOUSE 30 | LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space |

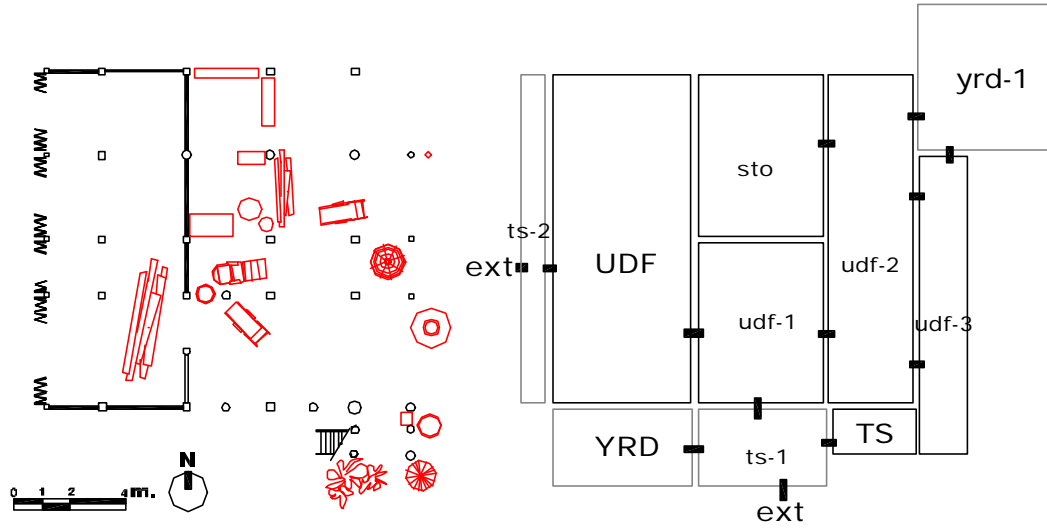a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
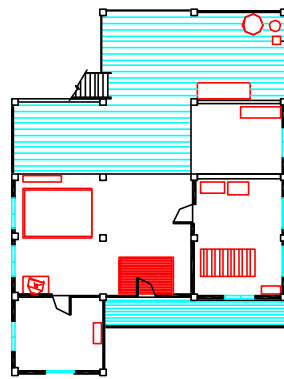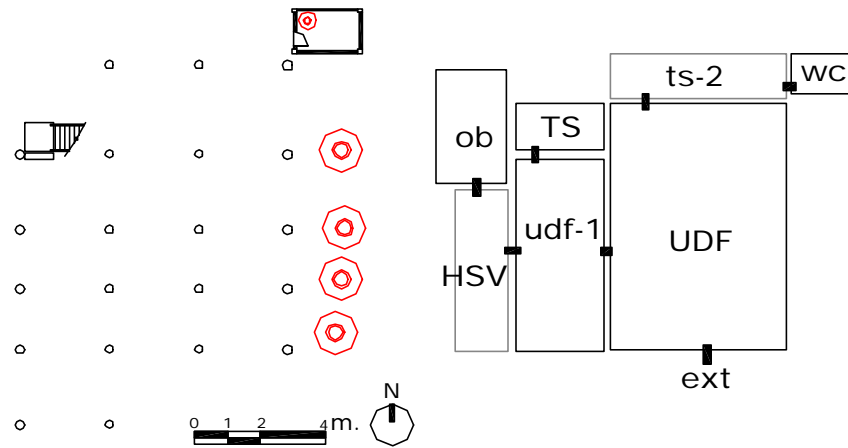
(a)
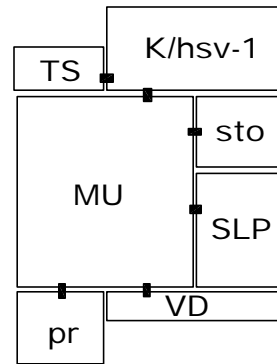
(b)

(c)

(d)

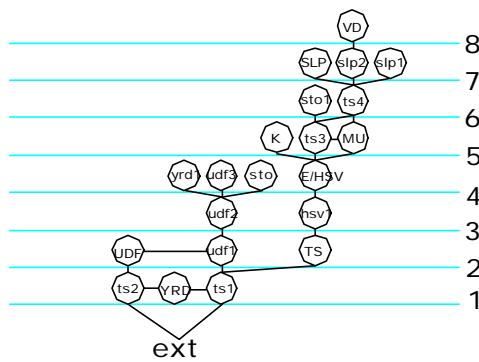| HOUSE 31	LEGEND:
	UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation
	MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space
	TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room
	w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

HOUSE 32

LEGEND:
UDF - Underfloor Space   YRD - Yard   WC - Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD - Veranda   SLP - Sleeping Space   HSV - Household Service Space
TS - Transition Space   ext - External Space   sto - Storage   pk - Parking Space   pr - Prayer Room
w - Working Space   ob - Outbuilding/ Barn   s - Social Space

(a)

(b)

(c)
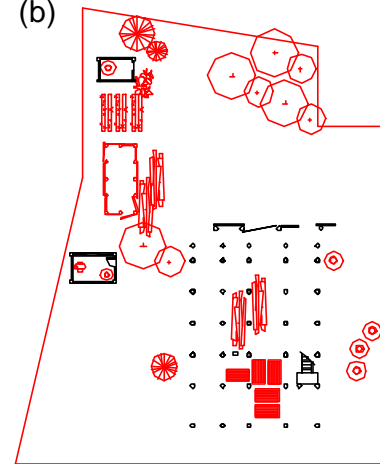
(d)

HOUSE 33

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

(c)

(d)

N

0 1 2 4 m.

ts-2 ob
YRD
wc
UDF
TS ts-1
ext

VD
K/HSV
E sto
MU-1/
HSV-1
MU SLP
TS

ob SLP sto K/HSV VD 5
wc ts2 MU E 4
YRD mu1/hsv1 3
UDF TS 2
ts1 1
ext

HOUSE 34	LEGEND:
	UDF- Underfloor Space YRD- Yard WC- Toilet & Bathing Space K- Food Preparation
	MU- Multi-use VD- Veranda SLP- Sleeping Space HSV- Household Service Space
	TS- Transition Space ext- External Space sto- Storage pk- Parking Space pr- Prayer Room
	w- Working Space ob- Outbuilding/ Barn s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)
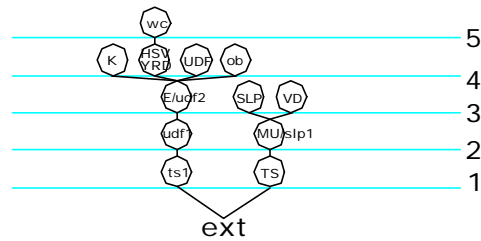
(c)

HOUSE 35

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk - Parking Space   pr- Prayer Room
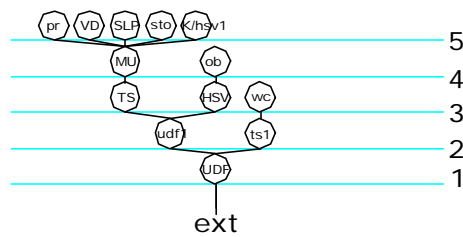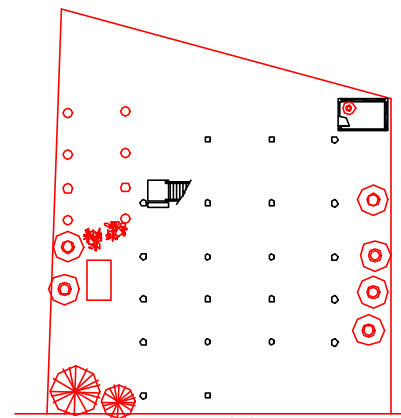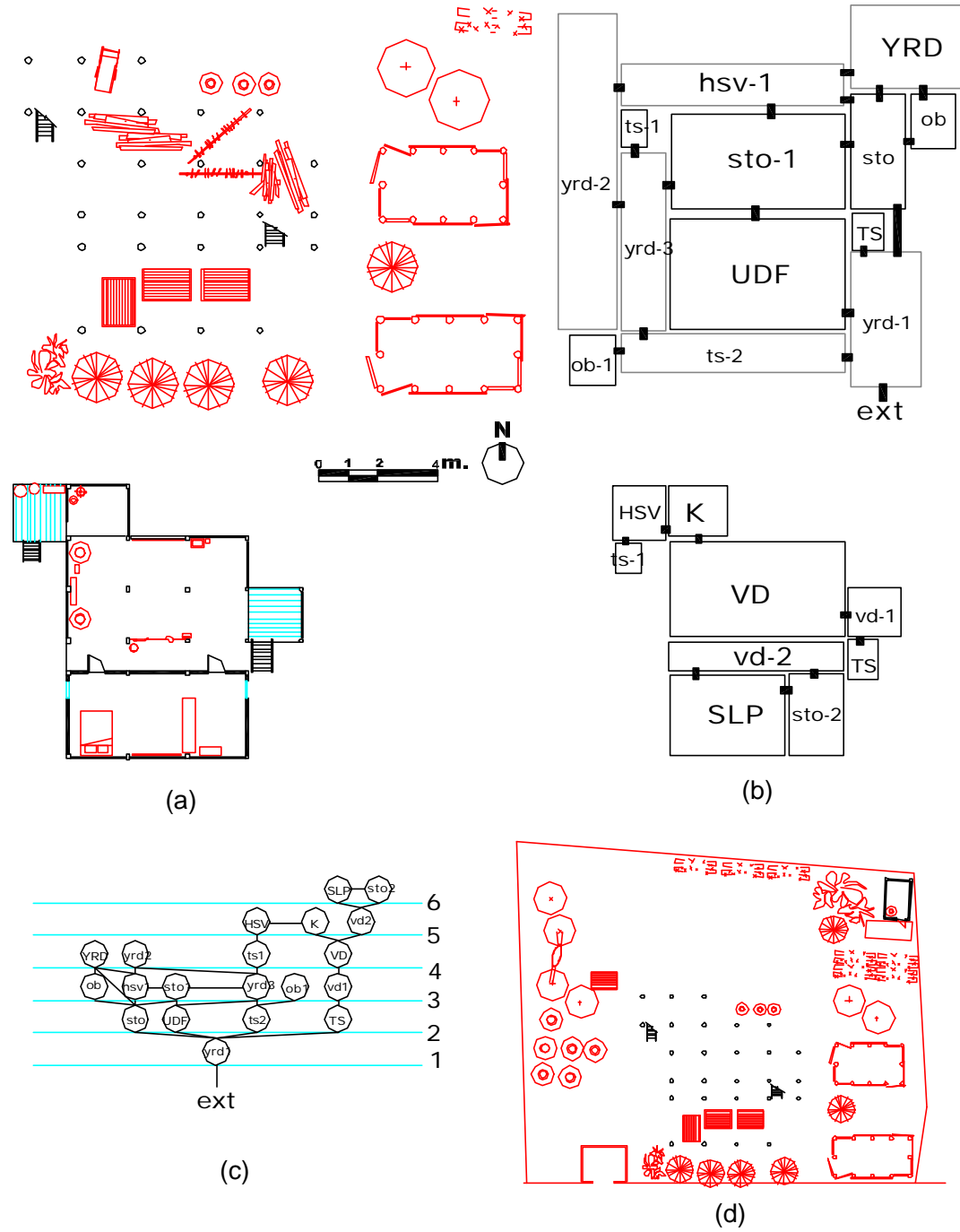w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram

(a)

(b)

(c)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram
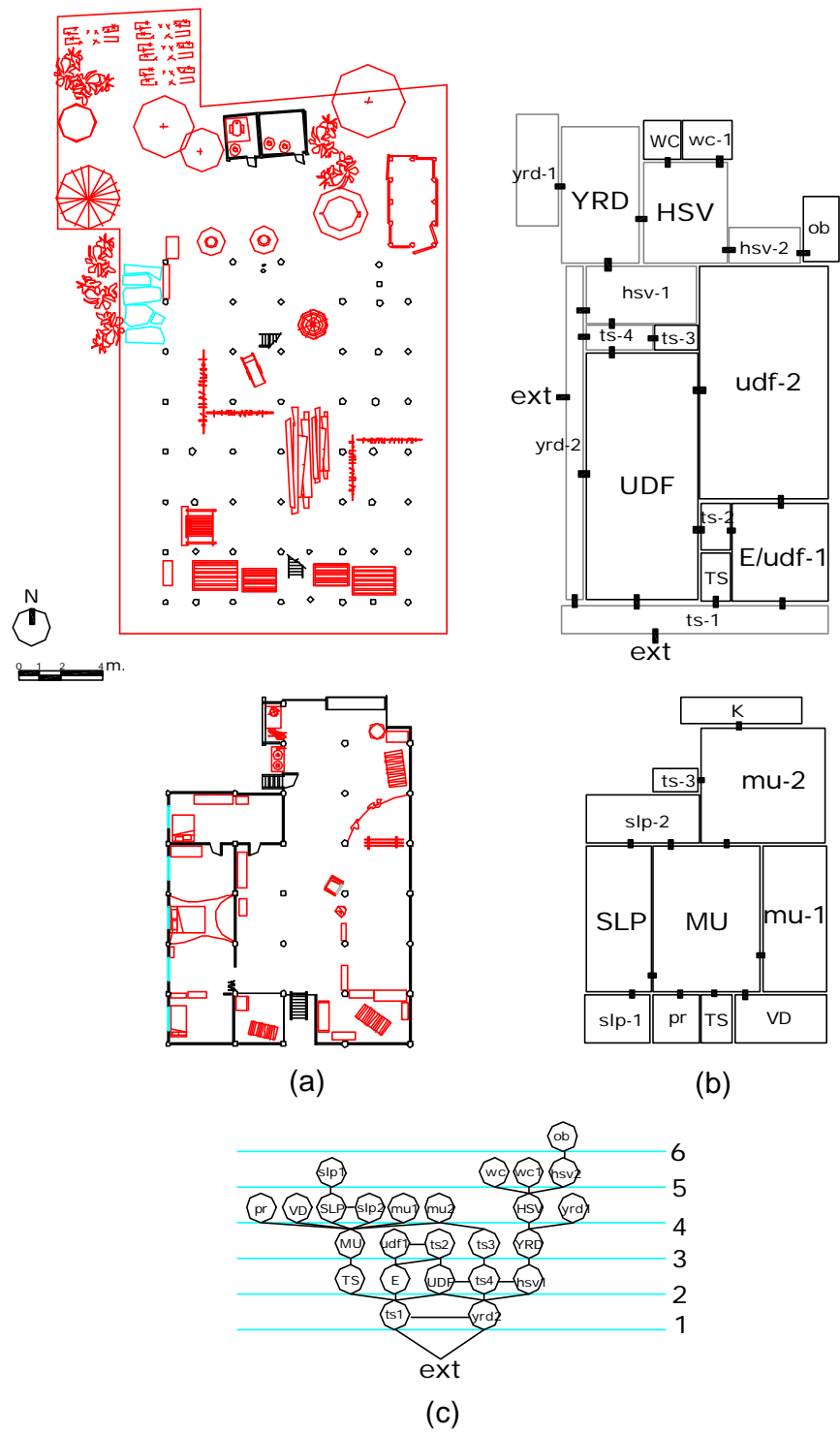
HOUSE 36

LEGEND:
UDF - Underfloor Space   YRD - Yard   WC - Toilet & Bathing Space   K - Food Preparation
MU - Multi-use   VD - Veranda   SLP - Sleeping Space   HSV - Household Service Space
TS - Transition Space   ext - External Space   sto - Storage   pk - Parking Space   pr - Prayer Room
w - Working Space   ob - Outbuilding/ Barn   s - Social Space
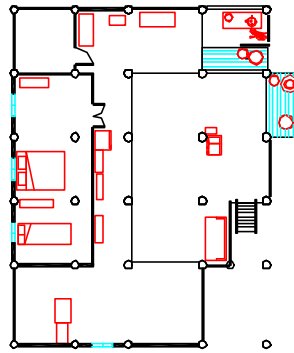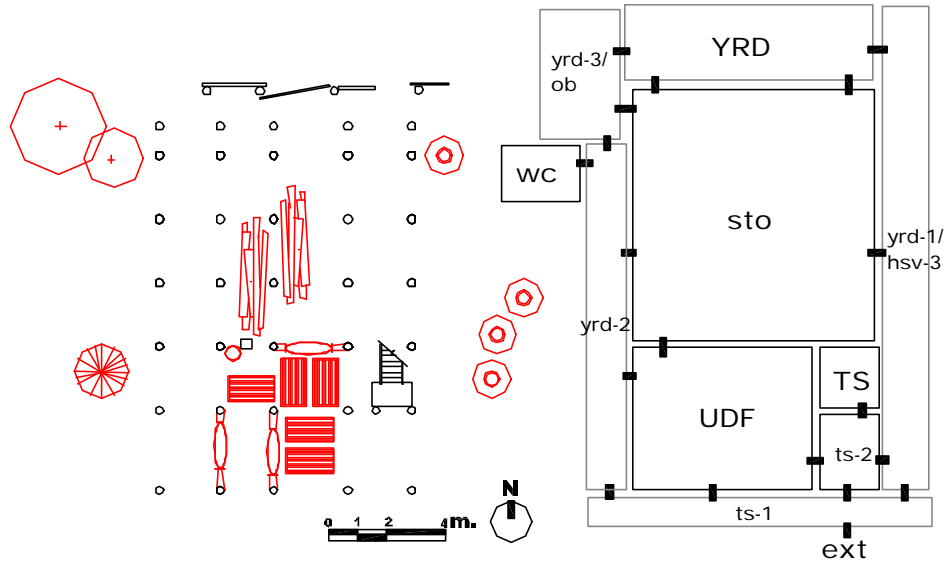
(a)

(b)

(c)
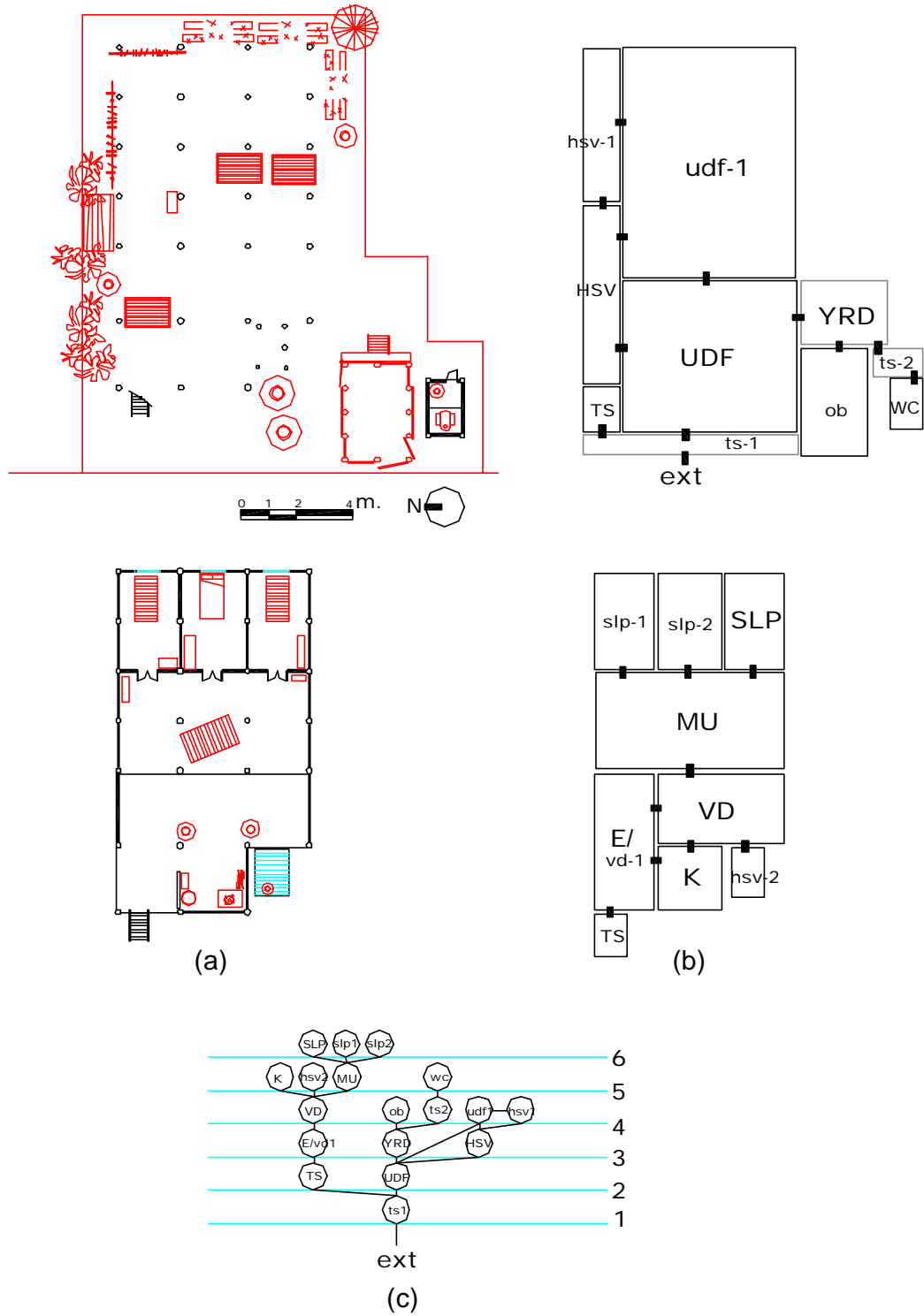
HOUSE **37**

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
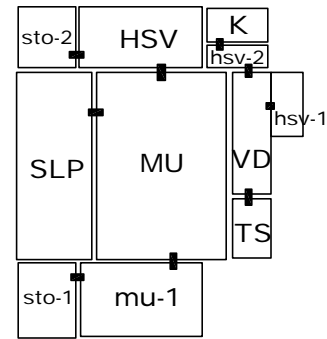TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram
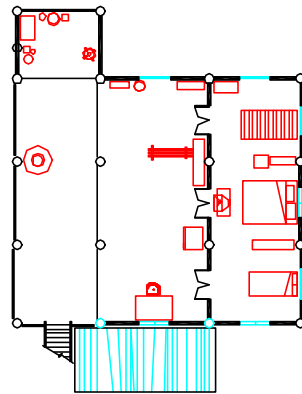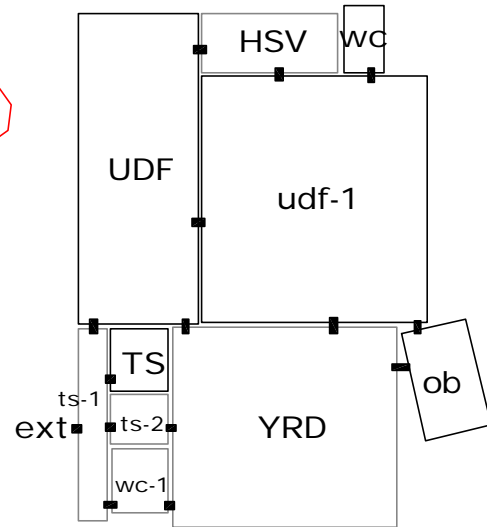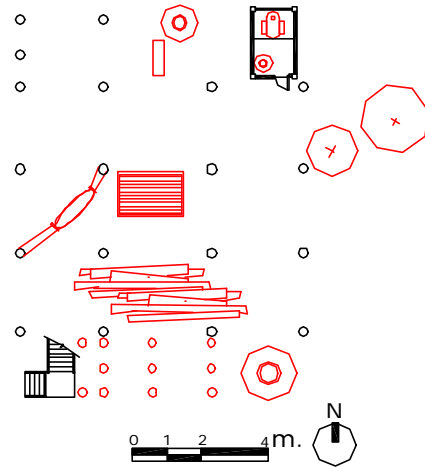
(a)
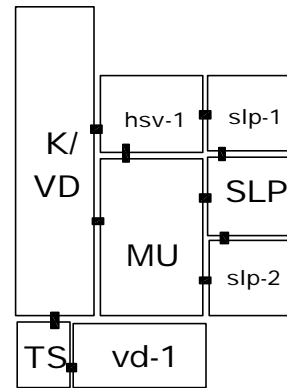
(b)
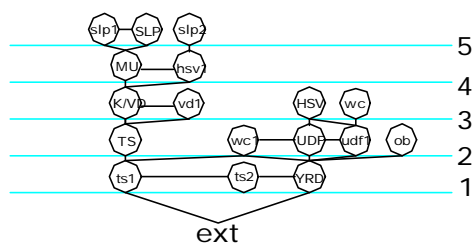
(c)
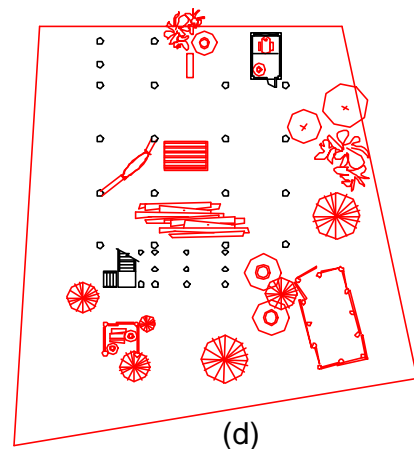
(d)

HOUSE 38

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
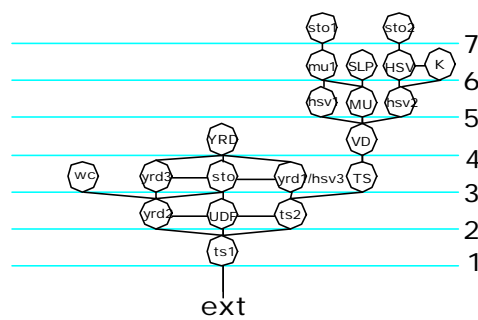w- Working Space   ob- Outbuilding/ Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

ts-5 WC
ts-4
ts-3
UDF/E
TS ts-2
ts-1 YRD
ext

(a)

SLP
K E/HSV
VD TS
MU
slp-1 mu-1

(b)

slp1
K SLP mu1
wc E/HSV MU
ts4 VD
ts5 ts3 TS
UDF ts2 YRD
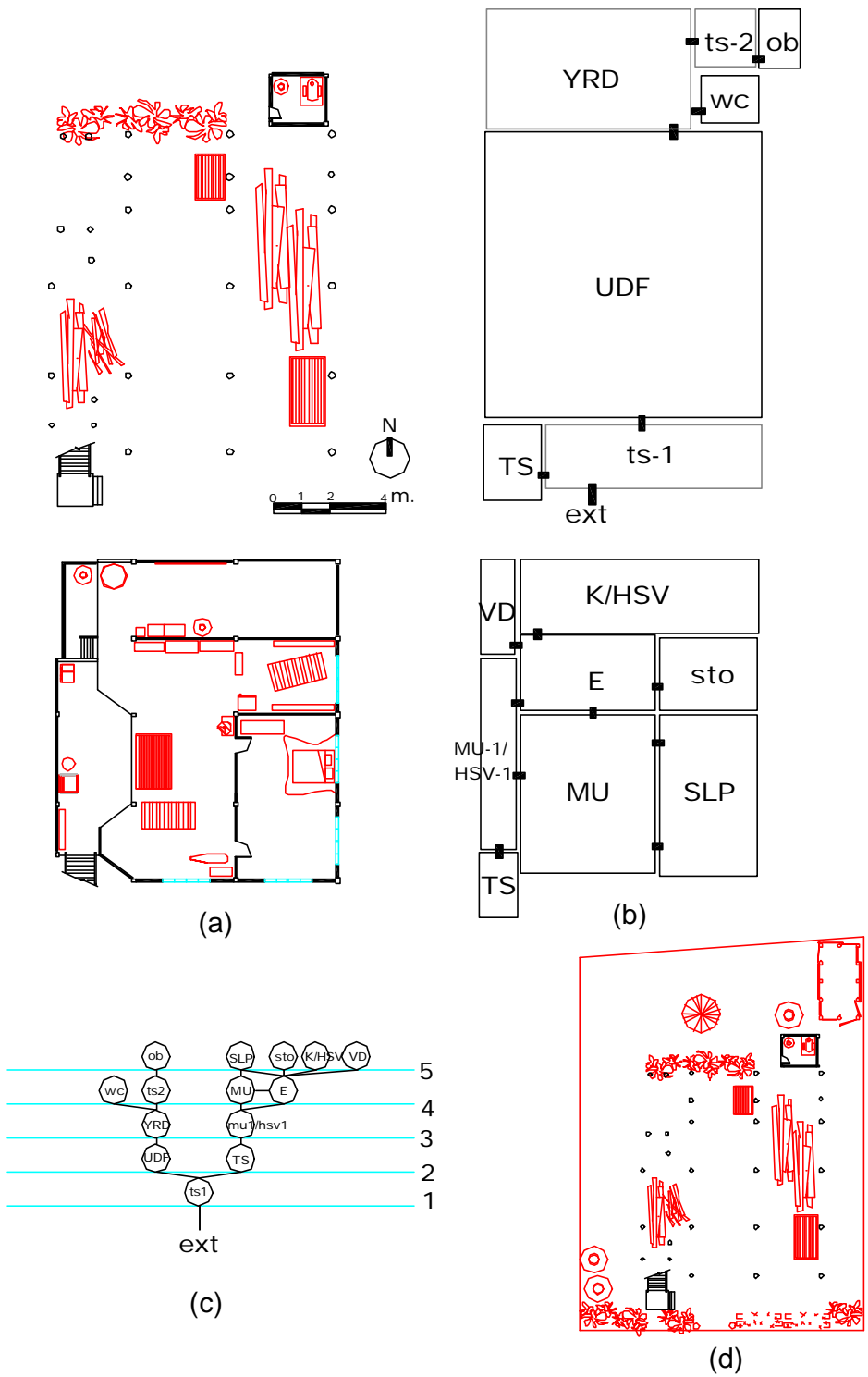ts1
ext

7
6
5
4
3
2
1
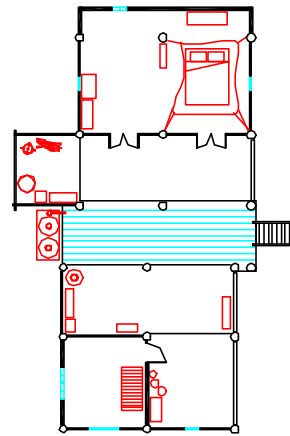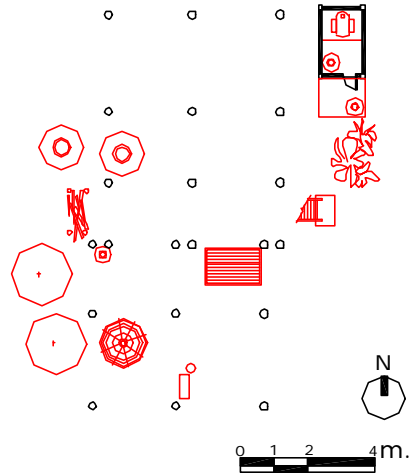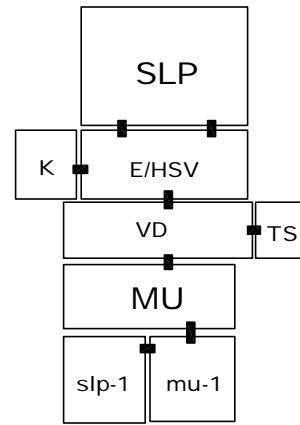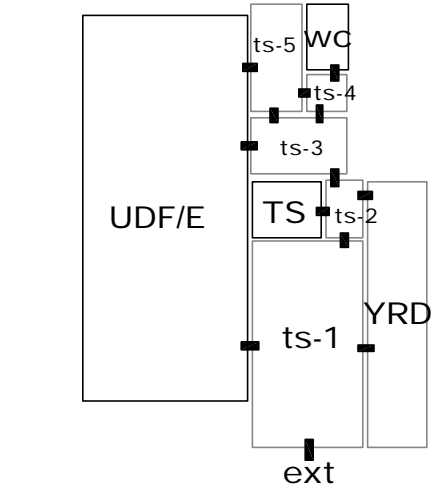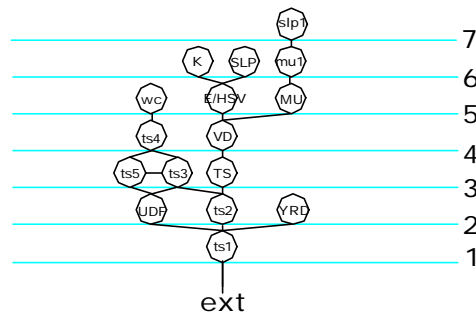
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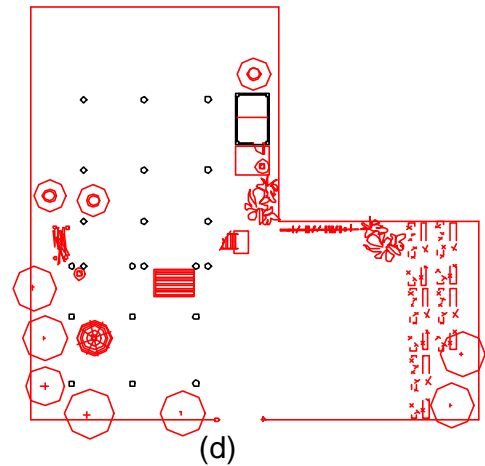
(d)

HOUSE 39

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
MU- Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/Barn   s- Social Space

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan

(a)

(b)

ext

(c)

HOUSE 40

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram

(a)

(b)

(c)

(d)

a) Floor Plans; b) Convex Spaces; c) Accessibility Diagram; d) Site Plan
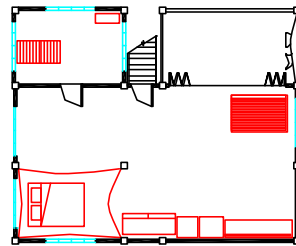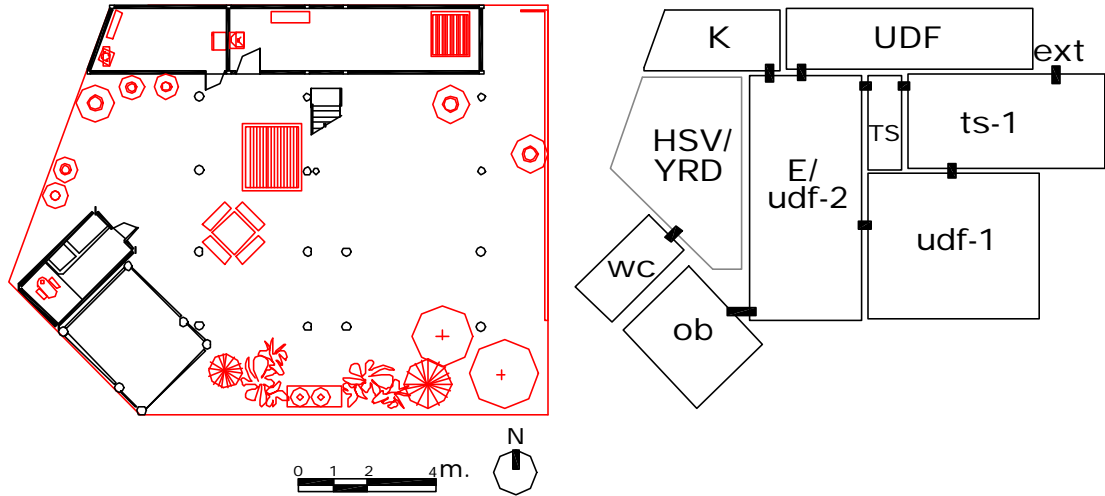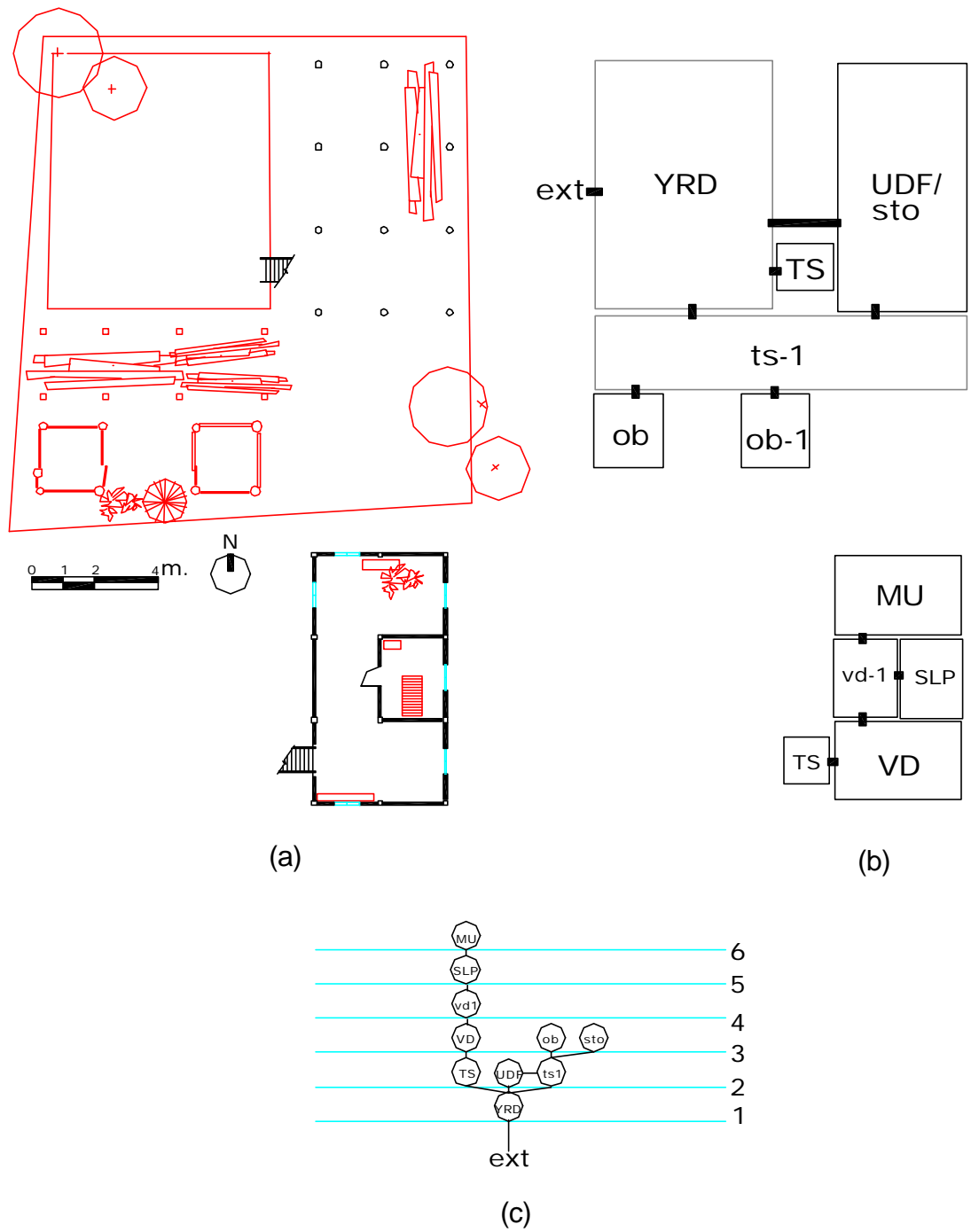
HOUSE 41

LEGEND:
UDF- Underfloor Space   YRD- Yard   WC- Toilet & Bathing Space   K- Food Preparation
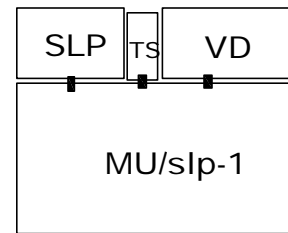MU - Multi-use   VD- Veranda   SLP- Sleeping Space   HSV- Household Service Space
TS- Transition Space   ext- External Space   sto- Storage   pk- Parking Space   pr- Prayer Room
w- Working Space   ob- Outbuilding/ Barn   s- Social Space

APPENDIX E
SYNTACTIC DATA OF HOUSE SAMPLES

Table E-1. Syntactic data of the house samples.

House	Age (years)	Depth Level	No. of Room	No. of Space	No. of Link	RRA		
						Min	Mean	Max
H01	4 m.	6	6	18	19	0.31	0.48	0.77
H02	7 m.	7	12	22	23	0.40	0.62	0.87
H03	1	6	5	22	28	0.35	0.49	0.67
H04	1+ 4 m.	6	6	12	11	0.38	0.54	0.70
H05	2	5	5	17	20	0.31	0.52	0.65
H06	3	7	9	23	27	0.41	0.54	0.87
H07	3	9	10	24	27	0.29	0.52	0.85
H08	6	4	3	10	9	0.36	0.49	0.73
H09	7	4	3	10	9	0.18	0.49	0.82
H10	13	7	5	16	15	0.30	0.52	0.80
H11	13	9	9	26	27	0.43	0.61	1.00
H12	13	7	8	20	22	0.34	0.59	1.04
H13	15	6	6	16	19	0.38	0.53	0.76
H14	15	6	2	13	12	0.33	0.59	0.77
H15	15	8	8	24	25	0.33	0.54	0.81
H16	18	8	6	20	20	0.42	0.54	0.73
H17	23	7	7	22	23	0.36	0.55	0.76
H18	28	5	4	14	13	0.38	0.58	0.91
H19	31	6	6	22	25	0.40	0.58	1.02
H20	32	5	5	17	18	0.31	0.52	0.75
H21	38	7	4	17	20	0.38	0.58	0.85
H22	40	5	2	12	15	0.26	0.50	0.77
H23	42	8	6	23	24	0.50	0.69	0.89
H24	45	11	7	19	18	0.48	0.69	0.91
H25	46	5	2	17	22	0.34	0.55	0.96
H26	50	6	2	16	20	0.23	0.50	0.91
H27	52	8	3	21	25	0.41	0.65	1.10
H28	52	7	5	19	23	0.28	0.56	0.82
H29	53	6	5	22	25	0.36	0.54	0.78
H30	55	8	5	22	24	0.40	0.65	1.11

Table E-1.—Continued.

House Number	Age (years)	Depth Level	No. of Room	No. of Space	No. of Link	RRA		
						Min	Mean	Max
H31	55	5	4	14	13	0.19	0.48	0.72
H32	58	6	3	21	29	0.34	0.48	0.77
H33	58	7	5	21	28	0.36	0.55	0.77
H34	60	5	5	15	16	0.42	0.58	0.81
H35	62	5	6	13	12	0.27	0.45	0.66
H36	65	6	4	26	33	0.37	0.58	0.74
H37	70	6	5	19	20	0.42	0.60	0.82
H38	72	5	4	18	25	0.31	0.52	0.84
H39	85	7	5	17	19	0.31	0.53	0.79
H40	86	6	4	11	11	0.38	0.52	0.75
H41	100	7	3	15	18	0.3	0.48	0.85

Note: RRA = Real Relative Asymmetry

Table E-2. Summary of mean RRA values by space-use pattern.

House Number	SPECE-USE										
	UDF	YRD	WC	K	MU	VD	SLP	E	HSV	TS	EXT
H01	0.37	0.43	0.47	0.34	0.42	N/A	0.77	N/A	0.55	0.43	0.47
H02	N/A	0.58	0.74	0.34	0.56	0.48	0.63	0.45	0.34	0.47	0.64
H03	N/A	0.48	0.62	0.36	0.43	0.56	0.59	0.36	0.56	0.48	0.53
H04	N/A	N/A	0.61	0.45	0.48	0.58	0.58	0.38	0.45	0.51	0.57
H05	0.44	0.34	0.65	0.41	0.48	N/A	0.61	N/A	0.49	0.53	0.58
H06	0.43	0.48	0.63	0.41	N/A	0.60	0.64	0.47	N/A	0.51	0.58
H07	0.39	0.37	0.70	0.35	0.49	0.62	0.60	N/A	0.62	0.42	0.64
H08	N/A	0.55	0.64	0.64	0.36	N/A	0.45	0.36	0.36	N/A	0.55
H09	N/A	0.36	0.27	0.82	0.60	N/A	0.19	N/A	N/A	0.36	0.55
H10	0.43	0.38	0.71	0.53	0.49	N/A	0.78	N/A	0.61	0.44	0.49
H11	0.61	0.63	0.61	0.51	0.56	0.71	0.64	0.44	0.54	0.54	0.44
H12	0.70	0.58	0.55	0.44	0.55	0.65	0.65	0.47	0.34	0.48	1.04
H13	0.49	0.53	0.76	0.53	0.53	0.53	0.61	0.46	0.38	0.51	0.64
H14	N/A	0.49	0.71	0.77	0.77	0.33	0.55	0.33	0.66	0.47	0.66
H15	0.47	0.46	0.50	0.82	0.47	0.64	0.62	0.82	0.64	0.53	0.62
H16	0.47	0.56	0.57	0.42	0.59	0.52	0.56	0.53	0.55	0.47	0.52
H17	0.46	0.49	0.53	0.62	0.47	0.62	0.72	0.40	0.66	0.52	0.53
H18	0.43	0.38	0.67	N/A	0.74	0.38	0.72	N/A	0.72	0.54	0.62
H19	0.46	0.58	0.58	0.51	0.73	0.44	0.69	N/A	0.63	0.50	0.44
H20	0.52	N/A	N/A	0.55	0.61	0.31	0.59	0.65	0.41	0.51	0.51

Table E-2.—Continued.

House Number	SPECE-USE										
	UDF	YRD	WC	K	MU	VD	SLP	E	HSV	TS	EXT
H21	0.41	0.65	0.65	0.72	0.56	0.50	0.79	N/A	0.66	0.46	0.48
H22	0.35	0.54	0.45	0.64	0.70	0.43	0.77	0.45	0.64	0.31	0.51
H23	0.66	0.64	0.79	0.60	0.56	0.70	0.81	0.60	0.63	0.61	0.52
H24	0.68	0.74	0.76	0.76	0.52	0.78	0.79	0.74	0.76	0.57	0.71
H25	0.56	0.58	N/A	0.48	0.60	0.34	0.73	N/A	0.46	0.52	0.44
H26	0.30	0.36	N/A	0.53	0.91	0.40	0.57	0.45	0.45	0.42	0.42
H27	0.52	0.56	0.74	0.62	N/A	0.72	0.98	N/A	0.49	0.60	0.62
H28	0.51	0.48	0.82	0.59	0.59	0.42	0.76	0.51	0.51	0.45	0.45
H29	0.57	0.47	0.71	0.42	0.53	0.53	0.51	N/A	0.66	0.46	0.35
H30	0.62	0.69	N/A	0.56	0.56	0.91	0.88	0.40	0.44	0.56	0.49
H31	0.55	N/A	0.48	0.48	0.19	0.62	0.58	N/A	0.60	0.38	0.48
H32	0.36	0.47	N/A	0.55	N/A	0.44	0.67	N/A	0.50	0.45	0.48
H33	0.46	0.52	0.62	0.77	0.64	0.36	0.58	N/A	0.57	0.45	0.43
H34	0.64	0.47	0.76	0.81	0.42	0.64	0.60	0.51	0.81	0.55	0.55
H35	0.37	0.60	0.55	0.33	0.60	0.44	0.63	0.33	0.55	0.41	0.27
H36	0.56	0.49	0.65	N/A	0.44	0.70	0.62	0.61	0.71	0.50	0.48
H37	0.57	0.51	0.82	0.54	0.54	0.42	0.81	0.38	0.64	0.55	0.54
H38	0.53	0.43	0.45	0.31	0.40	0.36	0.69	N/A	0.73	0.48	0.40
H39	0.38	0.48	0.79	0.61	0.48	0.31	0.70	0.48	0.58	0.48	0.48
H40	0.38	0.38	N/A	N/A	0.75	0.49	0.53	N/A	N/A	0.41	0.53
H41	0.47	0.34	N/A	N/A	0.55	0.38	0.72	0.38	0.38	0.38	0.55

Note: UDF = Under floor Space   SLP = Sleeping Space
        YRD = Yard and Outdoor Space   E = Eating Space
        WC = Toilet and Bathing Space   HSV = Household Service Space
        K= Food Preparation Space   TS = Transitional Space
        MU = Multiple use Space   EXT = External Space
        VD = Verandah Space

Table E-3. Summary of mean depth by space-use pattern.

House Number	SPECE-USE										
	UDF	YRD	WC	K	MU	VD	SLP	E	HSV	TS	EXT
H01	3.17	3.13	4.22	3.33	2.95	N/A	3.13	N/A	4.22	2.17	3.33
H02	N/A	4.18	4.21	2.82	3.00	4.08	3.50	2.36	2.82	2.87	4.05
H03	N/A	3.13	2.91	3.00	2.87	2.41	3.78	3.09	3.14	2.82	3.23
H04	N/A	N/A	3.09	2.08	1.92	3.17	3.00	1.75	2.08	2.42	3.42
H05	2.06	2.47	3.76	2.41	3.68	N/A	3.57	N/A	2.65	2.42	3.35
H06	2.70	3.38	4.35	3.00	N/A	3.62	4.56	2.91	N/A	3.18	3.78
H07	3.17	3.96	4.38	4.71	3.63	5.38	4.69	N/A	3.48	3.63	4.96
H08	N/A	2.50	3.30	2.50	1.70	N/A	2.70	1.90	1.90	N/A	2.40
H09	N/A	2.10	2.90	2.10	2.00	N/A	2.30	N/A	N/A	1.90	2.40
H10	2.56	2.50	4.00	4.12	4.12	N/A	5.00	N/A	4.12	3.02	3.38

Table E-3.—Continued.

House Number	SPECE-USE										
	UDF	YRD	WC	K	MU	VD	SLP	E	HSV	TS	EXT
H11	3.64	4.15	4.42	2.88	4.27	4.98	4.67	3.27	3.19	3.69	4.65
H12	3.27	3.25	3.00	2.55	3.50	4.00	3.82	2.55	2.10	2.94	4.05
H13	2.19	2.88	3.75	2.12	2.19	2.50	3.00	2.38	2.50	2.52	3.56
H14	N/A	2.73	3.92	2.92	3.85	2.08	2.46	2.08	2.92	2.58	3.31
H15	3.54	3.83	3.96	3.96	3.94	4.46	5.54	3.96	3.08	3.67	4.54
H16	2.88	4.01	4.15	3.25	4.27	4.40	4.40	2.75	3.75	3.25	3.95
H17	2.87	4.28	5.05	3.75	4.14	5.45	4.64	3.50	3.59	3.56	3.73
H18	2.43	2.71	4.14	N/A	4.14	3.14	4.57	N/A	4.14	2.86	3.29
H19	2.91	3.07	3.72	3.09	3.89	3.31	3.80	N/A	5.50	3.28	3.77
H20	3.35	N/A	N/A	3.47	2.88	2.24	3.17	3.62	2.58	2.62	2.88
H21	3.58	3.79	3.11	3.24	3.86	3.91	4.35	N/A	3.49	2.68	3.59
H22	2.25	2.13	3.08	2.83	3.67	2.58	3.67	2.25	2.83	2.00	2.67
H23	3.22	3.98	5.13	2.87	3.37	4.83	4.45	2.87	3.38	4.06	4.43
H24	4.39	4.68	5.42	3.89	3.92	5.63	5.29	4.78	3.89	3.34	5.63
H25	3.14	1.97	N/A	2.88	2.73	2.41	3.62	N/A	2.82	2.70	3.00
H26	2.62	2.66	N/A	3.44	4.63	3.57	5.50	3.12	3.12	3.02	2.56
H27	3.22	3.19	5.19	4.17	N/A	4.57	5.89	N/A	3.79	3.27	4.00
H28	3.00	2.75	4.26	4.36	3.41	2.63	3.78	3.00	4.36	3.04	3.21
H29	3.82	4.09	4.95	4.36	3.66	3.51	4.68	N/A	4.23	3.05	3.73
H30	4.25	4.36	N/A	4.13	3.59	5.77	4.92	3.23	3.23	4.25	3.95
H31	2.29	N/A	4.07	3.07	2.21	3.07	3.07	N/A	2.93	2.64	2.64
H32	2.76	2.92	N/A	3.38	N/A	3.35	4.76	N/A	3.17	2.85	3.19
H33	3.00	3.38	4.38	4.05	3.62	2.57	4.14	N/A	3.51	3.06	4.00
H34	2.93	3.40	4.27	3.73	2.84	3.73	3.13	2.87	3.73	3.00	3.07
H35	2.69	3.23	4.08	3.08	3.69	4.54	4.12	2.53	3.23	2.85	2.77
H36	3.70	3.61	5.15	N/A	3.64	4.23	4.47	3.54	4.04	3.18	3.27
H37	3.37	3.58	5.26	4.21	3.89	3.18	4.79	3.05	4.17	3.37	3.79
H38	3.19	2.83	3.47	2.55	3.11	5.44	3.98	N/A	3.45	2.54	2.67
H39	3.29	3.76	4.41	4.18	3.68	2.65	4.56	3.29	3.29	2.91	3.82
H40	2.54	2.00	N/A	N/A	4.27	2.59	3.45	N/A	N/A	2.23	2.82
H41	3.87	2.10	N/A	N/A	2.67	2.67	4.44	2.67	2.67	2.40	3.13

Note: UDF = Under floor Space   SLP = Sleeping Space
         YRD = Yard and Outdoor Space   E = Eating Space
         WC = Toilet and Bathing Space   HSV = Household Service Space
         K= Food Preparation Space   TS = Transitional Space
         MU = Multiple use Space   EXT = External Space
         VD = Verandah Space

NON-METRIC MULTIDIMENSIONAL SCALING
ÄÄÄ
ÄÄÄÄÄÄÄÄ

Input dataset: C:\ANTROPAC\MYDATA\AGPROX

Starting config: TORSCA

Type of Data: Similarities

                          1   2

                        ----- -----

  1 UNDERFLOORSPACE   -0.58   0.89

  2   YARD   -1.18 -0.02

  3   TOILETBATHING   0.39 -1.17

  4 FOODPREPARATION   -0.78   0.02

  5   MULTIUSEAREA   1.48 -0.17

  6   VERANDAH   0.01   0.69

  7   SLEEPINGSPACE   -0.30 -0.70

  8   EATINGSPACE   0.51 -0.28

  9 HOUSEHOLDSERVICE   0.46   0.74

Coordinates saved as dataset COORD

Stress 0.095 after 21 iterations.

```
Dim 2
        ÚÄÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄ¿
        ³                                                                    ³
        ³                                                                    ³
  1.22 ´                                                                    Ã
        ³                                                                    ³
        ³                                                                    ³
        ³                                                                    ³
  0.57 ´              UNDERFLOORSPACE        HOUSEHOLDSERVICE               Ã
        ³                             VERANDAH                               ³
        ³                                                                    ³
        ³                                                                    ³
 -0.09 ´    YARD     FOODPREPARATION                                       Ã
        ³                                  EATINGSPACE          MULTI ³
        ³                                                                    ³
        ³                    SLEEPINGSPACE                                   ³
 -0.74 ´                                                                    Ã
        ³                                TOILETBATHING                       ³
        ³                                                                    ³
        ³                                                                    ³
        ÀÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÙ
            -0.83         -0.29         0.25          0.79          1.33
                                                                   Dim 1
Stress in 2 dimensions is 0.095


Elapsed time:  1 second. 8/20/2000 10:55 PM.
ANTHROPAC 4.94 Copyright 1985-1998 by Analytic Technologies.
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APPENDIX G
DESCRIPTION OF HOUSE STYLES

The classification of vernacular houses is based on the descriptions and documentation by previous researchers on the northeastern traditional houses in Thailand. The studies conducted by Hengrasmee, Phalawattana and Sutthitham- *Architectual Development for Housing in Rural Isan along the Chi River Basin* and by Srisuro- *The Northeast House* are a few especially valuable among many.

Traditional Style

A typical traditional house is built from wood and raised on stilts that keeps living quarters above the ground. The general shape is rectangular with one or two double-pitched roofs, and sometimes perpendicular or longitudinal lean-to roofs. Many houses have only one roof, often extended by a lean-to roof covering a verandah on the long side of the house.

In the front of the house is an open terrace, accessible by a ladder. The platform leads to kitchen and verandah. On this platform, smaller jars of water, sheltered by a small roof, contain drinking water. Access to the interior of main house is via a verandah space. The interior of the house is normally divided into two rooms, one is a multifunctional space for family living and sleeping space and the other is the daughter's bedroom. The kitchen is often in the rear and can be separated as part of an open terrace or sheltered by an independent roof.

Posts are assembled on the ground. The house structure is generally made of teak, while bamboo frames can be found in a temporary dwelling, for example a house in a rice field. The original roofing material is wooden tiles, but over time has been re-roofed to clay tiles or corrugated iron sheets.

Bangkok High Style

Later styles of wooden house were built by people who came to the northeast region from other parts of Thailand. At the beginning, these houses were built dwellings for officers who worked for governmental institutions in rural areas. In later years this house style was built by local residents. Today it is found scattered throughout the area.

The hip roof is a dominant characteristic. Interiors, doors and windows are decorated with elaborately carved and cut woods. The houses are mainly built in two stories with the ground floor being either opened or walled. Most spaces of the house are covered with roof and enclosed walls.

Shop House

Shop houses were first constructed by Chinese immigrants who arrived during the 19th century. Over time especially in urbanized areas, shop houses have been built to serve dual functions of business and family living. A typical form is built in a row of uniform dwellings, normally located along the road in order to accommodate buying and selling activities. On the first level, entrance to the house opens into the main room for commercial use and receiving guests. The upper floor is residential although it is sometimes used as a stockroom for merchandise. The living area is clearly separated from commercial activities. The service quarters such as toilet and kitchen are located either in the back yard or next to the main room.

The shop house has a narrow and elongated floor plan with a small frontage to the road. The roof is covered with corrugated sheets or tiles. Most shop houses in rural areas are made of wood whereas those in urban areas are semi-timbered structures with mortar walls in the lower level.

Institutional Style

This style was originally produced by local housing agencies, aiming to provide an affordable house for a low-income family. Its design is essentially based on the availability of materials in the market and the hygienic appropriation of living spaces required by the regulations from public health agencies. The house mainly uses new materials such as corrugated iron sheets, pre-caste concrete columns, industrialized doors and windows. Because materials are always available for a replacement, and it is cheaper and more convenient to get the floor plan drawing for this type of house at no expense, in recent years people tend to build more institutional houses.

The house replicates the pile dwelling which basically focuses on the use of the under floor space for daytime activity. The lower level is a multifunctional space with an enclosed staircase leading to the main living area. Instead of separating kitchen and toilet spaces in back yard area, some houses may build them in the under house area. The house has a gable with a shallow slope roof. In some houses, under floor space is enclosed by concrete block walls and divided into kitchen, toilet and living area.

Contemporary Style

The contemporary style is a typical model that normally is built by land and property development companies. Spatial planning is influenced by Western lifestyle, including bedrooms, living room, working room, kitchen and toilet. In the provincial

areas, the similar style is an imitation of the design found everywhere in suburban housing projects. The house can have a single story or two stories. Access to the porch from the main entrance leads to the main living area for receiving guests and family living. The lower floor is usually enclosed for the living room, toilet and kitchen. Sometimes eating spaces are contained in the kitchen, while some are located adjacent to the living space. Most houses have small balconies next to the bedrooms in the upper floor.

The house structure is a reinforced concrete footing and slab floors, enclosed by concrete blocks or masonry walls. Roofs are built in hipped, gable or gable-hipped, covered with concrete tiles or corrugated asbestos cement sheets.

(a)

Figure G-1. House Styles.
a) Traditional Style; b) Bangkok High Style (Hipped Roof); c) Shop House;
d) Institutional Style; e) Contemporary Style

(b)

(c)

Figure G-1—Continued

(d)

(e)

Figure G-1—Continued.

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BIOGRAPHICAL SKETCH

Mr. Nopadon Thungsakul was born and raised in Nakhon Phanom province, part of the northeast region of Thailand. He earned a Bachelor of Architecture with high honors from Khon Kaen University in 1992 and a Master of Architecture from the University of Colorado at Denver in 1996.

After his graduation in 1992, he started to work the same year as a junior architect for Nond-Truengjai Architects and Planners Co.Ltd., Bangkok, Thailand. From 1993-1995 he worked as a lecturer in the Department of Architecture, Khon Kaen University, Khon Kaen. Among the courses he taught are Architectural Drawing, Design Criteria and Concepts, Seminar, Design Studio and Tropical Architecture. A year later he was awarded a master-doctoral scholarship from the Thai Government to pursue graduate studies in architecture. In 1997, he enrolled in the University of Florida, College of Design Construction and Planning, a doctoral program which he completed in 2001.

While he studied, he continued to be an active me mber of the Faculty of Architecture, Khon Kaen University, Khon Kaen, Thailand. He is also a licensed architect and a member of the Association of Siamese Architects. He expects to return to Thailand where he will teach and do research at Khon Kaen University. His major interest focuses on the transformation of conceptual design from traditional to contemporary architecture, including regionalism in architectural education.