A GENERATIVE MODEL FOR NEW HOUSES BASED ON THE CULTURAL TRADITIONS AND SUSTAINABILITY

(A Study on Villages of rice fields in the north of Iran)

MAJID YOUSEFNIAPASHA

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(A Study on Villages of rice fields in the north of Iran)

Majid Yousefniapasha

School of Architecture

Portsmouth University

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Supervision

Catherine Teeling

Department of Architecture

Portsmouth University

First Supervisor

Dr Brett Martinsen

Department of Civil Engineering & Surveying

Portsmouth University

Second Supervisor

Tim Goodhead

Department of Civil Engineering & Surveying

Portsmouth University

Third Supervisor

***To* two lovely ladies of my life:**

Maria

& ***Mana***

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'Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award'

The main body of this thesis is totally included of (77200) words excluding, preface, notes and terms, acknowledgment, dedication, list of contents, list of figures and tables, abstract, footnotes, bibliographies, diagrams, references and appendices.

Acknowledgement

First, I should express special thanks to my wife and daughter who always accompanied me with no obligation enduring all difficulties that were the only contributions of my study to them. Undoubtedly, without their faithful support and companionship, accomplishment of this research was out of imagination.

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Third, I would like to appreciate Dr. Razjouyan who encouraged me to pursue my study in PhD and advised production of primary proposal for this research. Thank to Dr. Nadimi, too for his kind assistance finding an appropriate university abroad who introduced me with Prof. Broadbent. In this regard, I would like to acknowledge Prof. Broadbent because of his invaluable advices during early stages of improvement of this research enlightening the research main path.

At finally yet importantly, I would like to thank all of staffs who had a role in development of Portsmouth University specially within the department of architecture that contributed appropriate environment, facilities and circumstances for this research to be accomplished towards obtaining PhD degree.

Preface and disseminations

This thesis is somehow the story of my own passion to an incredible region where is the location of my home village. Working on rice fields with our parents, immigration to the mountain area during summer, having close interaction with the forest area, and playing in rural religious wooden buildings were favourable and memorable activities for children as well as me within this region. In these beautiful, mysterious, and symbolic traditional spaces and buildings, we had precious interaction with other children and specially environment.

Skilful local carpenters played the main role of what we call them today as architects. They used to work based on communal public taste and knowledge of construction, which fortunately is still alive in this region. I remember how enthusiastic we were after school when my brothers and I were helping the carpenters to construct our new house. Influenced by these memories, I decided to pursue my education to be an architect in university. I believe construction, and creativity in relation to culture and life are appealing aspects of architecture.

During the university courses, I was intrigued by the important values of rural architecture and the strong relationships between rural culture and life of the region where I grew up. Despite the complexity of this rural inhabitant's life, surprisingly simplicity is the main course of the rural architecture. Due to the lower financial sources comparing to the cities, rural people need to do the best out of the available resources that they obtain from their natural environment. For this reason, they understand the context more and there are obligations to make the intelligent decision out of it.

Nowadays lifestyle is unexpectedly transforming and simultaneously destroying vernacular architecture, local population do not know how to preserve their environment, and there is no appropriate methodology to deal with the new impact distinctively with new rural perception and outlook, and new form demands for houses. It has been my desire to find a solution for new houses within our region's villages to be designed well suit to the original context, which the

current ones have not provided yet. With my actively and persistently perusing these types of architectural issues, including conduction of researches and practices, I made up my mind to pursue my further study on this fascinating subject for Ph.D through a research and finished by writing up this thesis.

This thesis is composed of three distinct parts each of which is included of different chapters. This division is to help the reader to sensibly peruse the subject achieving better understand of the thesis. Some documents that their explanation would have broken the continuity of discussion or could help better understanding of a subject or support the discussion but not full relevant, have been added to the appendix. Some of words and concepts, which have been used many times within the research, have been defined within the section called 'terms' to make a common definition. Some local words refereeing to the name of some places and spaces, which there is no corresponding English word for them, are written in italic and in local language; however, they are defined and explained once they are mentioned.

During conduction of this research, I have endeavoured to improve my academic skills through participation in the university's graduate office programmes and dissemination of the result of my study mentioned through the list below.

- Oral presentation of a paper entitled as ' *Climatic implication within houses of villages of Mazandaran in north of Iran'*, International conference about research in science and technology, 14 December 2016, Kualalumpor, Malaysia
- Oral presentation of a paper entitled as *'Agriculture, food production and appropriate development for villages in Mazandaran'*, International conference of architecture, construction and urban development, Hamedan, 28, November 2016, Hamedan, Iran
- Oral presentation of a paper entitled *'Looking for a proper development pattern according to the earth and environment of*

villages in Mazandaran', first national conference on sustainable rural development, 02-04 July 2015, Tehran, Iran

- Poster presentation about this research in an exhibition at CCI department of Portsmouth University, July 2016.

At the end, I hope the result of this thesis to be able appropriately to support practitioners and authorities enabling local population to create admirable solutions for their housing problems according to their cultural and environmental characteristics making their living environment favourable and memorial for new generations, again.

Terms and notes

This section defines terms as used in the context of this document. Some of them have other definitions and in such cases, references are mentioned for further elucidation. This section merely attempts to clarify the definitions of certain key terms that may otherwise seem ambiguous, subjective, or contentious thereby lending themselves to alternative interpretations. The definitions however, are not contrary to popular meanings except where stated otherwise.

Architecture: *(noun)***1.** The art or practice of designing and constructing buildings: schools of architecture and design and **1.1.** The style in which a building is designed and constructed, especially with regard to a specific period, place, or culture (Oxford Dictionaries, 2015). **2.** "*... an art of distinctions in the continuum of space, for example between solid and void, interior and exterior, light and dark, or warm and cold (Mitchell, 1990)."* **3.** "*...the masterly, correct, and magnificent display of masses brought together in light*." – Charles Edwardo Jeannerett (Le-Corbusier): (1889-1965) **4.** "... *the triumph of human imagination over materials, methods and men*."- Frank Lloyd wright (1867-1959) **5.** "*when technology reaches its ultimate fulfilment, it transcends into architecture*." –Mies Van der Rohe (1901-1971)

Babol:*(Noun)* name of second major city and county located in Mazandaran province in Iran.

Characteristic :*(noun)* A feature or quality belonging typically to a person, place, or thing and serving to identify those (Oxford dictionaries, 2015)

County: *(noun)* **1.A** territorial division of some countries, forming the chief unit of local administration (Oxford Dictionaries, 2015). In Iran and region of this study, county refers to a territory including of a major city, some towns and villages entitled the same name as the name of major city, which is used in this document.

Culture:*(noun) and verb***1.**The arts and other manifestations of human intellectual achievement regarded collectively**1.1**.A refined understanding or appreciation of culture: *men of culture***2.**The ideas, customs, and social behaviour of a particular people or society:

'*Afro-Caribbean culture*' **2.1.**The attitudes and behaviour characteristic of a particular social group: *'the emerging drug culture'* (Oxford Dictionaries, 2015). Rapoport (1980) develops the meaning of the culture and puts it into three 'broad classes'; *'one defines it as a way of life typically of a group; the second as a system of symbols, meaning and cognitive, schemata transmitted through symbolic codes; the third as a set of adaptive strategies for survival related to ecology and resources (p.337)'.*

Dwelling: *(noun)*a house, flat, or other place of residence (Oxford Dictionaries, 2015).

Form: *(noun)***1.**The visible shape or configuration of something, **1.1.** Style, design, and arrangement in an artistic work as distinct from its content (Oxford Dictionaries, 2015).

Generate: (*verb)* **1.**Produce or create**1.2.***Mathematics* & *Linguistics* Produce (a set or sequence of items) by performing specified mathematical or logical operations on an initial set, **1.3.***Linguistics* Produce (a sentence or other unit, especially a well-formed one) by the application of a finite set of rules to lexical or other linguistic input. **Generative***(adjective)* (Oxford Dictionaries, 2015).

House: *(noun)* **1.**A building for human habitation, especially one that consists of a ground floor and one or more upper stories, **1.1.** A building in which animals live or in which things are kept: *a hen house (*Oxford Dictionaries, 2015).

Mazandaran: *(noun)* name of a northern province of Iran surrounded with Caspian sea in north and Alborz chain of mountains in south.

Model: (*noun)* **1.**A thing used as an example to follow or imitate **2.** A simplified description, specially a mathematical one, of a system or process, to assist calculations and predictions. *(Verb)***1.** (model something on/after) Use (a system, procedure, etc.) as an example to follow or imitate **1.1.** Devise a representation, specially a mathematical one, of (a phenomenon or system) (Oxford Dictionaries, 2015).

Property: *(noun)* A building or buildings and the land belonging to it or them (Oxford Dictionaries, 2015).

Province: *(noun)* A principal administrative division of a country or empire(Oxford Dictionaries, 2015).

Region*: (noun)* **1.An** area, specially part of a country or the world having definable characteristics but not always fixed boundaries, **1.1.**An administrative district of a city or country. In this document, this word is used to mention the region that has been selected for field trip conducting case study research. **Regional** *(adjective)*

Sari:*(noun)* name of capital city of Mazandaran province in Iran and as the first major city and county of this province.

Setting: *(noun)***1.**The place or type of surroundings where something is positioned or where an event takes place(Oxford Dictionaries, 2015).

System:*(noun)***1.**A set of things working together as parts of a mechanism or an interconnecting network; a complex whole: *the state railway system;***2.**A set of principles or procedures according to which something is done; an organized scheme or method(Oxford Dictionaries, 2015).

Sustainable: *(adjective)***1.** Able to be maintained at a certain rate or level, **1.1.** Conserving an ecological balance by avoiding depletion of natural resources. **Sustainability** (*noun)*, **Sustainably***(adverb)* (Oxford Dictionaries, 2015).

Tradition*: (noun)* **1.** [Mass noun] The transmission of customs or beliefs from generation to generation, or the fact of being passed on in this way, **1.1**[Count noun] A long-established custom or belief that has been passed on from one generation to another(Oxford Dictionaries, 2015).

Typology*: (noun)* **1.**A classification according to general type, specially in archaeology, psychology, or the social sciences,**1.1.**[Mass noun] Study or analysis using a classification according to a general type(Oxford Dictionaries, 2015).

Vernacular: *(noun)***1. [**Mass noun] Architecture concerned with domestic and functional rather than public or monumental buildings. *(Adjective)* **2.**(Of architecture) concerned with domestic and functional rather than public buildings (Oxford Dictionaries, 2015). Vernacular in this document refers to a particular architecture that designed and constructed by residents of a particular place themselves, based on their own knowledge using local materials derived from the natural environment, considering cultural, social, climatic and environmental conditions and their own needs.

Village:*(noun) A* group of houses and associated buildings, larger than a hamlet and smaller than a town, situated in a rural area(Oxford Dictionaries, 2015).

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Abstract

Domestication of rice production in Mazandaran, a province located in North of Iran has influenced shaping a specific culture based on food production, which has influenced the form of houses and configuration of villages. This rural lifestyle is evolving to be modernised, which endangers the identity of the villages, its architecture and the natural environment. The current houses in result of modern intervention do not make proper respect to the vernacular architecture, and culture. Accordingly, we still do not know how to deal with traditions and new impacts, distinctively with new technology, sustainability, and new rural perception. Importantly there is no appropriate model, or method addressing this problem.

This thesis seeks to understand the vernacular architecture and dwelling of the region, which seemingly it is the first research on this topic. The main aim of this research is development of a new generative model that when applied can produce new houses, which are sustainable and responsive to locals' new form demands and lifestyle. This new model is combined of two models including 'Culture as model system' expanding on this definition with theory of 'Shape Grammars'. This is the hypothesis of this research that combination of these two models can be contributed to a new full model in order to generate new appropriate houses.

The research is based on studying four villages as case studies, which have been selected purposefully in or to obtain a comprehensive data regarding to the aim and objectives of the research. A combination of the whole range of useful methodologies applicable in cultural studies and according to regional conditions has been established and employed during successful field trip.

The findings make two important contributions to the current literature. First, the present study provides the first comprehensive investigation on villages of Mazandaran. Second, a new model has been developed and its efficiency has been examined, which seems can be conformed to the cultural traditions, and sustainability of the region of this study.

PART ONE

PROBLEM DEFINITION, RELATED LITERATURE

AND METHODOLOGY

Introduction of the study

Since the introduction of 'architecture without architect' by Rudofsky (1981), studying vernacular architecture has increasingly become one of the growing interests in order to obtain some knowledge enabling inspiring creation of new built environment. Learning from 'vernacular architecture' initiated from 'modernists', which was purely for architectural purposes supporting architects in designing new buildings (Oliver, 1997). Even if the lifestyle and culture are changing, and the changes are intensified by progress in science and technology, vernacular lifestyle and built environment have still useful lessons including 'aesthetical', climatic' or 'technological' lessons (Oliver, 1997; Rapoport, 1980; Rewal & Jahanbegloo, 2010; Fathy, 1986; Webber and Yannas, 2014).

Rapoport (2006a, 1983, and 1980) suggests that new design models should be congruent with culture. He introduced a model based on an anthropological and behavioural approach for understanding culture in order to employ culture in design process through looking at culture as a 'model system'. In order to achieve this model system, one must be more analytical to understand and define the language of existing styles of design. Rapoport has not considered essential analysis, evaluation, and selection as part of rule system and has not concentrated to improve this model to be a full methodology. Additionally, the efficiency of the performance of this model for vernacular study and design has not still been tested.

'A Pattern Language' produced by Christopher Alexander (1977) presents a model, a design system, as a simple set of rules intended to be understood and used by people to design their own houses. In theory, new patterns could be added or eliminated and it was intended that these patterns could be updated over time; however, there was little evidence that these could be applied successfully by the layperson and it is difficult to understand how these generic patterns can be culturally specific.

'Shape grammars' introduced by Stiny (1976), provides a framework for solving design problems, firstly through the analysis and generation of existing designs and design styles, and secondly for the creative generation of new design types. This methodology has been originally used to describe vernacular buildings during the two first decades of its initiation from 1972, which has an emphasis on shape, geometry, and spatial configurations of the physical characteristics of designed objects. This approach is appeared to be effective as a suitable solution in evaluation of vernacular houses towards establishment of compositional rules aiming for generation of new vernacular houses. On the other hand, the cultural, human behavioural and climatic characteristics of a place, its dwellings and their development over time have not been considered in shape grammar.

Many architectural practitioners reviewed and analysed historical material and contextual information from existing traditional and vernacular architecture as a part of their design process (Fathy, 1979; Rehwal and Jahanbegloo, 2010, Barragan foundation, 2014). The main emphasis of their performance is based upon their own opinions and preferences rather than to be based on a theoretical approach to support emergence of designing similar solutions.

Consequently, we still do not know how to deal with traditions and new impacts, distinctively with new technologies and sustainability, new rural perception and new houses form demands according to sustainability, traditional identity, and modernity. Additionally, there is no full methodology in order to design new built environment within vernacular environment to be cultural, social, climatic, and environmental specific, which is a big gap in the field of new vernacular design.

Domestication of rice production –the process and the product- has formed a specific agrarian culture and settlement in Mazandaran a province located in north of Iran, which accordingly a productive traditional lifestyle based on employing natural local resources has been formed (Koulaeeyan, 2006). The principles of this culture and lifestyle have affected the form of vernacular houses, configuration, and the structure of villages, and shaped a specific vernacular architecture within this region, which due to changes in local lifestyle from

traditional way of living to modern lifestyle is being withdrawn. In terms of dwelling, local villagers want new vernacular house that respects their tradition and identity while accommodating the quality of life standards provided by modernity demonstrated in city areas, which modern intervention in new house design demonstrates insufficient respect and acknowledge to the cultural traditional lifestyle (Rapoport, 2006a, 1980; Fathy, 1976). This situation makes it necessary to do special research on this region concentrating to find out an efficient solution in regard to culture, and tradition.

The research literature on the vernacular architecture is very limited specially on dwelling of Mazandaran (the region of the study), much of them are descriptive in nature and failed to address the problem. Some of the journal papers focus on climatic aspects of the region (Tahbaz and Djalilian, 2007 & 2009) while others demonstrate historical documents explaining architectural characteristics of this region as one small section of themselves (Zargar, 1998; Memarian, 1995). No full research/s has been emerged disseminating cultural, climatic, and architectural aspects of the region, which is another gap of the knowledge.

This research set out to provide a new generative model supporting designers to generate new dwellings based on the cultural traditions and sustainability of villages within the rice fields of north of Iran as its main aim, which could be a model for vernacular environments of all around the world. Accordingly, the hypothesis of this research is that, the combination of two theoretical methodologies including the 'cultural analysis methodology' proposed by Rapoport entitled 'Culture as model system' (Rapoport, 2006b) with the theory and methodology provided by 'Shape Grammars'(Stiny, 1976) in the analysis and evaluation of the vernacular architecture in Mazandaran is a complete model generating appropriate new houses respecting cultural tradition and sustainability of the local environment. The first methodology presents cultural approach towards removing the concern of this research aiming to understand cultural manifestations and aspects of vernacular houses. The second methodology is supportive in obtaining information about physical appearance of vernacular houses and their compositional rules. In this research, these two methodologies

have been considered and employed complementary for each other producing a new model.

In order to examine the new model, this thesis is organised on conduction of case study research. Accordingly, four villages located within the region, Mazandaran in north of Iran, have been purposefully selected based on predefined criteria. In order to collect essential qualitative and quantitative information, a mixed methodology including different types of appropriate methodologies has been adopted. This mixed method takes advantage of questionnaires, focus group interviews, one on one interviews, observation, measurement and mapping of houses, sketches, photography, content and historical study, which have been deliberately selected according to the nature of required information and specially cultural and environmental characteristics of the region. In this regard, a combination of quantitative and qualitative approaches was used in the data analysis, too.

This study is the first investigation exploring the vernacular environment and society of the rice fields of Mazandaran in order to define the cultural and social issues that have informed the configuration and characteristic of its settlements and dwellings. Additionally it identifies and evaluates the sustainable principles utilised within the vernacular dwellings and settlements of this region and defines a set of compositional rules from the analysis that embodies the cultural, social and sustainable characteristics. Besides that, this research contributes to the knowledge by proposing a new model helpful for generation of new vernacular houses. In order to examine this model, it has been employed to design two new houses, which have been presented and discussed in conclusion section of chapter 10 at the end of this thesis.

It should be noted that, the thesis mainly concentrates on the habitat part of dwellings (occupied house) of the region and does not engage with outbuildings of the dwellings and does not intend to understand compositional and physical characteristics of villages. However, they are mentioned through all essential places considered relevant with habitat part of dwellings. As another limitation, employment of some useful methods for conduction of cultural and human

behavioural researches was not possible within this study such as behavioural mapping, videotaping (Gehl and Svarre, 2013, Whyte, 1980, Cosco et al, 2010), and mailed questionnaire. It was because of cultural and environmental characteristic of this region, which has been explained in chapter 4. I, as the researcher have been born and grown up within the region of this study, which despite of this mentioned limitation, was able to interact with locals appropriately due to familiarity with the region, its culture, people, and especially local language. However, any prejudgment has been avoided.

The overall structure of the thesis is divided into three distinct parts including ten chapters. The first part begins by introduction of the problem, context and background through chapter one, going on laying out the theoretical dimensions of the research and looks at how the new model could be created through chapter two concerning advantages of cultural study. Chapter 3 of this part focuses on shape grammar and its advantages for this study followed by chapter four introducing the employed methodology. The mission of part two is to introduce and analyse the collected data about regional characteristic in chapter five, cultural characteristics and responses within chapter six and characteristics of villages and dwellings of the region in chapter seven. The third part that is the last part of the research represents development of the model from introduction of characteristics of houses and activities within them in chapter eight which is followed by chapter nine with introduction of sustainable rules and climatic responses that local adopted providing desired thermal comfort. The last chapter is devoted to identification of compositional rules embodied dwellings of the region and draws together the key findings of previous studies and analysis creating some samples representing layout of two new houses based on the adopted grammatical rules. This chapter and this study terminate with presentation of a diagram as development of the model that Rapoport (2006a, b) provided; this is the main contribution of this research.

CHAPTER 1

The Nature and Content of The study

1.1 Problem definition

According to the Food and Agriculture Organisation of United Nations (FAO), evidence of rice cultivation in Iran dates back to 100 B.C, this for the first time in Iran has been operated in Mazandaran (Koulaeeyan, 2006). Domestication of rice production in Mazandaran was a main reason that encouraged local nomads in the mountain areas into settling into two southern parts of the region; in the forest area and in the flat plain adjacent to the forest area (Koulaeeyan, 2006). Rice production –the process and the product- has formed a specific agrarian culture, settlement, and subsequently a society, which accordingly a productive traditional lifestyle based on employment of natural local resources has been created within those two areas. This culture and lifestyle have influenced the form of vernacular houses, their configuration, and the structure of villages in rural settlements of the north of Iran, shaping specific vernacular architecture belonging to this region.

Nowadays, local lifestyles is increasingly changing from a traditional way of living to a modern lifestyle, and the settlement has been shifted from a productive society towards becoming a consumer society, from being a self-sufficient to an independent society. Following to this evolution, the vernacular architecture, traditional style of housing and configuration of the settlements have been withdrawn. This situation was caused by different factors such as; increase of population, which within 50 years from 1956 to 2011 has been approximately quadrupled (Statistical Centre of Iran, 2015) (fig 1.1), needing and looking for more houses and settlements, close contact with cities 'Modernisation' phenomena (Rapoport, 2006,1980), employment of new construction materials and technologies imported from outside of the region, advent of modern home and kitchen appliances, advancement in vehicles and accessibility, and modern farming machinery. These factors made some inevitable changes in the development of the configuration and spatial organization of new houses and settlements through needing particular spatial requirements.

The phenomenon of 'Modernisation', known as 'Westernisation' in developing countries (Rapoport; 2006a, 1980) has been developed in consequence

of close contact with cities. This phenomenon is the main source of modern influential factors that have affected the local traditional way and preferences of living. In architecture and construction, employment of new and modern construction materials along with modern technologies is another influential factor, which local population does not know how to work with them properly such a way that they had previously been dexterous in employing local construction materials and traditional technologies (Zargar,1998).

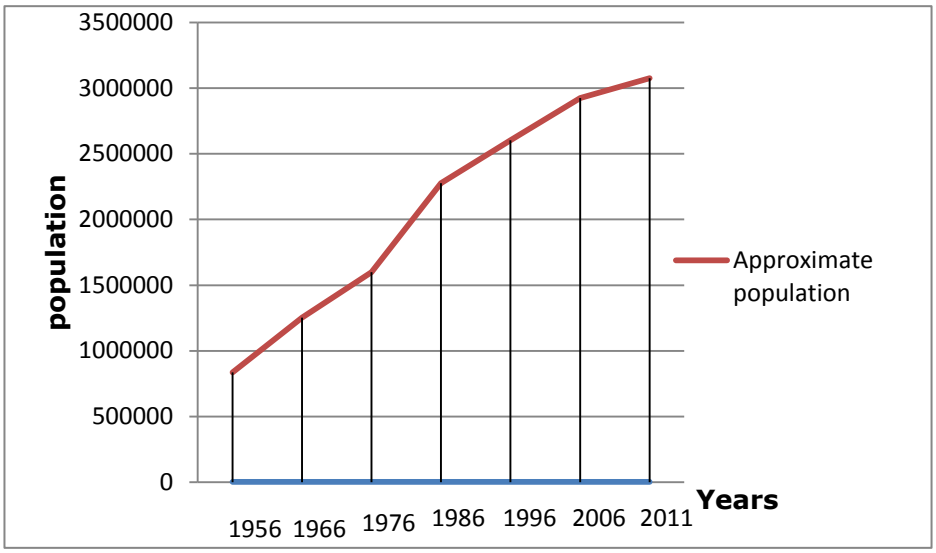


Figure 1.1: Population of Mazandaran from 1955 to 2011 (Source: Statistical Centre of Iran, 2015)

In addition, modern interventions in new housing in term of design demonstrate insufficient respect and acknowledgement to the cultural traditional lifestyle (Rapoport, 2006a, 1980; Fathy, 1976). The new designed houses by professional architects[1] have been proved to be unacceptable to the local population, which are essential to obtain permission grant from Government. They pay little regards to culture, tradition, and new demands of local residences. On the other hand, the current way of design and construction of houses applied by local people within rural villages are crumbling and dilapidated (Sartippipour, 2007),

[1]: University educated architects and civil engineers are those professions that are officially allowed to design the houses within Iran and within this region. For this aim, they need to obtain special certificate from the government and only the houses signed by these professionals could get permission from the related officials in order to be constructed. Nevertheless, most of the confirmed layouts of the houses are rejected or are dramatically changed during the construction process by owners themselves.

these allegations have been reinforced by field trip studies. Both performances contributed by professionals and local population are endangering and affecting the identity of the villages, are not sustainable, and are not paying sufficient attention to new demands of locals.

Local villagers want new vernacular house designs that respect their tradition and identity; thus accommodating the quality of life standards provided by modernity demonstrated in city areas. This situation makes it necessary to do special research on this region focusing on finding an efficient solution to this problem.

1.2 Review on relevant studies and proposed solutions

Vernacular architecture in one place has been defined as 'architecture without architect' (Rudofsky, 1981). It is a kind of architecture that is designed and constructed by local users or local experts employing local and natural materials that responds to local climatic and natural environmental conditions and is designed as per their own special needs (Oliver, 1987, 1997; Zargar, 1998). The phrase 'vernacular architecture' can describe this type of architecture better than other names such as 'traditional architecture, 'indigenous architecture' or 'primitive architecture' (Oliver, 1987), this name is adopted and repeated in this research. This topic was a focus of many studies in architecture and was an inspirational source for professional practices; these have been approached separately from different point of views and priorities.

The literature studies specifically related to Mazandaran vernacular architecture, some professional practices performed all around the world on this subject, and the theories and methodologies concerning derivation of rules from vernacular architecture are discussed in this section. The evaluation of theories and their application towards the definition of a newly developed methodology for designing new buildings will be considered in this research, such as '*using Culture as Model System'* proposed by Rapoport (2006a,b), 'A *Pattern Language'* by Alexander (1977) and '*Shape Grammars'* by Stiny and Knight (1976). In addition, professional practices in this field are also described and analysed.

1.2.1 Literature on the vernacular architecture of Mazandaran

The research literature on the vernacular architecture of Mazandaran is very limited. Some of the journal papers focus on climatic aspects of the region (Tahbaz and Delijani, 2007 & 2009) while others consider historical documents (Zargar, 1998; Memarian, 1995). A book written by Bromberger (1991), a French sociologist, provides an anthropological approach, it describes and analyses the society and houses of Guilan, another province of the north of Iran adjacent to Mazandaran with similar climatic and environmental conditions. The book 'Outward Architecture' (Memarian, 1998) also discusses about the Guilan province and introduces maps and layouts of some rural houses and their design details through photography and drawings but with no rigorous in-depth analysis. Zargar (1998) authored a collection related to Iranian rural architecture using maps, details, and photography as well as historical documents and some analysis. This book is similar to the encyclopaedia provided by Oliver (1997) which discusses about vernacular architecture from around the world. Sartippipour (2007) takes an analytical approach in his evaluation of the main problems of Iranian vernacular and rural architecture and his book focuses on the defects and weaknesses of vernacular buildings with respect to new standards, lifestyle demands, sustainability, natural disasters and technology.

There are a considerable number of research studies about the traditional urban architecture of the central part of Iran (Kiani, 1987; Memarian, 1995; Pirnia, 1995; Hillenbrand, 2004; Ghobadian, 2009). This kind of architecture is mainly constructed with the application of raw adobe, which is entirely different from vernacular architecture of the north of Iran, which employs wood as its main construction material. The climatic conditions, nature and culture of these two regions are also very different; imposing different types of courtyard house in central parts and detached house in the north. Most of these papers introduce the vernacular architecture of central Iran and Mazandaran, purely using a historical approach, focusing on the evolution process or the technological approaches i.e. construction methods and details. However, in some books the impact of climate was an important consideration (Pirnia, 1995; Tahbaz& Djalilian, 2004; Kasmaei,

1983; Ghobadian, 1995). None of these papers or books defined any theory on the vernacular aesthetics or compositional rules that underpin this architecture.

1.2.2 Theories and methodologies for application of vernacular patterns in design and architecture

Architecture is not a free artistic activity; it has been defined as a science-based profession concerned with problem solving (Rapoport, 1980, 2006a; Alexander, 1971). Designers and decision makers need to know much more about the qualities and rules that shape the built environment and particularly the dwelling of different societies and cultures. This knowledge supports all of interferences in these environments, concerning housing provision and designing new places to be proper, preferable, and acceptable to local users. In order to achieve this ability, some theories and methodologies have been proposed.

'A Pattern Language' produced by Christopher Alexander (1977) presents a model, a design system, as a simple set of rules intending to be understood and used by people to design their own houses. 253 patterns were introduced, it was believed they could be applied by individuals to develop designs based upon their individual preferences and needs. These patterns are related to each other in a hierarchical structure and are proposed to guide users (the public) to form their own settlements, public buildings, and houses without relying on a professional designer. Alexander stated that these patterns are culturally specific and accorded with different cultures and their requirements. In theory, new patterns could be added or eliminated and it was intended that these patterns could be updated over time. However, these have never been tested in reality and there was little evidence that these could be applied successfully by the layperson and it is difficult to understand how these generic patterns can be culturally specific.

Designers produce environments in response to the client's wishes through the project brief, it is therefore important that they work on knowledge based rules extracted from a 'process' of extensive research and analysis of the environment, building type and occupant requirements (Rapoport 2006a, Oliver, 1987). Accordingly, Rapoport (2006a, 1983, and 1980) suggests that new design

models should be congruent with culture and he introduces a theory and methodology based on an anthropological and behavioural research approach for understanding culture. Rapoport (2006b) encourages the view that designing settlements and buildings should be considered as 'problem-oriented' and comparative from a conceptual theoretical stage, which should be based on an understanding derived from culture, and this is best achieved by looking at culture as a 'model system'. In order to achieve this model system, one must be more analytical to understand and define the language of existing styles of design. This analysis, evaluation, and selection can be defined as part of a rule system, which has not been considered by Rapoport. Despite of this, the approach proposed by Rapoport is suitable to be used in this research because of the characteristics of the region, which include a considerable amount of vernacular buildings and houses, along with existing traditional culture which plays an influential role in forming local's lifestyle.

An example of solution for this concern can be found within another theory and methodology entitled 'Shape Grammars' (Stiny, 1976). This process provides a framework resolving design problems, firstly through the analysis and generation of existing designs and design styles, and secondly for the creative generation of new design types of different scales such as a table, house or even a town. This methodology has been used to describe vernacular buildings during the two first decades of its initiation from 1972, such as the studyis on; Taiwanese traditional houses (Chiou & Krishnamurti, 1996), Queen Anne houses (Flemming, 1987), Ndebele homesteads (Herberts, Sanders & Mills, 1994), Frank Lloyd Wright's prairie houses (Koning & Eizenberg, 1981), and the Palladian grammars (Stiny & Mitchell, 1978), which are elaborated in chapter 3 of this thesis. This theory has an emphasis on shape, geometry, and spatial configurations of the physical characteristics of designed objects. It has been used in both two and three dimensions and has been applied for the analysis of existing designs through the deconstruction of the physical elements into shapes and forms. Spatial relationships defined between shapes (this stablishes a compositional relationship) these are expressed as a set of 'rules' (with sub-sets), which when applied can generate existing designs within a design style and new design types.

This approach appears to be effective when looking for a suitable solution and methodology since it has been successfully applied in the evaluation of vernacular houses in different parts of the world towards establishment of compositional rules aiming for generation of new vernacular houses.

1.2.3 Professional practices related to application of vernacular patterns

Many architectural practitioners review and analyse historical materials and contextual information from existing traditional and vernacular architecture as part of the design process. Fathy employed traditional Egyptian patterns while he was designing new houses for the New Gourna village in Egypt (1979). Fathy attempted to develop a prototype for the design of several villages, and *'houses for the poor'*, by using traditional techniques and materials. Unfortunately, the result was not acceptable to the users; Rapoport (2006a) believes that, it is because 'adobe' was used as the main material of these houses and buildings, which represented the past poor and miserly lifestyle of the region. Fathy's performance has taken the architectural profession half a century to appreciate the importance of vernacular architecture. Likely, Raj Rehwal (2010), an Indian architect has designed settlements, buildings and houses, such as '*Olympic game village'* project in India, based on historical aesthetic patterns, architectural symbols and the climatic responses of vernacular architecture. Rehwal employed new modern technologies and materials such as concrete simultaneously with traditional materials such as fired-brick and wood in such a way that Charles Correa (Charles Correa associates, 2015), another Indian architect, demonstrated his architectural practices. Le Corbusier in the same way was interested in application of vernacular patterns of Greek architecture, applied them in his modern developments because of their minimalist, and whitewashed characteristics (Pavlides, 1997). Likewise, some other modernists such as Pikionis in Greece, Eldem in Turkey and Mexican architect Barragan (Barragan foundation, 2013) founded their practices on information gleaned from vernacular architecture mixed with new modern invented technologies and materials for construction. They have been inspired from vernacular architecture but it is an individual's subjective understanding and interpretation rather than to be theory-based.

In Iran, and specifically in Mazandaran, no coherent practices have been perused and performed by local practitioners. As a limited recognised example within scattered practices, Razjouyan designed his own new house in a village located in the outskirts of the city of Amol in Mazandaran. The new house is inspired by rural vernacular patterns of houses with new modern interpretations in shape, size, scale, and form. In terms of material, raw local materials have been employed. Stone collected from the nearby riverbed has been used for plinth and front yard paving. Wood, as a traditional material of construction of the region, has applied as the main material for roofing and columns, which resembles picture of vernacular style. The spatial configuration and space organisation are inspired by rural patterns but are different from rural houses with the use of new appliances for the kitchen and new modern furniture for the house (fig 1.2).

Figure 1.2: Two pictures show Razjouyan house in Mazandaran

These were some distinguished practices and literature. The full list of reviewed literature, accompanied with an evaluation of the content and importance for the research, is presented in two separated matrices within appendix 1.

1.3 Description of gaps in research literature

Many architectural practitioners review and analyse historical materials and contextual information from existing traditional and vernacular architecture as part of the design process. The main emphasis of their performance is on original vernacular strategies in terms of aesthetic, climate and construction technologies, and pragmatic design planning to aid the design of new solutions irrespective of their success or failure. Much of this analysis is based upon the practitioners' own opinions and preferences rather than a theoretical approach to support the design of similar solutions. In terms of material usage, some of practitioners employed traditional materials such as adobe, wood and soil such as Fathy (1979), which the appearance of outcomes are too old (Rapoport, 2006a; Oliver, 1987). This appearance stimulates local population to oppose those buildings and houses, which are constructed with local traditional materials. Accordingly, a few of these practices are based on an understanding of the users' culture, demands and preferences, which is essential in the process of making any new decision for interfering in local's affairs (Rapoport, 2006a; 1980; Oliver, 1987; Fathy, 1987). There is some evidence that this approach is changing but it is practice specific and is often in the form of the '*design charrette'*, where public engagement and participation forms part of the design process, often to aid planning approval. However, some practices that focus on traditional architecture have defined patterns for particular urban developments such as the *'Pattern Book for Newquay'* by Hugh Petter of Adam Architecture (2005). A few theories and methodologies studying vernacular architecture are concerned with the derivation of potential information applicable for new proper solutions and practices.

The use of defined theories, particularly the process for recognising and extracting culture specific patterns according to 'pattern language' is not clear. Additionally, it is a hard process for both professionals and local population to understand. The application of the patterns is a particularly difficult and complex process for people with no training or study in this area, which is why the charrette form of engagement has become popular. This is a time-consuming methodology, involving a whole range of consultants, and practitioners are not

able to work successfully with. Additionally, some of the patterns presented by Alexander are not necessarily suitable and require appropriate adaption and modification to support new lifestyle demands, which is even more difficult for untrained users to do.

Rapoport from 1970 appears to provide the only literature source on the study of culture and its application within the design process, however, most of this work has a strong emphasis on the importance of culture as an aspect of human life, and its influence on built environment. He proposes that culture should be *'dismantled'* into some smaller components such as; values, lifestyle and activity systems, and this dismantlement should be repeated and carried out for built environment to understand relationships of the components of built environment to components of culture. This is in order to find out the *'systems of activities'*, which is concrete for architects and take place within *'systems of settings'*. This is the key point suggested by Rapoport, in which new culture-specific appropriate solutions can be contributed without studying other components of culture. Rapoport puts forward a methodology to discover these two culture-specific systems in order to apply them in the design process but only the first section of his structure of methodology has achieved a clear definition. The understanding of possible cultural components, their relationships and inter-relationships and essentially studying and identifying these two systems have not been translated into a full methodology. In addition, and more importantly, the lack of Rapoport's consideration to physical manifestations of cultural actions and activities such as shape, geometry, climate, materials and construction technology makes the methodological structure proposed by him incomplete. According to Rapoport (2006a), they are of secondary importance or of a lower priority as well as the definition of rules for the orientation, structure and form, which are not discussed in this methodology. He emphasises the subjective aspects of culture and offers less consideration to the physical manifestations of culture. Rapoport introduces the cultural variables but they themselves have also not been developed sufficiently to be useful for others and there is little discussion about a proper methodology These issues should be observed objectively and are useful studies

because they provide tangible evidence however, he does advocate a definition of *rule system* within built environment (Rapoport, 2006b).

Stiny (1980) has proposed a useful methodology for definition of physical variables and compositional rule system in order to design new alternatives entitled '*Shape Grammars*'. The literature on shape grammars shows the methodology to be efficient and supportive in the representation and generation of designs. These sets of shape rules are powerful; they are computational and can be applied easily as a set of deterministic or non-deterministic forms. This methodology is supportive in understanding physical aspects of the systems of settings through undertaking compositional analysis of existing samples and definition of compositional rules of those samples aiming to generate new architectural solutions. On the other hand, the cultural or human behavioural and climatic characteristics of a place, its dwellings and their development over time have not been considered in shape grammars. Studies employing this methodology provide an objective interpretation of the design forms and there is no evidence that the spatial relationships have been informed by an understanding of the principles or theories underpinning the designs and urban developments.

Consequently, no integrated research on this important topic is evident. Accordingly, the main concern is that we still do not know how to deal with traditions and new impacts, with new technology and with new form demands for houses according to interrelation with sustainability, traditional identity, modernity and globalization, which are the main concerns and challenges of this research.

1.4 Aim and objectives

This research combines two theoretical methodologies including the '*cultural analysis methodology'* proposed by Rapoport entitled '*Culture as model system'* (Rapoport, 2006a, b) and expands this definition with the theory and methodology provided by *'Shape Grammars'* (Stiny, 1976) in the analysis and evaluation of the vernacular architecture in Mazandaran. The first methodology presents a cultural approach toward the subject of this research, aiming to

understand cultural manifestation and aspects of vernacular houses and the second one is supportive in achieving information about the physical appearance of vernacular houses and their compositional rules. The hypothesis of this research study is that these two methodologies are complementary and their combination can assist this research to find a solution. To do so, the objectives of this research are:

1) To investigate the vernacular environment and society of the rice fields of Mazandaran in order to define the cultural and social issues that have informed the configuration and characteristics of its settlements and dwellings.
2) To identify and evaluate the sustainable principles utilised within the vernacular dwellings and settlements.
3) To define a set of compositional rules from the analysis those embody the cultural, social and sustainable characteristics that are useful to regenerate this type of vernacular dwelling.

These objectives are set to achieve a better insight of vernacular types of development, and the cultural and climatic responses in Mazandaran, aiming to provide a model that will inform and guide future developments while retaining cultural integrity, as well as being appropriate sustainable solution. The aim and main contribution of this research is;

- To develop a formal model derived from the analysis of the environment, society and compositional rules that can be used to generate new alternative architectural solutions responding to current development requirements, which support new lifestyle demands.

This is a new model comprised of a set of compositional rules that when applied can generate sustainable vernacular dwellings for the region of the study and exemplifies culture, tradition and new lifestyles, which is fulfilled for the first time. In addition, introduction of a methodology to bring together understanding

culture, and vernacular sustainable principles for the design of new vernacular architecture, which is embedded with a rule system, has never been done before. Defining a set of rules to be culture-specific, that respond to environmental conditions and are useful for the generation of new vernacular houses is the challenge of this PhD.

1.5 Importance and contribution of proposed research

The way of life in the rice fields of the region is transforming rapidly, many villages, traditional settlements and their vernacular architectural forms are being influenced by new construction methods, new technologies and western architecture. These factors are in addition to a cultural shift from productive to consumerism. Change of lifestyle in these rural areas has proceeded with advent of new forces such as new home appliances, mobile phones, computers, new construction materials and technologies. These dominant technologies have changed communities and the rural architecture, that were once almost sustainable with a specific relationship to the land, into microcosms of city forms and structures relying on non-renewable technologies as well as lacking of functionality with the environment. Iran is one of the top high consumers of fuel energy in the world of which, around 70% of the energy is being burned just in residential buildings and houses in order to facilitate cooking, warming, cooling and other daily routine residential activities (Ministry of oil of Iran, 2014; Ministry of power of Iran, 2014; National Oil Company of Iran, 2014). In addition to high-energy consumption, water scarcity and drought are going to be critical in causing serious problems. It has been emphasised that, according to current level of water resources and its consumption pattern, the Iran plateau must be evacuated and 50 million Iranians have to immigrate looking for a better place to live due to lack of water (Kalantari, 2015).

Traditionally, residences of the region of this study have had the efficient skill and know-how to effectively build their houses and settlements with regard to the land, the climate and the resources that were available. Consequently, the vernacular rural architecture and settlements carry useful lessons for making

decision about the manipulation of new build environment (Rapoport, 1986; Oliver, 1987; Fathy, 1976). These lessons appear that have been forgotten and, in many cases, the changes to rice villages occur hastily and carelessly without planning. Many of the villagers are eager to preserve and respect their traditions and retain their identity in the context of rice farming culture. The results of this study will be able to help built environment professionals (planners, architects and urban designers), government and official authorities involved in making decisions to improve the growth and advancement of rice field villages, their spatial forms and rural houses to be more sustainable, efficient and yet represent their cultural identity.

In respect to the above-mentioned concerns, this research introduces a new model comprised of a set of compositional rules, that when applied, can generate sustainable vernacular dwellings for the region of the study that exemplify culture, tradition and new lifestyles, which has never been done before. Definition of a set of rules to be culture-specific responding to the environmental conditions and to be useful for the generation of new vernacular houses is the aim of this PhD. Achieving this aim, this research adopted two theoretical methodologies, the 'cultural approach and methodology' proposed by Rapoport, expanding on his definition with theory and methodology of 'Shape Grammars'. These two methodologies have been combined together for the development of a 'model', this model is also another contribution of this research.

The next two chapters are dedicated to discussion about the application of these two approaches in the design process of new vernacular houses and theoretically are focused on justification of their efficiency and supportiveness for this research towards proposing a new effective solution.

Chapter 2

Vernacular, Culture and Architecture

(Culture as Model System)

2.1 Introduction

The main aim of this chapter is to review various opinions, theories and practices related to ideas around culture, vernacular environment and dwelling design, these are summarised and analysed.

At first, the discussion is around the materials and subjects to find out what culture is, the different definitions of culture and how culture plays a role in the creation of a vernacular built environment. This section also concentrates on which lessons are obtainable from studying vernacular designs and strategies that can be implemented supportive for new designs according to newly changed situations and residents' preferences.

The second main discussion is devoted to the analysis of studies and endeavours that concentrated on facilitating how cultural and vernacular study can support an architect in the design process of new buildings and dwellings especially in vernacular settlements. This will add to the existing literature by proposing a new methodology for the design process emphasising culture, tradition and residents' preferences. Accordingly, some distinguished methodologies related to this subject including; 'pattern language' by Alexander (1977), and 'Culture as model system' proposed by Rapoport (2006a) are analysed alongside reviewing the professional practices of some distinguished architects of this scope such as Fathy and Rehwal.

The result is the identification of appropriate methodology, its suitability, strengths and weaknesses when designing a vernacular environment that responds to residents' new lifestyle, demands and preferences, which reflects their culture and vernacular architecture.

2.2 Why is cultural approach important?

Architecture is not defined a free artistic activity but as a science-based profession concerned with problem solving (Rapoport, 1980, 2006a; Alexander, 1971). It is, therefore, important that designers work on knowledge-based rules, extracted from a 'process' including thorough extensive research and

analysis of the environment, building type and occupant requirements (Rapoport 2006a, Oliver, 1987). Traditionally, people have had the skills and ability to design and construct their own environment and specifically their accommodation according to the land, climate and resources. These designs reflect their special values and needs, which the outcomes were often integrated with the specific culture of the community and harmony of design (Oliver, 1987; Rapoport, 1980, 2006a; Alexander, 1971; Zargar, 1998).

Designers and decision makers need to know much more about the qualities and rules that shape the built environment and particularly how the dwelling and culture support all aspects of these environments concerning housing provisions and designing new places to be proper, preferable and acceptable by local populaton (Oliver, 1987, Rapoport, 2006a). Lack of understanding with regards to cultural norms and characteristics throughout the decision making process for the design solutions for vernacular environments can cause serious problems. The consequences of these decisions even could be irrecoverable such as what happened through proposing new Bohio[1] for the Motilon Indians (Rapoport, 2006a; Elsass, 1995) and for foresters in the North of Iran, in Mazandaran.

New type of Bohio resulted in the application of simple changes that was destructive for that culture. The installation of electric lamps contributed to catastrophe and destruction of privacy as it eliminated the ability of the Indians to define the private territories of each family, which traditionally would have been defined by individual pointed wooden fires set up on the earth floor (Rapoport, 2006a). Another decision, aiming to make old Bohio progressive and sanitised, was application of concrete to cover the floor of the Bohio, which traditionally was covered with soil. The result was contrariwise by creation of unsanitary floors with dirt on it, foul smelling faeces indoors after urination by children (Elsass, 1995; Rapoport, 2006a). It also led to the abandonment of weaving traditional clothes

[1] : Bohio is a circular big long house in which the Motilon Indians live as a complete unit (tribe), where to a hundred people lived under the same roof (Elsass, 1995).

which they were reputed about, consequently, they began came to look like vagabonds. They lost self-esteem, got ill because of decreased resistance to colds and flu, which raised the death rate and increased the prevalence of some diseases (Elsass, 1995).

A similar example comes from North of Iran where many local people (foresters) live separately from each other inside the dense tree planted forest areas (fig 2.1). Each family has its own dwelling called *menzel,* which includes a combination of a wooden house for the family daily routine life, shed and places for livestock (cows and sheep) and a pasture area for animals, which extends from the *menzel* to inside the forest area (fig 2.2). The forest is part of the pasture area and is usually more than 10 hectares' square meters; this designates the distance from other families' *menzel,* which can sometimes be more than a one-hour walk.

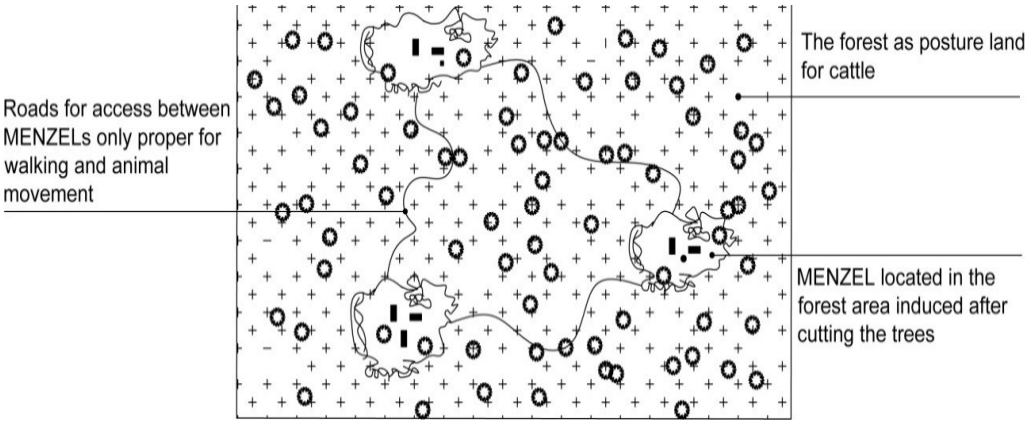


Figure 2.1: Previous traditional Pattern of foresters'' Settlement

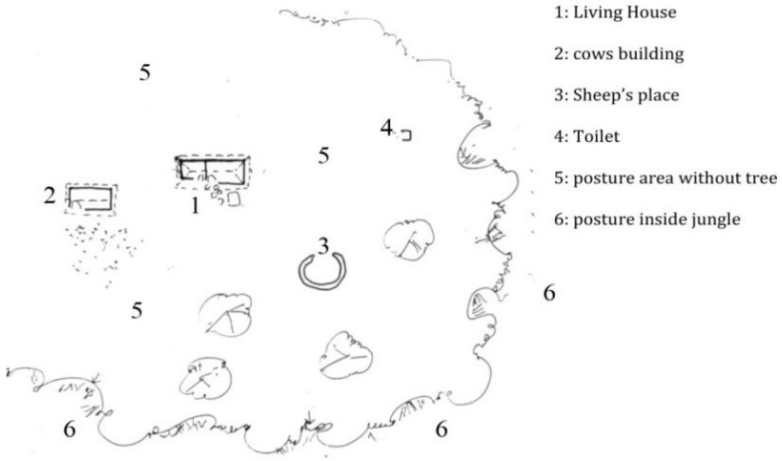


Figure 2.2: Site plan of a traditional *menzel*

Authorities and decision makers of the Organisation of Forest Preservation in Iran removed the foresters out of the forest areas. Porvali, who is responsible for the execution of the plan aiming to remove meat and milk farms from the forest, believes the foresters and their animals are the main culprits in the destruction of the forest ecology (Irna, 2014). Following this plan, they gathered and settled the foresters together in pre-constructed villages; these comprised of buildings with concrete block walls, steel roofs for the houses, installed outbuildings close or even attached to the houses constructed for their livestock (cows and sheep). The house, livestock houses and sheds were located-

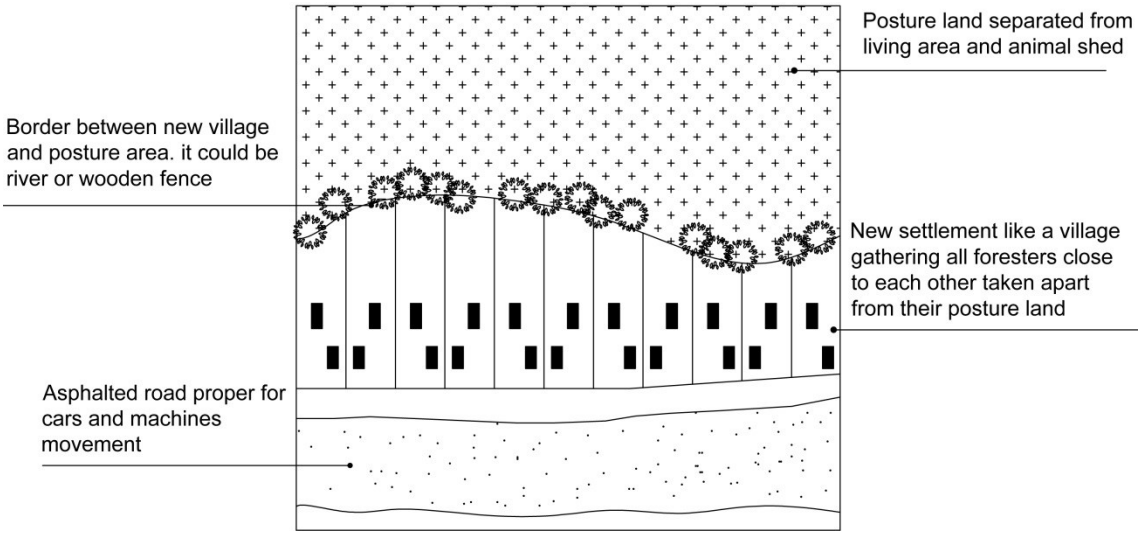


Figure 2.3: New designed pattern of settlement for moved foresters

-together in a centralised place, on the other hand, the pastureland for their animals was located separately at a significant distance. The traditional and preferred settlement pattern, appropriate to their lifestyle and occupation, had been completely transformed. (fig 2.3).

This plan did not make local population satisfied (Azimi and Amiri, 2008). Within a year, the majority of the foresters returned to their previous *menzel* within the forest area with the exception of one or two families who were enticed by becoming owners of the pasturelands of others. One important reason mentioned by foresters during interviews was that, in the new homes, human living area and animal shed were not separated or not located at a sufficient

distance from each other. This new pattern of location provided a foul smelling insanitary area attracted different harmful insects and mosquitoes. In addition, in traditional patterns, *menzels* were considerably far from each other located alone at different points inside the forest area like separated islands, giving each family a vast territory, and an element of independence and privacy (fig 2.1). Nevertheless, all of those families had been gathered and settled in the newly designed village-like area, which the compact nature of this new development greatly decreased their vast territory and endangered their independence and privacy. Besides that, pasture area in the newly designed place had been located separately from the animal house and living quarters, which this pattern separated working area from living area that ranchers were not used to this pattern. In the traditional pattern, the grazing area was sufficiently close and attached to the dwellings. This allowed all family members to keep an eye on animals whilst going about their daily routines. This new separation made the previous routines impossible and animals needed much more exclusive supervision. It also led to an increase in animal theft, decrease in the safety of animals and weakened security.

In both of these cases, the problems arose from decision makers' unfamiliarity with social and cultural factors of locals, lack of knowledge about their traditions, lifestyle along with unfamiliarity with appropriate pattern of settlement and layout for their houses. These examples demonstrate how vital and critical it is for designers to understand non-physical factors such as human variables. The social and cultural aspects of a community's living environment should be considered along with physical characteristics of these societies (Rapoport, 2006a, 1980; Oliver, 1987; Fathy, 1986).

2. 3 What is culture or what does it do?

Culture has been defined by Oxford dictionary (2015) as 1)The arts and other manifestations of human intellectual achievement regarded collectively 2)The ideas, customs, and social behaviour of a particular people or society and the attitudes and behaviour characteristic of a particular social group.

Some scholars such as Broadbent believe it is impossible to define culture even though it has a significant influence on human life (Meeting, June 2013). However, there are varieties of different opinions regarding the definition of culture. It is a man-made part of the human environment (Triandis, 1972) which is a set of values determined by a structure of interacting beliefs leading to the perception of rules, the group's norms, roles and values, they are components of the subjective culture (Watson et al ,2002).

No one ever has or will observe culture and only its affects and products are visible. Indeed, Rapoport (1980) tends to look at the culture as a concept focusing on the way in which 'culture' is conceptualised and tends to ask 'what culture does rather than what it is?' He mentions that culture may be regarded as the useful means by which people maintain and preserve their identity. Secondly 'it can be seen as mechanism' that links people and environment including; '*Physiology (comfort, adaptation, standards), anatomy (ergonomics, different ways of doing things, different postures), perception (including aesthetics understood as the perceptual aspects of environmental quality), cognition (structuring and ordering the world, mental maps, orientation systems and their importance), affect evaluation (preference, choice and significance of little choice in vernacular environments and of great increased choice now), meaning supportiveness (physiological, anatomical, psychological, behavioural, social, cultural), and some of the components and expressions of cultural derived through dismantling)*' *(Rapoport, 2006b, p,179)*. Accordingly, culture leads both how behaviour and artefacts are to be and transmits information by behavioural means and through various artefacts like built environments, which these knowledge can be acquired.

Individuals can acquire cultural knowledge through sharing a similar way of thinking, feeling or behaving (Rapoport, 2006a; Thomas, 1997) and through guidance and correction acquire the domestic behaviour patterns appropriate to their culture (Oliver, 1987). This is known as 'enculturation'. According to this view, culture can be seen as share experiences of individuals from their day-to-day life. Besides that, people can also acquire culture through 'acculturation' from having interaction and confrontation with alien cultures, from outside of their own

culture, which can be accepted or adjusted with their own culture (Rapoport, 2006a). Both these two terms change the characteristics of culture over time.

2.4 Culture change and new approaches to design

Culture and vernacular architecture traditions have always been dynamic and changing (Asquith & Vellinga, 2006a; Fathy, 1986). Changes in culture and its components can be progressed by using new forms, materials or technologies in built environments (Lewcock, 1997). Culture can be changed with fast or slow pace, which each of them has different consequences.

The speed of change is dependent on different forces and resistance of communities. The way of life in Iran and generally in developing countries is changing very fast from traditional to modern. We are living in a period of constant change, which has been stimulated by the development and growth of computers, mobile phones and information technology, and intensified by accelerating population and movement of people (Rehval and Jahanbegloo, 2010). The relationships and contact between humans are growing due to the invention and advent of these new technologies, which transfer values from one place of the world to another place far from it, causing fast changes and elimination of some cultural and social norms. Rapoport (1980) suggests that slow change is better than fast-paced change since it gives opportunities to the societies to adapt gradually and may assist a synthesis of economic growth and preservation of cultural identity.

'Modernisation', known as 'Westernisation' in developing countries, is recognised as a major cause of fast changes in these countries, and it seems that there is a desire for many world cultures to become similar to the western world technologically, economically and socially (Rapoport, 1980; Rehwal & Jahanbeglo, 2010). Proponents of westernisation justify it for its ability to replace the 'superstition' with 'rationalism' and 'tradition' with 'progress' (Lewcock, 1997) Rehwal as an architect from a developing country, India, believes rationalism is a very good lesson for developing countries obtainable from the West. Opponents of westernisation insist that the impacts of this phenomenon are not compatible with

the ideologies and way of life of older cultures such Iran. They argue for appropriate development based on the existing social values and practices rather than complete westernisation (Lewcock, 1997) such as the propositions delivered for developing countries by Fathy(1986), Rehwal and Jahanbegloo (2010) and Rapoport (1980). Leon Krier also argued against the use of western technology. Krier was eager to abandon Hi-Tech because of industrialisation of the construction, since he believed it did not provide any significant improvement in the technique of construction but destroyed 'an ancient architectural culture' and argued that the best solutions are based on a highly developed and professional manual abilities and material culture (Broadbent, 1990).

Environments in developing countries have '*higher criticality*'[1]. Despite this, the changes in developing countries are mostly unplanned, without prediction, demoralising all last dignities, resulting in 'junk architecture', which leads to a reduction of complexity, mental depth and spiritual purpose in architecture (Rehwal & Jahanbegloo, 2010). This is the result of a one-dimensional emphasis on material and technological developments (Terzoglou, 2012). Additionally, behavioural and social pattern change influenced cultural changes, the physical characteristics of society, and changes in the layout of houses and villages (Rapoport 1980; Vellinga, 2006; Ozkan, 2006). These changes unconsciously make all cultures similar to each other, eliminating and endangering the identity of societies, which is indicated as a major concern in developing countries (Fathy, 1986; Zargar 1998). As for example, change in the 'human scale' of the physical characteristics of past human settlements and buildings are the other main concern affected by modernisation. The result of this phenomenon is destruction of small scale, vital, safe, healthy, social and sustainable settlements reducing the human scale of urban spaces (Gehl, 2010; Moughtin, 1996). Pirnia (1995) mentions that 'human scale' was one of the main principles of Iranian Vernacular

1: this expression has been used only by Rapoport without a clear explanation in his books and articles, one interpretation could be that these environments are very susceptible to changes as a result of new technologies, and their culture and society could be destroyed or changed dramatically.

(traditional) architecture meaning that the size and scale of the components of the buildings were compatible to human size supporting the intimate interaction of humans with buildings, which is lost in new modern Iranian architecture influenced by modernity.

Respecting and reviving local identity, wisdom and cultural communities are important aspects, which need to be considered when creating a sustainable community looking for enhancement and underpinning a more sustainable approach (bioregional, 2015). Based on a sustainable approach, human life has been seen as analogous to ecology (Rapoport, 1980) the complexity and diversity of spices lead to stability for the ecosystem. Accordingly, it has been concluded that a variety of cultures are necessary to be in the world (Eiseley, 1959). It has been strongly suggested that it is better to be multi-cultural on the world having different civilisations discussing and cooperating with each other rather than being mono-culture (Rehwal and Jahanbegloo, 2010).

Implementing the vernacular as a model for new design and shaping the built environment according to the lessons gained from the cultural study can support keeping the world multi-cultural. The problem is that the current vernacular approaches for architecture and built environment design are judged just by using economic criteria with western values, scales, technology, materials, services, health, climates, which are inadequate and unsuitable (Rapoport, 1980; Rehwal & Jahanbeglo, 2010). Some other fields of studies and area of practices such as business studies remarkably consider new lifestyle, taste and demands of the consumers in creation of new methodologies or solutions (Hofstede, 1991, Wurtz, 2005; Singh and Pereira, 2005). This approach can be inspired by architecture in order to create a proper model or theory in relation to the application of cultural study towards designing new vernacular designs.

Consequently, in order to design in developing countries with vernacular environments, understanding the culture, worldview, values, and social organisation alongside obtaining lessons from vernacular built environment is necessary. Employing obtained lessons from the vernacular is an authentic and

reliable approach towards solving the problem of built environment and architecture particularly, housing, which have been advocated by many scholars (Rapoport, 1980; Oliver, 1987; Rehwal & Jahanbegloo, 2010; Fathy, 1986, Chambers, 1998). This is useful for the region of this study with having vernacular architecture.

2.5 What lessons does vernacular have for new design?

Lifestyles and culture are changing and these changes are intensified by progress in science and technology, yet traditional lifestyle and the vernacular built environment has useful lessons to be employed (Oliver, 1997; Rapoport, 1980; Rehwal & Jahanbegloo; 2010; Fathy, 1986). The obtained lessons vary depending on the adopted approach used to study the vernacular built environment. This section concentrates on the possible lessons that architecture can draw from vernacular built environment and lifestyle when designing new 'built environment' and 'houses'.

The vernacular built environment provides 'Physical', 'Psychological', and 'cultural' lessons for new practices (Rapoport, 1980). Vernacular construction technology is also an inspirational source for designers (Fathy, 1986; Oliver, 19987, 1997; Pirnia, 1992; Ghobadian, 1995) however it needs to be renewed or updated through a generative fusion of vernacular wisdom with innovative technologies responsive to sustainable architectural forms (Rehwal & Jahanbegloo, 2010; Zargar, 2000). Studying the relationships between vernacular environments and lifestyle, including the natural environment and ecology, has specific implications in response to the climatic conditions and energy use (Rapoport, 1980). It is also possible to learn from physical aspects of vernacular towns such as the shape and scales of streets, the invaluable functions of courts, which provide privacy, and open space, urbanity, and high density all at the same time, and from the visual quality of the townscape and the social function of plazas, and streets (Rapoport, 1980, Moughtin, 2000).

Lessons might be gained from studying alien cultures in order to be source of inspiration although learning from own culture is preferred (Rapoport, 2006a).

Le Corbusier, who travelled eastward, studied the vernacular building of the Balkans and Turkey in order to learn from their techniques and aesthetical details for new modern architecture in the West (Glassie, 1997). The advent of this approach of learning from the past, local, indigenous, traditional or vernacular architecture originated at a fair that was displaying pictures entitled 'architecture without architect' they were exhibited by Rudofsky (1981). It attracted the attention of modern educated architects and has been adopted by 'modernists' for 'architectural' purposes to support architects in designing new buildings through objectives including 'iconic evocation of symbolic identity', 'climatic, material and functional determinism', and 'emotional, spiritual sensory embodiment' (Oliver, 1997).

Consequently, learning from the vernacular supportive for architectural purposes encompasses 'aesthetical', climate' or 'technological' objectives applicable in either town or building scales. Next, this discussion elaborately explains these lessons and some practices performed all around the world.

2.5.1 Lesson one: Aesthetical or iconic evocation of symbolic identity

This lesson is related to the preservation of vernacular regional archetypes, which are considered to express locals' identity and are picturesque. A picturesque archetype of the vernacular can be derived from the diagram of the plan, and the most common features of elevation, decorative details or shape of openings. Regarding experiences related to this issue, this aim is obtainable through using vernacular materials and building methods (Pavlides, 1997).

Accordingly, Hassan Fathy (1976) used mud-brick construction technology to design the new village of New Gourna[1] in Egypt, in which he uses his well-known technique of turning to local materials and traditional forms such as vault, dome and building techniques accompanied with copying from vernacular layouts

[1]: Hassan Fathy (1900 –1989) was a noted Egyptian architect who pioneered appropriate technology for building in Egypt, specially by working to re-establish the use of mud brick (or adobe) and traditional forms as opposed to Western building designs and lay-outs. Fathy gained international critical acclaim for his involvement in the construction of New Gourna, located on Luxor's West Bank (Fathy, 1976).

both in building and village scale, which have all eventually been rejected by locals. Fathy remarkably employed vernacular dominant shape for rooms, openings and roofs, and applied vernacular courtyards surrounded by rooms within houses as the main element for space organisation. He also added new rooms to the house spatial configuration to meet new needs and demands of users, such as a bathroom and kitchen with new modern appliances and furniture (Ahmad, 2010). This approach has been pursued by some other architects, such as Abdul Halim Ibrahim who designed a playground and park for children in Egypt (Ahmad, 2010). These architects focused on aesthetics and the architectural product that was based on their own interpretations, thus neglecting a participatory process of locals and social preferences (Afshar & Norton, 1997). In particular, mud-brick was not an acceptable material for locals as it was related to the old season of construction and life, meaning miserly and backwardness (Rapoport, 2006a).

Modernism theory emphasised and advocated rational responses to building methods and materials, to climatic and topographic site conditions, and to human needs and activities. Modernist architects employed only those vernacular features that matched modernist ideology such as using primary forms of mass and space, flat roofs, and absence of exterior decoration, repetition of masses and white interiors and exteriors but ignoring magnificent vernacular examples of surface decoration (Pavlides, 1997). Accordingly, Le Corbusier designed the details of Ronechamp chapel largely influenced by the whitewashed, undecorated masses of Thira (Santorini) houses. He also travelled to learn from traditional buildings of the Balkans and Turkey (Oliver, 1987). Alvar Alto and Luis Kahn applied the sculptural use of balconies, which can be traced back to their familiarity with Mediterranean vernacular architecture (Pavlides, 1997).

In Greece, a modernist architect, Pikionis similarly to Fathy, used vernacular stonework predominantly in landscape design in Greece. He employed picturesque interpretations of the vernacular in his research for a national architecture (Pavlides, 1997) using traditional forms such as a wooden veranda, steep roof, stonewall and work and woodwork in a similar way adopted by Sedat Hakki Eldem, a Turkish modernist architect, in his work. Eldem, inspired by

traditional architecture in Turkey, adopted vernacular forms such as pitched roof, vernacular windows, and in terms of materials, applied stone, wood and earthen material for roof cover.

In Mexico a modernist architect, Luis Barragans during modernism used expansively colour in the design of the interior and exterior of buildings and landscape design inspired by the polychrome Mexican vernacular arts (pavlides, 1997), as well as using raw materials such as stone and wood. Additionally, he attempted to intensify the relationships between house and garden or between open and closed spaces inspired by traditional Mexican architecture (Barragan foundation, 2013). Barragans believed that physical and climatic conditions must be considered in every design as well as cultural background. His approach was based on the identification of essential building elements and their conversion into a contemporary image. According to this view, Barragans employed terraces, porticoes and roof areas as important spaces in house design that the use of outdoor and semi-open spaces was most desirable in Mexican climate (Figeroa and Catrena, 2014).

In India, Charles Correa, a modernist architect attempted to interpret Indian's vernacular architecture in a modern typology, incorporating extensive use of vernacular material such as stone, bamboo, brick, mud and thatch with emphasising on employment of local resources, and energy (Airoots, 2013). Also in india, Raj Rehwal employed vernacular symbols, forms and materials while spatial configuration and space organisation of houses are still based on modern interpretation using a new modern concrete structure, creating new houses with new views, volume and modern appearance such as the well-known project, 'Olympic game village' (Rehwal & Jahanbegloo, 2010).

As for new rural architecture in Iran, Razjouyan designed his own new house in the outskirts of the city of Amol, located in the north of the country in Mazandaran province. He was inspired by rural houses and applied a new modern interpretation of them. He applied some vernacular spaces, elements and motifs but according to modern language. The spatial configuration and space

organisation are modern and different from rural houses with using new appliances for the kitchen and new modern furniture for the house.

Consequently, architectural lessons derived from vernacular architecture support aesthetic approaches in architecture including inspiration of the form, space configuration, spatial organisation, scale proportion and size of components, traditional materials and technology of construction were based on the designer's own interpretation, understanding and preferences of vernacular built environment. This was due to a selective and creative process that concentrates just on 'product' without using or proposing a comprehensive 'methodology' based on cultural studies and in accordance with local users' opinions, lifestyle and preferences to encompass and develop the 'process' of construction to be adopted and employed by other designers.

2.5.2 Lesson two: sustainability and climatic design

The climatic condition is an influential factor on human behaviour and built environment solutions. Many examples of vernacular architecture demonstrate sustainable life and design including adaptions to the specific conditions of the natural environment. These include the employment of different kinds of strategies, which all are responses to the interaction between humans and the environment. In this regard, it is necessary to research behaviour, lifestyle of residents for energy responsive purposes as well as technological and architectural responses towards sustainability (Rapoport, 1980; Fathy, 1986; Oliver, 1987, 1997; Weber & Yannas, 2014).

Responses to the climatic conditions currently expressed as 'Sustainability' have always been an important characteristic of vernacular architecture in building and settlement scale. Sustainability is the pathway to re-discover the worth and benefit of vernacular solutions that are relevant today (Grant, 2000). The word 'sustainability' is a noun, which means; 1) the ability to be sustained, supported, upheld, or confirmed. 2) Environmental Science, the quality of not being harmful to the environment or depleting natural resources, thereby supporting long-term ecological balance (Oxford Dictionary, 2015). The

development of human settlement is highly encouraged to be sustainable. The general accepted definition for sustainable development is taken from the Brundtland report, which states it is a development that meets the needs of the present generation without compromising the ability of future generations to meet their needs (World commission on environment and development, 1987).

Sustainability should also combine protection of the environment, sensible use of natural resources, economic growth and social life (Armstrong, 2000). Accordingly, the basic requirements to constitute a sustainable community and settlement are self-sufficiency in food, water, energy and shelter. With this in mind, a human settlement is sustainable if it is able to reproduce its population, is self-sufficient in terms of its own employment, and is able to deal with its own waste products and to do all this while enhancing environmental quality without damaging its precious gifts (Moughtin and Shirley, 2005). Bioregional Development Group develops the ten principles of one planet living sustainably (fig 2.4). Accordingly, sustainability is a framework to help people enjoy a high quality of life within a fair share of the earth's resources (Bioregional, 2015). Overall, sustainable development is beneficial to the enhancement of economic growth, social cohesion, cultural preservation and protection of environmental resources (Edward, 2000; Lynn R. et al, 2014). Vernacular and traditional settlements, including rural areas and villages, are good examples of sustainable human experiments creating either sustainable settlements or buildings through achieving sustainable life (Fathy, 1986; Rapoport, 2006; Duany, A. and DPZ, 2012).

In terms of settlement scale, vernacular settlements can be a good model supporting the new argument for the sustainable approach such as location of mixed use buildings, high density settlements, designing compact dwellings encourages less energy usage with activities such as walking and cycling, having equal access to communal amenities and facilities within 5-10 minutes' walk provision of safe environment and streets for pedestrians suitable for all ages and genders i.e. elderly, children and handicapped, and best land use strategy (Moughtin, 1996; Duany & DPZ ,2012; James, P. et al, 2015; Furusth, O. J. 1997; Rapoport, 1980; Edwards, 2000). 'Self-contained' neighbourhoods have also been-

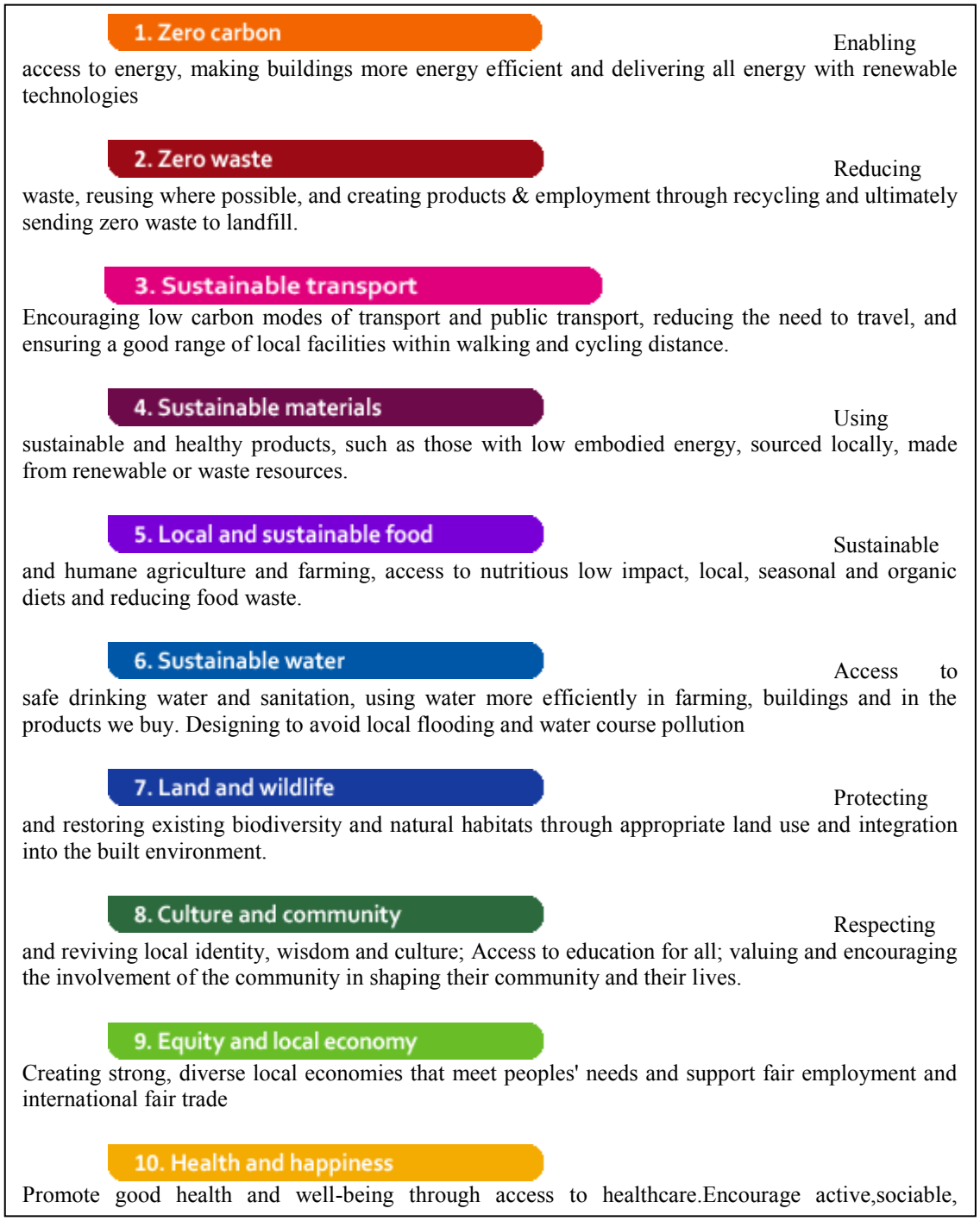


Figure 2.4: 10 principles of sustainability defined by Bioregional website (www.bioregional.co.uk/oneplanetliving/what-is-one-planet-living/, 2013)

_ inspired of vernacular settlement, which most of human daily life activities are possible to occur entirely within the neighbourhoods, minimising energy use and maximising social cohesion (Rapoport, 1980).

In vernacular settlements of Iran, the corresponding word for neighbourhood is '*mahalleh'* where people of similar ethnic and religious backgrounds cluster together in their own quarter, each quarter has its own worship place (mosque), *Hammam* (public bath), *Bazaarcheh* (mall and shops), and other facilities making the quarters self-contained (Sharifi, A. and Murayama, A., 2013). Self-contained neighbourhoods of traditional settlements inspired the creation of neo-traditional theory for city design through studying traditional settlements to extract solutions and proper rules for definition of spatial configuration and building organisation of the new city (Furusth, o. J.1997). The idea of 'compact city' form is inspired by traditional settlements, which are employed to reduce energy consumption and land use that raises quality of the urban and communal life. Duany & Plater Zyberke (2012) has used this method when designing of Seaside City in USA. The idea of using lands for food production through planting fruit trees and implementing agricultural activities is also originates from vernacular settlements and makes the human community capable of being productive and self-sufficient instead of promoting consumerism. The idea of food production is generalised according to the 'agrarian urbanism' theory pioneered by Duany & DPZ (2012) and 'Permaculture' developed by Mollinson (1992), which are applicable for the areas located within cities' territory. They have guidelines for definition of some strategies for land use, urban organisation, size and form of the lands, with emphasis on employing local technologies and knowledge, placement of private and communal houses, provision of private or communal gardens to be used for agricultural purposes (Duany &DPZ, 2012; Mollinson, 1992)). The agrarian urbanism theory is inspired by rural settlements and farming communities. This theory can be applied and used for development of villages of north of Iran. They are an agricultural-based development, influenced by rice farming and generally food production.

Vernacular settlement can support production of low rate of waste, low air, water and soil pollution, and particularly the reduction of construction material waste, which is an incremental concern about modern construction (Ng, 2010). This style of architecture provides appropriate context for interaction, close relationships and proximity with the nature. Close relationships with nature helps people to alleviate the stress of daily routine life, feel happier and it is useful for physical health (Mongomery, 2013). This supports creation and improvement of community cohesion (Gehl, 2010; Moughtin, 1996; Rapoport, 1980).

In addition, consideration to specific local climatic conditions is an important influential factor when designing and constructing buildings and has a basic role in sustainability. In terms of physical and technical responses to the climatic conditions and sustainability in building scale, most vernaculars were designed to use natural renewable resources such as 'passive' or 'bio-climatic'[1] (Weber& Yannas, 2014). Techniques including solar power for heating and wind power for cooling purposes through reducing heating loss, fossil fuels and non-renewable energy use and using environmental friendly energy. This concept in vernacular building was obtained through a combined strategy of choosing the best orientation, volume, form, size, proportion and scale for buildings, spaces and openings, and through employment of natural renewable materials with proper thickness of wall and roof (Fathy, 1986; Oliver, 1987; Weber& Yannas, 2014). Materials used for vernacular construction were sustainable, provided locally from close nature including soil, wood and stone with no harm to existence of humans or nature and needing less transportation conveying them to the site (Pirnia, 1992; Fathy, 1986; Oliver, 1987).

Vernacular buildings were usually designed and constructed by local craftsmen's such as masons or carpenters. In some areas, they are still active and skilful according to the same way as traditional and can be employed for new construction work. Employment of these local craftsman, enables local population

[1] : Bioclimatic, indicates that the mechanisms involved in design do not depend on mechanical systems but on biological and climatic process. (Weber and yannas, 2014)

to be involved with the project, earn more money and resources within their own community helping their local economic development (Edwards, 2000). Those local professionals are also nurtured and trained within the culture that is common with the users, which helps them easily recognise the users' needs and preferences. Employment of local craftsman and craftsmanship has also the ability to support local population strengthening their social ties and communication achieving social cohesion.

ASHRAE (2001) outlines in its guidelines that adaptive adjustments from human to climatic conditions are typically behavioural such as 'altering clothing, posture, activity, schedules, activity levels, rate of working, diet ventilation, air movement, and local temperature' (p.8.18). Rapoport (1980*)* provides a similar list for human responses to climatic conditions including:

- *Individuals can change expectation, norms, and standards, for example accepting discomfort.*
- *Individuals can adapt in various way –even to the extent of changing one's metabolism*
- *Individuals can change one's lifestyle and behaviour.*
- *Individuals can change one's furnishing, clothing (whether wearing sweaters indoors or covering oneself with grease), food habits.*
- *Individuals can change location in some way (summer and winter settlements, long-term migration to warmer or cooler climate, permanently leaving undesirable climatic zones).*
- *Individuals can change the form and design of settlements, dwelling, etc.(P. 452-453)*

Vernacular buildings provide a good 'model' for sustainable building design (Forster, Heal and Paradise, 2014) by employing these responses, which may be adopted wholly or individually depending on the human and environmental conditions (Oliver, 1987; Fathy, 1986; Weber and Yannas, 2014). It should be noted that behavioural responses are not defined by architects and designers as they are independent from their control, so architects are interested in concentrating on physical derivation and strategies of vernacular environment to design sustainably. Concentrating on the responses to the climatic conditions,

some practices in architecture and urban design influenced by vernacular architecture are discussed.

Rehwal (2010), who believes that the essence of architectural expression is based on culture and climate, adopted a sun control system of vernacular Indian cities to design new houses and buildings incorporating new strategies. He, as well as Correa (other Indian distinguished architect), brought together vernacular solutions to protect residents from the harsh sunshine of India by keeping the buildings in shade in favour of using courtyards, roof overhangs and deep-set windows.

In the hot and arid environment of Egypt with the harsh climate, Fathy preferred adoption of vernacular physical solutions. He used a combination of bioclimatic techniques in house design including designing courtyards with an inside water pool producing cool air, raising the inside humidity simultaneously. He promoted the construction of thick mud-brick walls to delay thermal transmission as well as applying dome and vaults to cover the rooms. In addition, he used 'Wind-catcher', which is an exclusive climatic component of vernacular buildings in hot arid climates from Iran to North Africa (Fathy, 1986) leading outside breeze inside the rooms. These techniques also influenced the volume design of the house, its appearance, façade, spatial configuration and space organisation.

Some useful guidelines have originated from vernacular architecture of Mazandaran in the north of Iran in order to design an 'optimum hydrocarbon energy saved building', which is one aspect of sustainable design (Djalilian and Tahbaz, 2004). Razjouyan when designing his own house in Mazandaran has employed them all. A steep slope roof covered with corrugated concrete sheet, and projected with deep eaves from all sides of the house's volume protects the house and its components during rainstorms of this rainy environment and sunshine during hot summer.

Consequently, according to contemporary approaches vernacular housing and settlements can provide variety of lessons and experiences for new

construction and design both in building and settlement scales to make new houses and settlements sustainable providing thermal comfort based on climatic conditions. These strategies also help people to be sustainably adapted to climatic conditions through needing less exploitation of nature and depending less on new mechanical aids and technology accompanied with enhancement of social cohesion and obtaining economic growth. In this research, the vernacular environment of the region of this study is specifically focused in order to discover those sustainable strategies adopted by local population, and employed to create sustainable built environment and lifestyle. This supports the invention of new sustainable construction within the region.

2.5.3 Lesson three: house and technology

Traditionally, all members of society were dexterous in construction technology, and had the skills to effectively build their home. They knew the physical principles that affected the structure of the buildings and the proper methods to assemble the materials. In addition, they knew their local materials and how to make the best of these materials (Oliver, 1987). These materials are usually natural resources sourced locally, environmentally friendly, retrievable or reusable.

Regarding Iranian traditional architecture, Pirnia (1995) argues that traditional construction technology and materials were 'self-sufficient' because the materials were mainly from the close nature and craftsmen were local. The structure was resistant and strong because of the efficient construction technology employed less materials and energy in construction, and applied deliberate and functional details. Pirnia concluded that applying traditional materials and employing traditional construction technologies for new construction without any change is still suitable and efficient. This is the way, which Fathy adopted this method when designing and constructing houses, particularly in New Gourna. He used traditional local materials and technologies in construction with no change such as using adobe wall, vault and dome according to traditional method and techniques.

People in developing countries are not seemingly interested in employing vernacular technologies and materials according to traditional expression. Likely, villagers of New Gourna rejected the houses designed by Fathy, because they were old-fashioned while dwellers wanted homes that represent progress, modernity and ultimately become their aspiration as a measure of success (Rapoport, 2006a). In many developing countries, high prestige is a positive value of new buildings with the use of new forms and materials; they represent high-status (Rapoport, 1980, 2006a; Oliver, 1987). This is the same in Guilan, a province in the north of Iran adjacent to Mazandaran. Local population in this region are not interested in traditional old houses and forms. Instead, their passion is to design and construct new houses, which demonstrate new forms and employ new materials. It is because the old style houses, by implication, are representations of their past life, which was full of misery and difficulties (Bromberger, 1995). This can be a socio-cultural variable due to low status according to their tradition, culture and lifestyle, which is the reason for the rejection of traditional materials and technologies. In this regard, employing vernacular technologies and materials need to be with new expression responding to the interest of users towards high prestige and modernity.

The technology as a whole, and specifically in construction, changed and progressed during human life cycles. Changes in the progress of technology can be seen including technology for communication and transportation, home appliances, technology in construction materials and processes of construction. These changes are mainly caused by modernism.

'We are living in globalized world of fantastic changes. Nokia from Finland, Toyota from Japan, computers from China, and Airbus from Europe are part of our daily lives. The use of mobile phones, the internet, and computer software, and international travel have revolutionised our world…. New building materials like structural glass, aluminium panels, and tools for cutting stone are changing the methodology of building (Rehwal & Jahanbegloo, 2010, p.100)'.

Modernism evolved vernacular construction technologies. New technologies and materials that emerged after modernism within the region of this

study, such as concrete structure, can strengthen buildings against natural disasters like earthquakes, which traditionally were important factors for rural residents of Mazandaran in house construction. This new technology can provide construction of multi-storey houses, thus reducing land use for housing and leaving the most for agricultural and food production purposes. On the other hand, unlike local materials and technologies, new modern materials are non-renewable, locals particularly in rural areas, are not sufficiently familiar with these technologies to work effectively. These materials are imported and transported to their region from another places or city areas, which make them expensive. So, how to use technologies belonging to the past in new designs and how to weld regional architectural values whilst respecting ecological and urban concerns with cutting-edge technologies are current concerns for architectural practices in order to develop syntheses of contemporary theories based on 'revived traditions' and to incorporat traditional solutions with the use of modern technologies (Emmons, Hendrix, Lomholt, 2012). This kind of approach towards new technologies seems logical because new technologies in construction can improve progress, intensify our ability in design and construction of new buildings, reduce the duration of the construction process, and increase construction of durable buildings, which have been approached and practiced worldwide (Rehwal & Jahanbeglo, 2010), and Barragans in Mexico (airoots, 2013).

Influenced by progress in technologies in result of modernisation, lifestyle also has been changed by using new technologies for home appliances such as new furniture, sofa, bed, TV and kitchen appliances such as (washing machines, washing sink, oven, and fridge, ventilation machines, dishes accompanied with toiletries, sanitary productions and cosmetics). These new appliances affected the form of new houses, their spatial configuration and space organisation. Furniture such as sofa, chair, and new wardrobes for blankets and clothes, and tables necessitate the need for a larger living room, adjustments of size and proportion, and addition of extra rooms. This evolution made space organisation and spatial configuration of the houses completely different from vernacular pattern.

New modern cooling and heating appliances particularly in Iran and its use of available cheap fossil fuels make it easily possible to design bigger houses with larger rooms. These big houses need to use new construction technology for their construction because traditional methods are not efficient enough for the construction of large houses with long length and width. In addition, these new cooling and heating systems and cheap fossil fuels have made people including laypersons and experts, unresponsive about employing renewable, environmental friendly and natural energies or applying vernacular knowledge about designing sustainable houses. Renewable energy in this region can be produced from local bio-mass such as sugarcane, left over woods of carpenters, rice skin, and specially bio-gas mainly from cow's dung in rural areas (Sonj, 2004; Da Costa, 2004; Omrani, 1997). Additionally, material for enhancement of concrete performance can be obtained from burning rice skin, which is abundant in this agrarian region based on rice production (Ardakani, 1994).

Because of modernisation, new means of transportation, including cars and machines, also changed the lifestyle, house configuration and construction technologies in vernacular areas. It made it possible and easy to convey the new modern appliances and facilities to every part of the world, as well as helping productive regions such as agricultural societies to produce more yields, export their products and increase their income. Progress in agricultural planets and machines, accompanied with progress in new modern pesticides and fertilizers, help farmers to produce much more yield, which means earning more money enabling them to by new appliances for the home and constructing new bigger house. On the other hand, new cars for commuting and planets for agriculture need a new standard of roads from traditional alley, changing the shape of the rural roads to be straighter than the previous windy shape. Roads need to be wider and asphalted permitting cars move easier, faster and more comfortable. As a result new rural transportation systems are predominantly designed for cars without sufficient consideration to pedestrians, making them unsafe especially for children to play on and for animals to walk on, exploiting more lands, destroying village structures and configuration to meet the need to be wider, and makes the rural areas similar to cities in appearance. This new transportation system also allows

rural residents to transport new modern materials from the city faster and with cheaper expanses. It provides comfort for travelling for different purposes, which can provide welfare.

Consequently, all new technologies themselves should not be recognised as negative phenomena, and should not be polarised with tradition, they can increase choice, make it easier to do things by giving people more power and control. On the negative side, if technology is used without knowledge it can be destructive and catastrophic. Technology is an essential reality in modern life and has different influences on different cultures and groups. Some of them are more 'vulnerable' to the technology for different reasons (Rapoport, 1980). Thus, different groups and cultures should have their own evaluation of technology may be differently, may incorporate, adapt, adopt or reject with very different results.

2.6 Culture and housing

Culture leads to various social variables, which then can be transformed into physical form. It means that forms can be seen as a transformation of cultural norms and behavioural and social characteristics. In better word, some components of culture are related to some components of built environment (Rapoport, 1980). Mutually they influence each other in such a way that any change or modification in the environment can be resulted in changes of the culture and behaviour of the people and vs. (Lang, 1998, Rapoport, 2006, 1980). House is a main type of human made environment and every community has some sort of its own, which specially in vernacular environments is composed mainly influenced by culture demonstrated in various shapes and designs regarding to natural resources and materials, climate and local population's knowledge of construction (Rapoport, 2006, Oliver 1987).

The concept of housing primarily influences the form of housing and its spatial configuration. For instance, in agrarian or any society that food production is the first priority, house should be an appropriate place for food production (Duany & DPZ, 2012; Oliver, 1987). Accordingly, most houses of villages in north of Iran obliged to be interwoven with spaces employed for producing foods such as;

orchard garden, livestock and poultry buildings, production of diary space, weaving textiles and making handicrafts spaces. House as a safe shelter or haven also can be another probable conceptualisation of housing. Depending on environmental hazards specially in places that are in danger of attack from strangers harbouring in places like castle or in hazard of natural disasters such as storm, building houses on wooden studs like in Thailand (Oliver, 1987, 1997) or in hazard of earthquake, building wooden houses of north of Iran. House also can be described as a recreational phenomenon resulting in privatisation of recreation through accessibly and using Television, video, records, stereo, barbecues, swimming pools, books and magazine, games, computers which clearly can change the structure of houses, lifestyle and daily activities (Rapoport, 1980). Therefore, the main concept of housing is influential factor on the shape of houses and is related to the culture and hence to the lifestyle.

Different lifestyle also leads to different activities, which Rapoport (1980, 2006a) entitles it as 'systems of activities'. It includes activities related to living, work, shopping, recreation, gardening, playing, worship and something more related to the daily living activities not only in the dwelling itself. It is because people do not live in house buildings alone but they inhabit in different types of building, blocks, villages, neighbourhoods, streets, shops, pubs, tearooms, bakeries, open spaces and plazas (Rapoport, 1980, 2006a; Moughtin, 1999; Gehl, 2010). Rapoport (1980, 2006a) mentions that these places are 'systems of settings' where the 'systems of activities' take place. Accordingly, pub in UK, Tavern in U.S.A, tearoom in Korea, small wine drinking settings in Austrian villages, and coffee shops in many locals can be identified as the extension of living room of the house since some parts of activities related to living and living room take place inside these places. This view also influences the evaluation of quality of housing specially about perceived density, crowding, cleanliness and beauty, and even influences 'choosing' a place or area for living (Rapoport, 2006a). Thus, if we are to compare or study different kinds of houses or dwellings, we should not only compare or study the buildings themselves but the systems of settings and systems of activities must be concentrated (Rapoport, 2006a).

The variable cultures combining with climate and other environmental variables, settlement size, social characteristics lead to various kinds of housing, which culture in vernacular environment has much influential rule (Rapoport, 1980, 2006a; Oliver, 1987).

2.7 Cultural study and vernacular architecture

Cultural and vernacular study towards solving the problem of built environment and new housing is one of the authentic approaches. Its necessity and efficiency in studying and designing new build environment for developing countries has been advocated by many scholars (Rapoport, 2006; Rehwal & Jahanbeglo, 2010; Oliver, 1987). This is a vast area and needs a combination of different approaches to be efficiently studied because there is no single approach encompassing all objectives of this kind of study comprehensively. The problem is that there is not a proper methodology for studying vernacular architecture and housing based on a cultural approach (Oliver, 1987; Rapoport, 1980; Wike, 1990).

It should be made clear that the studying of the culture is according to *'emic'* or *'etic'* (Triandis, 1972, Rapoport, 2006). Most anthropologists stress that culture should be understood in its own terms in contrast to psychologists who believe that looking for universal (pan-cultural) laws of human behaviours must be considered. The first view, emic, endeavours to provide the best description of social phenomena and utilises concepts developed from the examination of only one culture which is the case for architectural study, and the second view, etic, provides the most general description of social phenomena with the concepts that are culture-free, pan-cultural or universal (Triandis, 1972). This research adopted emic approach because it wants to concentrate on the particular vernacular architecture of houses within a particular region.

Oliver (1987) studied vernacular architecture itself in order to obtain some lessons or solutions for designing new alternatives. He believes that a discipline studying vernacular architecture could emerge as a result of combination of some elements of architecture and anthropology. He stated that approaches are broadly of three classes including; 'disciplinary' which is supported by a body of knowledge

such as an archaeological approach, and 'interdisciplinary' which is conceptual such as a spatial approach, and 'methodological' which is used with recording and documentation. Those broad class approaches in detail comprise of; aesthetic, anthropological, archaeological, architectural, behavioural, cognitive, etic/emic, conservational, developmental, diffusional, ecological, ethnological, evolutionary, folkloristic approaches that have concentrated on localised traditions, geographical, historical, musicological and phenomenological approaches focused on geography, topology and history of the settlement. Buildings of vernacular settlements supported by combination of different methods and approaches can be 'recorded and documented'. According to 'spatial' concept, their organization and articulation of space can be analysed. In addition, their structure can be analysed using 'structuralism' theory and definition of rule systems underlying evolutions and changes in architecture using 'generative-transformational method'. This approach towards vernacular architecture makes the role of building prominent focusing on describing or documenting vernacular buildings and settlements but does not sufficiently consider the role of human behaviour. This approach also appeared to be just descriptive with no proposed methodology for analysis and evaluation of vernacular buildings.

Rapoport (2006, 1980) strongly believes that architects need to study human behaviour, culture and their relationships within the built environment when designing vernacular environment in order to be able to design new suitable alternatives. For studying the culture, Rapoport (2006) emphasises that there are three problems as preconditions, which need to be solved:

a) 'There is a cultural and communication gap between designer and user which makes it difficult fully to know the culture and its design implication in sufficient detail.

b) The great variety of cultures and the fact that they are changing rapidly and at different rates complicates acquisition of this knowledge.

c) As corollary to (b) it must be accepted that there exist many different stages of changes and levels of acculturation within a given population...it is ...useful...to use consultants and variable data to find out as much as possible about the given culture...' (p.163).

Rapoprt (2006) argues that culture is a big concept and that concept is useless. Therefore, culture should be *'dismantled* [1] into small components, which has been presented in a diagram (fig 2.5). All components -for instance values- can have smaller components related to each other, which have not been included in the dismantlement presented by Rapoport (2006) because he believes that it is an endless activity. Besides that, no definition for these components has been suggested[2] and this diagram has not been examined by Rapoport himself.

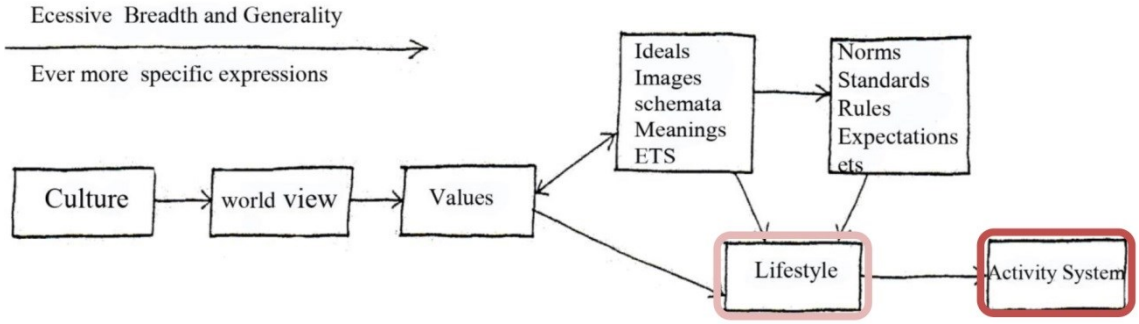


Figure 2.5: Diagram for dismantling culture proposed by Rapoport, which the outcome is 'Activity System'(Rapoport, 2006a, p.117)

Environmental-behaviour researchers believe that the design should be according to human behaviour (Rapoport, 2006; Lang, 1987; Hall, 1990). The diagram shows that human behaviour is related to culture and lifestyle. The outcome of this diagram is 'Activity System', which is directly related to lifestyle and related to all components of the culture. One cannot look at single activity but must consider activity systems or behaviour circuits (Rapoport, 1990). According to the diagram, lifestyle leads to understanding activity and activity systems, which are the most concrete expression of culture, and architects and planners, are relatively familiar with using activity analysis and find it extremely useful when analysing and designing environments. This is the main result of studying the culture proposed by Rapoport. Cultural study is reduced into understanding and

[1]: The word 'dismantle' has been proposed and used by Rapoport himself

[2] : Despite of Rapoport, some of them as 'subjective components' of culture have been defined by Triandis (1972) as are described in continue (p.14-15).

discovering the activity system, its latent aspects and meanings simultaneously makes one capable of understanding the cultural aspects and influences of human behaviour of a built environment. It means that one does not have to study the previous steps shown in the diagram, which makes studying the culture easier and faster, and contributes concrete achievements for the designer. This diagram seems appropriate for design of new houses and dwellings based on studying activity systems, however it needs to be understood that where these activities they occur.

2.8 The use of culture in design_ the theory of culture as 'Model System'

Vernacular houses were designed through a process, which Rapoport (1980, 2006) calls it 'Selectionism'. It means that users are able to select some rules between varieties of choices and can make their own decision in order to design or construct appropriate places according to their lifestyle. Alexander (1964) names it 'unself-conscious' design and Broadbent (1990) known it 'irregular design' which are perceived against new modern design approach and process as 'self-conscious' mentioned by Alexander and 'regular design' according to Broadbent's interpretation**.** Rapoport (1980, 2006) eagers to know this new model as 'Instructionism'[1], which is new current design process using by professionals by instructing their own selections and decisions to users.

The difference is that with the old model common in the past, designers and clients had shared values and images, which sometime clients were often users and additionally, users were more homogenous and uniform without considerable cultural gap with each other, leading to choices were very close to societies preferences. The second model, which is common nowadays in modern time, designer tries to select its own preferences and instruct it to the users. But in this

[1]: These two words including ' selectionism and instructionism; have been used by Rapoport (1980, 2006).

process most of the time the result is rejected, changed or modified by the users such as the experience of Hassn Fathy in designing new Gourna village in Egypt and what is happening in new housing of rural areas of Mazandaran. In this region, spatial configuration of the houses in result of modernisation has become complex and out of local population's ability to design accordingly. This phenomenon imposes them to employ professional designers such as academic educated architects or civil engineers to design and construct their new house, who mostly have different opinions, preferences, values and lifestyle from local population.

In order to solve the mentioned problem in designing new alternative built environment induced by considerable cultural gap between the designer and user, some design methodologies have been proposed. Alexander (1977) introduced around 253 patterns suitable for shaping the whole settlement to details of buildings, which he believes that applying these patterns in a hierarchical process supports users to form their own settlement, public buildings and houses without relying on a professional designer. He states that these patterns are cultural specific such a way that according to different culture and need, some new patterns can be added or some new one can be deleted as well as some of these patterns, which could be updated and changed over time. Nevertheless, the way of recognition and extraction of all of culture specific patterns is not cleared and is a hard process for local population and layperson. Besides that applying them through a process is also harder for people with no training or study in this subject.

Rapoport (1980, 1983, 2006a) suggests that we need to use culture as 'model system' for designing new alternative. He states that design can be perceived as a 'choice model'[1]. To do so and aiming to use culture in design

[1] : It means a user or designer can select between many alternatives to design a new place, development of living space, refurbishment or remodelling and even furnishing. The designer role is to be knowledgeable about the user's culture and hence their wants and preferences in order to provide and propose certain proper choices for people. The designer's task is to maximize the variety of residential environments to maximize choice, which are translation of user's wants directly finding better way responding those wants (Rapoport, 2006a).

process, built environment should be dismantled into smaller components along with dismantlement of the culture in order to discover 'systems of settings'[1]. It is because activities occur not in architecture but in systems of settings, which include outdoor areas, settlements and the whole landscape, which in any given case cannot be assumed but need to be discovered (Rapoport, 1990). In this respect, Rapoport proposes another diagram (fig 2.6) which accordingly components of culture have relationship with built environment and its components. Understanding and discovering two main outcomes from both dismantlement including 'systems of activities' from dismantlement of culture taking place within 'systems of settings' derived from dismantlement of built environment support designing new houses and assure their successes for any given culture. This is the key point suggested and derived from the second diagram proposed by Rapoport (2006a) which reduces studying culture into studying 'systems of activities' and 'systems of settings', and their relationships, which makes designers needless of conduction of exhaustive research studying all components of culture or built environment[2]. This methodology provides a

[1] : It should be emphasised that 'Setting' is not the same as space, since one space may include many different settings at one time. For example, one room in house may be used for sitting and watching TV, having food, entertaining guest and sleeping like that happen in vernacular houses of villages in north of Iran in a room named as '*Kelesi khene'*. Also one space can be different setting at different time with the changes in rules temporarily, for example a main square in a village in north of Iran can be used as a fair place, wrestling area and religious demonstration place at different time. These written or unwritten rules (Oliver, 1997) which are simple or complex are an aspect of culture and specifically related to 'objective culture'. The simplicity or complexity of rules and systems of settings because of some forces or events can evolve. Rapoport (2006) believes that this can happen with 'modernisation' in developing countries or as societies become larger and more complex, which can be accompanied with increased number of special and separated settings. In a vernacular society, many settings may take place in a single house space in contrast to modern cities where there are a large number of very specialised settings such as; many kinds of buildings, dining places, shops, offices, classrooms, and for houses there are many distinct settings such as; porch, entry, corridor, living room, dining room, master bedroom, guest room, bed room, pantry, storage, basement, attic which are related to the systems of activities and lifestyle and hens culture.

[2] : Culture, preferences and wants change during the time, which for this phenomenon, Rapoport (1983) proposes one another method suitable for developing countries. He mentions that it is better to begin with identifying those elements, which are changing rapidly and those changing slowly or not at all. These later, which resist change and maybe retained to the end, are the important components of traditional environment as the 'core elements'. Those changing rapidly or given up are less important and they are peripheral. So, we should identify three elements in order to be able to design for new situation; core elements (both socio-cultural, and physical which are supportive of them), peripheral elements which are less important in the traditional environment, and important new elements. Also, designer should try to discover priorities preferences and the elements which comprise environmental quality and should separate materials and shape from space organization. Cultural core is related to social groups, activities, behaviour, lifestyle, meanings,

possible methodology to employ culture in design process, designing new houses, which might be culturally appropriate and fill the gap between the designer and the user.

Rapoport is seemingly the only person who from around 1970 attempted to make cultural study usable in design process while others just wanted to show the importance of cultural study or its components in architecture. In this regard, Rapoport (2006b) encourages using vernacular built environment as a 'model system' applying from concept stage of designing new alternatives, but his propose still seems that is not a full methodology for design process. It is because of lack of his consideration to Physical aspects of culture and built environment such as shape, geometry, material and construction technology, and is because of his less emphasis on climatic influences and implications on the form of built environment. This is in result of Rapoport's belief that categorises these physical aspects of built environment as second importance or priority. In other word, he emphasises on 'subjective aspect'[1] of culture giving less importance to consideration of -'objective aspects' of culture including physical aspects of built environment. It seems that, consideration of physical aspects accompanied with climatic influences on culture and vernacular built environment are two requirements, which Rapoports methodology needs them to be improved as a full methodology and in order to be employed for designing new vernacular alternatives.

On the other hand, this process proposed by Rapoport is proper for research and understanding the culture, through discovering 'systems of activities'

cognitive, schemata, institutions, and physical elements are related to organization of various settings. So, one should try to identify important social units (castes, kinship groups, families, social networks). The corresponding physical units (neighbourhoods, compounds, house groups, villages, various systems of settings), the unit of integration where social interaction occurs and corresponding institutions like recreation, fairs, rituals, shopping, eating to be able to design according to new wants.

[1] : Terlutter et al. (2005) divided cultural researches into two main categories including studies concentrating on 'objective criteria', which are related to economic, geographical, and socio-demographic dimensions. The others concern 'subjective criteria', which are on the other hand related to values, attitude, and behaviours. Therefore doing comprehensive study on culture needs to cover both of these kinds of approaches to be authentic and reliable in order to be ended up in obtaining proper lessons.

taking place within 'systems of settings', which because of this potential capability has been selected as one of the base methodology for conduction of this research.

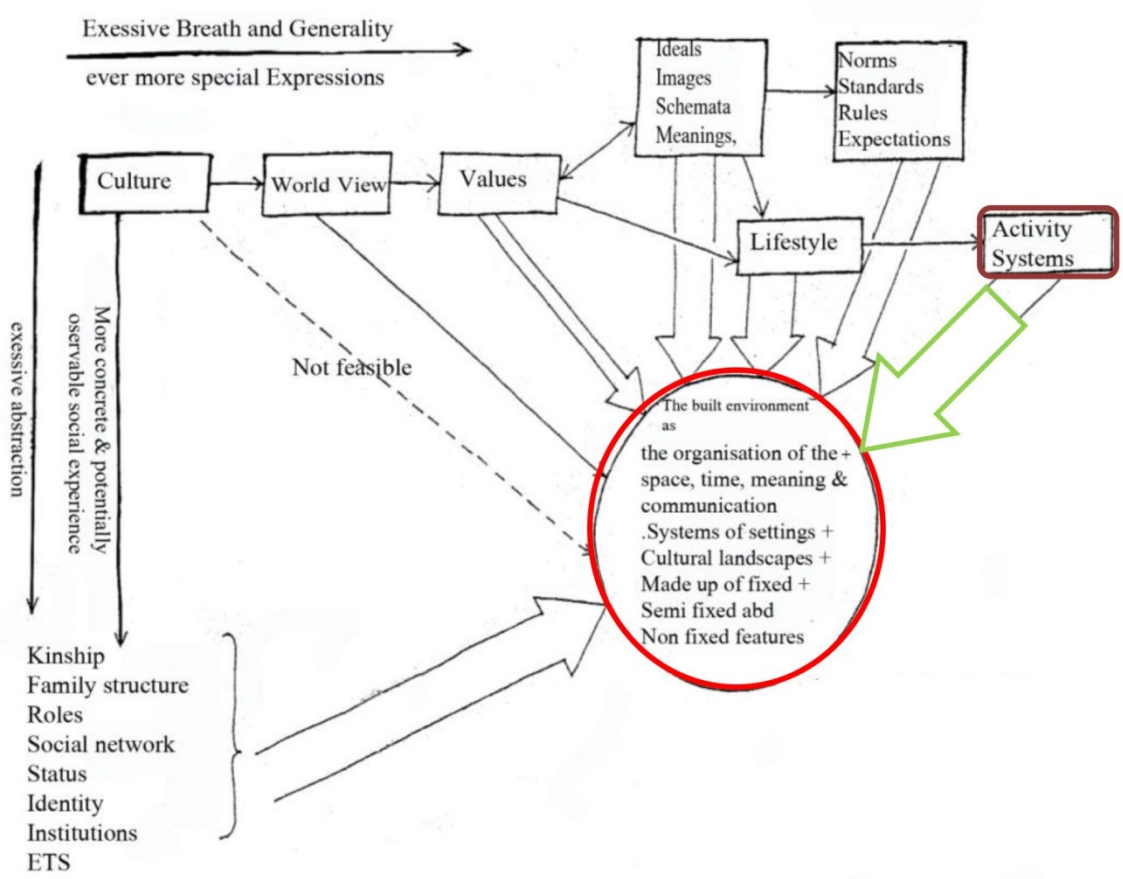


Figure 2.6: Interrelationships between components of culture and built environment proposed by Rapoport (2006a, p.98)

- However, if we are to design or synthesise a form, all aspects of that form must be considered in a same weight as well as their interaction (Alexander, 1971), which this action includes physical aspects and rule systems supportive for improvement of Rapoport's methodology to be usable as proper model system.

Rule systems are important to be studied for using culture as model system, because they are led by norms and are followed by choice criteria that consistent application of them leads to style in buildings and to identifiable cultural

landscapes implying the presence of shared models or schemata (Rapoport, 2006b). Rule systems can be unwritten known as 'Urf' (Hakim, 1986) in Iran and Arabian countries or is formal, written and legalistic, which leads and shapes the physical aspects of the built environment. Rapoport (2006b) within one of his latest article supports the validity of rules extracted and defined from studying 'Bungalows of buffaloes'[1] in order to design and generate new vernacular alternatives. This study has been performed based on employment of the theory called 'Shape Grammars', although Rapoport has no indication to name of this theory within his dissemination. Analytically, understanding and definition of the language of existing styles of design, and extraction, selection and definition of rule systems of a specific style and application of them in designing new type/s of buildings are main concerns of 'Shape Grammars' (Stiny, 1976). This theory, which emphasises on shape, geometry and physical aspects of buildings is beneficial for studying and analysis of physical aspects of built environment and completes the emitted part of the methodology 'culture as model system', proposed by Rapoport. This is the topic of the next chapter in order to find out a full methodology as the basis for this research and one contribution of this study.

[1]: This research has been carried out by Downing and Flemming presented in an article entitled 'Bungalows of buffaloes' in Environment and planning B (Downing and Flemming, 1981).

Chapter 3

Notes on Shape Grammars

3.1 Introduction

Stiny and Gips (1972) pioneered Shape Grammars from 1972. The development of Shape Grammars is underpinned by research in linguistics by Noam Chomsky in the 1950s, which attempted to establish transformational grammars based on an innate grammar, which is considered to be universal, in order to generate correct grammatical sentences. Its use in architecture evolved within the context of formal structure, spatial and visual structure and its application, from the very beginning in design. It has progressed within two distinct contexts;

1) It was used analytically to understand and define the language of existing styles of design.
2) With the definition and selection of certain rules and shapes, it was adapted to solve design problems and generate designs (Stiny, 1976)

The first application of shape grammars was used to analyse principles of existing architectural styles particularly vernacular architecture during the first two decades of its creation. The second application relates to the possible use of shape grammars to enable architects and designers to create new designs with embedded design criteria.

Shape grammars as a whole are a system used when interpreting designs as a possible series of points, lines and geometric shapes (point 2 above) and consists of four components (Stiny 1980);

1) *'S a finite set of initial shapes*
2) *L a finite set of symbols*
3) *R a set of shape rules*
4) *I a labelled shape called the initial shape (p.347)'*

A shape grammar is a set of shape rules that are applied in a systematic way to generate a set, or language, of designs. Shape grammars are both descriptive for analysis and generative for new designs. The rules of a shape grammars generate

or compute designs, and the rules themselves are descriptions of the forms of the generated designs. Points, lines, planes or volumes are the components of shape rules by which designs are generated. This by application of these shape rules through using the operation of addition and subtraction, and spatial transformation such as shifting, mirroring and rotating, which are all familiar transitions for designers. Accordingly, shape grammars are founded on Boolean operation for a combination of shapes (Stiny, 1980). Therefore, to understand the shape grammars, it is important to understand that what the shape and the design are composed of, and to understand a Boolean operation of shapes that have been or could be deployed.

3.2 Shape

'A shape is a limited arrangement of straight lines defined in a Cartesian coordinate system with real axes and an associated Euclidean metric'. According to this definition 'a line L, l= {p1, p2}, is determined by any set of two distinct points p1 and p2, called the end points of the line. A line has always a limited but non-zero size', a finite set of lines specifies every shape, and one shape is a sub-shape (Part) of another shape whenever every line of the first shape is also a line of the second shape (Stiny, 1980, p.343).

Boolean algebra, which is key in shape grammars, is formed by a set of all sub-shapes of a given shape *s* and the operations of shape union and intersection and difference (p. 344) including;

'The *shape union* of shapes s1 and s2 (denoted by s1+s2) is the shape consisting of all of the lines in s1 or s2 or produced by combining lines in s1 or s2. And the shapes s1 and s2 are both sub-shapes of the shape s1+s2' (p. 344).

'The *shape intersection* of s1 and s2 (denoted by s1. s2) is the shape consisting of the shape s1 and s2. Shape s1. s2 is a sub-shape of s1 and a sub-shape of s2, (p. 344).

'The *shape difference* of shapes s1 and s2 (denoted by s1-s2) is the shape consisting of just those lines in s1 that are not also lines in s2. The shape s1-s2 is always a sub-shape of the shape s1, but need not be a sub-shape of shape s2' (p. 344).

Production of new shapes using these Boolean operations transforms the given shapes by changing the location, orientation, reflection or size. Accordingly, transformations are translation, rotation, reflection and scale or finite composition of them, which all of them except scale are isometric

3.3 Shape Grammars

A shape grammar consists of four components. It is initially defined as a set of shapes (in the set *S*), the shape rules use the other three components to define and control its application through the labelling of the shapes (in the set *L)*, it consists of two labelled shapes, one on each side of an arrow, a left-hand side and a right-hand side. To start a grammar, a rule is applied to an initial shape (*I*). Designs are generated by a shape grammar through the application of the shape rules one at a time to the initial shape or to labelled shapes produced by previous applications of shape rules (Stiny, 1980).

A set of all shapes and rules defined by a shape grammar is called the language of that design and each of these shapes within the language is derived from the initial shape by applying the shape rules '*each is made up of shapes or sub-shapes in the set S'*(Stiny, 1980, p. 347).

Visualising the shape grammar helps one to understand the process and the method of its application. Figure 3.1, derived from Stiny (1980, p. 348), illustrates two shape rules including rule 1 and rule 2, the initial shape *I* (b), the shape set (*S*) in the rules is a square and the label symbol is indicated as •. The given example is one interpretation of how this design can be developed through a set of shape rules.

The initial shape is a labelled square with the symbol • at the midpoint of one of the edges. The labelled shape on the left-hand side of both shape rules

consists of a square and the symbol • located at the midpoint of one of its edges. The labelled shape on the right-hand side of the first shape rule consists of this square and another one is inscribed within it (fig 3.2).

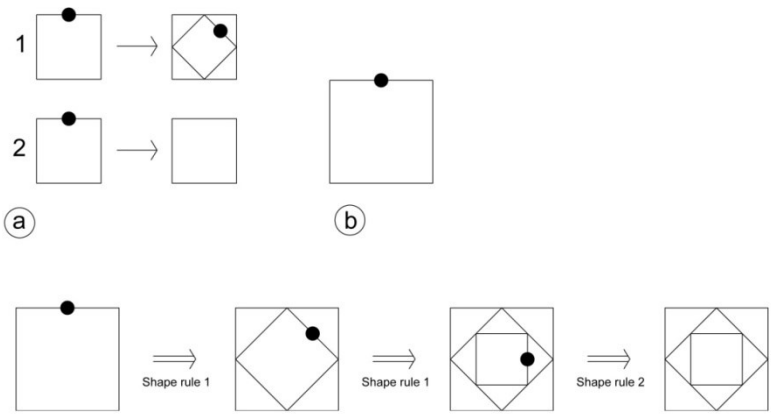


Figure 3.1: A simple 'Shape grammar': a) shape rule, b) initial shape, and generation f a shape using presented shape grammar (Stiny, 1980, p.348)

Designs are generated by the application of the rules. These are applied when the condition of the left-had side of the rule is transformed through a transitional activity to the right-hand side of the rule. Iterations can continue when you can recognise left-had side conditions of rules. An initial shape is always needed in order to apply the first rule.

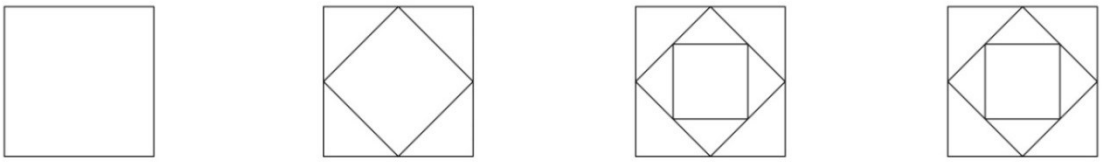


Figure 3.2: Three iterations of the application of rules in previous figure to produce design shapes (Stiny, 1980, p.348)

3.4 Parametric shape grammars

Stiny has defined '*parametric shape grammar*s', these are an extension of shape grammars in which shape rules are defined by *'filling in the open terms in a general schema'* (Stiny, 1980). This kind of shape grammar is illustrated in figures 3.3 and 3.4. It should be noticed that the initial shape in parametric shape

grammars is a point, labelled by the symbol ■, and unlikely is not a parameterised labelled shape' (Stiny, 1980).

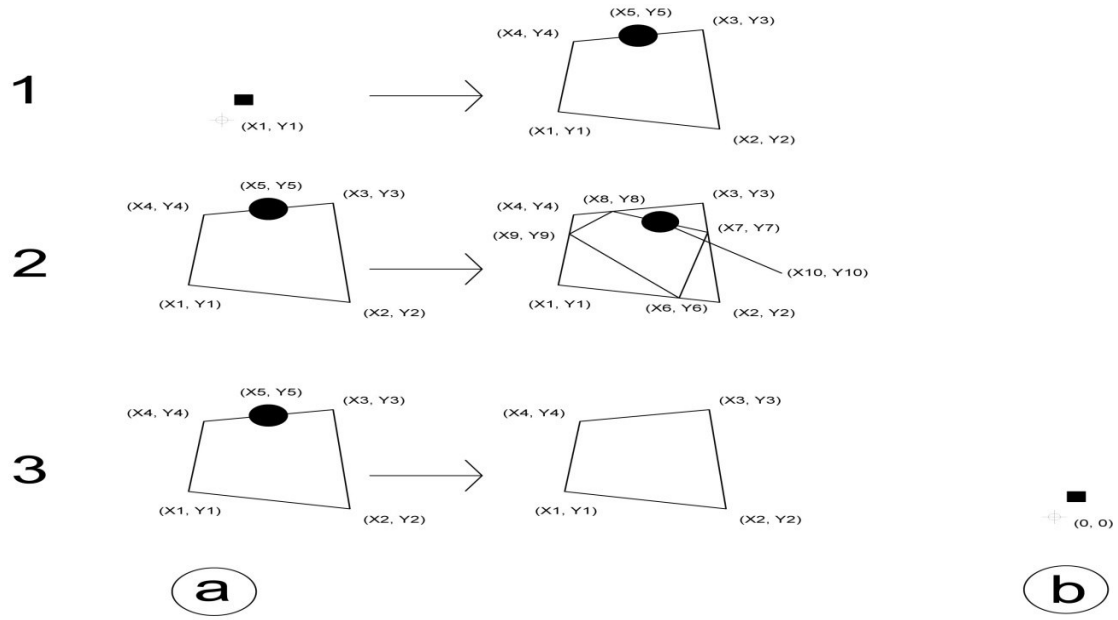


Figure 3.3: A simple parametric shape grammar that inscribes convex quadrilaterals in convex quadrilaterals; a) shape rule schemata, b) initial shape (Stiny, 1980, P.349)

Figure 3.4: Some shapes in the language defined by parametric shape grammar of previous figure

In parametric shape grammar, x and y parameters of a shapes' endpoint can vary, which is the result of flexibility aspect of shape grammars. Testing this type of shape grammar, Stiny (1977) analysed the Chinese lattice for the first time as Ice-ray, supported by parametric shape grammar (fig 3.5 & 3.6) which has also been used to generate new alternatives.

3.5 Types of shape grammars

Based on the definition of restrictions that have been used in shape grammars applications, Knight (1999) has defined different types of shape grammars. These have also been inspired by Chomsky's hierarchy or types of grammars in literature.

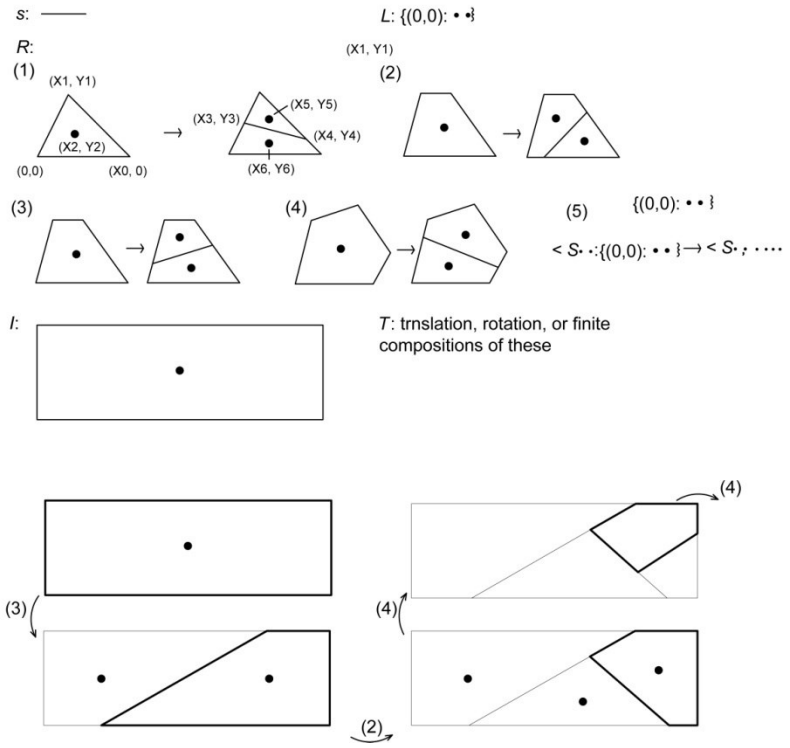


Figure 3.5: A set of shape grammar at the top that generates Ice Ray design and part example of the process of Lattice shape grammar generation (Stiny, 1977)

'*One kind of restriction is on the format of rules. It concerns the shapes and labels that may appear in a rule. Another kind of restriction is one about rule applications. This kind of restriction concerns when rules apply the sequence in which, rules apply and the number of times rules repeat*' (Knight, 1999, p.16). Knight believes that these restrictions increase the generative power of a grammar, or lead to language with interesting productive properties. According to Knight (1999) based on these two categories of restrictions, there are six types of grammars; these are: basic grammars, nondeterministic (ND) basic grammars, sequential grammars, additive grammars, deterministic grammars and unrestricted grammars. The last three are generalisations of the first three types. The six types of shape grammars along with their restrictions are shown in table 3.1.

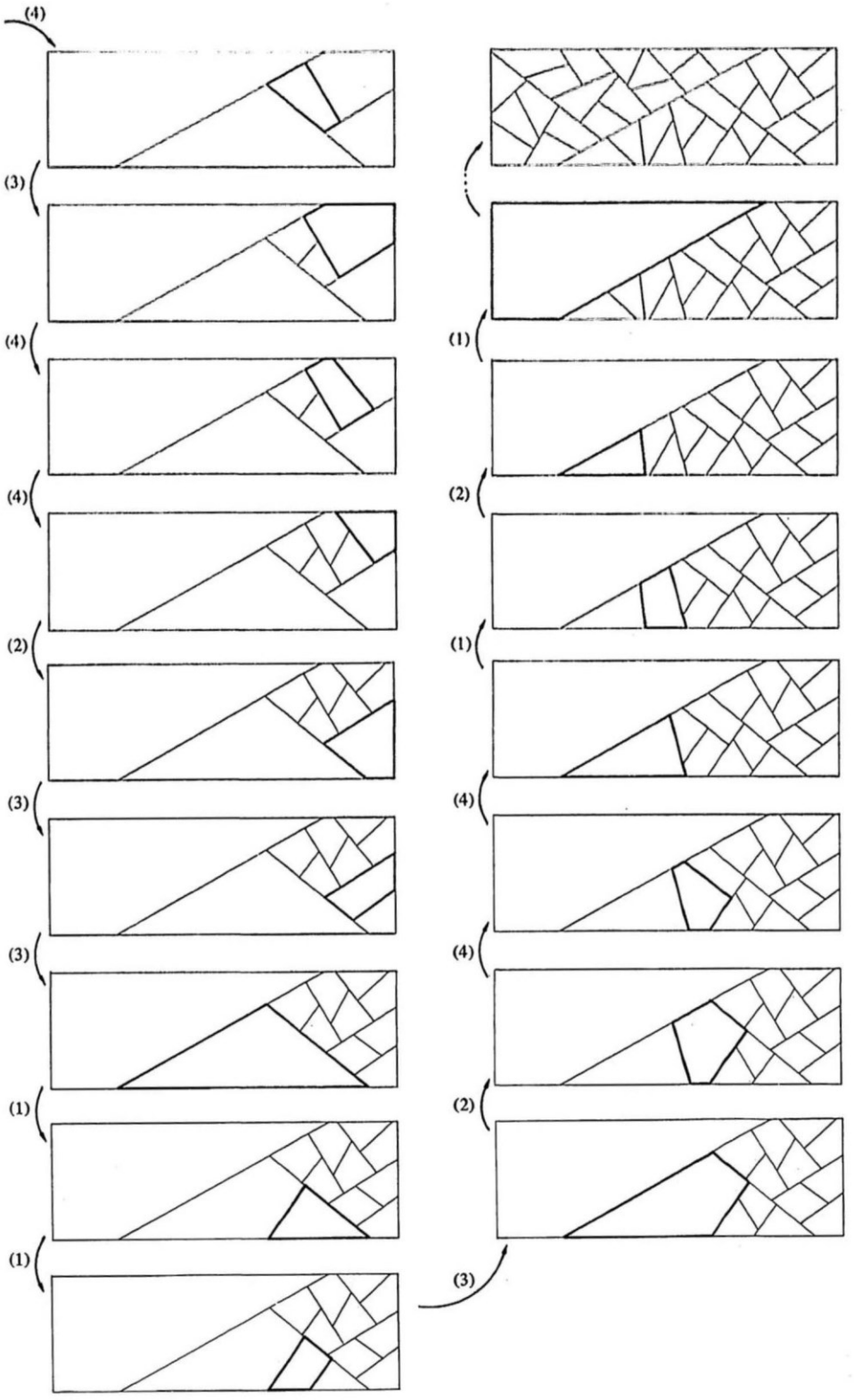


Figure 3.5: Part example of the process of Lattice shape grammar generation (Stiny, 1977).

Table 3.1: Different types of shape grammars and all kinds of restrictions used to define them (Knight, 1999, p.17)

	Rule format	Rule ordering
1 basic grammar	☆	☆
2 ND basic grammar	☆	☆
3 sequential grammar	☆	☆
4 additive grammar	☆	
5 deterministic grammar		☆
6 unrestricted grammar		

Accordingly and as a whole, shape grammars are categorised into two main deterministic and nondeterministic (ND) categories. In a deterministic grammar, only one derivation is possible and applied rules are conducted to only one design or no design may be generated from the previously generated design. It generates a highly restricted language containing very regular designs (Knight, 1999). These characteristics make this type of grammar unproductive for this study needing the generation of more choices and alternatives. On the other hand, ND grammar allows multiple designs to be generated from previous designs in some steps of some derivation so that there is a choice of ways to use grammar. In this regard, generated designs by ND grammar are more diverse. ND grammars produce more complex, less repetitive designs by allowing for choices in rule applications that respond to the goals and constraints imposed by a designer or design project (knight, 1999). Rapoport (1980, 1983, 2006a) argues that design is a choice model which means that the designer's role is to provide and propose certain proper choices for users, and his main task in housing is to increase the variation of houses to maximise choices. This is achieved by employment of ND grammar, which has been adopted for this research for the accomplishment of the adopted cultural study toward proposing new proper alternatives.

3.6 Applications of shape grammars

Shape grammars in architecture and design have been applied in two ways, firstly for the analysis of existing designs and secondly for the generation of new design alternatives. During the two first decades of shape grammars, their applications concentrated mainly on analysis, which due to this work, shape grammars became an established paradigm in design theory, computer-aided

design and related fields. Stiny (1977) introduced the first analytical exercise with shape grammars in his paper, 'Ice-ray: a note on the generation of Chinese lattice designs'. It is the first parametric shape grammar, showing the power and necessity for parameters to describe and generate existing design languages. With five simple rules, the grammar defines the compositional conventions of lattice designs, generates existing lattice designs and an infinite number of new, hypothetical designs in the same style. Inspired by this exercise, an analytical approach has been demonstrated and applied for the Islamic *gireh*, Korean pattern (Lee, Park, Lim, Kim, 2013) and lately in understanding and designing new alternatives.

In addition, the use of shape grammars to define two-dimensional and three-dimensional aspects of design and style formulation for dwellings has been clearly established as a proven methodology. Studies have been undertaken for vernacular architecture including the Taiwanese traditional house (Chiou, Krishnamurti, 1996), Queen Anne houses (Flemming, 1987), Ndebele homesteads (Herberts, Sanders, Mills, 1994), the Palladian grammars (Stiny, Mitchell, 1978), and most notably for Frank Lloyd Wright's prairie houses (Koning, Eizenberg, 1981). Accordingly, the potential of shape grammars makes them suitable in analysis of existing vernacular houses of this research.

The use of grammars in exploring new design alternatives of a particular design/style by capturing the common characteristics of a particular corpus of buildings, which are then categorised within one style, has the potential to design new instances of the same style. Regarding this point, a set of rules extracted from the analysis of the buildings need to be identified, which new alternatives could be proposed accordingly. Koning and Eizenberg (1981) designed new alternatives for Frank Lloyds Wright's Prairie houses using these rules, they were identified through their analysis of these building types, the same as Stiny and Mitchell (1978) did for the Palladian grammars. Recently, shape grammars have been applied in town planning; it is a new kind of application of shape grammars which have been illustrated in the design of a flexible urban area using urban patterns

and shape grammars (Duarte, J.P. and Beirao, J, 2011) and before that for city edge development of Friedrichshafen (Teeling,1996).

Many studies have demonstrated that it is possible to discover and define rules for smaller scales of buildings and built environment such as the colour of buildings, patterns, decorations and details. Mitchell and Radford (1987) defined a set of rules to generate eave details in Australian domestic housing construction (fig 3.7) and Flemming (1986), in his research on the shape rules of Queen Anne Houses, defined rules for roof and brick patterns at the bottom of chimney stacks. Shape grammars have been successfully employed to analyse and design new Korean patterns (Lee et al, 2013) and the geometric Islamic pattern known as *girih*, (Cenani and Cagdas, 2007) are both decorative elements. Consequently, a set of shape rules could be defined including spatial, volumetric, details, including decorative and structural rules, which could result in the design of a complete building according to a specific or an existing style.

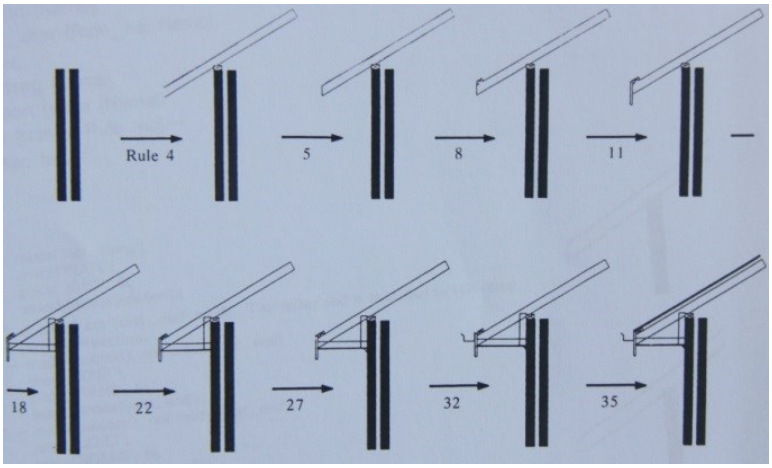


Figure 3.7: An example of EAVE design through sequential application of rules (Mitchel and Radford, 1987)

These studies and practices demonstrate that shape grammars are powerful tools for formal analysis of artefacts and are descriptive enough to reveal intrinsic simplicity or regularities in different styles (Lee eta al, 2013). They have the potential to support the analysis of cultural artefacts like vernacular architecture and embed an understanding of the cultural characteristics within the formalisation of rule sets and can be of tremendous practical value in design teaching and practice (Knight, 1999). The formalism of the shape grammar process is one of the most convincing methods available to represent our understanding of

the composition of designs in existing architecture (Koning and Eizenberg, 1981). However, the successful and novel use of shape grammars in a design project depends greatly on the designer's ability to shape the development of an original grammar to fit specific requirements of a project. The process of developing or designing a grammar involves numerous changes and refinements, guesswork and imagination (Knight, 1999). In addition, shape grammars have the potential to generate infinite designs using a predefined or extracted set of shapes and shape rules, which support the generation of new design forms without precedents. This methodology could support designers looking for new forms to fulfil both creative exploration and specific design requirements.

8 Conclusion of chapters 1 to 3

3.8.1 Problem

Domestication of rice production in Mazandaran encouraged local nomads living within the mountain area to becoming settlers in the two southern parts of the region; in the forest areas and in the adjacent flat plain area (Koulaeeyan, 2006). Rice production was the main factor in formation of a specific agrarian culture and lifestyle. This agricultural activity has influenced the form of houses, the configuration and the structure of villages in rural settlements of this region located in the north of Iran. Nowadays, this lifestyle is rapidly evolving from its vernacular existence. This is caused particularly with an increase in the population, increased contact with city areas, and the advent of new home appliances from outside of the society, and new construction materials, which are endangering the identity of the villages as its architecture was heavily influenced by rice cultivation, food production and the characteristics of natural environment. The villagers are eager to preserve and respect their traditions and their identity in the context of rice culture, whilst retaining the quality living standards that modernity and cities can provide.

Regarding this problem, many architectural practitioners review and analyse historical material and contextual information using existing traditional

and vernacular architecture as part of the design process in order to find out some solutions. Some of these endeavours are intended to theorise obtaining inspiration from vernacular environments. However, many of these endeavours have not guided architectural practitioners to an appropriate methodology to aid the design of new solutions according to new lifestyles, so that they cannot support this research to solve the problem of this region.

Much of vernacular practices are based upon practitioners' own opinions and preferences rather than a theoretical approach to support the design of similar solutions. Few are based on an understanding of the users' culture, demands and preferences so, as they are not theory-based, they cannot be employed and replicated by other practitioners.

Looking at theories, the application, definition and extracting culture specific patterns according to 'pattern language' are not clear and it is a hard process for professionals, particularly for locals, which also makes updating the set of patterns difficult. 'Culture as model system', proposed by Rapoport, is useful in understanding cultural components, local preferences and demands especially since discovering 'systems of activities' taking place within 'systems of settings'. On the other hand, because of lack of consideration to physical manifestations of systems of settings, cultural actions and activities, shape, geometry, climate, material and construction technology, it has not translated to a full methodology to be employed for designing new alternatives within vernacular environments. Despite this, the theory of 'Shape Grammars' is useful in compositional analysis of existing architecture, and is useful to define compositional rules for generation of new architectural solutions, but the cultural or human behavioural and climatic characteristics of a place, its dwellings and their development over time has not been considered in this theory.

Therefore, the problem is, we still do not know how to deal with traditions and new impacts, particularly with new technology and sustainability, new rural perception, and new form demands for houses according to interrelation with sustainability, traditional identity and modernity.

3.8.2 Aim and objectives

The achievements obtained from the literature review have directed the research to combine the 'cultural approach and methodology' proposed by Rapoport entitled 'Culture as model system' and expanding on his definition the theory and methodology of 'Shape Grammars', which is hypothesised to be an appropriate methodology to solve the problem of the region of this study (fig 3.8).

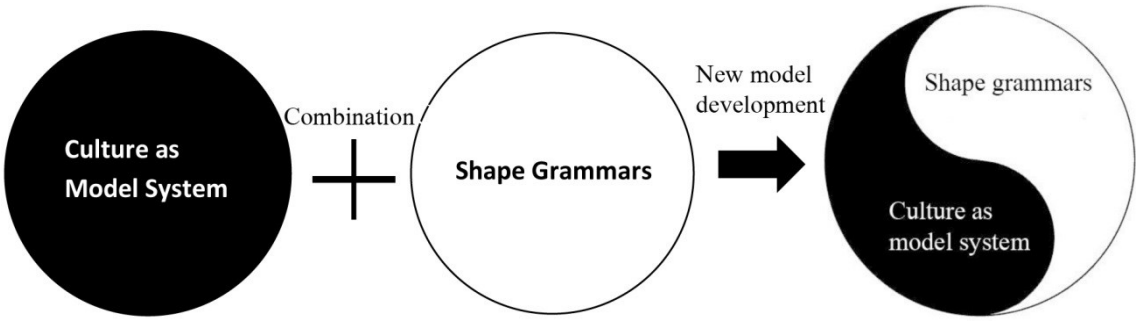


Figure 3.8: A diagram showing the combination of based theoretical methodologies

Accordingly, and to test this hypothesis, this study is based on the defined aim and objectives engages in three specific studies on the region as below;

1) Investigates the vernacular environment and society of the rice fields of Mazandaran, in order to define the cultural and social issues that have formed the configuration and characteristics of its settlements and architecture, according to the theory proposed by Rapoport to understand local's lifestyles through exploration of 'systems of activities' taking place within 'systems of settings'.
2) Defines a set of compositional rules from the analysis that embodies the cultural, social and sustainable characteristics that are used to generate this type of vernacular architecture based on the theory of 'shape grammars'.
3) Identifies and evaluates the sustainable principles utilised within the vernacular dwellings and settlements of the region with reference to the climate and society.

3.8.3 Contribution of the research

This research adds two contributions to the knowledge. The first and the main is *'developm*ent of a model'. The afore mentioned 3 research studies have

common ground, including analysis of the environment, society and compositional rules, which contribute to development of a 'model' by creating a set of rules that, when applied can generate vernacular dwellings to provide sustainable solutions for the region of the study and exemplifies culture, tradition and new lifestyles (fig 3.9).

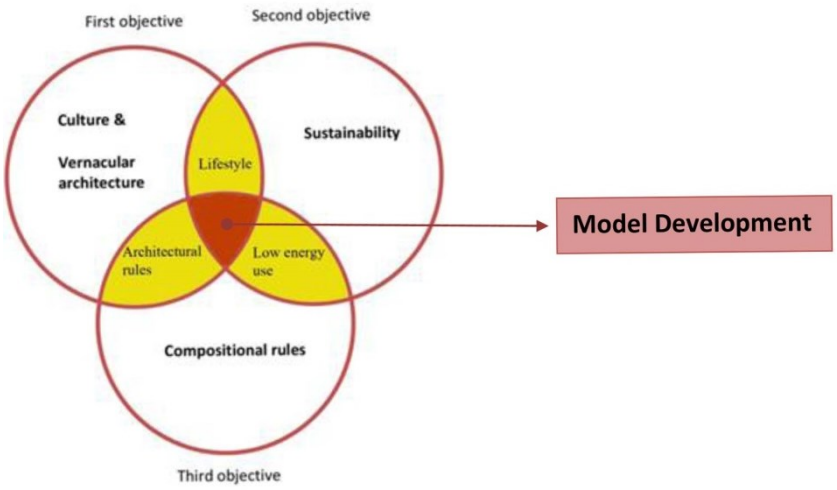


Figure 3.9: The diagram shows different aspects of this research, its objectives and main contribution

Additionally, there is a gap in information about the vernacular architecture of the region and there is no appropriate information and research about its dwellings to represent essential maps of dwellings and their characteristics to be employed as the base data for this research. In this regard, this research conducted a study providing essential information about dwellings. These dwellings have been examined through measurement, and mappings, which all of those maps have been drafted and drawn using CAD software on computer. Following that, a study has been conducted to represent typology of dwellings within the region. This is the second contribution of this research to the knowledge on this subject area *'recording vernacular housing through measurement, mapping, and representing typology of dwellings within the region of this study'*.

Chapter 4

Research Methodology & Data Collection Procedure

4.1 Introduction

The main concern and problem of this research is that there is still not a full clear methodology to facilitate generation of new vernacular alternatives. This issue makes a definition of a new generative model essential. The process of introducing this model including, adoption of base theoretical methodologies selection of methodologies for data collection, and their examination, has been deliberately designed and carefully explained, with the intention of being employed by other researchers, which is the topic of this chapter.

The study of vernacular settlement and housing with an emphasis on culture provides critical supporting information regarding new alternative houses within the region. Through an analytical understanding of the definition of the language of existing styles of design, these new compositional sets of rules assist and complete cultural studies. This key methodology has been adopted in this process. Validation of rules to understand if they respond to new lifestyles are evaluated by criteria obtained from the cultural study. These two different aspects of this research are combined together to provide an innovative and novel system towards designing new sustainable solutions for the villages in the rice fields of Mazandaran. To bring together a methodology for understanding culture, and providing sustainable principles to be used for design of new vernacular architecture, which is embedded with a rule system has never been done before.

Defining a set of culture-specific rules that respond to the environmental conditions and are useful for the generation of architecture is the challenge of this PhD. Aim and objectives of this research focus on:

1) Discovering vernacular compositional rules of housing in Mazandaran
2) Understanding culture, lifestyle, and 'systems of activities' taking place in 'systems of settings' (Rapoport, 2006)
3) Exploring influences of culture change on housing
4) Exploring influences of new technologies on lifestyle and housing
5) Apprehending local climate condition and natural characteristics of the region of this study with the intention of figuring out the sustainable strategies employed by locals

In order to achieve those objectives, the research needs to employ different types of methodologies not just rely on conduction of a single methodology. Although, Rapoport (2006a, 2006b, and 1980) argues that understanding and finding out 'systems of activities', in which the members of community perform within 'systems of settings' of any given culture, is critical before the design phase, he does not propose any methodology to assist achieving this objective. In this regard, and as a result of the evaluation of various methodologies used for the conduction of cultural and vernacular studies, it is advocated that the full range of methods should be employed to understand the build environment particularly its relationship to social and cultural issues (Wike, 1990; Oliver, 1997). This research planned based on conduction of 'case studies' consist of villages located within the region of the study. The analysis concentrates on the cultural, social and climatic issues related to physical aspects of their built environment in order to identify the characteristics of 'systems of settings' where 'systems of activities' take place (Rapoport, 2006a). This is in order to set up compositional rules of the dwellings. These achievements combined with each other support the suggestion of 'a generative model for new houses based on the cultural traditions and sustainability of villages in rice fields of the north of Iran'.

4.2 Case studies

The case studies for this research have been selected through a 'purposeful sampling strategy', so they can purposefully inform an understanding of the research problem. Usually, more than one case study and no more than five case studies are selected (Creswell, 2007). Accordingly, four villages has been specifically chosen for case studies based on different climatic and geographic characteristics of the region of this study, in order to get comprehensive data regarding the aim and objectives of the research.

Mazandaran is located in the north of Iran (fig 4.1) and is combined of 3 regions known as eastern, western and central regions while they have various differences and commonalities (fig 4.3).

Figure 4.1: Location of Mazandaran in Iran

The main and more populated cities of this province are located in the central region. More importantly, the civilisation fallowed by giving up a nomadic lifestyle and adopting a settled lifestyle brought about by rice production and domestication started in this region (Koulaeeyan, 2006). However, this region has still preserved its traditional agrarian lifestyle and vernacular environment especially within the rural areas (fig 4.2). Based on these reasons, 'the central region' has been selected for this study. This central region has different climatic conditions and different natural environment areas. These include 1) mountain area, 2) flat plain area, 3) the forest area and 4) the forest border (foothill area[1]) (fig 4.3, 4.4, 4.5 and 4.6).

1 : This area is located at the edge of the flat plain area where it reaches to the forest area. The forest in Mazandaran is also located on the hills so that the forest border is actually the foothill area of the forest adjacent to the flat plain areas. For simplicity, this are in this research is called the forest border area.

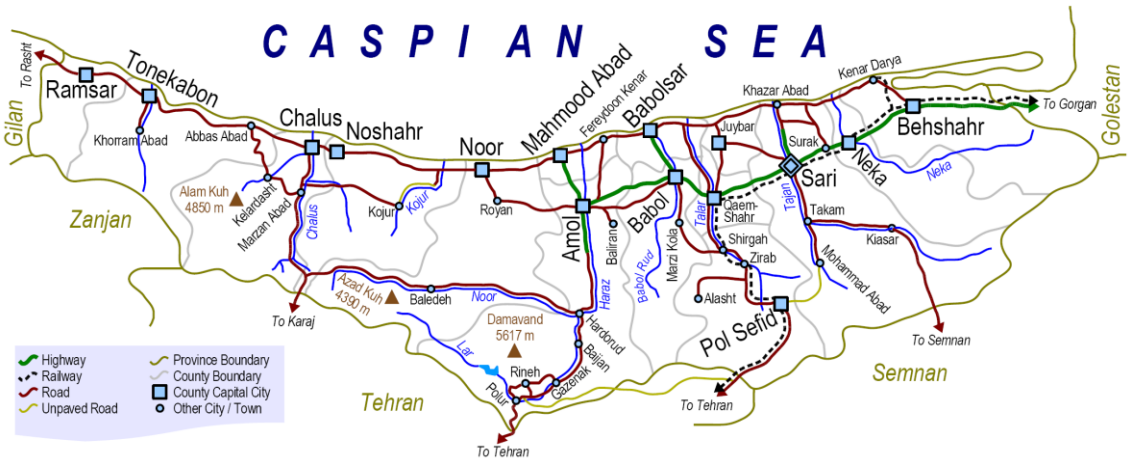


Figure 4.2: Map of Mazandaran and the location of different cities and settlements

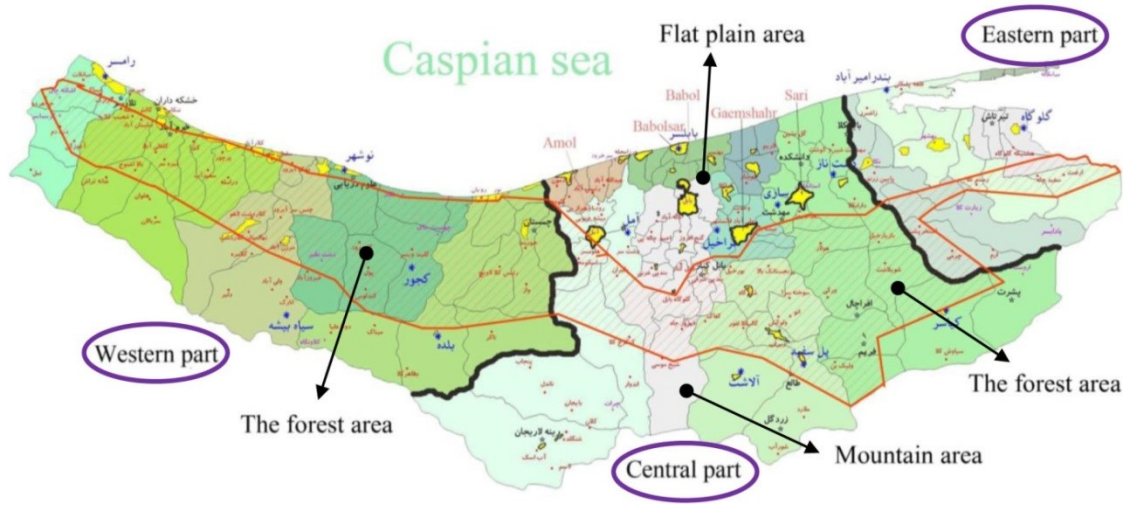


Figure 4.3: Different parts and areas of Mazandaran

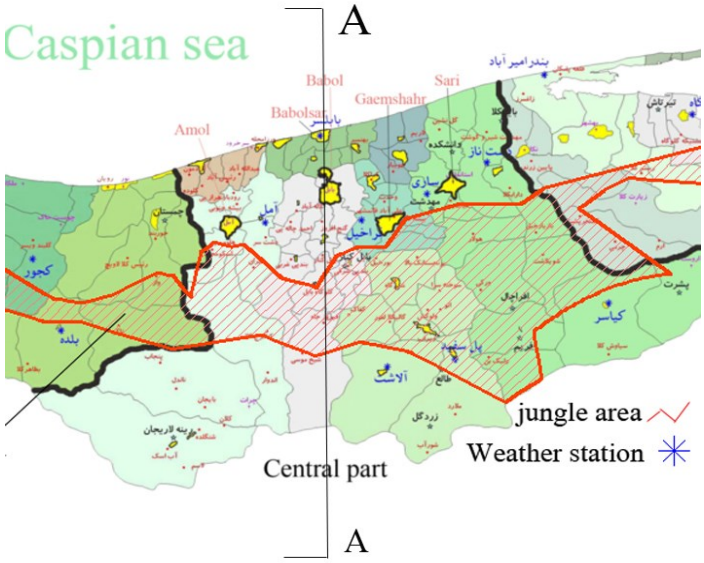


Figure 4.4: Central part of Mazandaran

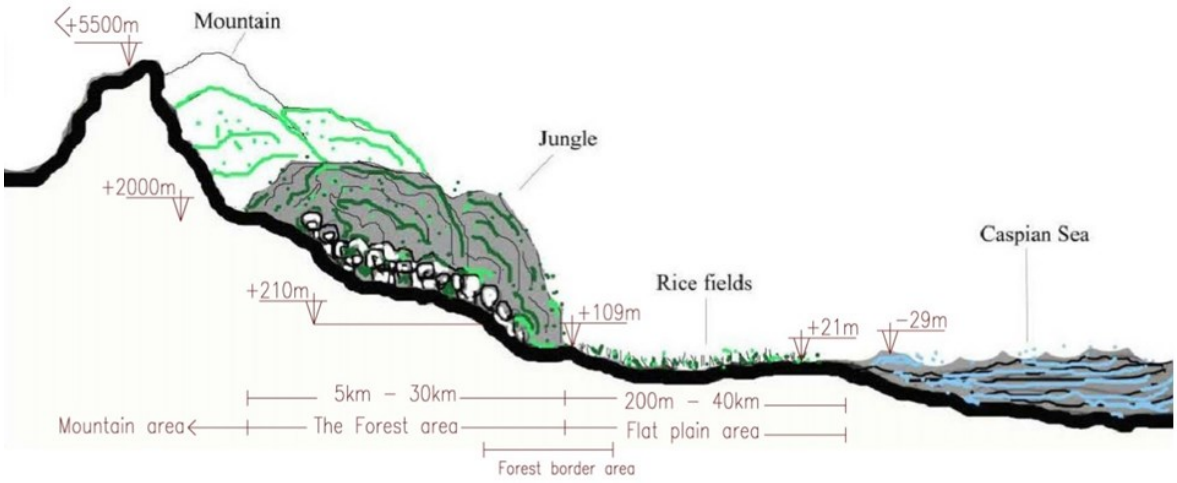


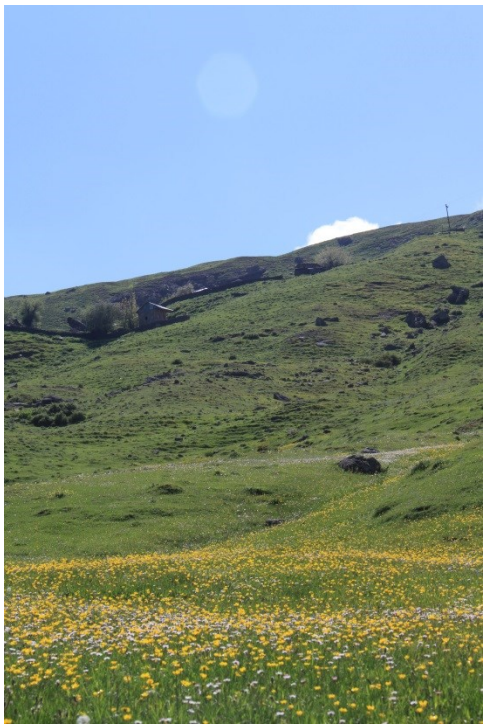
Figure 4.5: A diagrammatic section of central part of Mazandaran

Figure 4.6: Pictures show different transects of the region, rice field, and the forest and mountain areas.

4.2.1 Mountain area

This is the highest part of the region with the average height being about 3000m above sea level. The highest, the most famous and symbolic summit of Iran, Damavand, at 5671m above the sea level is also located in this area (Damawand,

2015). Mountain area was the first place of residency in ancient times when local residences had a nomadic lifestyle due to animal husbandry, nurturing sheep and grazing goats in prairies and meadows of this land. Because of advent of rice farming, they moved to lower areas inside the forest and flat plain areas becoming settlers (Koulaeeyan, 2006). In more recent time, local population have been using villages in the mountain areas temporarily during summer holidays because of cool and dry weather. Traditionally, houses were mainly constructed from stone due to its abundance in the local environment, and wood provided and imported from the flat plain and forest areas. All of vernacular houses are linear and are mainly one story high in this part (fig 4.7).



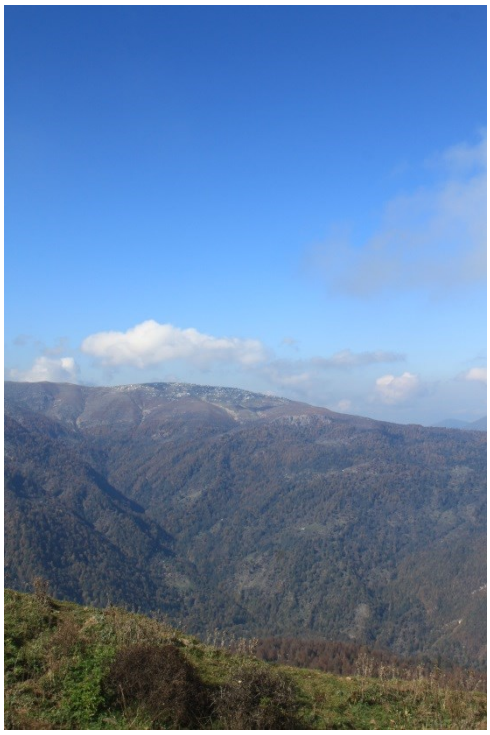


Figure 4.7: Pictures of mountain area and a village in this area

4.2.2 The forest area and the forest border adjacent to flat plain area;

These two areas were the first destinations for local people to settle in due to rice domestication production. These areas were selected for rice cultivation because of having suitable natural conditions such as fertile soil, humid weather, and abundant water resources. This forest in scientific society is called 'Hyrcanian forest' and is recognised as one of the unique forests of the world, which is more than one million years old. It has been stated that this area is the biggest and virgin forest of deciduous trees within the Middle East and Europe. It nurtures some rare species of deciduous trees and accommodates a rich variety of fauna and flora (Heydari, 2015) (fig 4.8). Log house is the main construction technology and form, which has used indigenous local materials from the forest. Traditionally, linear and L shape are two generally preferred house forms within this region, and are mainly one storey high. Rice farming is one of the main occupations of villagers along with animal husbandry, both of which had an influential role in the formation and consolidation of their traditional lifestyle. Lifestyle changed within villages of the forest area but at a slower speed in comparison to the flat plain area.

Figure 4.8: Pictures of The forest area during different seasons and a village in this area.

4.2.3 Flat plain area

This area was the second destination for settlement, which is less historic compared to the villages in the forest area. Materials for vernacular house construction are local taken from the surrounding nature, usually a combination of earth and timber frames, which are assembled mainly linear in shape and generally two stories high. Rice farming is the main occupation of the villagers, it influences and shapes an agrarian lifestyle and society of which food production was the main aim. This agrarian lifestyle and society is changing rapidly from traditional to modern and has already changed more than other areas. The change of lifestyle changed the configuration of villages and houses in such a way that it has replicated city configuration. This evolution transforms the current human-base environment into a machine-based environment (Montgomery, 2013). Houses also evolved from being constructed using natural local materials to using new modern materials such as concrete and steel imported from outside of the villages, along with changes the house spatial configuration and space organisation. Traditionally houses, were generally a maximum of two stories high while new common apartments a modern style, inspired by the city, with five storeys from the ground are being built, accommodating more than one family over different floors.

4.3 Selected areas for this study

Focused villages for this study are those located within *the forest area* and at *the forest border* adjacent to the flat plain area of two cities' counties[1] (fig 4.9). These are:*1) SARI County*; Sari is the capital city of the province, the first rice cultivation and domestication started from this county back in 100 BC (Koulaeeyan, 2006) and 2) Second County is *BABOL County;* which is the second important, largest and human populated city in Mazandaran (Statistical

[1] : City county; this means a city with different rural districts located around including different villages within these rural districts. Usually each city county includes flat plain, Forest and mountain areas.

Organisation of Iran, 2015). This county contains the most villages and the most populated rural areas in Mazandaran. Historically, this county has greater economic importance in Mazandaran province compare to other main cities of this province, which made it attractive, important and a strategic place. Some determinative historical events also have taken place within this county that determined the fate of the province and even the country (Saleh Tabari, 1997).

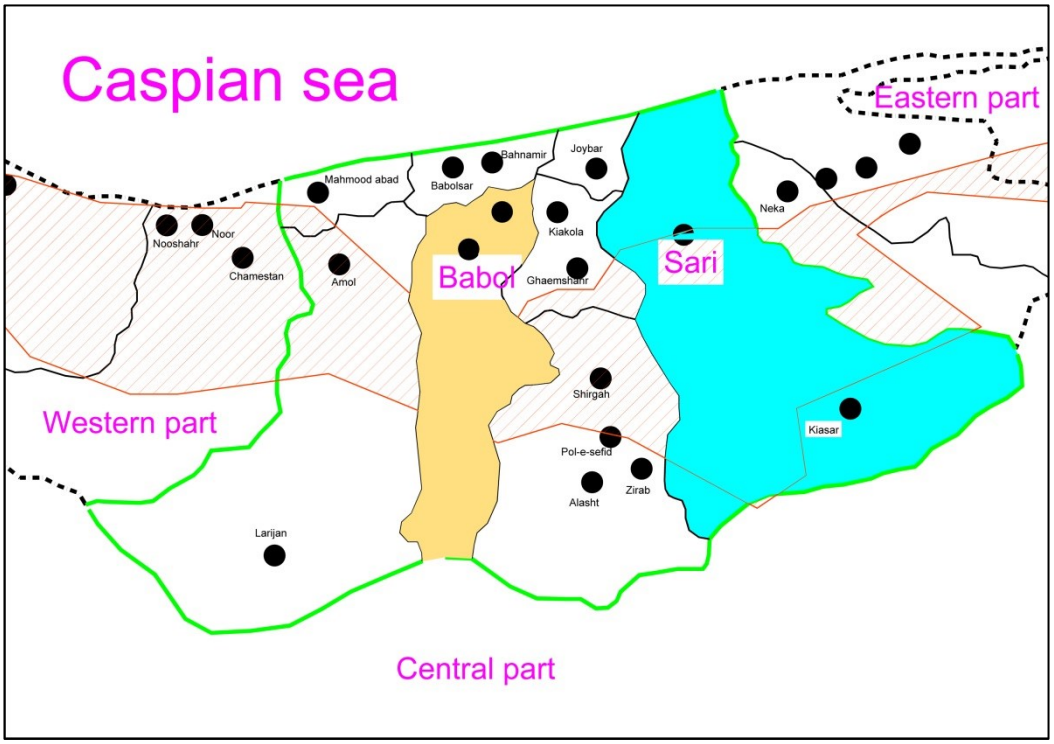


Figure 4.9: Location of two city counties selected as the region of this study

Accordingly, the villages located within the forest area and the forest borders have been selected for the case study evaluation and appraisal, which are elaborated on below.

4.4 defined criteria for selection of case studies

Four villages have been selected as case studies including one village located within the forest area, one village located at the border of the forest area within each of two city counties. Collected data supports a comparison study conducted between these areas contributing to an understanding of different kinds of villages and house configurations, spatial organisation, and local population's

lifestyle. In order to fulfil a purposeful selection of the villages as case studies, some criteria have knowledgably been defined according to the aim and objectives of the research (Cresswell, 2007). Those four villages that meet all of the criteria have been recognised and selected. The Criteria for the selection of villages as a case study are mentioned below.

4.4.1 **Size and scale;** It has been defined in terms of scale and size by Alexander (1977) that a neighbourhood is the small size of people 500 to 2000 who can identify and agree communal goals and then pursue these goals actively and efficiently. This number of people has also been defined as a local community (Moughtin, 2005). This definition relates very closely to the characteristics such as size, population, and cultural situation of the villages in Mazandaran, which case studies have been selected based on this definition.

4.4.2 **Containing rice fields,** villages must be located besides a rice field, which means that rice farming is one of their main occupations. It needs to be said that the size of the rice field is not the subject of this research.

4.4.3 **Distance to the city;** villages should not be close to the city and must be located at least 15 kilometres far from the main city defined by road access. Some 'new towns' have just emerged and were defined by the government less than 10 years ago. These new towns increased in population size while their lifestyle is still generally and traditionally rural and they do not have considerable impact on the surrounded villages. Distance of the case study villages to these new towns has not been considered.

4.4.4 **Lifestyle,** traditional lifestyle and transitioning life style[1] with gradual speed over time must exist within the villages.

4.4.5 **House style,** vernacular houses and new modern style, which are being occupied must be found in these villages. Vernacular houses are those constructed with local natural materials, vernacular technologies, and rules. New modern style houses are those that have been made or are made by new modern materials and technologies such as concrete and steel.

4.4.6 **Importance;** Villages should be selected that have higher status between other villages including architecturally, economically, religiously, industrially, officially, and historically.

4.4.7 **Distance to the main road;** Villages have should be close or adjacent to a main road, which connects most of villages and no more than 10 to 15 minutes walking or 1 kilometre distance by road access.

4.4.8 **Containing traditional religious buildings;** Traditional religious buildings are a sign of the importance of a village within the region of the study.

1: A kind of lifestyle, which is changing towards another style but still has not been changed completely. In this region it is traditional lifestyle which is moving to be modern but still is struggling.

4.4.9 Containing a sacred tomb[1]; the building of a tomb is usually a sign of a village's importance and antiquity.

Using these criteria, a process for selection of villages as case studies has been arranged. At first, a list of all of villages located within two city counties of the study (Babol and Sari counties) has been provided with some statistical data about them including their population, mode of transportation, access to the internet, containing religious building, the male and female population, literate population and the level of education, the numbers of houses based on defined size ranges in square metre, population of employed and unemployed people, and location of work place whether in the same village, other village or within a city have been extracted from the Statistical Centre of Iran (2013) about villages in Mazandaran issued for the year 2012. This list has been filtered in seven steps using the defined criteria, of which the result of each stage has been described below.

4.4.10 First stage: Shows all villages located in different parts of Sari and Babol region, which includes 1159 villages.

4.4.11 Second stage: Sacred tomb is a sign of the historical age of a village and a sign of the importance of that village amongst others. At this stage, those villages that do not have this kind of building have been eliminated from the first list and the result has been shown in second list differently for two city regions.

4.4.12 Third stage: The focus of this stage is on geographical situation. According to the definition of the Statistic Centre of Iran (2012), number (1) is the sign of the flat plain area, number (2) is the sign of a mountain area, number (3) is the sign of the boarder of the forest area adjacent to the flat plain area and number (4) is the sign of the forest area. In this stage, based on the defined criteria for this research, the rice fields are found only in 1, 3 and 4. All of villages located in mountain areas, where there is no rice field, have been eliminated from the previous list as well as flat plain areas, which this type of areas are not the focus area of this study. The result of this stage is shown in third list differently for both city regions.

4.4.13 Fourth stage: Based on the defined criterion in 4.4.1, related to the size and scale of the village, the third list has been filtered. The villages with population of between 200-2000 in the forest area and border of the forest remained in the list while others have been removed from third list.

4.4.14 Fifth stage: This stage involves undertaking more research on the villages remaining in the fourth list. The previous list has been filtered according to the

1: Sacred tomb is the grave of one sacred or respectful man that a building usually is constructed on the grave as monument and memory where locals go there for pilgrimage.

criteria of 4.4.3, 4.4.5 and 4.4.7. Accordingly, those villages who do not meet all these criteria have been removed.

4.4.15 Sixth stage: Villages meeting the criteria of 4.4.9 remain and are included in the sixth list, while others have been eliminated from the fifth list.

4.4.16 Seventh stage: Based on criteria number 4.4.4, the sixth list has been filtered and the resulting lists have been presented separately for different areas of the study. related to two city counties, which the last village have been selected between them based on criteria numbers 4.4.8 and 4.4.9.

4.4.17 Eighth stage: Villages at this stage have been scored based on criteria numbers 4.4.8 and 4.4.9 to indicate their important prominent characteristics in comparison to each other. Scores are chosen numerically from 1 to 5, of which 1 indicates least importance and 5 indicates most importance. Official importance is identified based on existence of public official, educational, sanitary, public bath and telecommunication buildings according to data issued by Iran Statistic Centre (2013). Religious importance has been achieved by telephone interviews with some elite people from each district based on question of which village is the main destination of people from other villagers and each district for the purposes of pilgrimage[1] and mourning demonstration during Moharram[2]. In addition, through content study focusing on culture and folklore characteristics in Mazandaran, the special characteristics of a village have been explored (Kiani Haji, 1997; Mahjorian, 2006). Content study using different sources was the main method used to identify historical importance (Barzegar, 2003; Eslami, 1994, 1998; Koulaeeyan, 2006; Kenari haji, 1972; Kiani Haji, 1997; Sotode, 1966; Marashi, 1984; Saleh, 1997). Architectural importance has been elucidated by pre-field studies. In addition, a village, which is more distant further away from road, gains a lower number and villages that are closer to the road get a higher number. Those villages with higher number have been selected as case study.

As a result, the village ***'Diva'*** has been selected from the forest border of Babol County, and from the forest area of this county, ***'Firozjah[3]'*** has been identified. For Sari County, ***'Osa'*** has been selected from the forest border and ***'Vareki'*** from the forest area, which they have all been highlighted in the figure 4.10.

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[1] : Pilgrimage because of sacred tomb or places

[2]: '*Moharram'* is the name of Arabic month, Shia Muslims mourn specially during first 10 days of this month for one of their Imam, Hosein-ebn-e-Ali, who has been killed in this month around 1400 years ago. This custom has religiously very prominent position within Shias and in rural districts of Mazandaran, people usually go to other village, which is bigger or has better situation in group while mourning.

[3]: This village has different names, Firozjah, Firozja, and Perija, which the first one is quite frequently used formally and the last one is used by locals. Both on these names are used within this research.

It should be mentioned that the first villages selected as case studies in Sari County were 'Varand' in the forest area and 'Pilekoh' on the forest boarder. However, a field trip established that they are not suitable as a case study based on defined criteria, as they did not have proper vernacular houses and in Pilekoh there were also no rice farms. All villages have been re-scored, which accordingly the outcome was selection of another villages as case studies for Sari County.

Required data necessary for this research are those, which can help to pinpoint 'systems of activities' and 'systems of settings' in both village and dwelling scales. This is based on finding who does what and where, when, why and how (Rapoport 2006a P20, 2006b p189, and 1980 p16). This made studying dwellings as the main topic of this research, which shaped the main part of this research.

4.5 Criteria for the selection of houses as samples

Choosing houses as samples is one important stage of this study towards collecting appropriate and relevant data to achieve the aim and objectives. House samples have been processed based on a purposeful sampling strategy (Cresswell, 2007) by defining the criteria according to aim and objectives of this study. Samples have been selected from different common types of houses to inform the research about past and current rules and characteristics of housing, this also provides fundamental information for the conduction of a comparative study, finding the interior and exterior physical characteristics of the houses, lifestyle, and different types of housing taste of the region. Samples of dwellings have been selected on the following criteria;

- Locating different parts of the village, within different neighbourhoods and with different distances to rice field(s)
- House size and class based on economy and income.

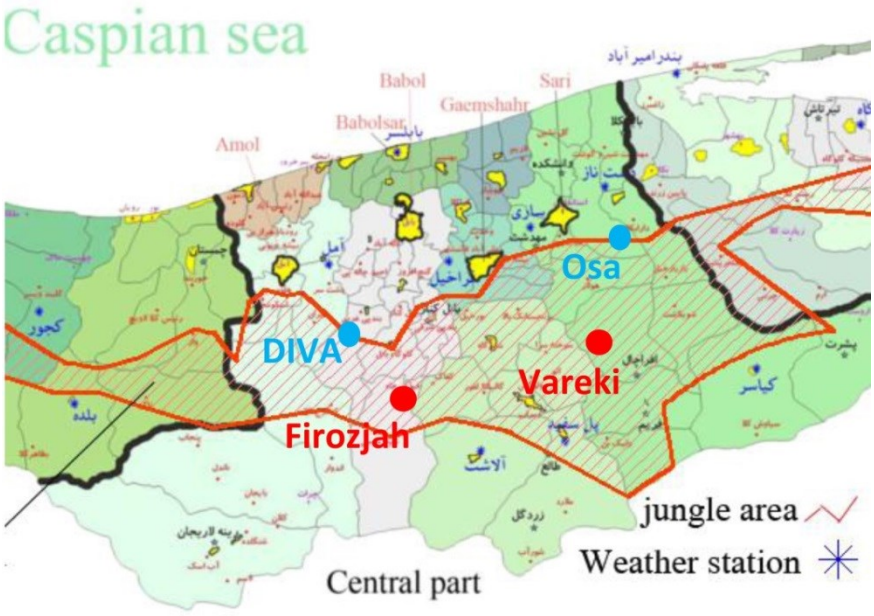


Figure 4.10: Location of four selected villages as case studies

- A consideration of a variety of house styles; new modern, middle and vernacular style of dwellings[1]
- From different types of architectural details and decoration, connection and distance to a main road of the village and the village centre.

Based on the defined criteria, a total of 44 houses have been selected within four case study villages. 16 houses are located in '*Diva',* of which 10 are of vernacular style, 3 of them are in middle style and 3 others are in new style. In '*Firozja*', 10 houses have been selected, of which 6 are vernacular, 2 are middle style and 2 others are new. 8 houses have been chosen in '*Osa*', of which 5 of them are vernacular, one middle style and 2 of them are new style. In '*Vareki*' 10 houses have been selected which 8 of them are vernacular, and 2 new houses have been

[1] : Vernacular style of houses is those constructed by local natural materials, vernacular technologies and rules generally belong to the time before the change of the government in result of revolution in 1979. Middle style is used as a name for those houses which constructed by employing a combination of new and local materials such as fired brick, and concrete for walling and wood for roofing, using load bearing wall as for their structure system and generally designed according to vernacular housing rules in one story high and usually belong to the time after revolution until 1988 the year of ending of the war between Iran and Iraq. Houses which are constructed with new modern materials such as concrete and steel specially employed in structural construction according to modern technology of construction are called new modern style of dwelling. They have been or are constructed differently regardless from application of vernacular rules, lack of consideration to climate and sustainability and most of them are more than 2 stories high prevailed after the war until now.

selected; this is because most of the houses were vernacular and new style was less common and no middle style house has been found in this village.

The result of studying these houses is the definition of the different typologies of different dwelling styles, in order to undertake in depth formal insight and compositional analysis in relation to building scales. The typology undertaken with this research has its origins in the developed methodology proposed by Van Leuse (1996). This methodology has been improved and changed by achieved results from the data collection in order to be more appropriate for this study, which is explained in chapter 9.

4.6 Details of methodologies for Data Collection & Record

In order to propose a new generative model, this research needs to gather necessary data from case studies and sampled houses through cultural, social, climatic and architectural studies. This data is associated to both village and house scales. The data listed and mentioned below is general information about each case study village related to both scales essential for the purposes of the study.

4.6.1 General data related to case study village

- Demography; Population, numbers of families, numbers of literate people, level of education, numbers of migrated people, access to the internet.
- The situation and stage of accomplishment of 'guidance plan[1]' prepared from housing foundation.
- Modes of transportation and distance to the main regional city or village based on the access road and times according to different modes of transportation.
- Main occupation and activities related to food production, the additional occupations (traditional and new), average income and expenses.
- Cultural, religious or other background and events and their performance in village scale.
- Gender's and different age's activities, territory and activities in village scale.
- Village management, problem solving process, security, and safety situation
- Main fuel consumption and their preparation
- Water resources, waste water, hygiene situation, all kinds of waste disposal and pollution.

1: Guidance Plan is development plan mainly physical development for villages and houses of those villages, which is set up by Housing Foundation of Iran.

- Identification and distribution of old, middle, and new houses.
- Local micro-climatic condition, nature and environment, and natural resources (vegetation, soil...) especially building materials.
- Deficiencies, problems, and difficulties in villages, and new demands and wants of residents
- Formal climatic data related to two counties and four districts of the study.

This data is used in part 3 for data analysis at the end of the research and some of them are used as base data for conduction of other steps of data collection. Required data related to each sample house in property scale is arranged specially in order to find out 'systems of activities' and 'systems of settings', this general collected data about each sample house is listed below.

4.6.2 General data related to sample properties and dwellings

- Number of families and population live in the house.
- Density of people in house and site scales.
- Means of transportation of the family within the village
- Machines for agriculture or other production activities
- Deficiencies, problems, and difficulties in site scale of the house, and new demand and wants of resident.
- Fuel, water, wastewater, trash and the house for different purposes

4.6.3 Data related to the property (dwellings' site)

- Site plan (area and size) and section, Figure and ground, open and closed spaces and related activities
- Relationship to the neighbourhood, neighbour site, street and its location.
- Relation to the climate and environment
- Cultural, religious, or other background and events occur in dwelling scale.
- Percentage of built area
- Gender's and different age roles, territory and activity in site scale –grouping and segregation.
- Activities in site scale and particularly the pattern of open space use.

4.6.4 Dwellings and other important structures

- Plan, section, and elevation of each sampled house.
- Number of rooms, sizes, and area of the house and its rooms (old and new addition).
- Material of different components and means of their preparation
- Construction technology and details

- Craftsmanship and labour system.
- Architectural details and decoration
- History, all changes, and changes over time of each house.
- Furniture and the way of using rooms and other components
- Activities in house scale within each space.
- The pattern of use of spaces
- The place and the tradition of entertaining guests
- New demands and wants of the shape of the houses
- New spatial condition demands and local wants rooms related to space pattern.
- Relationship to the site and other components
- Relationship to the climate and environment
- Relationship to the neighbour and street and its location

Accordingly, the nature of data is different from each other and they belong to different categories, which because of that, a single methodology has not merely been employed during conduction of field trip in this research. Rapoport (2006a, 2006b, and 1980) argues that understanding and finding out 'systems of activities', which the members do within 'systems of settings', must inevitably be the priority before starting any action toward designing any kind of buildings particularly houses, which need exhaustive research. In order to obtain this aim, he does not propose any methodology through his literatures, while Wike (1990) argues that the full range of methods should be employed simultaneously on understanding of the build environment especially its relationship to social and cultural issues. Some methods of this include; following people for a short period, observing their behaviour, which Kent (1984) proposes is possible only for a small number. Self-recording methods coupled with observation as supported by Wilhite and Wike (1987) can help define actual behaviour for a larger sample, though some detail is lost. The participant observation and interviewing employed by Rodman (1984, 1985) for cultural study can be useful for understanding the meaning and result of activities, but it does not tell us very much about actual behaviour or the process of that.

In addition, there is no single way to conduct case study research, a combination of methods is advised (Sommer & Sommer, 2001; Creswell, 2007). This has been the structure of the methodology used for this research combining, different methods according to their advantages in order to obtain comprehensive

information and reliable data. There is no full methodology for conduction of cultural study. Besides that, employment of one single methodology for this comprehensive research is insufficient and inefficient; therefore, the best methodology that could be supportive and fruitful is use of a combination of the whole range of useful methodologies applicable for cultural studies.

4.6.5 Techniques and methodologies for data collection

Various kinds of methodologies have been recognised appropriate for data collection, this has achieved after studying their efficiency based upon the nature and aims of this research.

4.6.5.1 Questionnaire

Many of the older residents living within the region of the study are illiterate, and so it is nearly impossible for them to complete any kind of questionnaire. Most of the residents think all researches are working for governmental reasons, this makes them reluctant and uninterested and so are not reliable participants. It is also the case for literate and educated villagers who are not eager to fill out the questionnaire, and so it was useful for the questionnaire to be filled by the researcher in conversation with the village's member as a 'structured interview' (Gilbert, 2001; Wang & Groat, 2002; De Vaus, 2002; Silverman, 2000, 2001). This method lets the researcher convince the respondents to answer carefully by increasing interaction with them, which in turn raises the respondents' trust to the researcher. This made answers reliable and obtaining correct data more possible. Besides that, the researcher had the opportunity to elucidate each vague and unclear question for respondents.

Four different questionnaires have been set up aiming to find out different types of data, all shown in appendix 2. The questionnaire 01 concentrates on obtaining relevant information related to the family. It includes; number of families and people, their gender, age, level of education and literacy who live in any sampled house; mode of transportation to the city and around their villages; which machines are used for agriculture or other production activities; main occupation

and average monthly or yearly income and expenses of the family, main fuel consumption for heating, cooling and lightening, methods of human, animal and garden waste disposal and some information about the house such as year of its construction or age of the house, who designed the house and method of construction according to use of labour and craftsman, approximate cost of construction at the time of erection. The questionnaire has been employed as the main guideline for structured interview. Two types of open-ended and close-ended questions have been set up, which the optional answers have been ticked or noted within the forms of questionnaires by the researcher.

A total of 44 houses have been selected as samples for this study. For 38 of them the questionnaire 01 aiming to collect general information about different types of the houses and their occupants has been employed. It has been completed within 4 villages that had been selected as case studies. Twenty-seven samples of houses are vernacular style (73.5%), three of them are middle style (10%), and seven samples are new style (18.5%). Their distribution within 4 different villages is represented in tables 4.1, and figures 4.11 and 4.12 representing two pie charts.

Table 4.1: Distribution of house types within four different case study villages

House Type	Name of the village				Total
	Diva	Perija	Vareki	Osa	
Traditional	10	5	9	4	28
Middle	1	1	0	1	3
New style	2	2	2	1	7
Total	13	8	11	6	38

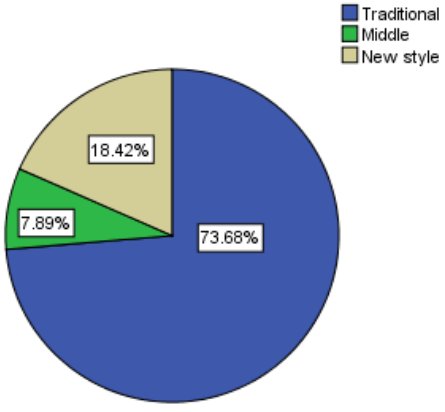


Figure 4.11: Percentage of different selected house type

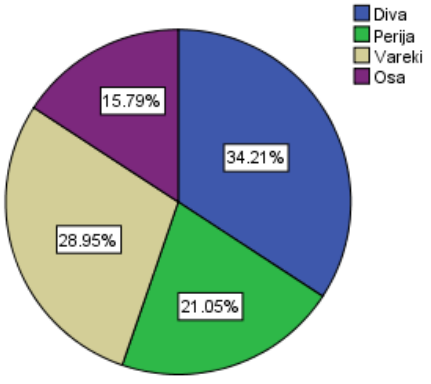


Figure 4.12: Percentage of different selected house type within four case study villages

27 respondents were male (71.1%) while 11 (28.9%) were female respondents. Around 86 % of the respondents were married (33 person) while just one respondent was single (2.6%) and 4 of them (10.5%) were widowed. 23 male respondents were husband and 3 of them were sons. In terms of female, 8 and 3 of them were wife and daughter respectively while just 1 was the bride of the son of the family living in the separated house but within the same land (table 4.2).

Table 4.2: Marital status of respondents

Marital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	1	2.6	2.6	2.6
	Single	33	86.8	86.8	89.5
	Widow	4	10.5	10.5	100.0
	Total	38	100.0	100.0	

Fourteen of respondents were over 75 years old (36.8%) and 11 (28.9%) were 55-74 years old while just 6 and 7 of them were 35-54 or younger respectively which are less than the amount of respondents over 75 years old indicating that the young population is lower and villages contain an older demographic (table 4.3).

In terms of education, the main group of respondents around 34.2 percent finished 'primary school' and did not pursue further study any more. 21.1% of them are literate, merely sufficient to read Islam's holy book 'Quran', and 5.3% have been educated following the 'literacy movement plan' implemented by the government in which the level of literacy is usually lower than primary school. These three groups mainly belong to the old generation, while 18.4% of respondents have attended high school, according to the age information these-

Table 4.3: Frequency and percentage of respondents' age group

Age group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	35-54	6	15.8	15.8	15.8
	55-74	11	28.9	28.9	44.7
	0ver75	14	36.8	36.8	81.6
	Under 35	7	18.4	18.4	100.0
	Total	38	100.0	100.0	

-respondents belong to the younger generation. Some respondents finished 'university technician' degree, and 'university Bachelor' 2.6% for each. One of the respondents was an Islamic priest (table 4.4).

Table 4.4: Frequency and perception of first questionnaire respondents'' educational level

		Frequency	Percept	Valid Percept	Cumulative Percept
Valid	Literacy movement	2	5.3	5.9	5.9
	primary	13	34.2	38.2	44.1
	guidance school	1	2.6	2.9	47.1
	high school	7	18.4	20.6	67.6
	University Technician	1	2.6	2.9	70.6
	University Bachelor	1	2.6	2.9	73.5
	Can read Quran	8	21.1	23.5	97.1
	religious science	1	2.6	2.9	100.0
	Total	34	89.5	100.0	
Missing	999	4	10.5		
Total		38	100.0		

30 respondents (around 79%) were permanently living within the village whilst 28 were originally from related village and just 2 of them were not originally from that village. A few respondents (8) moved to the village temporarily during weekends or the summer, whilst only one of them is not originally from that village (table 4.5).

Table 4.5: Information about the origin and living place of first questionnaire respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I am originally from this village and live here **permanently**	28	73.7	73.7	73.7
	I am not originally from this village but live here **permanently**	2	5.3	5.3	78.9
	I am not originally from this village and live here **temporarily**	1	2.6	2.6	81.6
	I am originally from this village but live here **temporarily**	7	18.4	18.4	100.0
	Total	38	100.0	100.0	

The answers of this questionnaire have been transported into SPSS[1] software, and have been used as the source of evaluation and explanation of the studied environment. The results of analysis are represented and summarised within different types of graphs and tables.

The questionnaire 02 represented in appendix 2 is actually a self-questionnaire and it attempts to assist recording quantitative information about 44 selected sample houses including materials of different parts of the house, and employed construction technology. This questionnaire is a matrix table, in which its rows are dedicated to the name of different probable materials, and columns bear the name of the house components. The relevant squares have been marked by the researcher. They have been summarised in three different tables representing the relevant information concerning different materials and construction technology used in the construction of different styles of sampled houses using excel software. The result of this questionnaire provides statistical and quantitative information in order to get an overview about construction tradition within the region of this study. It should be noted that the detail of different joints and components of the houses have also been sketched, pictured and drawn, simultaneously aiming to get complete knowledge and conduction of beneficial analysis.

The concentration of questionnaire 03 introduced in appendix 2, was to establish the main opinions, demands, tastes and values of local residents about the house organisation, space configuration along with having a glimpse on the form of new houses. It should be noted that obtaining an overview about locals' opinion on construction materials and technologies are not a priority of this questionnaire. This is the most important questionnaire of this research, supportive to obtain necessary criteria based upon user's opinion and wants. These criteria are used for evaluation of extracted compositional rules towards defining a set of appropriate rules for generation of new alternative designs. This

[1] : Excel software also could be employed for this objective but the software SPSS has the stronger ability to analyse, compare and test the results.

questionnaire has been employed during 48 focus group structured interviews, and structured one-on-one interviews, completed through conversation with respondents. The response to each main question is rated on a five-point opinion scale: Strongly agree, agree, neither, disagree, strongly disagree, and do not know.

48 people have been asked to answer this questionnaire, and their answers have been filled out by the researcher. 16 respondents have been selected from Diva, 14 within Vareki, 12 within Perija, and the fewest respondents live in Osa, which is smaller in square area and population than other villages. 23 of questioned sample were male, 18 of those were husband of the family, four were sons, one was a relative, and the remaining 25 were female, 18 of those were wives of the family, 3 were daughters and 3 were relatives. Most of the respondents (42 or 87.5%) are married, just one is single, and one is divorced while 3 are widowed (fig 4.13).

Most respondents (35.4%) belong to the age group between 35-54 years old and the second most respondent group are 55-74 years old (27.1%) which means most of them are in middle age or slightly higher. Less than 15 years old has not been interviewed in this questionnaire at all, just one respondent (2.1%) belongs to the young age group 15-24 years old, however 19% of respondents are 25-34 years. 16.5% are over 75 years old which means the second asked group are quite young (fig 4.14).

Most of the respondents, totally 58%, are mainly above 35 years old are illiterate or with low literacy educated the 'Literacy movement program' or having finished primary school, or have not been educated in the modern education system and have been traditionally educated to purely be able to read the holy Quran. As for the remaining respondents, most finished high school and a few of them finished the guidance school. 3 respondents (6.3%) graduated from university with bachelor degree.

79% of respondents were permanently living within the village whilst among them 73.7% were originally from related village and just 5.3% of them

migrated to this village and originally are from other villages. A few amounts of respondents, 21% of samples live within the village temporarily during weekend or summer whilst just one of them is not originally from that village.

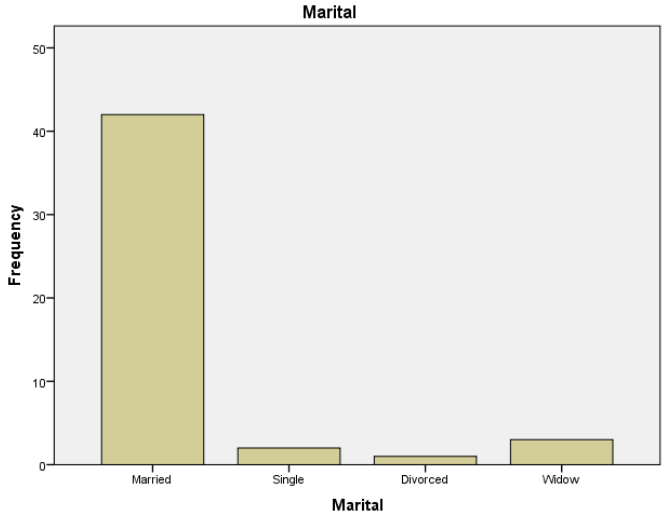


Figure 4.13: Graph showing marital status of respondents to third questionnaire

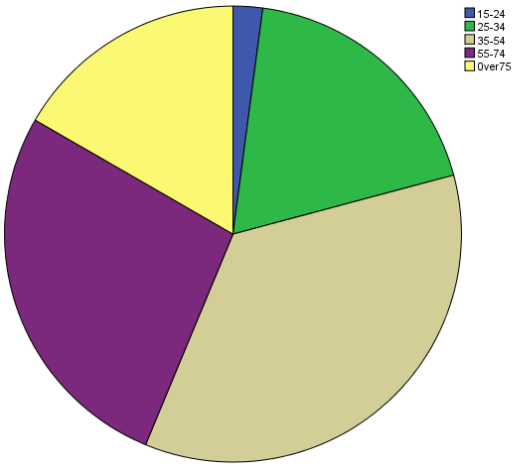


Figure 4.14: Age group information of respondents to the third questionnaire

The responses have been processed using SPSS software, and the results have been summarised and represented through graphs and tables produced by SPSS. The produced data has also been analysed by SPSS software to find out a probably potential relationship between questions such as correlation between age of respondent and some questions or correlation between some demands. The result supported identification of new form demands of local population, which need to be considered when designing new dwellings and importantly these

results provide some authentic criteria for evaluation of identified compositional rules.

Questionnaire 04 in appendix 2 has been designed based on theory of 'culture as a model system' proposed by Rapoport and inspired by a method proposed and employed by Canter and Tagg (1980) created for the purpose of identification of activities and their probable occurrence settings, which is the pillar part of this research. Indeed this method offers understanding of 'systems of activities' within systems of home settings. Canter and Tagg (1980) argue that this method could lead to predictions of the nature of lifestyle and reaction to original house design. Their proposed method has been modified due to the specific conditions of this research.

This questionnaire is actually a matrix-like table containing rows and columns. Based on earlier research, observing and interviewing about different activities of residents, a list of all activities has been drafted, which could be added or removed during the field trip study. The drafted activities have been differently noted within the first boxes of the column in the left side of the table while the rows were left blank to be completed when doing the main stage of field trip research. After asking the residents of the 44 sample houses about the name of different spaces of their houses, the blank rows have been filled noting the name of the different spaces and rooms of that particular house. Then all over 18 years old members of the family have been interviewed through 'focus group interviews' to find out which activity mentioned within the table they do within which space of the house. The answers have been ticked in the relevant box by the researcher himself. In addition, the group has been asked to discuss and indicate which activities they participate in according to different times of the day and year and what do they do within each space and in which particular part of that room or space; these answers have been noted down along the margin of the table. The result of this interview facilitates understanding which 'systems of activities', all family members do and which 'systems of settings', they composed within their

dwellings. This is one of the most important objectives of this research, resulting in being able to design new alternatives accordingly.

It should be noted that answers and discussion related to all kinds of questionnaires have been noted on the paper along with recording the sound on a digital electric device. These recorded sounds have later been transcript, and in some cases the layout of settings has been sketched on separate papers showing the settings of activities during that particular time of observation and interview using some symbols inspired from 'behavioural mapping' methodology (Madden, 2008). Questionnaires of this research due to the different types of required data, employed both types of closed and open ended questions. Closed ended questions are more to let the researcher obtaining the most and exact answer within less dedicated time, which also is easier to be coded during data analysis. The participants have been selected from residents of those houses that have been selected as samples because of easy accessibility to the respondent and having related data to the measured, studied houses.

Recorded data from the questionnaires have been used in producing graphs, tables and charts for analysis. Results of these analyses reveal cultural and social issues of the region useful to evaluate compositional rules towards introducing suitable rules for current lifestyle of the residents.

4.6.5.2 Interview

As this is an assured and credential method in architecture (Wang and Groat, 2002), two types of this methodology have been carried out for this research. One-on-one or individual interview in this research has been carried out with a local artisan master in vernacular house construction such as carpenters and masons who had the main role in designing and construction of all buildings of the village. They have been selected to obtain some information about vernacular architectural and structural rules, characteristics of the employed materials, details of their application vernacular process, and way of construction and construction management as well as some information about new and traditional

types of house design and construction. These masters have been identified and selected during field trip research as a consequence of asking the residents or gatekeepers[1]. Culturally, for engaging with these groups, the researcher had to be accompanied with a gatekeeper and a familiar female especially during interviews with female and family groups. The presence of the gatekeeper and a female researcher intensified locals' trust on the researcher.

Conducting separate interviews with individual people to obtain an activity network of different people within different house spaces, settings and rooms during different times of the day and years is very time consuming. It is also very obtrusive to encourage local population particularly illiterates and females to engage in the discussion and speak about their own personal private activities, which even would be interpreted as asking about their privacy. This kind of data was obtainable through focus interviews with family members as a group. This group was suitable for conduction of the focus interviews whilst sitting together with the gatekeeper along with a female for tea or dinner talking about which 'systems of activities' each member does within which 'systems of house settings' during different times of the day and year employing 'semi-structured' questions. The history of the house, daily activities, and occupants' perceptions of their homes, historical and contemporary social changes and physical changes of the dwellings were focus area of this methodology. It has also been the intention of this research to understand the residents new form demands for houses. According to this intention, the employed method performed supportive in understanding of what forms are preferable in new house design by rural residents and what characteristics they should have.

Residents of the selected case study villages usually organise specific groups according to age and gender in different parts of public areas of the village and no attempt is necessary for the researcher in order to organise or invite these

[1] : Gatekeeper is usually one of the residents of the village or originally from the case study village and residents usually trusts him. This person will be supportive in finding and defining samples and interviewee as well as giving some information that cannot be obtained from other sources (Gilbert, 2001; De Vaus, 2002; Silverman, 2000, 2001; Somer & Somer, 2001; Creswell, 2007).

groups for interview. The family members of each house that has been selected as a sample has also been chosen as a group intended for focus interviews. These groups have been interviewed to obtain information about how often they use these areas, which places of the village they usually choose for these activities, how long they stay in these places, participants are from which part of the village, and which activities they usually do in these areas. It should be noted that all interviews including one-on-one and focus group serve as a springboard for subsequent complementary observation and documentation (Wang & Groat, 2002).

Since residents of the villages are not familiar with a formal interview, both selected types of interviews were 'semi-structured', which offered better involvement for direct interaction. This strategy allows the researcher to move the conversation freely in any direction of interest that may come up and can operate as a useful tool to explore alternative opinions, attitudes or beliefs (Socialresearchmethod, 2014). Interviews within this research used open-ended questions because the possible answers are not known and this method lets the research collect the answers in the participant's own words. The probable broad responses can be categorised for ease of analysis (Somer & Somer, 2001; Guerin & Dohr, 2014; Creswell, 2007; Gilbert, 2001; Silverman, 2001, 2011). The discussion during both types of interview and any events has been noted during the focus interview on the paper along with recording the audio on a suitable digital electric device, which was able to record speech of all members within the interviews setting. Each of interviews have been transcribed and translated into English from local language. The transcript has been the base information for conduction of a qualitative analysis.

In total forty-seven interviews with different groups have been conducted along with 5 one-on-one interviews. Twenty focus groups have been conducted in 'Diva' village, in which ten interviewees were family members and five of them were the male group, two from the female group and two from mixed gender and one from the adolescent group. Within '*Firozja',* eight focus group interviews have

been undertaken including six with family groups, one with male and one with mixed group. Nine focus group interviews have also been conducted in '*Osa'*, in which six were with family groups and one with men, mixed gender and adolescent group each. Within '*Vareki'* ten focus groups have been undertaken including seven with family groups and one with men and two with female groups. In addition, five one–on-one semi-structured interviews have been carried out including three one–on-one interviews with two carpenters and one master mason in Diva, and two one-on-one interviews completed in *Firozja,* one with a carpenter and one with a shopkeeper.

The focus group interviews with family members were structured interviews based on the questionnaire to find out sufficient information related to the houses, which have been summed up and analysed through mixed method using SPSS and Excel software. One-on-one interviews were semi-structured to find out efficient and general information related to the village scale and to collect professional information about some expertise, which has been qualitatively analysed and coded to find out important topics, reasons and factors mentioned by respondents relevant to the aim and objectives of the research.

4.6.5.3 Observation

Observation has a key role in the study of public life studies (Gehl & Svarre, 2013) which has been used by most of researchers for the purpose of understanding and determining how people do their activities and behaviours in public places or how a built environment is actually being used (Gehl & Svarre, 2013; Gehl, 2006; Whyte, 1980; Madden, 2008). It helps the researcher to become gradually familiar to the cultural members (kawulich, 2005). Employment of different types of this method has also been carried out and is known in the field of architecture particularly for visual and physical studies. Observation is also a good method for understanding vernacular architecture around the world to identify their configuration and spatial organisation, construction technology and details, ornamental elements, and social, cultural, and economic issues (Oliver, 1987, 1977; Wang & Groat, 2001). This research carried out different types of this

method along with other methods to obtain comprehensive data. This method can provide good insights into how the different participants are behaving and interacting (Somer & Somer, 2001, Creswell, 2007; Gilbert, 2001; Silverman, 2001, 2011; Cohen et al, 2000).

The observation was 'semi- structured' because it could allow for issues to emerge from the observation and the issues are considered to be relevant to the evaluation. Because the researcher of this research has grown up according to the culture of this study and is a member of the region 'the direct observation' has been carried out. It offers unobtrusive research, helps the researcher to be more focused on the subject, and is useful in the collection of information independent of participant perception and the researcher can better focus on the events and subjects (Somer & Somer, 2001, Creswell, 2007; Gilbert, 2001). Direct observation supports this research to find out more information about; physical aspects of the villages and their configuration, different land use areas, public buildings, villages' residents various activities and events in different public settings during different times of the day and year within the context of the village, public buildings and rice fields; housing configuration and systems of settings of the dwellings, construction technologies and details, systems of activities within dwellings and residents' behavioural characteristics.

The data gathered based on direct observation in research has been recorded using; filed notes on the papers, sound tape, photography, free hand sketches and drawings, mapping and measurement, which some of them are recognised as a research method and are discussed further below. It should be noted that 'video tape' recording needs permission from the government, getting that permission is rarely achievable and also village residents are not interested to be filmed by a stranger, which would endanger the mutual trust between researcher and residents, these reasons make this recording method unusable.

4.6.5.4 Photography

'Photography' is generally used for historical research as a source of determinative evidence. It not only provides social context, but also often situates the topic in its natural context, which will lead to contextual evidence (Wang, Groat, 2001). In architecture, vernacular architecture and built environment studies, it has been broadly used for the purpose of making evidence and documentation of the environment, buildings and their different parts, for recording the data for later analysis, and is an essential part of public life studies (Gehl & Svarre, 2013; Madden, 2008; Wyhte, 1980; Oliver 1977, 1987). For studying public life, public areas and building, houses and different activities taking place within these houses, different space and parts of house buildings, this research employed a one-shot photography method with a digital camera to record data, documentation and also for later analysis and activities such as drawing maps of dwellings, buildings and public areas and details of their different parts.

4.6.5.5 Sketches

'Free hand sketches' were drawn on papers during field trip research. This is a suitable method for recording maps of public settings, houses, rooms, details of construction and decoration, places or furniture and things that have been used for measurement process. The sketched maps are used for drawing the exact and measured maps for later analysis and presentation of data. This has been used for studying and recording vernacular architecture all around the world (Oliver, 1987, 1977) and for teaching students to study vernacular architecture in order to use it as a model for sustainable design (Foster, Heal, Paradise, 2013). This method was beneficial for this research during data collection and for further steps and analysis.

4.6.5.6 Mapping and Measurement

'Mapping Physical Environment' is another way of recording the data related to public spaces, and buildings along with photography and hand sketches. It has been used to draw maps of the constructed dwellings, different buildings

within dwelling site, some valuable public buildings such as religious traditional buildings, and for drawing maps of some public open areas, which is highly essential for research on historical and vernacular buildings constructed with no map (Oliver, 1977, 1987; Zargar, 1998). This methodology has mainly operated to conduct further surveys on houses.

At first, the map of houses or every other buildings or subject have been sketched up on a paper by free hand. Then all components of that building, including different sizes of all rooms, thickness of the walls, height of the rooms and building, sizes of windows, doors and other components have been measured using a measure metal tape for small size components and a long measure fabric tape for bigger size. All sizes have been noted on sketched maps and a scale has been set up besides all parts of the building to be captured in photographs for further analysis and to rectify any assumed mistakes or emitted sizes and information. These measured buildings have been later drawn by computer using CAD software and have been processed using other computer software such as Photoshop.

The outcome formulated the main materials for later compositional, cultural, and climatic analysis of the built environments and houses through the framework that Shape Grammars theory provided finding space configuration and spatial organisation along with other physical characteristics of the houses. In this regard, at first a typology research has been conducted in order to provide different typologies of measured and mapped houses based on the methodology proposed by Van Lusen (1995) and criteria obtained through the research and analysis. The results of this stage provided pure materials to identify compositional rules that local population employed shaping their houses to be sustainable in respect to the regional climatic conditions and sufficiently efficient in respect to their lifestyle. This method has been operated for the purpose of mapping and 44 sample houses.

4.6.5.7 Document and content study

Document study is another type of study using some private, individual, or official documents to obtain required data. This research tried to obtain some information from documents of governmental offices such as the documents of 'Guidance plan' for each case study village and their precondition report, master map, and pictures from Housing Foundation of Iran. The content study has also been employed to obtain an overview about the history, cultural events and characteristics of the villages and their residents through studying some books covering various phrases such as historical, cultural and social topics (Creswell, 2007; Gilbert, 2001; Silverman, 2001, 2011). Consequently, document and content studies supported this study by providing an overview about the past cultural, historical, social, and physical conditions of the case study villages and housing traditions. They are important for conduction of the analysis to find out the social and cultural background of vernacular compositional rules and for evaluation of their efficiency for new lifestyle.

At the end, it should be added that 'Behavioural mapping' was a potential method for this research, which has not been employed. It can be used for data recording of activities, people and places and has been extensively used for conducting public life studies (Gehl, 2006; Gehl & Svarre, 2013; Wyhte, 1980; Madden, 2008;). It is an unobtrusive, direct observational method for recording the location of subjects and simultaneously measuring their activity level, which is efficient and useful when gathering, processing, analysing and representing data (Cosco, Moore, and Islam, 2010). This technique is usually used to indicate where people are standing and sitting (Gehl & Svarre, 2013), and for recording all types of activities, creating a comprehensive picture of the use of a place (madden, 2008). But it has not been used because the time for this research was restricted. In addition, it needed different cameras installed in different places, which was expensive, and more critically instalment of cameras in any place within public or private areas is against the law in Iran, the country of this research. Special permission was needed from the Government, which is highly unlikely. In addition,

occupants and village residents will oppose to instalment of any camera creating different unpredictable troubles for the researcher. Otherwise, it could be beneficial within some vernacular environments to gather proper data related to 'systems of activities' taking place within 'systems of settings' if all conditions are under control.

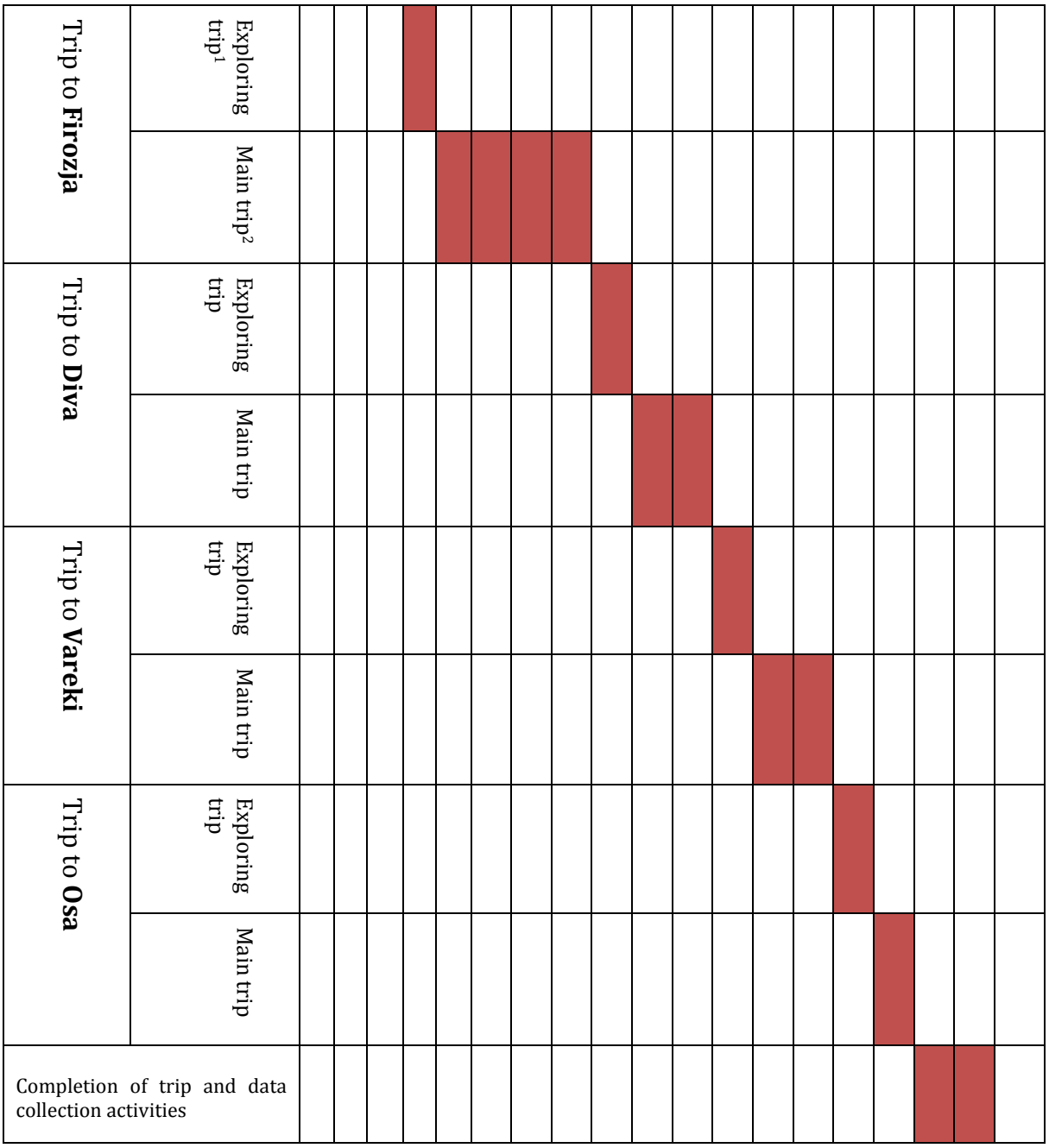
4.6.6 Data collection process

The proposed methodology submitted to the 'Ethical approval' office of the university and has been approved with the review number 'FO: 02/15 – 0087', which related documents are included in appendix 3. The process of data collection has been performed started form August 2014 lasted to 15 of December according to timetable of the whole research, which has been elaborated in detail through timetable presented within the table 4.6.

Table 4.6: The timetable and schedule for data collection

Month / Activity	August 2014				September 2014				October 2014				November 2014				Dec. 2014		
Planning for data collection and field trips	■																		
Content study	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Field trip to have an overview of the samples[1]		■																	
Data collection from official organisations			■																

[1] : This trip has been adjusted to have direct observation of the case studies finding out whether they are proper samples for this research according to the defined criteria, which in result two case studies that had been selected in Sari have been changed and two new villages have been replaced.



The research has been started from the most familiar villages providing the opportunity to test the selected methodologies in real circumstances and at the same time having the opportunity to obtain proper needed data towards

[1] : This trip has been arranged first to explore the detail of the village and to obtain an overview of the village, its streets, main square, public buildings, and houses to find appropriate houses as samples and to conduct the other research anticipated methodologies for data collection.

[2] : During this trip all of methodologies for data collection including; entering to the sample houses for mapping, measurement, and focus group interview, and other methods have been conducted.

improving the methodologies. This policy were very helpful to re-arrange the questionnaires in addition to do test the methodology, and useful for improvement of better communication and interaction with villagers towards identification of important and much essential data.

4.7 Research Outline

The research has been fulfilled through three years, 36 months from fist of February 2013 until 31th of January 2016 of fulltime engagement. The table 4.7 shows details of the various activities, the date, and the period of performances. It was prepared at the onset of the research and adhered to as closely as possible.

Table 4.7: Table showing schedule of activities for the research

Year	Month	Specific Activity
2013	February	Definition of the nature and content of study field in consultation with the supervisors
	March	Development of the abstract and background of the study
	April	Literature review, Book reviews and relevant essays
	May	Adoption of theories as base methodologies for conduction of this research followed by more studies on them
	June	Development of the introductory chapters of the dissertation
	July	Execution of pilot study related to different facets of the research, tested their validity for the research, and submitted at the end of six months for the supervisory team as 'annual appraisal' and obtaining more advice toward development of the achievements.
2014	August To January	Analysis and synthesis of data so far collected. Development of main chapters of dissertation and submission of package one through 'annual review' session and getting more advises from the juries.
	February To July	Further development of main chapters, conclusion of literature related chapters and preparation for field trip. Identification of criteria for selection of the region of the study and case study villages along with detail methodology for data collection in discussion with supervisors (stage two).
	August	Conduction of field trip study on location, Collection, and collation of data, Further development, and conclusion of aspects of main

	To December	chapter's corrections and updating the outcomes of aspects of previous performances in consultation with supervisors.
2015	January	Submission of field trip study report, analysis and sorting of field data, questionnaires, interviews and measurements of sampled houses
	January	Conduction of data processing and production including; Drawing all maps and physical details of sample houses, transcription of content of the interviews, importing data gathered from questionnaires and interviews into SPSS and Excel computer software.
	January To March	Submission of second stage including main chapters of thesis and summery of the process of data collection and data process accompanied with the future plan through 'second annual review' followed by further development in result of absorption more guidelines and advises from supervisors and juries.
	April To June	Conduction of data analysis including typology relevant to the sample houses, drawing tables and figures relevant to the data from questionnaires and interviews toward achieving the objectives of the research (Stage three)
	July	Beginning of conclusion and intensive research toward identification of the model
	August	Development of the model
2016	September To January	Revision of main chapters and final writing-up the chapter for final submission
	31th of January	Submission of the thesis to the University

The research includes three major stages or packages executed during each year, which are arranged in such a manner to assist the thesis write-up comprehensible and as logical as possible.

Stage *1: Literature review and problem definition;* this package has been designated for first year of the study, which is included of *Literature review*, mainly from February 2013 until January 2014. This was ongoing throughout the study reviewing articles, journal papers, books, PhD theses, all possible relevant literature related to rural architecture, urbanism, aesthetic and formal compositions in architectural design, sustainability at both the urban and individual building scale, ecological responses in building form, renewable energy systems, rural sociology, generative and computational theories for designing and analysing buildings such as shape grammars. Research techniques for stage 2 has been studied and recognised in this stage.

Stage *2: Data collection and field trip*; This part of the research has been achieved through second year of the study from February 2014 until January 2015 dedicated to data collection from the region of the study – this consists of three sections: Data collection, documentary study and interviews:

1) *Preparation for data collection: this has two stages including*:

First, Selection of region of the study and samples have implemented in this year: The region of this study is Mazandaran located in north of Iran. Completion of this research has been founded on conduction of case study research, which some appropriate villages must be selected. The process and methodology of this stage has also been defined and accomplished based on definition of some criteria during first year. Accordingly, villages in rice fields located in the forest and the forest border areas of the central part of Mazandaran have been selected, in addition to selection of houses as samples.

And secondly, definition of a methodology for data collection including preparation of format and number of questionnaires to be employed in the research, defining questions required for interviews and the methodology for recording these information, planning method for measurement and mapping of

sample villages and buildings have been defined in second year, which took three months.

2) Data collection

This stage took around 6 months and has been accomplished through field trip on site research and covered research investigation on the villages, communities and houses in relation to the architecture, culture, society, tradition and environment through conduction of all predefined methodologies.

Package 3: Analysis and conclusion; This package is included of analysis of data obtained from package 2, development of the model and writing up the chapters is achieved through third year started from February 2015 to January 2016 which was the due date of this research.

The data analysis includes two parts, 'Quantity analysis' including, codification, tabulation, and drawing graphs of information; and 'Qualitative analysis' including aesthetical, cultural, social, climatic, and functional analysis of samples. Results of this stage, the changes of house and life style, new form demands, ideals, concepts of locals and the basic rules of housing are thoroughly explored to understand how such rules can be applied in order to design sustainable new houses. An initial pilot study has been undertaken at the early stage using shape grammars to test its validity for new housing of the region of this study.

Development of a model of new houses for villages has been accomplished along with data analysis, which has led to the thesis and updating the model. The data process and analysis lasted for seven months, which accordingly writing-up of the chapters for PhD thesis and its submission have been implemented during 5 months.

Figure 4.15 illustrates the various main activities and packages of the research and shows how they relate to the actual dissertation. This may be considered as the framework on which the dissertation is based. All parts and chapters are consistent with this structure.

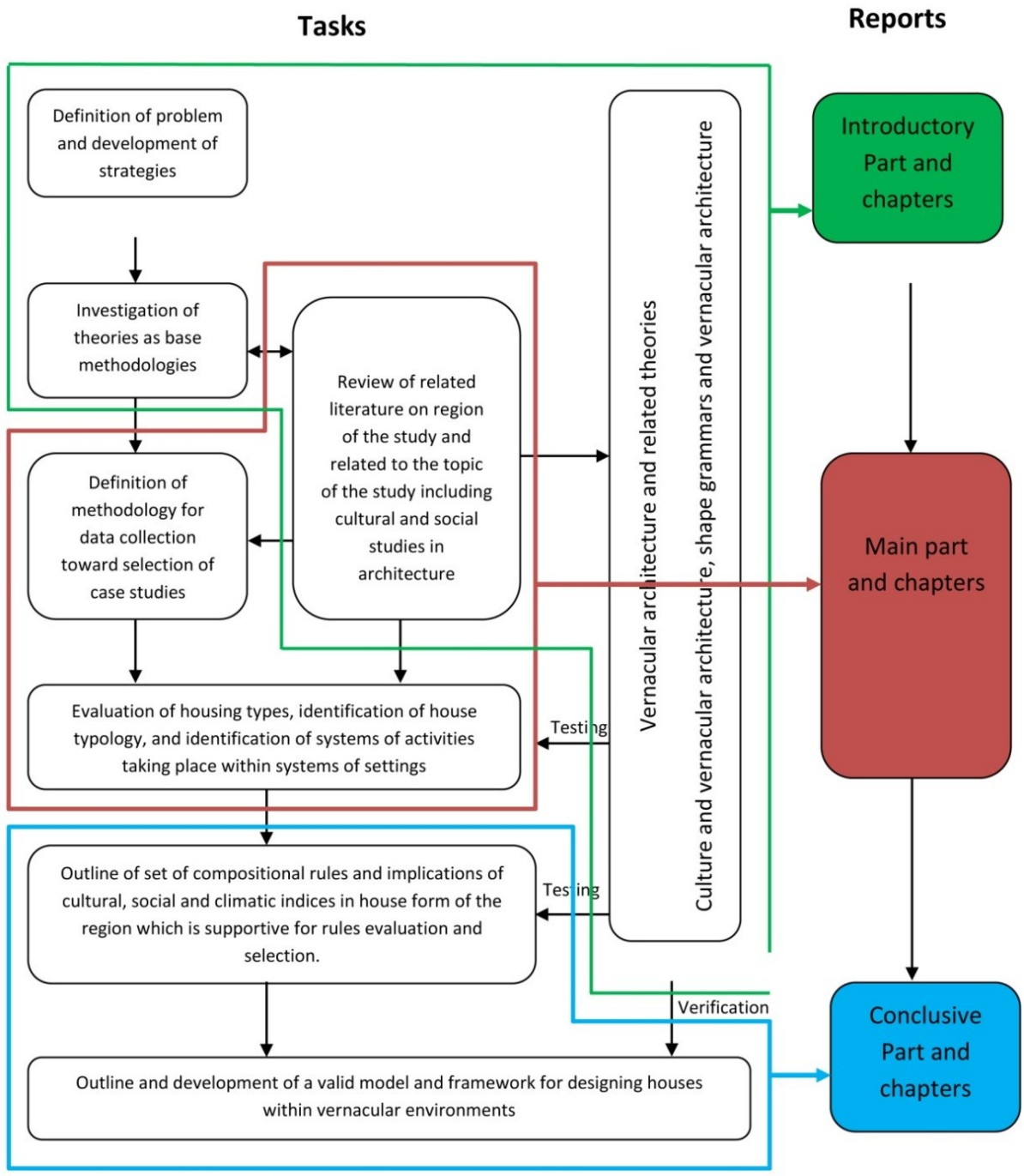


Figure 4.15: Schematic illustration of relationship between tasks and reports

4.8 Conclusion of part one

The main concern is that local lifestyles within the region of this study are changing dramatically from the traditional way of living to a modern lifestyle. The nature of the society of this region changed from being productive and self-sufficient to a consumer and dependent society. This evolution influenced the appearance and characteristics of vernacular architecture, the traditional style of housing and configuration of the settlements. In this regard, modern interventions and solutions did not pay any response to the vernacular architecture, tradition and culture (Rapoport, 2006a, 1980; Fathy, 1976), and no integrated research on this important topic has been achieved. Accordingly, the problem is that we still do not know how to deal with traditions and new impacts distinctively with new technology and sustainability, and with new form demands for houses according to interrelation modernity and globalization.

Rapoport's (2006b) methodology of using culture as a 'model system' is not a full methodology because of lack of consideration to physical aspects of the built environment, although this process is useful for this research specially for studying and understanding the culture. Studying vernacular settlement and houses with emphasis on culture is supportive for design of new alternatives. This needs to be improved related to physical aspects of build environment, which is possible by identification and application of compositional rule systems. Analytically, the understanding and definition of the language of existing styles of design, and definition of a compositional set of rules of a specific style, and application of them in designing new solutions are two main concerns of 'Shape Grammars' (Stiny, 1976), which is utilised as a methodology. The validation and acceptability of rules and clarification of needing new rules suitable for new lifestyles is evaluated by criteria resulting from cultural study.

Consequently, this research employed these two methodologies as theoretical based methodologies and combined them together to make a new model to provide an innovative and generative system for designing new sustainable solutions for the villages in the rice fields of Mazandaran respecting

cultural identity. Four villages have been purposefully selected from two different areas of the region and studied as case studies. Furthermore, a methodology has been designed based on deliberate selection and combination of different methodologies and techniques. Accordingly, essential data related to the settlements and sample houses gathered through five months of field trip study then collected data was sorted, processed, and analysed. The results of data analysis are the topic of next two parts of this research towards definition of the new model.

PART TWO

CHARACTERISTICS OF THE REGION AND VILLAGES

Chapter 5

Regional Characteristics and Responses

5.1 Introduction

Human habitation in Mazandaran dates back at least 75,000 years (IranMania, 2006). Recent excavations in 'Goher Tippe[1]' provide evidence that the area has been urbanised for more than 5,000 years, and this area is considered as one of the most important historical sites of Iran, which has played an important role in cultural and urban development within the country (Sadigh, 2007).

According to the Food and Agriculture Organisation of United Nations (FAO), evidence of rice cultivation in Iran dates back to 100 B.C. this process was brought by Indians who had migrated from India, they then trained local people with the relevant skills (Koulaeeyan, 2006). Domestication of rice production in Mazandaran was a milestone of human lifecycle and the faith of the region. It changed the local's nomadic lifestyle of residing in the mountain areas towards migrating and becoming settlers in two southern parts of Mazandaran; in the forest area and in the flat plain area adjacent to the forest area establishing an agrarian lifestyle (Koulaeeyan, 2006). A fertile natural environment is needed in order for rice to be grown successfully. This includes suitable soil conditions, abundant water supply, humid weather, and warm or hot sunshine. Due to these constraints, only the forest slopes and flat plains areas in Mazandaran are ideal places for rice production.

The complexity of the rice production process and various applications of the rice plant constituents include; seed, husk and stalk[2], these have become the main determinant factors shaping a specific agrarian lifestyle that leads the culture of this region. This agrarian lifestyle influenced by rice cultivation embodied the configuration of vernacular houses and the structure of villages in Mazandaran, which have also evolved in such a way that they are bound to the natural

[1]: This is supposes to be a human-made hill, which is located within rice fields in outskirt of Sari, the capital city of Mazandaran

[2]: Seed of rice plant is the main food of residents in this region and husk of it after threshing is one of the main forge of their domesticated animals like cow, bull, and sheep. In addition, the grained husk of rice seed after process in rice factory is even used for feeding the poultry. Remained stalk of the rice cluster on the field had been cut for buildings' sloped roof coverage in the past before the advent of iron sheet and other new materials for this purpose.

environment and have a distinctive beauty. This chapter illustrates characteristics of the vernacular 'home environment'[1], the configuration of dwellings and characteristics of associated neighbourhood within this region.

5.2 Location and Geographical characteristics

Iran is located in the Middle East and shares its borders with different countries such as Afghanistan, Iraq, Turkey, Turkmenistan (fig 5.1), while Mazandaran is a linear region located in the North of Iran between the Caspian Sea in the north, and Alborz Mountain along the southern side of it (fig 5.2). It is around 23.842-kilometre square area, approximately 480 by 100 kilometres (Mazandaran governor, 2013).

Figure 5.1: Location of Mazandaran In north of Iran

Three main car roads and one railway connect Mazandaran to Tehran, the capital city of Iran. The distance by road between Sari, capital city of Mazandaran province and Tehran is approximately 228.57 km to 248.45 km (equal to 142.02 miles to 154.38 miles). It takes around 4 hours by car or 7 hours by train. To do this, the mountain area must be crossed through both ways, which makes accessing this area longer from Tehran (fig 34). All of these accessing roads were constructed during Pahlavi era, particularly under the first king of Pahlavi, who

[1]: The word 'home environment' has been borrowed from Rapoport (1985) which according to his statement consists of home and neighbourhood (p.477).

wanted to make it easily for residents of Tehran and other parts of Iran to benefit from abundant resources of Mazandaran (Saleh Tabari, 2000).

This region is located between 35 degrees and 47 minutes to 36 degrees and 35 minutes of northern latitude, and between 50 degree and 45 minutes to 54 degree and 10 minutes of eastern longitude and is one of the most densely populated provinces in Iran (Statistical centre of Iran, 2015). There are around 14 major cities, most of which are located in the plain area and many of the rice fields and villages surround these cities. The four largest major counties are Sari, Babol , Amol and Qaemshahr and include towns and villages named by their major cities, and all of them are located in central part of Mazandaran (fig 5.3).

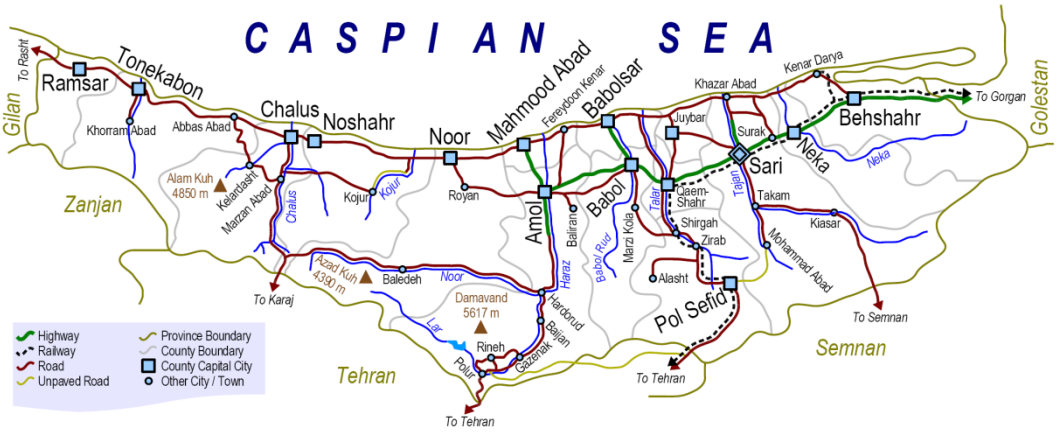


Figure 5.2: Roads connecting Mazandaran to Tehran and other provinces

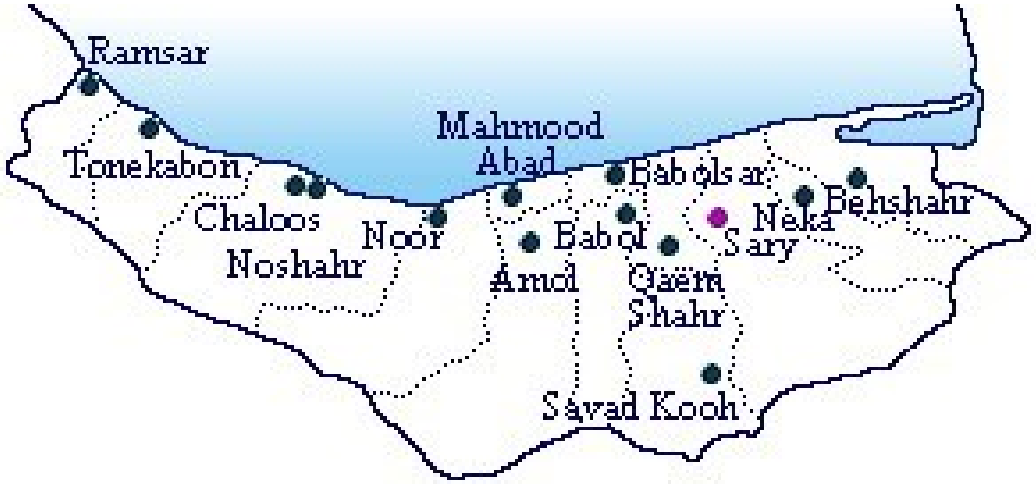


Figure 5.3: Division and boundaries of all counties of Mazandaran

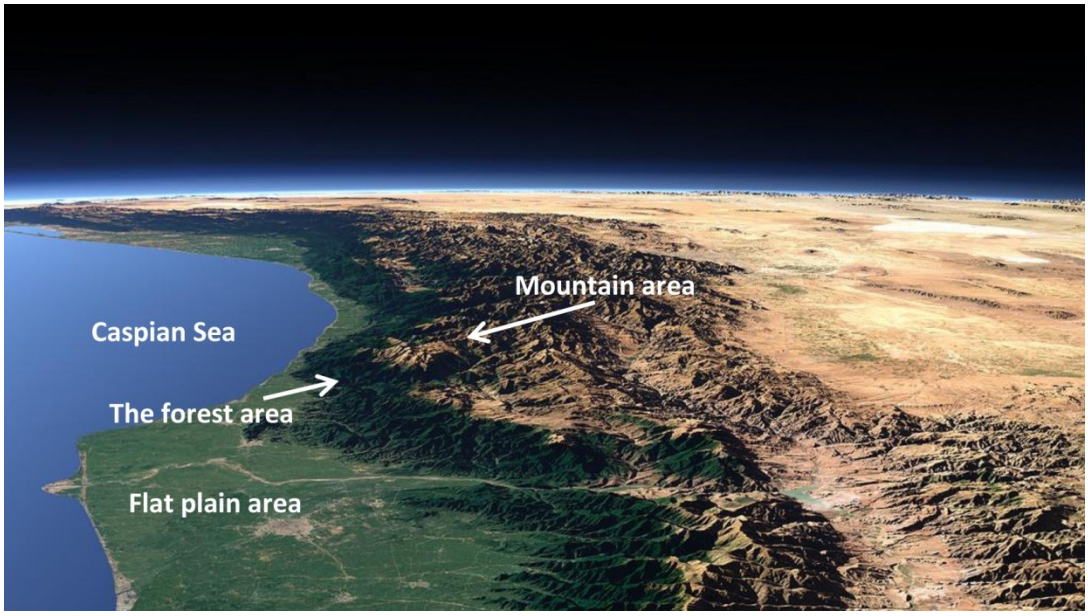


Figure 5.4: Three pars of Mazandaran including Flat plain, the forest and Mountain areas (Hormann, 2006)

From west to east, Mazandaran is divided to three parts including west of Mazandaran, central part, which is the oldest part of it, and east part (fig 3.2). They are culturally, climatically and socially distinguishable and are different from each other whilst retaining some similarities. In addition, Mazandaran is also divided into three parts vertically including plain areas in the north adjacent to the Caspian Sea, mountain area in south part along the southern boundary of the region shared with Tehran and Semnan provinces, and the forest area located between them (fig 5.4). Maximum distance from the Caspian Sea to the forest area of Babol County is approximately 40 kilometres in the central part and the minimum is around 200 meters in Nour County in western part where Caspian Sea and the forest area are actually attached to each other (fig 5.5).

5.2.1 Mountain area

Damavand, the highest summit of Iran belonging to Alborz Mountains, is located in Mazandaran at around 5610 metres above sea level. The mountain areas begin differently at around 2000 metres above sea level. All rivers and streams located down within the forest and flat plain areas originate from this mountain area (Siadati et al, 2010) (fig 5.5). The mountain areas are usually covered with different grasses up to around 4000 metres above sea level. This supported the establishment of the first Mazandaran living on running sheep husbandry, which

has been abandoned after domestication of rice cultivation aiming to find better places for rice farming (Koulaeeyan, 2006; Sotode, 1999).

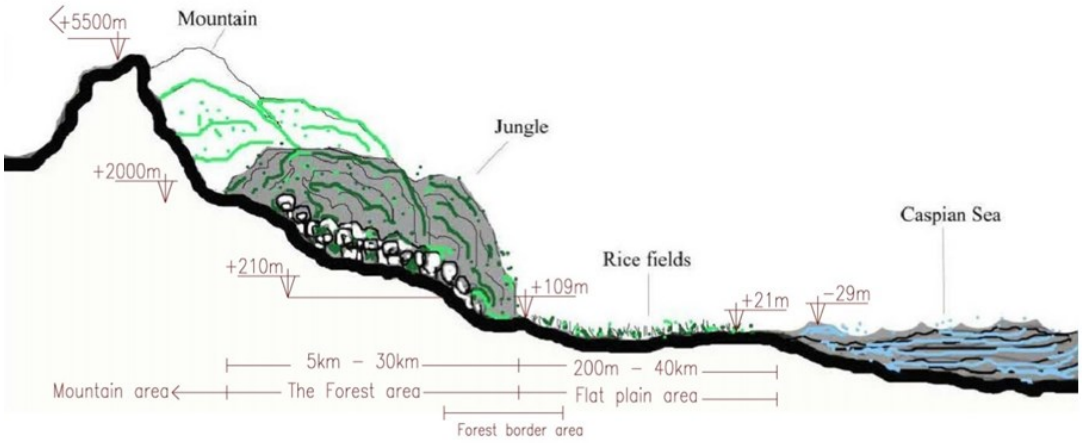


Figure 5.5: Lateral Section of Mazandaran showing different parts and their levels

5.2.2 The forest area

The forest area was the first destination for nomads living in the mountain area to become settlers. Specific characteristics of this area also let them establish a new lifestyle because of having fertile forestry soil, abundant water resources and climatic conditions suitable for rice cultivation. This area includes the 'Hyrcanian forest' which is one of the last remaining natural closed-canopy deciduous forests in the world (Naqinezhad et al. 2008) characterised by a Euro-Siberian flora unique to Iran (Siadati et al, 2010). This forest begins differently from around 100 metres above sea level extending to around 2500 metres above sea level across the province. It means that the forest area is literally a mountain forest. Villages within this area are located mostly on the hillside (fig 5.5). The location and form of these settlements and all buildings such as houses are influenced by natural sloped topography.

Villagers are self-sufficient, shaping agrarian lifestyles around food production, working on their rice fields and at the same time running animal husbandry, nurturing different domesticated livestock and poultries such as sheep, cow and bull, goose, turkey, duck, and chicken. They have also been employing different resources from the forest area for different purposes such as grass for animal forging and grazing, trees for construction of buildings and for engraving

cutleries and kitchen appliances and also wild herbs and fruits for food and medical purposes (Marashi, 1983; Saleh Tabari, 1999).

Some villages are located within the forest area next to the valleys, rivers. In addition, some of villages are located at the border of forest area at the foothills where the forest area reaches the flat plain area. In this case, the main part of the village is often located on the hill within the forest area and rice fields are located down on flat plain area by the riverside. All four case studies for this research are selected from these two areas, two from each.

5.2.3 The Flat plain area

The flat plain area was the third location to be established as a settlement area, this was decided due to rice cultivation. (Koulaeeyan, 2006). Flat land having alluvial fertile soil, warmer weather and most importantly water resources is the most appropriate and suitable land for rice cultivation, and so accommodates the largest populated area of Mazandaran. Major cities with large populations, are located within this area while, villages are scattered in the surrounding areas close to rice fields. Migration to this area evolved the agrarian civilization within the region and absorbed much of the country's population as it was adopted as their habitat (kolaeeyan, 2006).

5.3 Calendar and building activity period

The Iranian calendar is based on the rotation of the earth around the sun. Accordingly, a year has 12 months with different names and 365 days and is divided into 4 different seasons. The first month '*Farvardin'* is the first day of spring and advent of New Year, this day is 21st of March. Spring and summer months all are have 31 days, while autumn and winter months are 30 days long except the last month of winter, which has 29 days.

Rice farming starts at the beginning of spring and ends at the beginning of autumn. Therefore, farmers divide the year into two seasons, spring and autumn (table 5.1). The spring season includes spring and autumn and is the time of year for rice field preparation and the main rice-growing period, while autumn

including autumn and winter is the season for rest, companionships[1] and pilgrimage[2] according to the farmers' mentality. Traditionally, autumn is often a period when house construction takes place, as locals have no agricultural work and so have free time to do building activities. It should be mentioned that, as a result of access to new technologies and the change of lifestyle, the construction of house nowadays takes place all around the year.

Table 5.1: Different seasons and months of Iranian calendar and their accordance with Gregorian calendar

	Iranian month		
Spring	Farvardin	April	Farmers know these two seasons as **'Spring'**.
	Ordibehesht	May	
	Khordad	June	
Summer	Tir	July	
	Mordad	August	
	Shahrivar	September	
Autumn	Mehr	October	Farmers know these two seasons as **'Autumn'**.
	Aban	November	
	Azar	December	
Winter	Dey	January	
	Bahman	February	
	Esfand	March	

[1]: It is a usual and interesting tradition for people in this region going to each other house at night after or before dinner during normal day or at the time of crisis or sickness to speak about daily activities, modes of each other, let a hand, sympathy with having dinner, tea or fruits. This activity is called as companionship in this paper

[2]: Residents of this region are *Shia*, one branch of Islam which going to the tomb of some holy passed away people known as *'Imam'* mainly located in Iraq or *'Imamzadeh'* located in different part of Iran, is precious and holly. It is known as pilgrimage, they usually do when they have enough time and money.

5.4 Material resources

Local available materials include different types of timber, different types of clay and mud, thatch, rice stalk and a combination of two or more of them were employed for various purposes.

Timber and wood had various purposes for structural and ornamental use and are sourced from the forest area. There are number of different varieties of trees in the forest area such as different types of oak and elm, their timber is appropriate for construction purposes. Local population in the past have not had to get permission from the government to cut trees down, however this is not the case these days. It has been stated in interviews that the impossibility of getting permission from the government, reduction of some of the appropriate species of trees for construction due to diseases and expensive wood are reasons why locals do not use wood for new house construction.

Suitable mud and clay for different purposes of building construction are sourced from the surrounding ground. Mud for structural purpose is provided from the own territory of the building as the colour is not important. However, the colour of mud and clay for ornamental purposes is very important and is gathered from special mines to ensure specific colours can be used. Some of the mines are one to four hours walk from the settlements. These clays are white, red or orange, and are usually transported on the backs of locals, animals and nowadays cars.

Thatch is cut from the riverside or ponds and rice stalk is sourced from rice fields after harvesting the yield. Both materials are used for slope roof coverage. However, local people are now facing difficulty in their provision, maintenance and low durability against the climatic conditions of the region and have replaced them with metal tin sheets or other materials.

Modern materials are prevalent within new construction and approximately all local traditional materials are relinquished. Some of the more common modern materials are concrete and steel, used mainly for structural purposes, stone slabs, tile, ceramics and mosaic for coating the walls and floors,

metal and asbestos sheets for slope roof coverage and different types of new fired bricks and concrete blocks for wall construction. Nearly all of these materials are imported into the villages from the city areas.

5.5 Climatic conditions of the region - the multi-climate land

Based on information from the Mazandaran meteorological office, Mazandaran has a temperate climate classified into two sub-groups; firstly the *khazar* climate, which dominates in the flat plain areas contributing a mild winter and slightly hot summer. Secondly, the *mountainous* climate has two sub-group classifications, a) temperate mountainous climate, within the majority of the forest area, and b) cold mountainous climate dominates in the mountain areas at around 2000 metres above sea level producing heavy snowfalls in winter and extreme temperature differences across seasons (table 5.2). Unfortunately, this office does not present adequate information and variables aiming to design buildings.

Table 5.2 Climate classification of Mazandaran defined by Mazandaran metrological office

	Khazar temperate climate	Mountainous temperate climate	Mountainous cold climate
Flat plain area			
The forest area			Up to 2000 m above the sea level
Mountain area			Over 2000 m above the sea level

In this regard and according to Atkinson climate classification (1953), the region as a whole can be defined as having Warm-humid climate where overheating is not substantial but is aggravated by humidity. This restricts the evaporation potential with small diurnal temperature variation. Kopper-Geiger (1957) defines the climate of the whole region as type (Cfa) through the elaborate climate classification containing more groups and sub-groups. Cfa type is recognized as having mild winters, moist all the seasons and hot summer. These two classifications do not provide climatic data for sub-parts of the region including the forest area, mountain and flat plain areas.

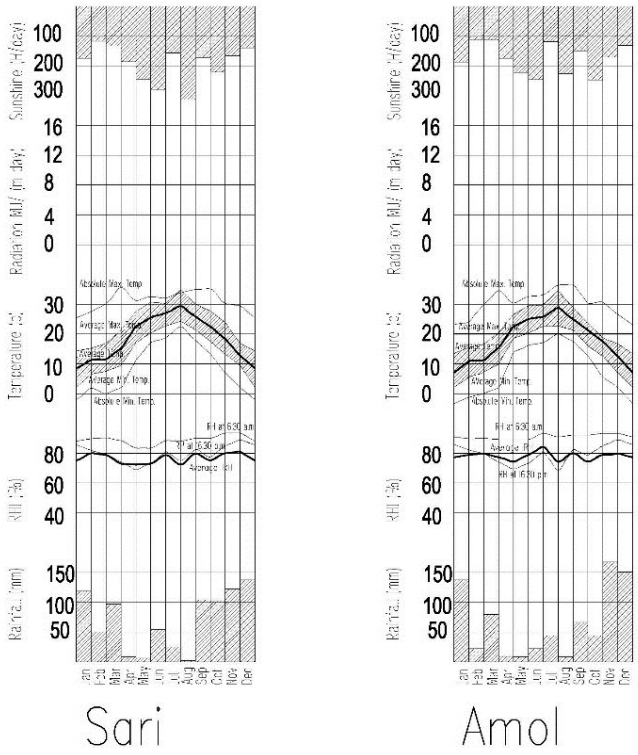


Figure 5.6: Climatic data for two major cities of Mazandaran in 2014

Figure 5.6 represents two graphs, they illustrate climatic data related to the year 2014 issued by Mazandaran metrological office. Data comes from two weather stations located on the outskirts of Sari and Amol[1], two major cities of the region. Both are located within the flat plain area[2] providing necessary climatic data related to two counties selected for this study. These graphs are explained below.

5.5.1 Seasonal climatic differences

According to the two graphs, summer within the region of study has a high temperature of around 30 degrees centigrade (most of the time slightly above 27 centigrade) and the humidity of the weather is around 80% (always above 65%)

[1]: The only weather station in Babol County is located in Babolsar in flat plain area close to Caspian Sea, which is far from (40 km) the area of case study villages. In order to get closest relevant climatic data, the weather station located in Amol has been chosen as it is close to the case study villages and is relatively with similar climatic conditions (fig 4.3).

2 : There are no weather stations within the forest or forest border areas to obtain proper exact climatic data for this research. However, according to the climatic classification presented by the Mazandaran meteorological office, climatic data from these two stations provides critical information for any location.

while 200 hours is the amount of sunshine (more than 16 days). The wind speed across this season hardly reaches 3 m/s and is always less than 5 m/s, which means the possibility of thermal stress, is high. The precipitation ratio during late summer should provide slight comfort; however, proper scheme providing thermal comfort is still crucial.

On the other hand, the winter has the highest precipitation of more than 100mm whilst the number of sunshine hours is at their lowest with less than 200 hours and subsequently lower temperatures. The average temperature during this time of the year is always higher than 5 degrees centigrade but less than 15 degrees centigrade (less than 18 degrees centigrade). The humidity of the weather is always close to 80% whilst the amount of wind blows rises, which does not influence the humidity greatly because the velocity is still less than 5 m/s. Consequently, winter is perceived as mild weather but providing solutions for thermal comfort is still necessary. According to the climatic data, heat offered by sunshine could be used to an advantage in winter.

Spring and autumn are two seasons in which thermal stress is not the issue such as in winter and summer. The temperature is mostly between 15-25 degrees centigrade, and the humidity is lower compared to summer and winter at between 65%-80% while sunshine and cloudy hours are quite balanced making climatic conditions without considerable thermal stress.

5.5.2 Wind condition

The prevailing wind direction within the region comes firstly from the north zone and secondly from south zone[1] directions with the same velocity range which is mainly less than 5 m/s however wind rose pattern is different when compared with two cities. According to the figure 5.7 representing wind rose of the year 2014 for Amol, north-west direction wind is the prevailing wind direction with the most frequency and velocity across the year in both hot summer and rainy

[1]: Within this text, the north zone means an angle within north-west to north-east, and the south zone means an angle from south-east to south-west.

days of winter. East and south-east directions are the second noticeable wind directions with far less frequency but with no remarkable difference in velocity.

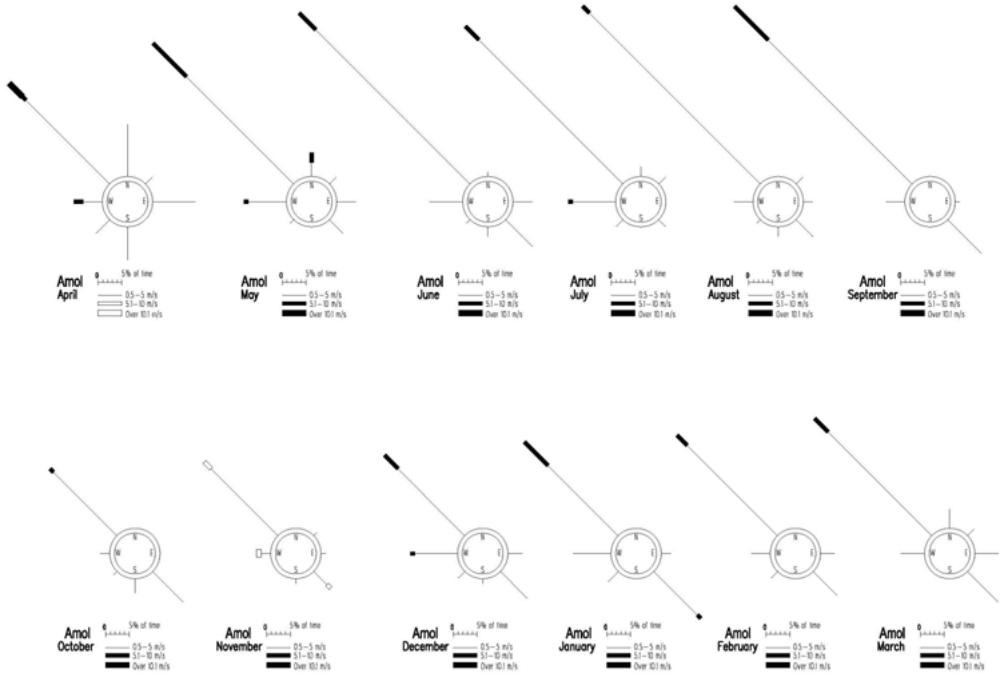


Figure 5.7: Wind rose in Amol for the year 2014

In Sari, the wind rose patterns exhibit variable prevailing wind directions and are not as stable across the year as in Amol. The prevailing wind directions during the hot and climatically stressful months of the year are north, north-west, and west while with slightly less frequencies, wind blowing from south-west, and north-west can be enjoyed. Prevailing wind directions during winter months are north, west, and south-west while wind comes from north-west, east, and south with slight less frequencies (fig 5.8).

It should be noted that the wind pattern represented through the wind rose is congruous to locals' testimony stated through interview. Prevailing winds used for comfort during the hot humid period comes from the mountainside (south zone direction) during the night and wind from the sea direction (North zone direction) during the day. Here are some statements delivered by local residences from four case study villages during focus group interviews.

'… The best wind in our location blows up from mountain and down from sea. At night from mountain and during the day from sea….' (A focus group in Perija)

'…As long as we are here when it turns to be hot, we usually open the front and back door or windows. The front is toward mountain which wind comes from this way at night and we have wind from sea at the backside of the house during the day. This wind [from the sea] is stronger than the mountain direction…' (A focus group in Diva)

'…during the day wind, blowing from sea at the backside of our house is enjoyable as well as mountain wind at night. Without them sleeping is not possible…' (A focus group in Osa)

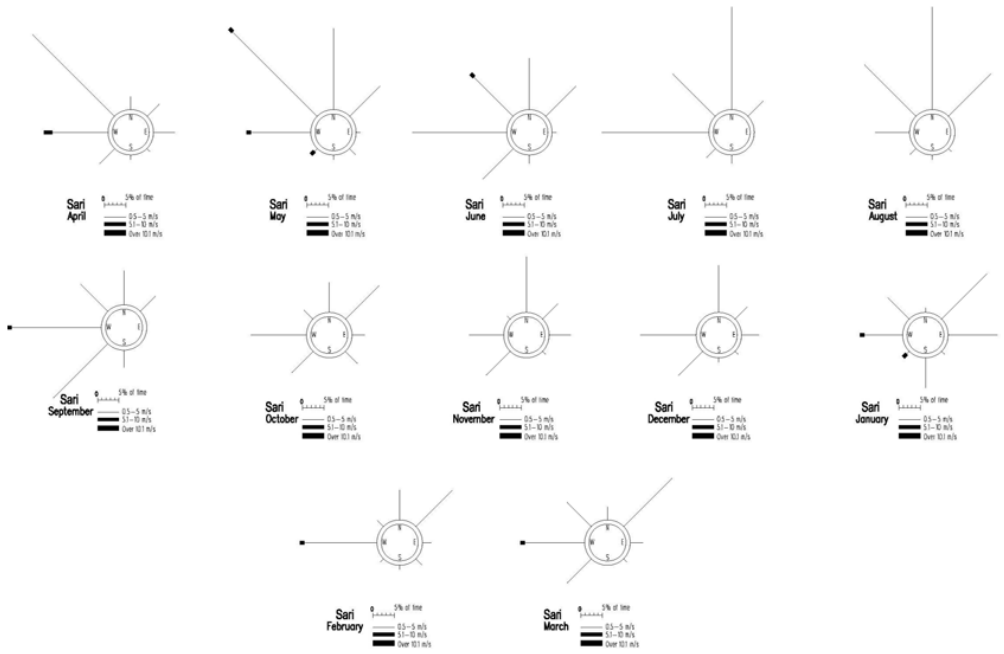


Figure 5.8: Wind rose for Sari related to the year 2014

5.5.3 Climatic variables, their limitation and solution

Consequently, based on the discussion and the table 5.2, some influential climatic variables of the region can be derived. They are high humidity (aggravates the hot summer and its harsh could be diminished employing natural wind blow), high temperature and sunny hours during the summer (protection from direct sunshine at this time is crucial), and high ratio of rainfall and intense rainy periods (makes the protection of the house from its impact critical). These variables influence designing houses and the lifestyle of local inhabitants.

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Chapter 6

Cultural Characteristics and Responses

6.1 Demographic information and infrastructure services

In total, 3,073,943 people live in Mazandaran according to the latest census report of 2011 issued by the Statistical Centre of Iran. This population within this province exhibits higher human density when compared with other provinces of Iran; this is possibly due to fertility of this land. This province accommodates 20 city counties and 2975 inhabited villages. 54.7 percent of the population lives in city areas compared to around 75% elsewhere in Iran. This means that habitation in rural areas within this region is higher and consistent. 85.7 percent of the whole population is literate according to the Statistical Centre of Iran in 2015. This is a much high rate than that of other provinces of Iran.

All human habitats including, cities and villages, have electrical power, Telephone, all cities have piped gas while 78 % of villages have piped gas, and the rest of villages use gas from tank (Mazandaran Broadcast Organisation, 2015). 83.7 percent of people in this province use different internet services while the average rate in Iran is 60% (Mehr News Agency, 2015) and most villages can connect themselves to the world by these services.

6.2 Ethnicity and language

Iran, as a multi-ethnicity country, embraces various ethnicities living within particular provinces. People living in Mazandaran, as a whole, are recognised as 'Mazandarani', belonging to different ethnicities from other parts of Iran and different characteristics such as language, costume, culture and lifestyle. They are also categorised in different tribes and clans living in different parts of this region and have different characteristics besides having many commonalities.

Inhabitants within this region employ a local 'Mazandarani language'[1] when communicating with each other. This language is believed to originate in the language called 'Medieval Pahlavi', which was the origin of 'Persian' or 'Farsi', the

[1]: Some linguistics believes that it is just a dialect of Farsi and is not a language but most linguistics evidently assorted it as an independent language.

formal language in Iran and within this region. There are different accents in Mazandarani; within different counties, cities but also within different villages, tribes and clans. However, they all share the use of the Mazandarani language and they all understand each accent managing to communicate without any problems (Samadi, 1991).

Traditionally, people wore special costume styles but currently their costume style is assimilated to other parts of Iran and is influenced by modernisation. Despite this, their religion is still the same as most of other parts of Iran.

6.3 Religion and religious spaces

Before Islam come to Iran and to this region the common religion in Iran and Mazandaran was 'Zoroaster'. Some of its traditions and beliefs remain in place today, such as the importance and holiness of fire and light and the holiness of natural elements including water, soil and snake. Relatively all residents of Mazandaran are *moslem* and *shia.* The building of 'Mosque' as a symbol of Islam plays an important role in the context of villages and life of villagers. The Mosque is one of the religious buildings located in religious complex besides '*Tekkiye*' and '*Saghnefar*', which will be explained later. These buildings and the courtyard of the religious complex are an important focal point of inhabitants for gathering of different cultural, religious and political purposes because usually they are located in the middle of the village and offer easy accessibility for all residents (fig 6.1, 6.2).

In the case study villages, the mosque had lower importance than within city areas. Religious complex including '*Tekkiye*' and '*Saghnefar*', play the same role as the mosque and some villages had not have mosque. Soon after the Islamic revolution of Iran, mosques were added to religious complex of some villages.

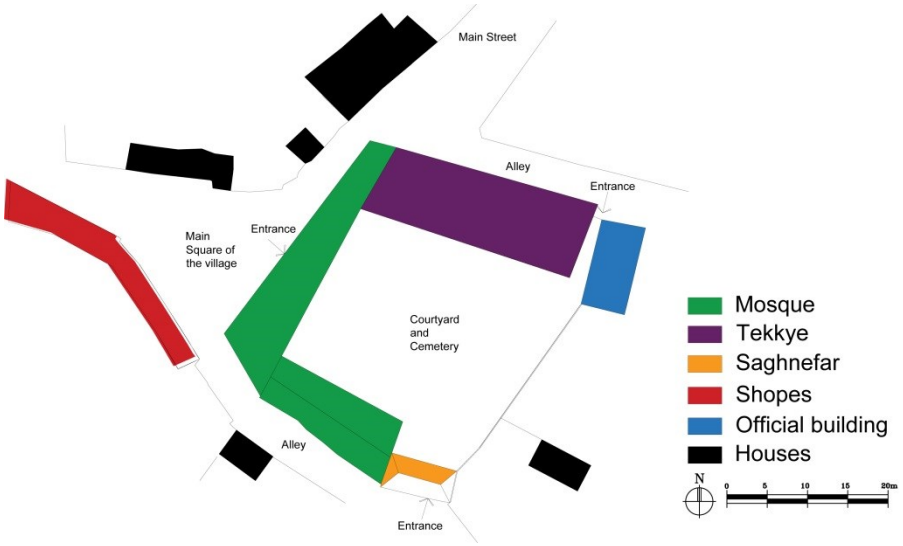


Figure 6.1: Religious complex of Diva

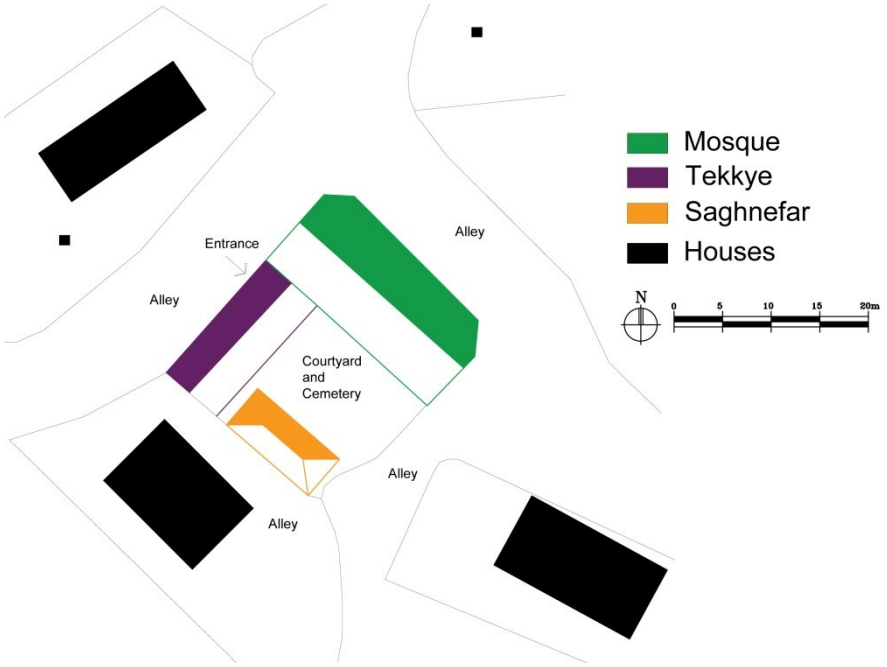


Figure 6.2: Religious complex of Perija

Tekkiye and *Saghnefar* originated for mourning for '*Imam Hosein*[1]*'* during first ten or thirteen nights of the '*Moharram'* month when people get together only

[1]: He is saint and innocent just according to Shia who has been slaughtered with his 72 helpers around 1400 years ago in Iraq and through a tribal war. Shia believers still mourn for him and this oppressive event, which is one of distinctive difference of Shia and Sunni.

at night, it is a kind of cultural soiree and takes place within homes during normal days of the year. They sit together mourning or launch demonstration walking from the religious complex of their own villages to neighbour villages at night or sometimes during late hours of weekdays or weekends. Therefore, the main road of the villages connecting these religious complexes must allow the demonstration to go ahead uninterrupted.

Tekkiye is in the name of *Imam Hosein* and is the building where older and mature males gather inside. It is often one floor high, narrow rectangular shape and southerly orientated (fig 6.3). On the other hand, *Saghnefar* is in the name of 'Abolfazl' who was *Imam Hosein's* brother and was killed with him. It is specifically for young males and adolescents to mourn inside. It is always two stories high with one room on each floor. The first floor is often encircled with solid walls but upstairs has usually no surrounding wall. It is a quadrangle and its proportion is close to square having four sides the same as each other with no orientation (fig 6.4).

Tekkye and *Saghnefar* are purely masculine spaces and are always located besides each other as they are symbols of *Imam Hosein* and *Abolfazl* who were two brothers and are buried besides each other in City *Karbal* in Iraq. The graves of villagers are usually within a religious complex located around these buildings. Sometimes tombs are located within these complexes and recently mosques were built within complexes for females to participate in religious rituals. This is unlike *Tekkiye* and *Saghnefar* where females are not allowed to show up during *Moharram* mourning.

Religious complex are usually financially supported by all villagers and are constructed by villagers themselves including master professions or handling labour activities. The construction technology and materials appropriate for religious building construction are usually the same as house construction but with more accuracy, quality and decoration. Traditionally, they were built with local materials derived from the natural environment by the villagers' partnership as well as management of religious rituals and maintenance of these buildings. This is a kind of cooperation that locals used to be used for any activity requiring

much energy and labour force such as house construction, occupational and agricultural affairs (Mahjorian, 2005).

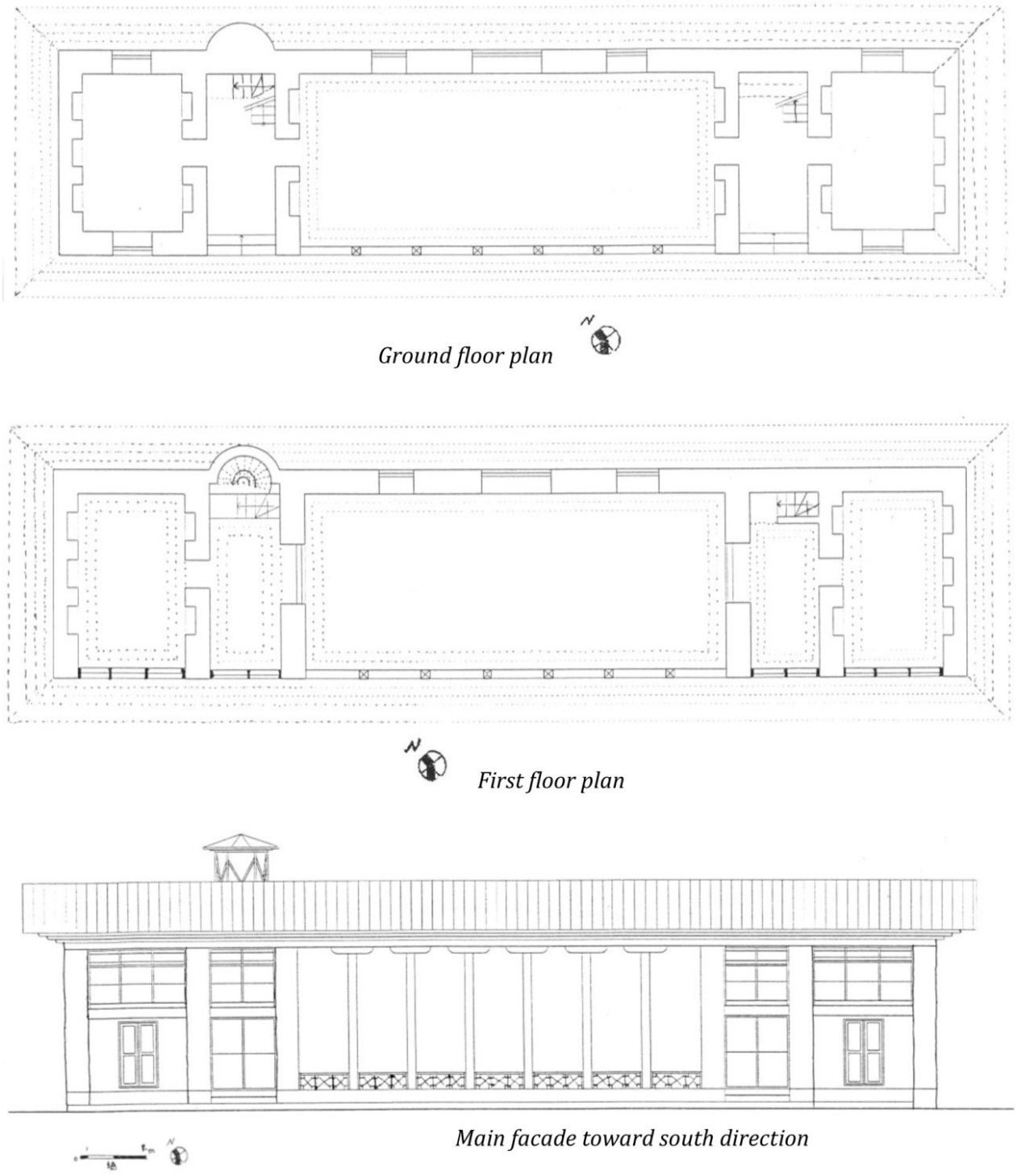


Figure 6.3: Tekkiye in Diva

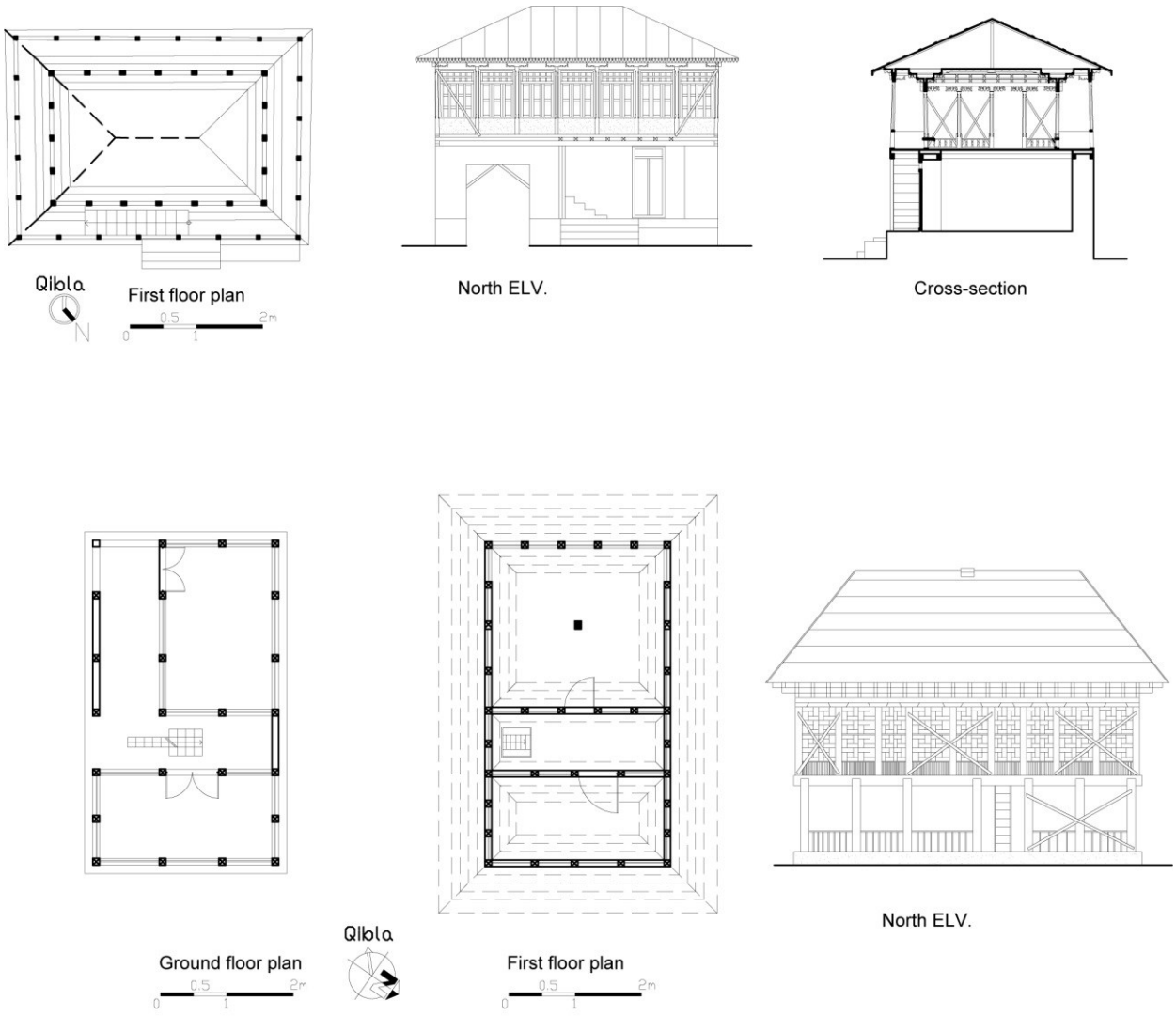


Figure 6.4: Two types of *Saghnefar* (above belongs to Diva and the below is located in Perija)

6.4 Cultural traditions

Culturally, people within the region of this study are religious and follow intimately religious rules; most cultural traditions are influenced by religion. Islam influences some of them and *Zaroster* before Islam influenced some, these are recognised as cultural costumes within the region (Yousefi, 2001). Some are very distinguished, which have been obtained from interviews, by observation and has been mentioned within two books authored by Yousefi (2001) and Mahjorian (2005).

- 'Celebration for new year'; all family members get inside home on the first day of the new year and meet and greet with relatives, friends, neighbours

and villagers within their homes for the next 13 days. Some other traditional national celebrations such as '*Marme'* and '*Sizdahbedar'* are held during this time and '*Noroz khani'* is performed before New Year.

- 'The final Wednesday of the year ceremony'; is a national ceremony in which a bonfire of wood are set up and all family members jump over it. It is held within the courtyard with their own family and relatives or within public areas such as streets with neighbours, this is followed by cooking a special soup made from nettles. Locals believe this special soup and jumping over fire is good for their future health.
- 'Party of *Tir-e-mah-e-sizdah sho'* (the night of 13th day of the month, *Tir*[1] party); on this night family members including all children and grandchildren gather within grandpa and grandma's home, hanging out, chatting and eating together. '*Lal-ine'* is a tradition which children execute in the evening of this day by going to local houses and demanding something as a rewards for their endeavours to remove poltergeists and miserly from their home and life.

It should be mentioned that all of these customs are celebrations that take place at home or within open settings such as courtyards, streets or other public areas. All of them are social celebrations helping people to improve social cohesion and emotional ties with their families and community members (Mahjorian, 2005) providing a sustainable society and life (Edward, 2000).

6.5 Economies

Many occupations that depend on the natural environment emerged due to the many natural resources in Mazandaran; fertile land with alluvial soil, abundant water resources such as springs, rivers, streams and brooks, and green lands and the forest areas. These occupations are mostly associated to 'food production' inducing an 'agrarian society' in this region. People in this region, as with other rural areas elsewhere in Iran usually adopt an occupation as their main livelihood and source of income whilst simultaneously fulfil other food production activities to make themselves self-sufficient (Zargar, 1998). Some occupations separate from food production are in service of food production activities such as manufacturing of farming tools and building construction. In addition, admittance of

[1]: This a month in local calendar which is according to October

modernisation in the country and its penetration within this region allowed some new professions and occupations have to emerge such as teaching, banking and working for governmental offices, factories, and industries. A few numbers of villagers do these new emerged occupations so that they do not have remarkable influence on the economy of the villages. Occupations involving food production control and influence the economies of villages. These occupations, which involve majority amount of residents, are agriculture (rice farming) and animal husbandry.

6.5.1 Agriculture

Agriculture is the main source of income within this region and specially within the case study villages. It is includes cultivation of different products such as rice, wheat, beans and vegetables. Rice cultivation is the most important and main food production activity and this province is known as the land of rice (Ahmadi et al, 2015). Rice cultivation is common within the forest areas but more so within the flat plain area as it is now a widespread agrarian society and culture.

Rice fields are located around the villages within the flat plain areas, close to the valleys created by rivers within the forest areas, which in this area are terraced in shape. It is very hard work and labours need to be recruited to do tasks. Traditionally, locals performed these tasks manually and in cooperation with each other, in much of the same way as when buildings are constructed. In addition, this is the job that all family members of different ages and genders take part in (Mahjorian, 2005). At this time, because of using modern machines, recruitment of many labours and family members does not happen anymore. These machines, which farmers have bought or hire, made farming easier and less difficulty than before.

Traditionally, collected and obtained yield, which was not considerable in amount was brought home and stored in the attic area of the house to be dried. Sometimes, rice is dried first in the sunshine and then stored in an attic area, this is still done within two case study villages, most of the yield is purely for their own consumption and only small residue amount is sold. On the other hand, rice farmers in other case study villages send the yield to the rice factory to be dried

with new electrical driers and peeled off. Due to the use of chemical fertilisers and pesticides and cultivation of new high product species of rice, the amount of yield grew so remarkably that it does not fit in an attic area; local farmers prefer to send it to the rice factory first and sell it as soon as possible. This phenomenon increased the income of farmers and made them not need an attic area, the lack of attic space can be observed within newly constructed dwellings.

Most farmers have their own rice fields, which based on the amount of their rice fields and produced yield, are classified economically. The first class who are recognised as poor are the owners of less than one hectare rice field. The second, the middle class have one to three hectares and the third group, recognised as rich class, have more than three hectares. The influence of their income earned from rice farming and other productive activities is noticeable when assessing the form and configuration of houses. The more income, the more house area with more rooms, better quality wood and professional master for house construction, the more decoration within the home and doing more other productive activities. It should be mentioned that there are some people who do not have their own rice fields. They do rice farming as a sharecropper working on second or third class farmers. Economically, they are classified as first class within the region. This stratification has not been observed within ranchers.

6.5.2 Animal husbandry

Animal husbandry is other main livelihood and food production occupation within the region (Biranvand, A., 2015) which is more prevalent within villages of the forest areas due to the abundant availability of foraging resources for animals. Cattle are the main animal husbandry used by foresters for the purpose of producing and selling, milk and meat.

Traditionally, local species of cattle are usually sent within the forest area to graze but because of new breeds imported from abroad, which are bigger in size and greater in milk and meat production, they are kept in barns and stables. They are fed with rice straw obtained after rice harvesting, grasses derived from the forest area or cultivated within rice fields after rice harvesting, and new industrial

foods. Like rice farming, keeping and supervising cattle is a cooperative activity done by the partnership of all family members including different genders and ages doing feeding and milking. Collected milk is boiled first in the kitchen of the house and then sold to some agencies that come and collect. This is the main income of a rancher.

It should be added that, besides animal nurturing, ranchers do rice farming as supplementary job as well as rice farmers who nurture some livestock with the same purpose. In addition, both of these two groups do other food production activities to supplement their income such as nurturing poultry, orchards and kitchen garden cultivation as well as doing other non-food production activities such production of textile, artefacts and silkworm nurturing. These activities help them to earn more income and spend less as the result of self-sufficiency. As a result of modernisation and importing industrial produced foods, most of locals prefer to buy them from shops rather than produce them. This is pushing this agrarian self-sufficient and productive society to be a consumer and dependent society.

Overall, Most villagers still have food production as their main job, which is accomplished cooperatively with the help of all family members and some related activities are carried out within the houses. However, industrially produced foods are increasingly being imported to these villages weakening productive characteristics of the region but villages are still agrarian societies producing food, nourishing themselves and selling to outside of their village which needs to be invigorated economically.(Sartippipour, 2007).

Chapter 7

Physical Characteristics of Villages and Dwellings

7.1 Introduction

Four villages within the two main counties of Mazandaran have been purposefully chosen as case studies according to the aim and objectives of this study. Two villages were selected from each county, one located in the forest area and another one in the forest boarder area. Although these villages have some common characteristics with other villages within other counties or areas such as mountain and flat plain, they have many differences due to climatic and geographic conditions. Reviewing these differences is outside of the remit and main purpose of this study. Therefore, this study discusses the characteristics of villages and their dwellings, which are located within the selected villages, counties and areas.

There are also many common aspects between villages and their dwellings; these make the differences insignificant and trivial. This chapter concentrates on studying and assessing the main common characteristics and their context, configuration of the villages and the activities that villagers perform within that context. This research will also study the location and configuration of the dwellings and their relationship to the context of the village.

7.2 Villages

Each village is locally recognised and known as a 'neighbourhood' and has its own name. These factors create strong social ties binding villagers who are usually from the same ancestor, clan or kinship. Historically in Iran, a neighbourhood that stands with its own facilities is a 'village' and when some villages joined, they became a 'city' or 'town' (fig 7.1). In this regard, food production was the main concept of the emergence of village consolidation supporting itself and the city area (Tavassoli, 1981). Accordingly, characteristics of food production activities include mainly agriculture, meat and milk farming embodied the configuration of the villages and the dwellings.

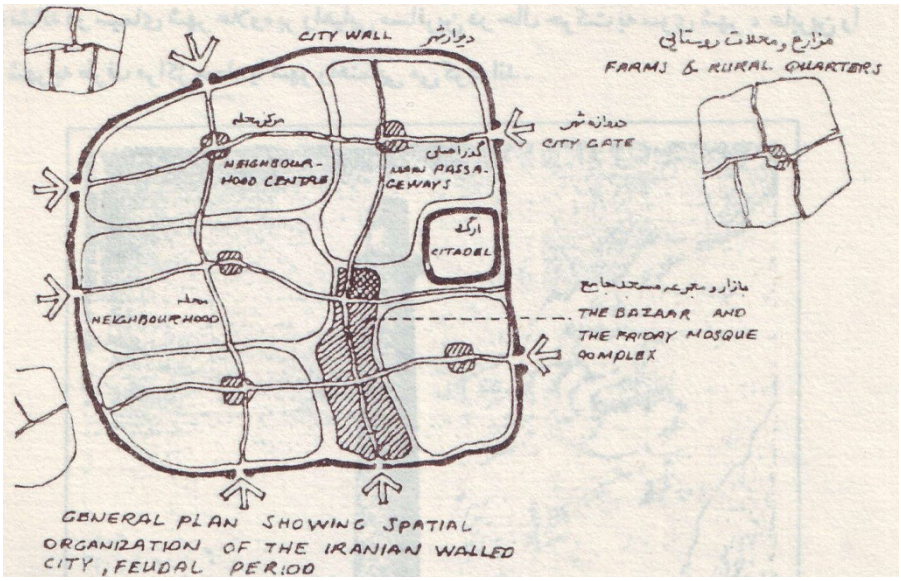


Figure 7.1: A diagram schematising development of a village and town in Iran from neighbourhood scale (Scanned from: Tavassoli, 1981)

In Mazandaran, each village physically defines its own territory by having specific rice farms or the forest area serving as grazing land for their animals around the villages. All villages provided their own infrastructures and public buildings. Besides that, all villages have their own place for religious and mourning rituals at the time of *Moharram.* They also have their own 'Village Council'; elected by villagers who manage most governmental affairs. Traditionally, these are the main criteria when indicating the independence of a village in addition to its physical separation from other villages and its specific location.

7.2.1 Location of the village[1]

With water resources being one of the main and most important reasons for the settlement of all villages in Mazandaran, the villages are located beside large rivers or near to the primary or secondary river branches; the rice fields has been created alongside them. In the forest area, the residential developed parts of the villages are usually on the hill whilst rivers and rice fields are usually located in the lower side of the village alongside the valley shaped by the river (fig 7.2). Usually, some branches of the river pass through the residential area, crossing local streets,

[1]: Form this part, all of information and discussions are related to the villages located within the forest and the forest border areas, these areas have been selected area for this study.

alleyways and orchards. Historically, before these streams became polluted with different types of contaminations (Interview with Taleshi, 2014)[1], these rivers and streams were social places used for different types of washing such as cloths and dishwashing. Because they were not deep and polluted, they were a favourable place for children to play; swimming and fishing in summer, adults sometimes joined them. It was a communal setting, which provided safety for children within the residential area so there were different eyes to watch out for them (Jacob, 1961).

Consideration to environmental factors and constraints was important in finding a proper location for a village. The forest area in Mazandaran is actually a hilly forest starting from 100 metres to 2500 metres above sea level; it extends across the region and is 27 kilometres wide on average (Siadati et al, 2010). The forest contains many valleys, rivers and hills covered with trees. Typically, the context of the villages as a whole consists of two main parts including rice fields and residential development[2]. Within the forest area, the residential development tends to be located on the hills where the soil is mostly not geographically suitable for rice farming but suitable for construction, orchard development and other tree cultivations. Besides that, because of topographic troubles, conduction of water from the main river into these high-level areas, rice farming is not possible there (fig 7.2, 7.3). In terms of villages located in the forest border or foothill area, similarly the residential area is located on the hillside while the rice field is situated down in the flat plain lands (fig 7.4).

[1]: The interviewee was the assistant director of the Health Home in Babol city at the time of interview

[2]: Residential development is actually the physical context of the village involving all buildings' infrastructures and streets. This part is always departed from rice field positioned far from or adjacent to it.

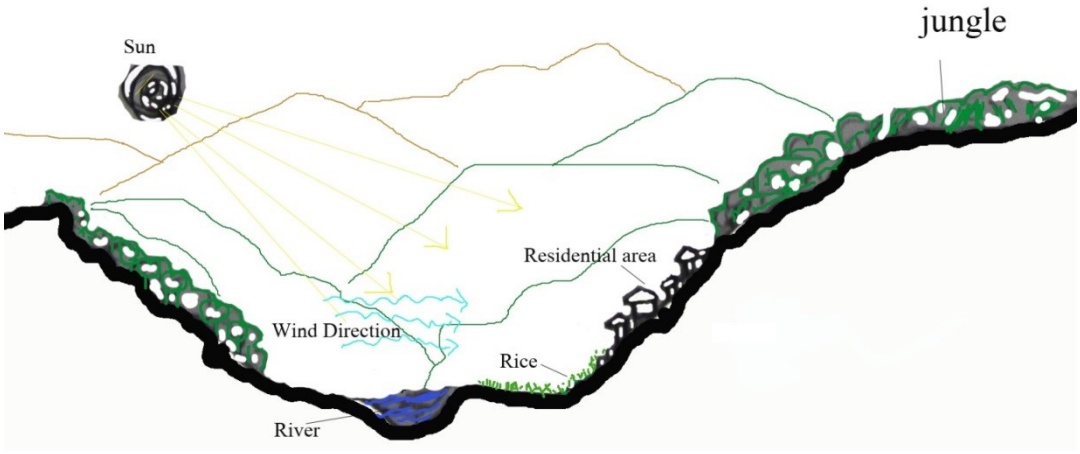


Figure 7.2: Schematic Location of villages located in the forest border and related parts

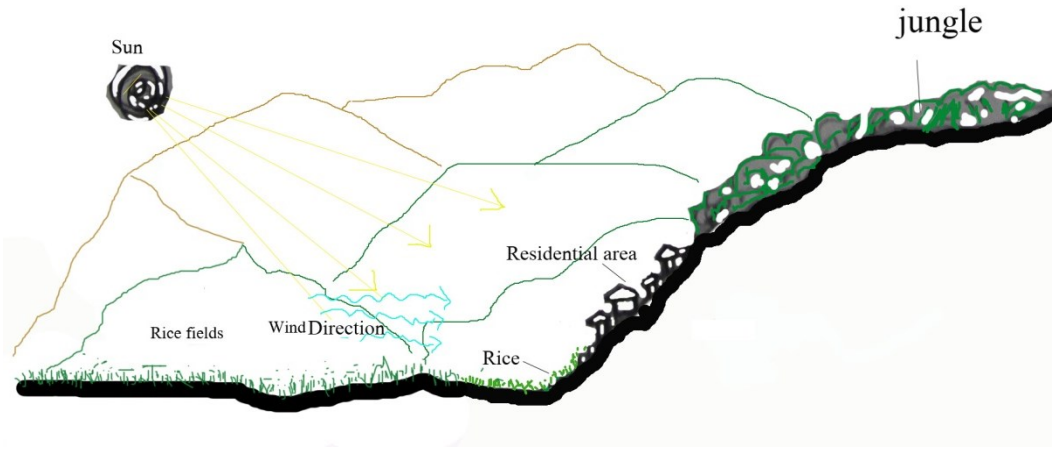


Figure 7.3: Schematic location of a village on hillside within the forest area showing different related parts of it.

Figure 7.4: Picture showing location of the residential area and rice fields

Hillside areas with interesting and specific climates have been favoured location for residential development. These areas should absorb the sunshine in winter and provide cooling winds during the humid and hot summer. The wind

direction within the region during the day is usually from the north and is known as sea direction and southwards is known as mountain direction during the night. These villages are commonly developed on the side of the hills which are orientated towards the south or east, thus providing the best direction for obtaining maximum sunshine while benefitting from wind breezes to bring down the humidity and cool the inside of the buildings (fig 7.2, 7.3). In addition to topographic factors, climatic and cultural conditions formed the configuration of residential development of villages within the forest areas and its border.

Rice fields of the villages located within the forest and forest border areas are usually located downhill by the rivers. If the rice fields are located on sloping land, always in the villages of forest area, they become terraced and form flat sections like a pond in order to efficiently reserve sufficient water for rice farming (fig 7.5). This terraced land adds a spectacular perspective to the overall composition of the village. This strategy is replicated for house construction with the provision of a flat base through digging up the ground or raising the ground by making platform within the residential development.

Figure 7.5: Picture showing terraced rice field within the forest area.

7.2.2 Characteristics of the context of residential development

The main characteristic of residential development is that buildings are detached. This kind of configuration allows the wind to whirl around, through and

inside buildings for cooling and ventilation, while letting them absorb maximum sunshine. This characteristic has also been mentioned for the neighbour provinces of Mazandaran with similar climatic characteristics (Djlilian & Tahbaz, 2007; Memarian, 1998). This characteristic is the main difference in village configuration along the southern side of the Caspian Sea, specifically with the villages located in other parts of Iran especially central part of Iran (Pirnia, 1995).

In terms of population, one village in this region can be also understood as one or two neighbourhoods according to the definition proposed by Lynch (1984) who suggests that '*Neighbourhoods of this kind are probably no larger than 100 households at the most and more likely 15 to 30' houses (1984, p. 246)'.* As for social characteristics of the neighbourhood, he continues; *'people are personally acquainted with each other by reason of residential proximity, and where size-plus other features such as social homogeneity, street patterns, identity of boundaries and common services may play a definite role in promoting control, present fit and sensibility (1984, p.246)'.* Alexander (1977) believes that, in terms of scale and size, a neighbourhood is the small amount of people 500 to 2000 who, can identify and agree communal goals and then pursue these goals actively and efficiently. A settlement accommodating this amount of people can also be defined as a local community (Moughtin, 2005). The size of the villages in the region of this study is often small, accommodating 10 to 300 families and all villagers, or at least most of them, are acquainted with each other by doing much of their work, particularly rice farming, cooperatively. As a result, each village should be considered as a neighbourhood as a village has a '*wholeness*' (Jacobs, 1961, p.127).

The word neighbourhood in Iran is called *mahalleh*, it is a place where people of similar ethnic and religious backgrounds are clustered together in their own quarters, their own place for worship, *hammam*[1], *bazaarcheh*[2], and other facilities, making, self-contained. *Mahallah* has dead-ends which makes it similar to the area belonging to the female community in villages of this study, since the area near dead-ends is only used by the group of neighbouring households as a

[1]: Public bath
[2]:Shopping centre or mall

gathering place for housewives as a children's playground (Sharifi and Murayama, 2013).

The social, cultural, and economic activities of a village are communal undertakings attributed to neighbourhoods, and mostly take place in open spaces. The villages comprise of multi-purpose spaces where not only one activity but systems of activities (Rapport, 2005) take place within them. These social activities are not only for communal activities but can support individual family activities. Rapoport (1985) defines this space as a home environment to bring home and neighbourhood together. The spaces of this neighbourhood or residential area support social activities consisting of: A) buildings including private dwellings and some public buildings, B) a network of nodes and a main square, and C) a network of narrow streets and alleys for human and animal movement, which are described and analysed in the following sections.

7.2.2.1 Figure and ground

The context of villages is sporadic and of a non-geometrical organic shape based on non-geometric division of lands as the territory of dwellings. They are not compact and buildings are detached from each other. Villages consist of a combination of gardens, open spaces and buildings. The area of the garden and open spaces is usually bigger than the area of buildings (fig 7.6, 7.7). This characteristic is a key point in shaping the context of these villages according to the climatic conditions. In addition to streets, squares and nodes, the garden is the main open space of villages, which is mainly founded for the purpose of fruit production including citrus orchards as the main type of orchard and other fruit trees such as apple, pomegranate, walnut and fig tree. A kitchen garden is usually set up within this area but protected from poultry. Having characteristics such as production of food and contributory green area, it is environmentally friendly. This is recognised as sustainable, which is recognised as another type of sustainable settlement besides compact settlements (Moughtin and Shirley, 2005).

Dwelling is the fundamental building function mainly constituting residential development in parts of the village, and is also the main topic of the

next chapters and part. Besides that, public buildings which can be seen within all villages are religious buildings, bakeries and some small shops; whilst public baths, rice factories and other new buildings such as banks, village council offices, holly shrines, schools and health centres are located just within some of them. These public buildings are usually encompassed with the dwellings areas but most of them are located around or close to the centre of the village. This will be discussed later. Cemeteries as another major open area of the village are usually located within the village as an independent plot of land or open area of a religious complex. Sometimes it is positioned out of the village (fig 7.8, 7.9).

7.2.2.2 Network of nodes and main square

All villages have a network of nodes and a main square, alleys and streets, which facilitate the commuting of the residents and their vehicles. These spaces facilitate neighbourly interactions taking place in different types and scales. Lynch (1960) states that they *'May be primarily junctions, place of a break in transportation, a crossing or convergence of paths.... simply concentration, which gain their importance from being the concentration of same use or physical character, as a street-corner hangout (p.47)'.* They may in reality to be large squares or somewhat extended linear shapes (Lynch, 1960) in theses villages, which improve community and social interactions. Three different types of communities within the context of the village in different ways and scales are distinctive in which social interactions take place. They support residents' daily activities, social interactions and communications. These communities are; A) 'adult male community' mainly take place within the main square of the village, B) 'female community' mostly within private streets, and C) 'adolescent community' forming in nodes along main street of the village. These places are the main preferable places supporting these communities being occupied as *patogh*[1] (Hangout place), although these activities can take place within other places of the village too.

[1]: This is a place that someone usually and sometimes regularly gets together for hanging out. It could be an open area, a shop, religious building, or the like.

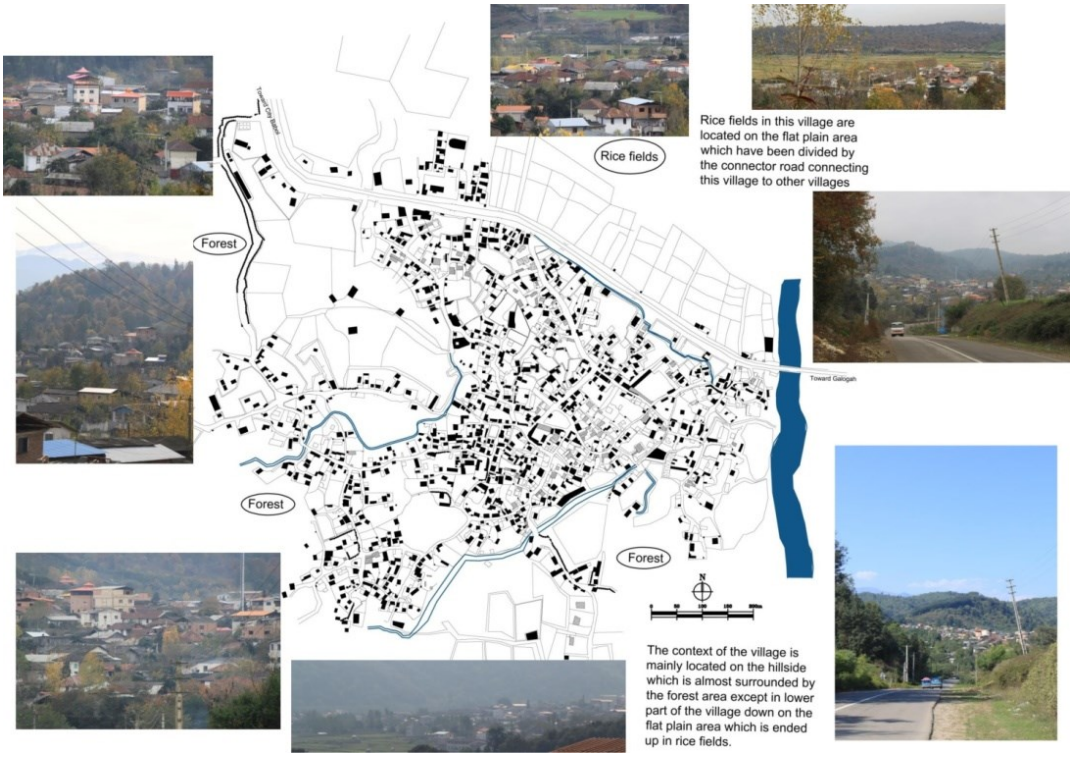


Figure 7.6: Figure/Ground map of Diva, a village within the forest border (Source of map: Housing foundation of Iran, 2014)

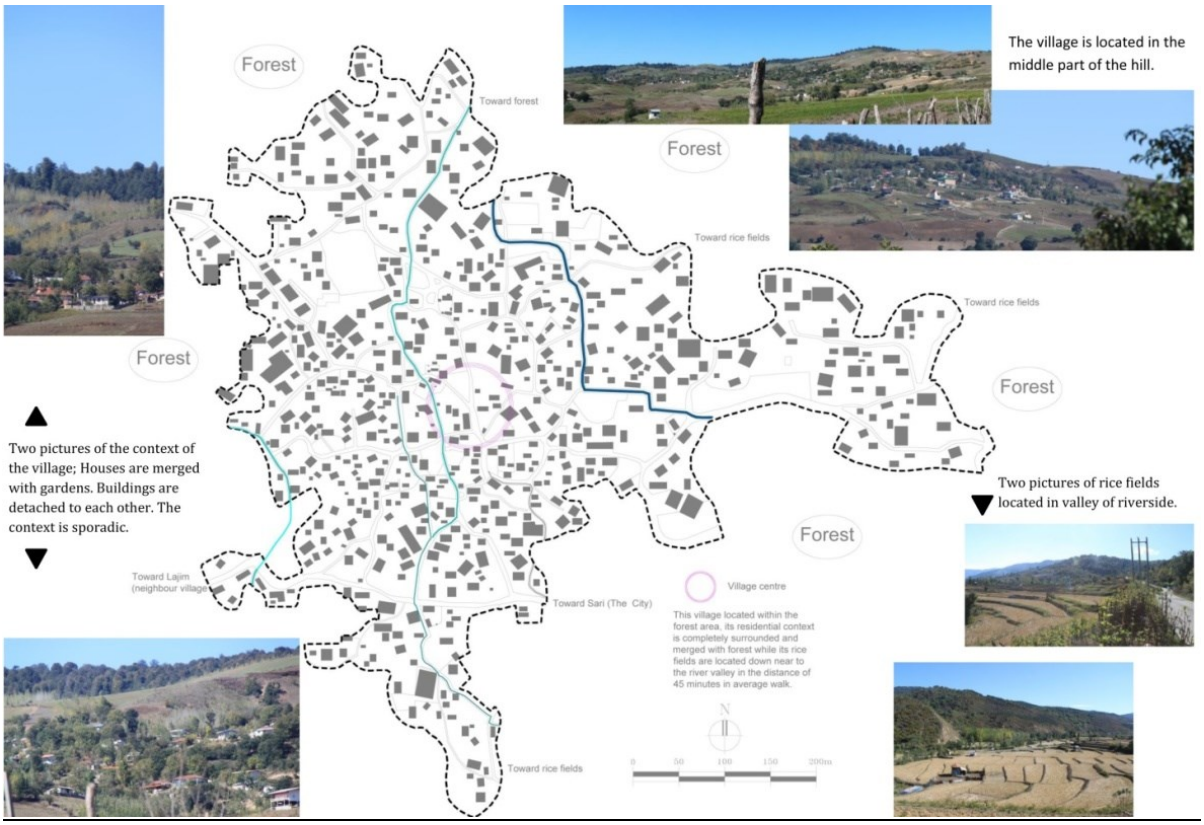


Figure 7.7: Figure/Ground map of Vareki, a village within the forest area (source of the map: Housing foundation of Iran. 2014)

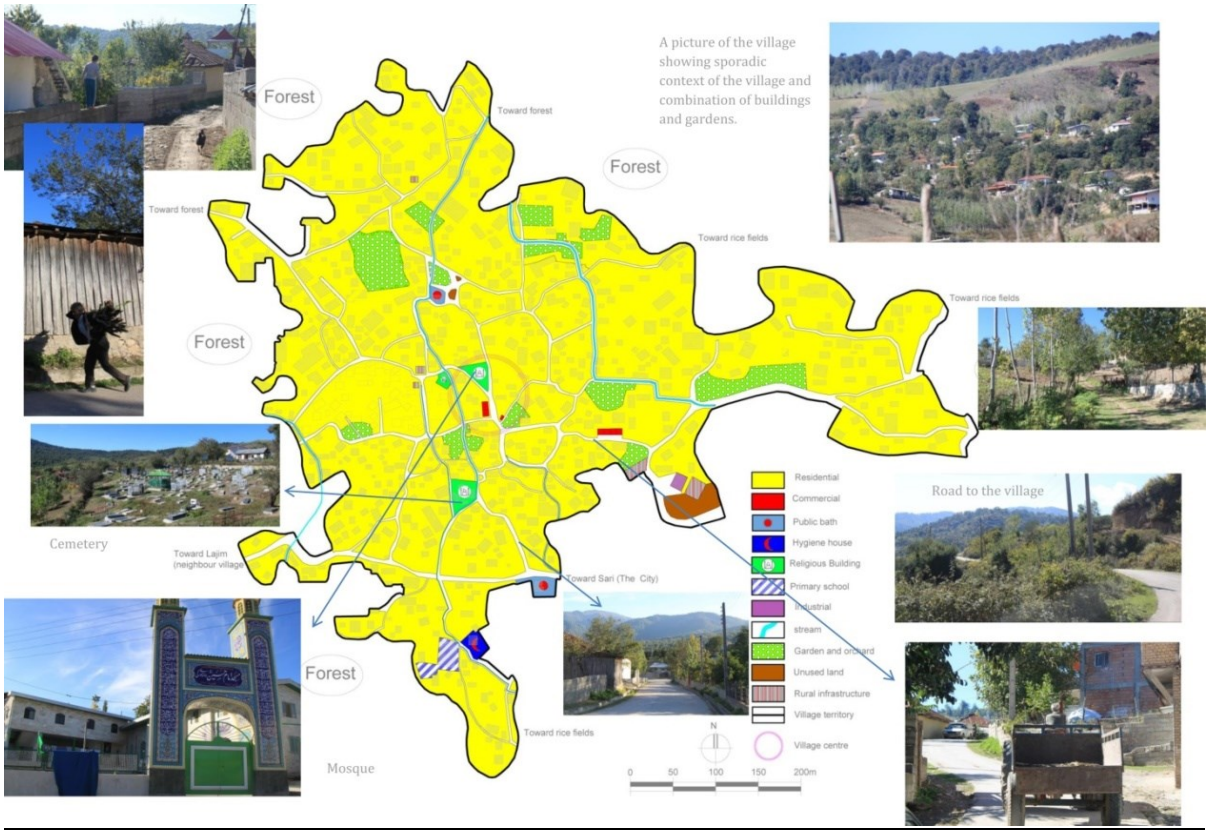


Figure 7.8: Land-use map of Vareki (Source of the map: Housing foundation of Iran, 2014)

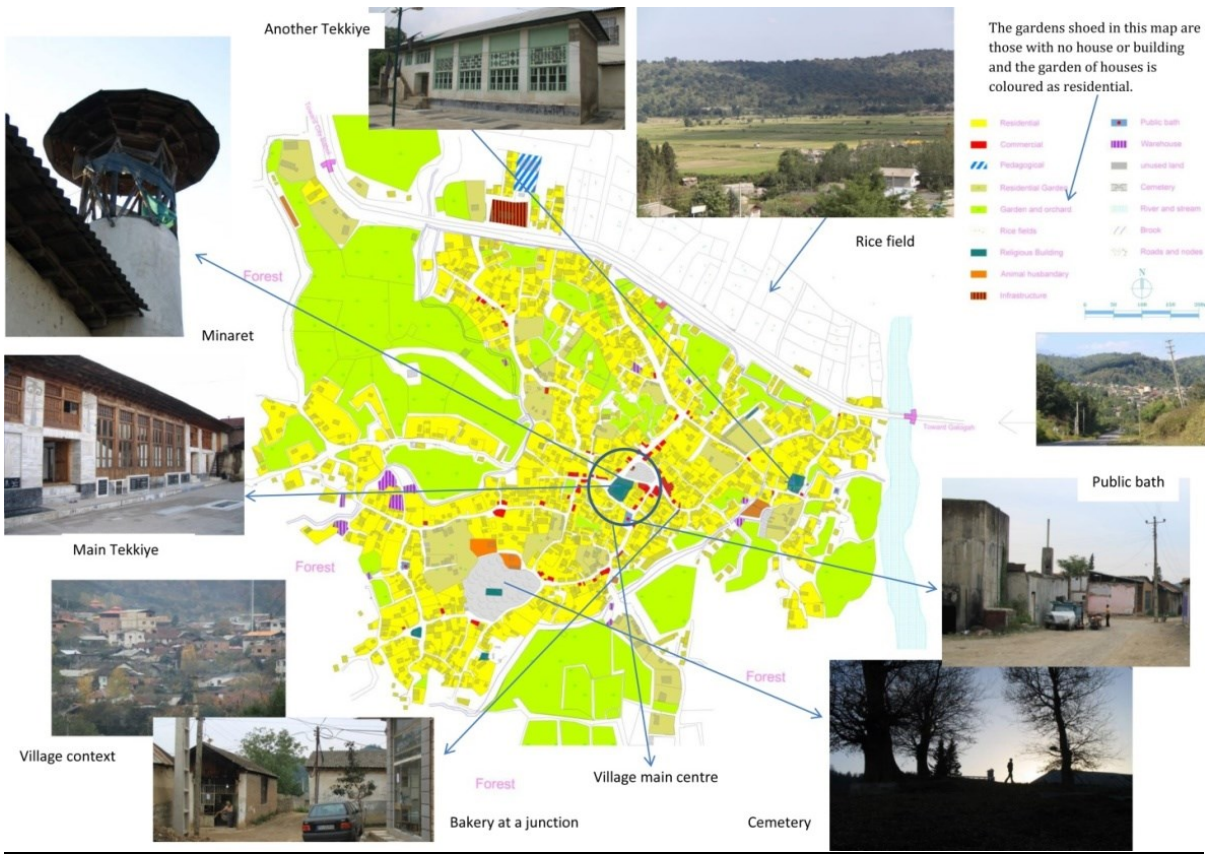


Figure 7.9: Land-use map of village Diva (Source of the map; Housing foundation of Iran, 2014)

A) Adult male community and *patough*, central square of village

This area, in the centre of the village is the most important place facilitating communication of villagers and their daily affairs. This area is often the primary focal point of the village where the village originated and extended outwards in accordance with various limitations. Each village usually has one central square that all residents can use. However, it is mainly the territory of adult males including the old and middle-aged. It also supports social activities such as religious and economical activities and main cultural events. This is akin to Jacobs, (1961) *'city wholeness'* (p.126). She states that it is essential and one of the *'greatest assets'* (p.129) for any society which has the ability to support the '*bringing of people together, communities of interest*' (Jacobs, 1961, p.129). During these communal activities, all villagers of different ages and genders swap this place in the same way as adult males.

The central square is usually surrounded by public buildings, which are often located around this heart of the village (fig 7.15). The religious complex is the main public building located at the centre of village, which is like a landmark making '*sense*' in a village context (Lynch, 1981, p.46). In some villages, public baths are located here however, now most homes have private baths. These public baths are rarely used. Rice factories, some small shops that provide daily or weekly family needs, schools and small governmental buildings are other public buildings surrounding this area (fig 7.10, 7.11, 7.15). It is accessible within 10 minutes' walk by all of the village residents and houses making the village a self-contained neighbourhood. This resembles neo-traditional neighbourhood theory, which states that a neighbourhood is 'self-contained' (Furusth 1997 p.204). It is usually a quarter mile distance from centre to edge of the village. This encourages residence to walk daily, this supports the human biological requirement of walking (Banai, 1996), and has a balanced mix of activities: dwelling, shopping, working, schooling, worshiping, and recreating (fig 7.12, 7.13). In some cases, besides public buildings, individual houses are also located near this area.

It is a vital area that supports many activities and accommodates the community of different kinds of people. All age groups of male have their own

territory in this open area or within the local shops or teahouse during rainy or very cold days. They hang out in these areas particularly during autumn and winter, which is their general leisure period since the rice-farming period is over. During the morning and especially during the evening, they use this area for hanging out, communication and companionship. During the long nights of these seasons, they go to each other's homes as *Shonisht* –gathering after dinner until midnight. According to a folklore poem, "winter's nights are enjoyable and spring's days". During long days of spring and summer, they are working on rice fields, undertaking exhaustive rice farming activities, and are too tired to be gathered during the short nights of these seasons.

This space is an area for hanging out during the day; residents do not hang out here at night. This would be culturally unacceptable and abnormal. This area operates as part of living room, according to Rapoport's views about the public houses (Pub) in the United Kingdom (UK) or tearooms in Korea (2006, p.46) in which some social and daily life activities take place in these communal spaces. It is a daily habit of old age and elder age males to go to this place in the early morning after breakfast, they go back home at noon for lunch. After lunch, they would generally take a nap, have a cup of tea, and go to this area again. In the evening, they will join other men on their way, a lovely coincidence that repeats when coming back home after sunset. Therefore, alleys and the main road are being observed and are under control of men and elder residents most of the time. They control the quality of streets, safety and security of the village, the playing of__

Figure 7.10: Shops around the Centre of the village

Figure 7.11: Different gathering points in the Centre of the village

Figure 7.12: Retailing as social activity in a village Centre

Figure 7.13: Small shop as social point in a village Centre

_the children is watched out, and decisions are made about manners and maintenance of the affairs of their village. During work time in spring and summer, the male farmers are so busy and tired for this type of hanging out thus, the rice field is their main communication area however, non-farmers still use the central area for their interactions at this time.

Females show off in this area; they use the space to pass though, shop or for communal cultural or religious activities. Buying bread from the bakery is an important need of a family early in the morning or late in the evening, this is usually the responsibility of females and one of their interesting gathering points (fig 7.14). Otherwise, it is not socially and traditionally acceptable for villagers to see women and girls hang out in this space or even in enclosed areas like shops or teahouses. Usually adult, newcomers and transitional visitors are not expected to hang out in this area but visiting this area for shopping and annual religious rituals does not matter.

The main road of the village usually originates or passes by this central space (fig 7.15). This road connects the village to neighbour villages, thus strangers freely come to this area for different purpose like, shopping, passing, using another village's public bath or rice factory or even for hanging out. Although, most of the time they do not have a formal geometrical shape, they are clearly distinguishable within the village configuration which is the bigger open space with no trees.

Figure 7.14: Bakery as social point

The average width of this area is 10 to 30 meters long, within this range people can distinguish and recognise each other improving eye contact and social cohesion (Gehl, 2010; Moughtin, 1999). Social connections made this area the centre for exchange of information and daily news, and the most interesting, vibrant and dynamic point attracting all villagers, which is still essential for each village.

B) Women community and *patough*, private alley and nodes

Private streets and alleys, dead-ends, junction of paths or small squares are territories of female. Most of these communities are shaped as they are because women sometimes are from one large family living in separated houses adjacent or close to each other, as a result of inheritance of the land. The mixture of being proximate and an acquaintance intensifies female interaction although sometimes they have conflict with each other. This area is like a social node (Lynch, 1984) and

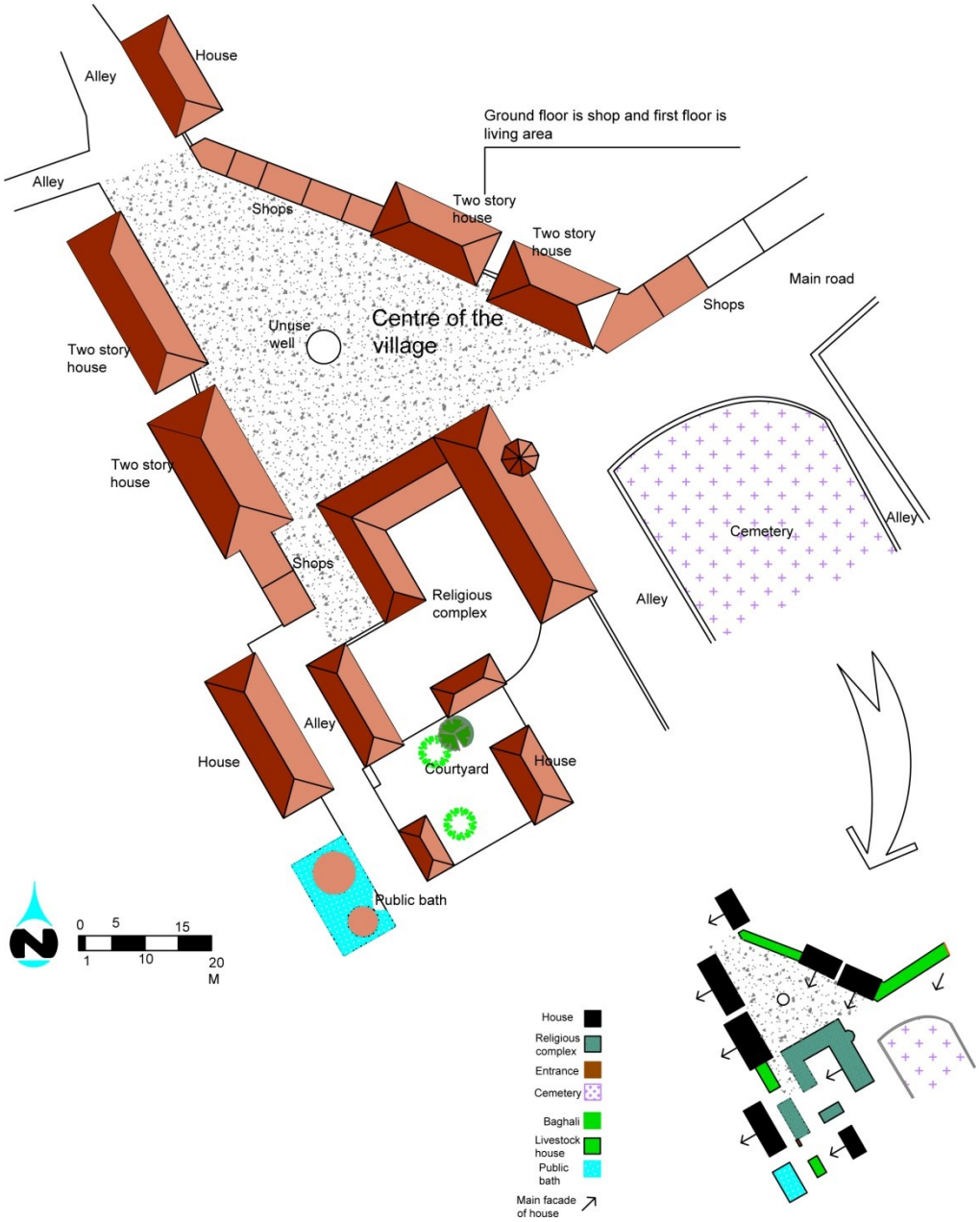


Figure 7.15: Village centre of Diva -Male *patogh*

__is a kind of feminine space, which is defined by the activities related to women and their tasks. Women gather in this area chatting and passing the time, this commonly takes during evening in summer. Children play under females supervision during the day, women carry out communal or individual activities like cooking, weaving fabrics, drying vegetables and drying harvested rice seed

during sunny days of autumn after harvest to enhance its quality[1]. This limits opportunities for children to have a nice day playing and hanging out (fig 7.16 to 7.19).

Neighbourhood women usually cooperate with each other to do various tasks for other families; such as watching out for their children, feeding poultry, and livestock. Neighbours watch out and even interfere in tiny affairs of each other's daily life, a characteristic that the younger generation now dislike. They believe that this practice, which puts their daily work life under the supervision of others, endangers their privacy and does not let them live and behave freely. In contrast, female *Patough* which is quite small, can be compared to Jacob's street neighbourhood (1961) providing a safe place for children and women. This is because there are many eyes on this area from houses and alleys to watch the space; this provides safety especially for their children and avoids dangerous situations like fighting, car accidents or drowning in the nearby river. Rarely would strangers enter into this area because all people in these villages are personally acquainted with each other making this area, neighbour's houses, and premises safe from stranger and theft. In addition, it is beneficial when creating a safe community and increasing 'control' over the place and society, this is one of five main criteria that Lynch (1984) states a good city must have.

This area is a multi-purpose area. In addition to the above activities, and because it is a big public open space, they are also sometimes used for threshing rice in harvest time during late summer; *Shahrivar* or September, and is used as a car park all year around at night and for farming machines during the farming period. Cars are restricted from moving fast into or crossing these spaces and are not sometimes able to occupy them, because of narrow and winding shaped alleys (fig 7.8, 7.9). Their floor material, which is clay or gravel, also intensifies this

[1]: According to ASHRAE, rice is the most difficult to process [drying] without quality loss. Rice containing more than 12.5% moisture cannot be stored safely for long periods, yet the recommended harvest moisture content for best milling and germination rangers from 20 to 26%. If the rice is harvested at this moisture content, drying must begin promptly to prevent heart-related damage which can result in "stack-burn" a yellowing of the kernel (ASHRAE, 2001, p 11.13)'. Although locals have not known about this statement of ASHRAE, they have gained this knowledge by last long experiences from many years ago.

characteristic discouraging the cars to move fast. These two characteristics have been employed by some neo-traditionalists and applied in the design of new neighbourhood for urban areas *'based on curvilinear streets, which are used to provide variety and changing street vistas, and cul-de-sacs, which discourage speeding and promote quiet and safety* (Ryan, McNally, 1995, p.96)*'*. To some extent, it has the same role as alleys in *mahalleh* within traditional Iranian settlements. '*The winding narrow alleys were linking the quarter's centre with the bazaar on the one hand and were ended in cul-de-sacs on the other* (Sharifi, Murayama 2013 p.130)*'.* This situation is changing very fast; the streets are widening, straight instead of being windy and are becoming asphalted because rural residents and official authorities believe that they are modern characteristics of urbanisation and are signs of development. These changes allow cars to use them and move at a faster speed. This results in making these previous quiet communal spaces unsafe and even dangerous for residents especially children, and discourages and eliminates a considerable part of community interaction and cohesion.

In most cases, these spaces do not have a formal geometrical shape. They are formed inside or beside the alley or cul-de-sacs and therefore are not necessarily distinguishable geometrically. There are generally more than two female communities in every village, which transitioning people[1] who, are originally from the village also participate in activities taking place , adults build relationships and children play with each other. Mobile retailors within some villages come twice or three times a week to this area to sell products brought from the city area (fig 7.20 to 7.23).

1: Transitional people in this research are who originally from the village but live in another place in town or city and go to the village during holydays visiting their parents or families, and some of them have their own house in the village or stay in their family's home. New comers are not originally from the village but buy a land and go there temporarily as transitional people or permanently but have their own house. Strangers are from other villages or every person who village's residents do not know him or her.

Figure 7.16: Female community besides the main street.

Figure 7.17: Female community besides a street in front of the house entrance.

Figure 7.18: Female community in Cul-de-sac, women are chatting while the kid is playing.

Figure 7.19: Female are boiling pomegranate to make its puree, an activity that takes place once a year. This is repeated for producing bitter orange puree once a year too.

This type of women's community involves maximum of 10-12 families whose dwellings are in proximity to this space or adjacent to each other unlike the village centre, which involves all residents and families of the village. Indeed, women make different clusters within the village for themselves, although their gathering area has no geometrical or functional definition. Aiming to improve its function and enhancing social and cultural cohesion, in addition to safety and security of children and residents, woman should be encouraged to come out and use this area more (Gehl, 2010). Planning and designing some specific and distinctive areas as a necessary space for this function, undoubtedly brings more females outdoors, making this area and village alive, dynamic and delightful (Montgomery, 2013).

Figure 7.20: Mobile retailor in female community in Perija.

Figure 7.21: Mobile retailor in Diva.

Figure 7.22: Another mobile retailor in Diva.

Figure 7.23: The same mobile retailor in the same place during another day in Perija.

C) Adolescent community and Patough

This space supports different kinds of interactions and communal activities dominantly performed by adolescents. In most areas, this is formed at a junction working as a node beside the main road of the village, where it originated or passing through the centre of the village and is the main path for humans and all kinds of agricultural and personal vehicle. It is seldom formed along narrow alleys or streets. Although it is reminiscent of Jacobs' (1961) *'street neighbourhood*', it is different because residential houses are the only buildings located around this

main road of the village and it is unlikely to be mixed-use. On the other hand, travellers who commute along street simultaneously control this space like '*street neighbourhood*'. Sometimes specific shapes define and separate territory of this space from the street or other village space into looking like Lynch's defined community area (1960). Young male adolescents usually occupy and control this *patough*, they are mainly between 9 and 12 years of age. They are not necessarily from the same alley but from different close alleys of the village gathering within the closest *patough* appropriated for their age (fig 7.24 to 7.27).

This space can hold sports activities like football especially during summer vacation days since there is no specific sport centre for adolescents within villages. This area is usually from 100 to 500 metres square, which is suitable for other activities needing a bigger area such as wedding party. In this regard, this area facilitates the instalment of a communal tent (fig 7.28), which accommodates 50 to 100 guests. This usually takes place in the autumn after the end of rice harvesting when farmers have enough time and money to hold celebrations. This area, as well as the female *patough*, does not usually have a formal geometrical shape. However, it does sometimes have a distinguishable shape, the outline of this area is usually not straight nor completely curve, it tends to be organic.

In addition, this space functions as a perfect place for threshing rice in harvesting time during the late summer; *Shahrivar*, separating rice seed from its stalk and as a place to spread rice seed to be dried under the sunshine besides being used as a car park at night. In comparison to the female *patough*, adolescent *patough* has a larger space encompassing more houses and population but the quantity of this kind is less than female *patough* within the village.

Sometimes, a very small *Baghali* shop, _ a small supermarket selling most daily essentials_ is located in this area within a maximum of 5 minutes' walk from all houses in its territory; this enhances the efficiency and performance of this place. Young adolescent females are usually sent by their parents to purchase_

Figure 7.24: Adolescent community within unused open land of the village.

Figure 7.25: Children are playing football with plastic ball besides the street.

Figure 7.26: Children are playing volleyball by the public bath close to the Centre of the village.

Figure 7.27: Children are playing together in an alley.

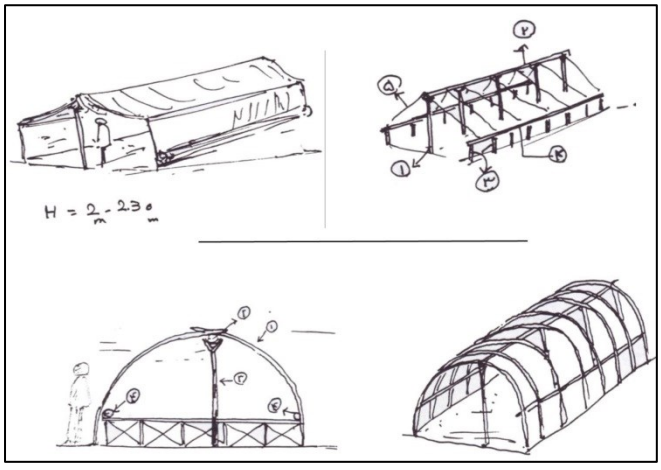


Figure 7.28: Two types of tent mounted with wood and covered with nylon sheet.

_small items as this shop is close to their house. Therefore, it is one of those rare opportunities for girls to go out freely by themselves; this naturally attracts more

adolescent males to the area. It would be a rare opportunity to see females of their community. This characteristic makes this area an interesting place for this group. Accordingly, this area is the other essential open area of the village for intensifying social and cultural interaction that needs to be considered in any plan for the future development of villages.

7.2.2.3 Street and alley network

Traditionally, villagers just used to walk through and commute within villages. They also used to transport agricultural yield and food products on horse within the roads of the village, it is a place for their poultry to parade, and graze. Therefore, streets were responsible for these functions, usually narrow and organised hierarchically with different widths from 1.5 metres to a maximum 10 metres, this serves different residents needs and purposes (table 7.1). In addition, streets are a public place used for socialisation such as meeting and greeting (fig 7.29).

Table 7.1: Hierarchy of alley and streets within villages, (It should be noted that their exultancy depends on the scale of the village, too)

	Range of Width (meter)	Number of houses	Main function	hierarchy
1)Alley or dead end	1.5 – 2	4-5	Human Access to houses	Private alley
2) Alley	2<W≥6	20>a<40	Human and residents' car access	Semi-private
3) Street	6<W≥8	40>a<100 or whole village	Access and all human and cars daily commuting	Semi-Public
4) Main Street	w>8	a>100 or whole village	Village spine Connecting to other village	Public

Figure 7.29: Two pictures indicating the function of street as a social space.

Traditionally, the territory of land of dwellings has no geometrical shape, and is completely organic so the alleys and streets in between and connecting them are organic and winding. This characteristic offers different vistas to the same alley and village making perspectives diverse. It also limits the driving speed of cars, which prevents dangerous and noisy driving. In addition, the floor of most alleys and streets were traditionally muddy, which according to the climatic condition of the region with having many rainy days and high precipitation, made commuting difficult and unpleasant (fig 7.30, 7.31).

Sidewalls of alleys were traditionally a maximum of 1.5 metres in height; this has now risen to a maximum 2.5 metres. This provides a wide proportion for alleys proper for sunshine absorption, and conduction of wind circulation through the context of the village. Most spaces behind the sidewalls of alleys are gardens, courtyards, and other open spaces belonging to the dwellings and other buildings giving low enclosure degree to the alley.

Figure 7.30: Network of streets and alleys in Diva. Pictures are framed with the same colour as relevant street colour (source of the map: Housing foundation of Iran, 2014)

The definition, function, and characteristics of alleys and streets have dramatically changed because of a revolution of lifestyle, transformation of transportation means, and prevalence of employing new vehicles for agricultural purposes. Currently, with an increased use of cars and farming vehicles, the streets and alleyways are becoming wider even up to 48 meter responding to this new demands, type of access and functions in result of 'Guidance Plan[1]' prepared by the Housing Foundation of Islamic Revolution of Iran. Mostly, no pedestrian access is provided and the street's floor has become asphalted. All changes intensify the functionality but improvements are mainly for cars and vehicles to pass smoothly, conveniently and fast. They are changing the nature of the village from being organised as a '*human base*' settlement to be a '*car base*' settlement (Gehl, 2010; Moughtin, 2013). Cars drive very fast making noise and pollution that_

[1]: This is a kind of comprehensive plan provided for development of villages in Iran

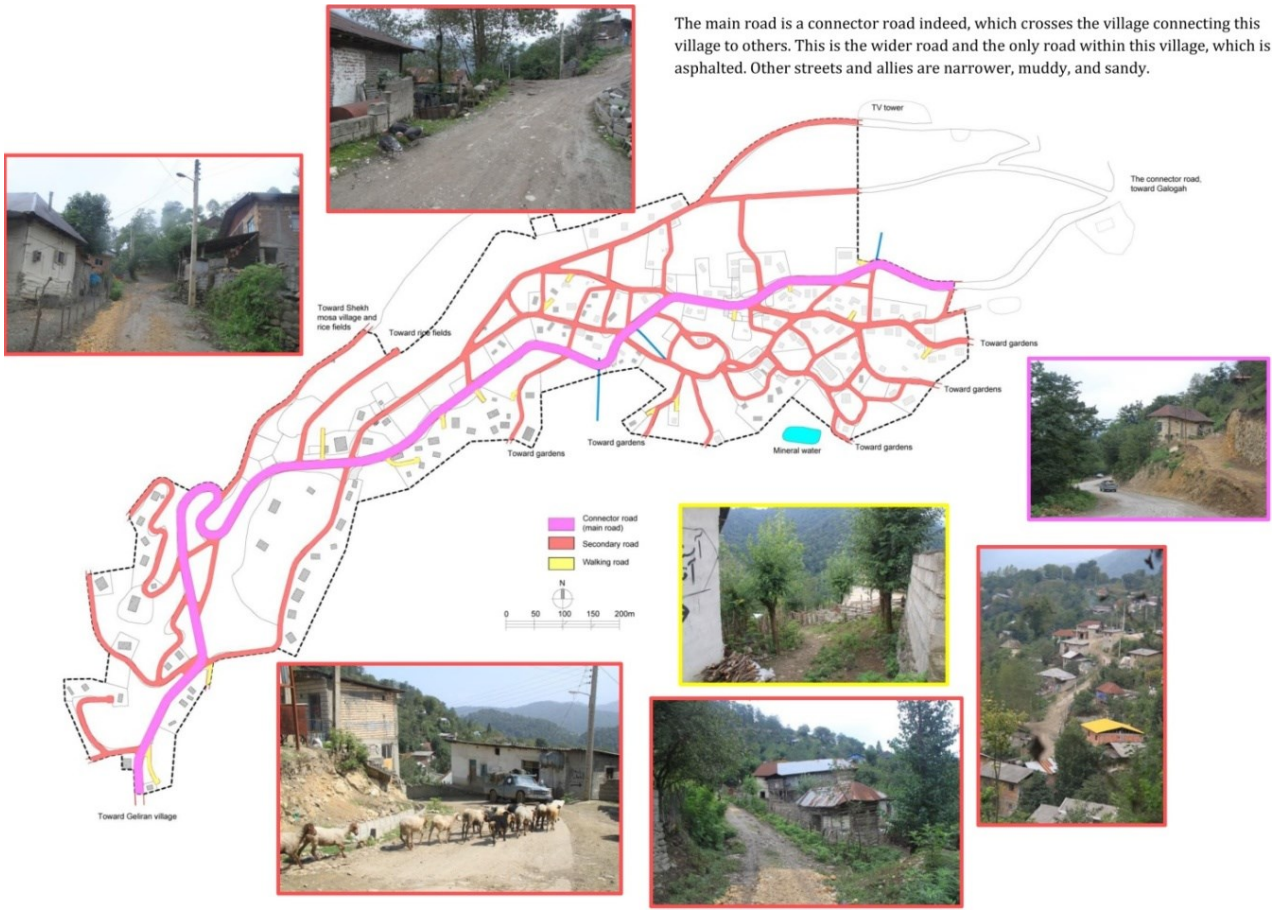


Figure 7.31: Network of streets and alleys of Perija a village within the forest area. Pictures are framed with the same colour as relevant street colour. (Source: Housing foundation of Iran' 2014)

_ together make a dangerous environment for pedestrians spatially children. This situation is increasingly destroying formation of communities and their permanency along alleys endangering social cohesion and interactions. Additionally, cars and other agricultural vehicles are parked at the side of streets where children play and women gather so it destroys the shape of these precious communities as well.

Some houses are accessed directly from the alley or street, usually because of being a small land area (fig 7.32). However, most houses have large land areas and so are not accessible directly from alleys or streets. One needs to pass the entrance, entering into an open area of the dwelling; the house is only accessible from this area. Therefore, the main facade of houses and orientation was not traditionally related to the place and direction of these alleys or streets, the

orientation was influenced by culture and the climatic conditions of the region as well as division of lands, the shape and form of dwellings.


Figure 7.32: Two houses located by the street and is accessed directly from street to inside.

7.3 Conclusion of chapter 7 and part two

Four villages located in the forest area and the forest border (foothill), have been studied as case study research. The rice fields are separated from the residential context located down the hill by the river, which is sometimes close to the village or far from it. The village's residential context is located on the hillside usually towards southerly direction.

Each village is independent and has its own facilities, necessary public buildings and open spaces according to this culture. Different groups based on gender and ages constitute their own community when socialising and doing their favourite activities. Villages provide different spaces appropriate for socialisation. This should be considered when designing new villages or developing existing ones as it improves social cohesion and safety.

Streets and alleys are not just for commuting but also places for doing some particular agricultural activities. They act as a social place for females and children to gather, play, and socialise, and are a meet and greeting place for all villagers. They specially were human-base indeed. The width and other characteristics of streets and alleys are conformed to these functions. Currently, because of changes such as asphalting and widening the streets and roads of the villages, the

community is increasingly becoming car-based. This situation causes severe problems for social groups and community to be shaped because of noise, pollution and danger produced by fast speed cars. Within most villages, the old traditional characteristics of streets are still compatible with new life style of villagers even for cars to commute easily, except the material of roadbed, which needs to be modified. Social characteristics of alleys and streets should be highlighted when designing them for benefit of human rather than cars.

Buildings are detached from each other to have the best opportunity for absorption of sunshine and benefits from wind. Buildings with a garden and orchard make the context of the villages incompact. Because of these characteristics, this has been defined as another type of sustainable human settlement besides compact settlements (Moughtin and Shirley, 2005). Therefore, new buildings in the villages of this region should be detached, merged with open green areas such as gardens or orchards and the village should be incompact. These are key characteristics of villages in this region, which need to be preserved and improved in order to promote their cultural, climatic and social sustainability.

Accordingly, some activities pertaining to local daily life take place within the public area of the village. The activities that all genders and ages do such as meeting and greeting, playing of children and accompanied with doing some food production related activities form systems of activities in village scale. These 'systems of activities' take place within 'systems of settings' as public areas of the village such as the religious complex, street, alley, node, and main square depending on the season and time of the day. These systems of settings provide appropriate conditions for the above-mentioned communal systems of activities.

Some of these settings support the performance of some activities belonging to dwelling space. For instance, meeting and greeting takes place within all kinds of *patough* areas, which have the same role as a living room within dwellings. For example, residents can meet each other within *patough* and chat together rather than doing that within their homes; they can nurture poultry in the street rather than within their own garden. This has been stated by Rapoport (2006a), pertaining to the role of public houses in the UK, that this building works

as a life space letting users have smaller residential spaces such as living rooms. Therefore, these spaces should be considered as a part of a dwelling's 'systems of settings' and need to be considered when designing new dwelling.

Dwellings are the major buildings of villages and are combined of 'systems of settings' pertaining to the daily life and food production. This topic will be discussed in detail in the next part and chapters.

PART THREE

Dwelling's Physical Characteristics

& Development of the Model

Chapter 8

Physical Characteristics of Dwelling and the Use of Spaces

('Systems of Activities' within 'Systems of Settings')

8.1 Introduction

Dwellings are the main components of a village in Mazandaran. Traditionally, they do not only consist of one building but are a kind of residential complex called '*sere'* which includes enclosed settings (different buildings) and different open settings. These buildings are all located in a private land, which is called 'property' in this thesis. Dwellings are not only designated places to accommodate life activities but also to undertake production activities particularly food production. All of these activities are located in either enclosed or open settings. Indeed, they are constituted of systems of settings, which are closed or open where systems of activities related to life or food production take place (Rapoport, 2006a, p.20), and are positioned to take place in property *(sere)* and inside the house building. This chapter concentrates to study systems of settings within the properties and houses to reveal included systems of activities and to identify what kind of settings, villagers prefer for their new housing. This is accompanied with a description and analysis of their characteristics and principles.

There is an information gap about the vernacular architecture of the region; there is no appropriate information or research about dwellings of the region. Specifically, there is a lack of dwellings' maps and information about the characteristics to be employed as the base data for this research. Therefore, 44 dwellings including vernacular, middle, and new styles have been studied which, based on pre-defined criteria according to the aim and objectives of the research, have been selected within four case study villages. They have been examined through measurement and mappings, all of these maps have been drafted and drawn using CAD software on computers. Further to this step, a study to define their typology has been conducted for both of the above-mentioned scales of dwelling, property and house, represented in appendix 5 represents the typologies along with an introduction of all related maps of those properties and houses. The resulting physical analysis coupled with the results of different questionnaires and

focus group interviews reveal new demands and characteristics of spatial preferences of the villagers. This is the main outcome of this chapter.

8.2 Properties[1] (*Sere*) and property types

Dwellings are located in land surrounded by solid walls, fences, or trees. The shape of the land or territory of the property is usually organic without any geometrical shapes. This boundary is common between two neighbours. The whole order, principles, buildings and functions related to properties are common in the forest and forest border areas but sometimes have some differences according to their main occupation or natural environment. The land of property encompasses different open settings and enclosed settings (buildings). Open settings are front yard (*sere pish*), back yard (*peshte sere*), garden and orchard, their location is defined by location of enclosed settings (all kinds of buildings) (table 8.1). The main living house building[2], livestock house, poultry house, bath and toilet are the buildings distributed within the property land. Sometimes poultry and livestock houses are located under the living house building on the ground floor.

Table 8.1: Table naming different main components of a dwelling

Property's main settings	
Open settings	**Enclosed settings**
Front yard (*sere pish*) Back yard (*peshte sere*) Garden and orchard Lateral open settings	The living house Livestock house Poultry house Nefar Outdoor kitchen Toilet Bath

[1]: Within this part of the research, dwelling and property is used to indicate the whole components of rural house including the land and all buildings and spaces located within. Moreover, house is used indicating just the building employed by residents as their home.

[2]: It means the building or house that residents themselves live in.

The location of the living house determines the location of all buildings, in other words, the location of the living house building defines the location of all open and enclosed settings, and activities within a certain land area. Open space around the living house is necessary according to climatic conditions. According to this point and in order to access the living house, one needs to enter to the land from the street by the entrance gate, into these open spaces of the property; it means usually into the front yard, sometimes from lateral side of the house or seldom from back yard. The location of entrance is significantly related to the location of both street and the living house, the form of the land and its elongation, and North Pole direction. The width of the entrance door must be wide enough for cars and agricultural vehicles in order to park inside to bring in rice yields, straws and other stuffs. This width is usually 3 meters.

The land area varies within villages and within each individual village itself. The smallest area of the land belongs to a dwelling located in Diva with 102.70 square metres; the context of this village is more compact than other case study villages. The biggest land area is 7589 square metres belonging to a house located in Firozja, which has an outspread context, and dwellings are located far away from each other. The land area is in average 817 square metres and the constructed buildings within it are156 square metres on average (appendix 4). Although this difference varies within different case study villages, this high amount of difference shows that the open area is bigger than the area dedicated to building enclosed settings, which indicates open settings have greater importance within dwellings of this region. These points to the role of open settings as the main part of dwelling to support residents when performing daily activities related to life and particularly food production. In this regard, land areas around 500 metres square have been recognised as suitable for dwellings where food production is the priority (Duany, A. and DPZ, 2012). It proves that the average amount of land of the dwellings within the region, which is 817 metres square, is suitable when supporting and improving food production activities.

The location of buildings within the dwellings is influenced by factors such as the location of the street, the location of the entrance, and location of neighbouring houses and their outbuildings[1]. Some outbuildings and open settings, particularly those dedicated to livestock and poultry nurturing have unpleasant odours and so these buildings are located at a sufficient distance from the living houses of the owner and neighbours as much as possible (fig 8.1,8.2).

In this regard, depending on the form of land, its elongation and north direction, the typology has been carried out on dwellings. The form of land in the region is organic and non-geometrical, which has been postulated as geometrical in this study to do typology. It is according to the methodology that Krier (1993) provided for preparation of typology for city public open areas based on the shape of those spaces. According to Krier's methodology, the closeness and similarity of proportion of a shape to a geometrical shape is enough to represent it as that geometrical shape. Accordingly, three main dwelling types have been identified. All of them are categorised into subtypes according to the location of street and entrance. All enclosed settings are distributed across the land according to the location of the living house and entrance and the direction of north[2]. General characteristics and principles have been explained below.

8.2.1 Property type (1)

This type represents lands with a rectangular proportion shape, which is elongated in an angle within east-west zone (table 13). The living house almost faces towards southerly direction and elongated in accordance with the elongation of the land towards east –west, except some new houses in which street location is the main factor for their orientation in that they face towards the east or even north. Dwellings usually have a front yard, back yard, and garden; other

[1]: All of service buildings and those belong to food production and stores except the buildings occupied by residents for living are outbuildings.

[2]: In this research, north direction represents north zone direction. North zone direction an angle from north-east to north-west which have approximately the same condition within the region. It is also the same for south zone direction as well.

outbuildings such as poultry and livestock house are distributed within them. A garden in this type is mostly located in the lateral side of the living house unless the house faces the east, so that the garden merged with the back yard (type1b), or the garden is eliminated if the dwelling is too small (type 1c). Having those open settings and outbuildings depends on the area of the land and the size of its edges. Accordingly, the width of the land determines whether that dwelling could benefit from a back yard, front yard, or garden so that the width is deterministic in this type. In respect of the commonalities and differences, this type is divided into four sub-types based on four different directions of entrance; these have been represented in the table 8.2. Additionally, some samples have been introduced in figures 8.3 to 8.6.

The entrance could be accessed from the front yard or lateral side of the land depending on the location of the street, which in most cases it allows access to the living house from these open settings. When the house is too small with no open setting or very limited land, the entrance is directly from the street into the front porch of the living house (type 1c). This type of entrance is becoming prevalent in new houses; the location of the street defines the orientation of the house and accordingly the location of the entrance (type 1d). Moreover, within the vernacular style, there is no entrance into the garden allowing access to the living house except in new house style in which this pattern is becoming popular.

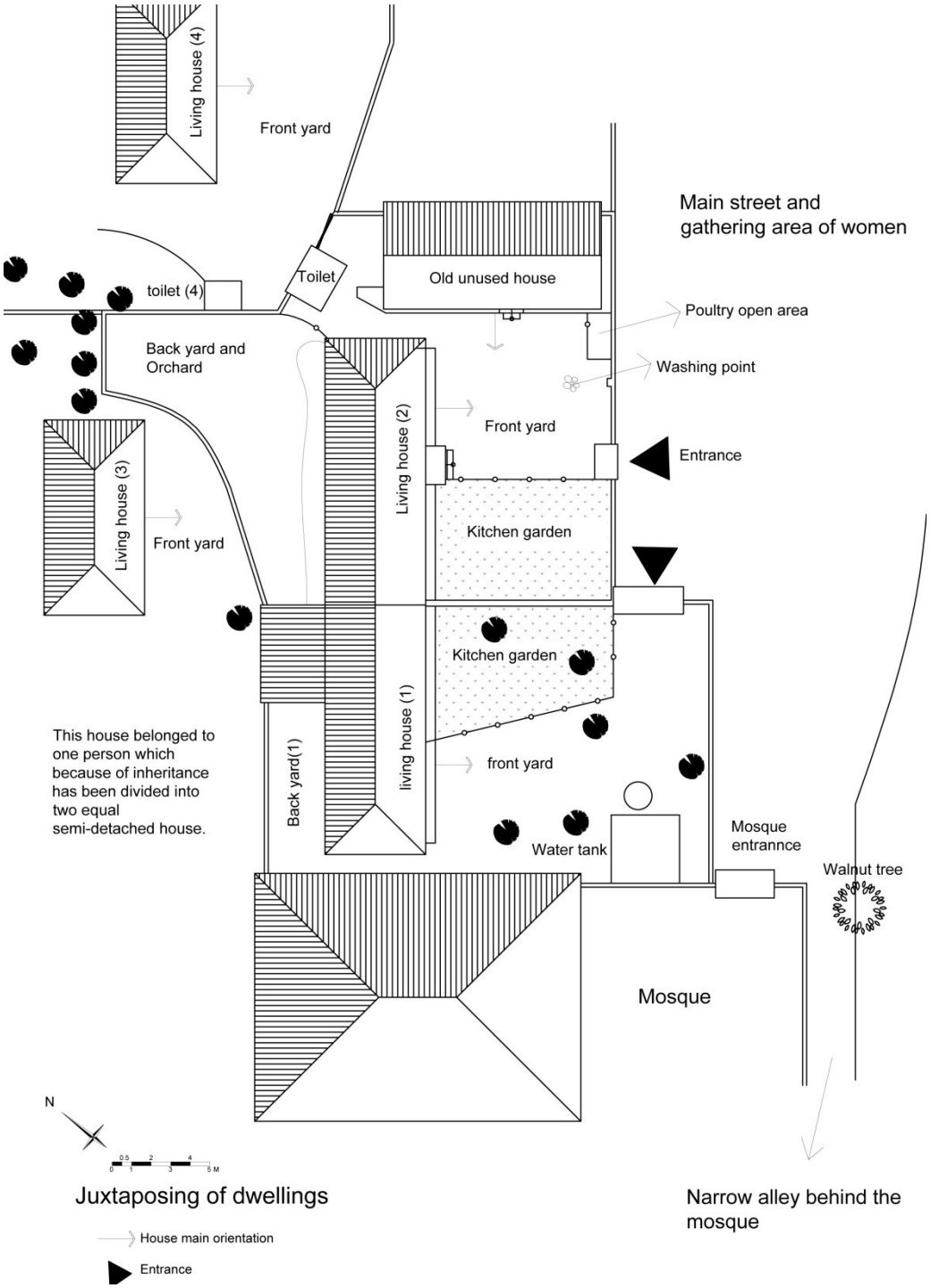


Figure 8.1: Juxtaposition of dwellings and their components besides each other within a village of the forest border

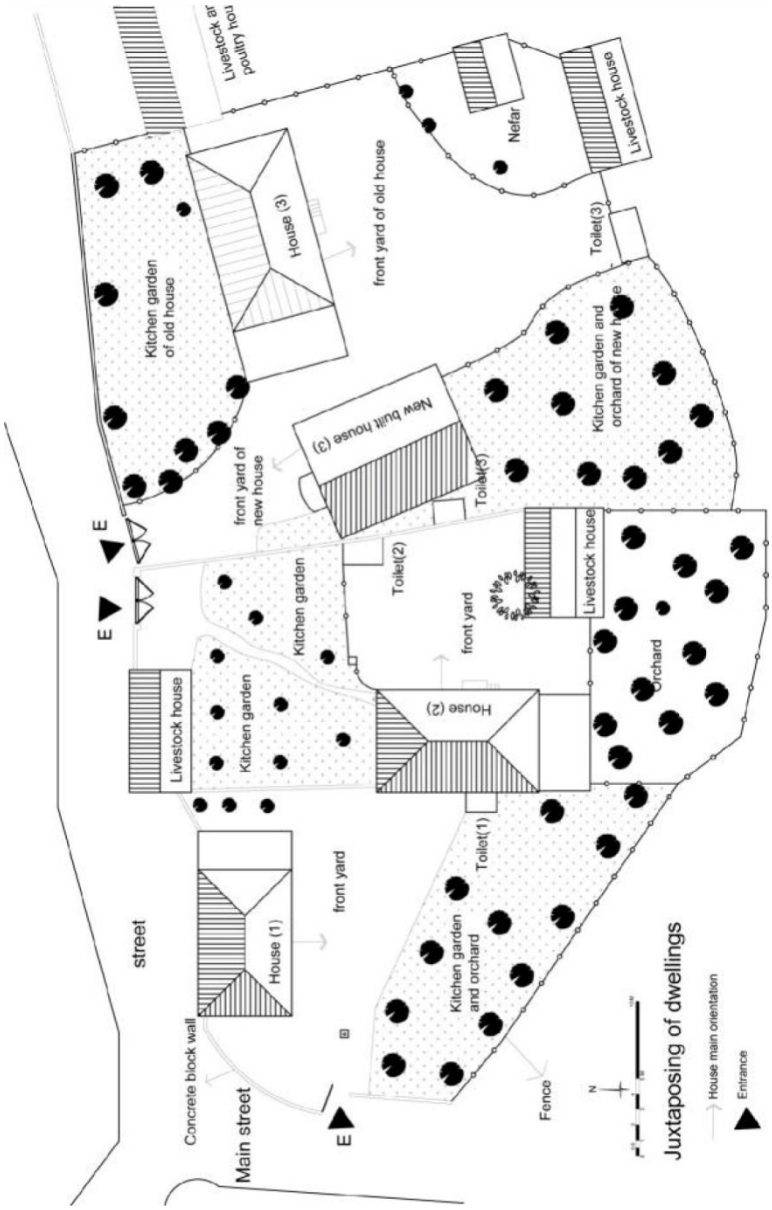
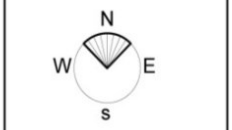
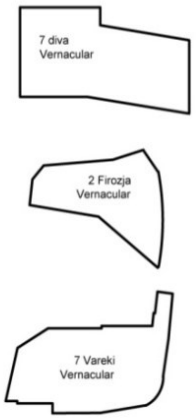
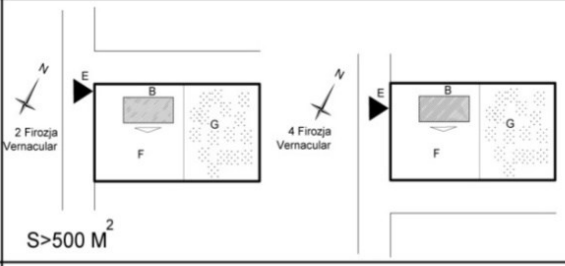
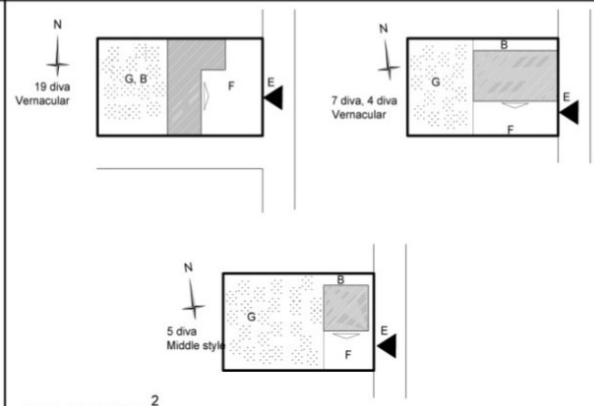
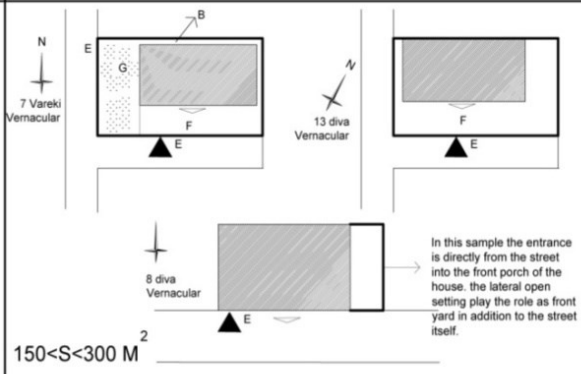
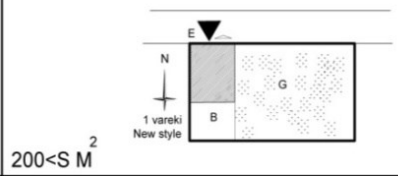


Figure 8.2: Juxtaposition of four dwellings and their components within a village of the forest area

8.2.2 Property type (2)

This type represents the land having a rectangular shape but, unlike the previous one, is elongated in an angle within north-south zone (table 8.3). The houses are usually oriented toward the south zone elongated like the previous type toward east west, which is the best orientation and elongation within this region. If the house has a garden, it can locate whether in front of the house united with front yard or in the back unified with back yard. Other service buildings such as poultry and livestock house are distributed within the garden, front yard or_

Table 8.2: Table represents property type (1) and its sub-types

Type	Land shape	Sub-type		Sample/s	Description
Type (1)	  This type represents the lands having rectangular proportion elongated east-west zone. Roads could be one or more located around any side of the land. The size of the land varies but within the table the range of size of each land belongs to each sub-type has been printed. Legend F: Front yard B: Back yard E: Enterance G: Garden S: Square area of the land Orientation Some of original land of this type 	Type (1a)	The main entrance is from western road		The dwelling is oriented toward south and elongated east-west. The entrance is from lateral side of the dwelling. Depending on the size of the land, the dwelling could have front yard, backyard and garden. Outbuildings such as the house for livestock, poultry, toilet and bath could locate in front yard or garden. this type just has been observed within vernacular dwellings.
		Type (1b)	The main entrance is from eastern or western road		The dwelling can orient toward south and elongated east-west, or can be L shape to get sunshine from south and east. Entering is first into the front yard. Depending on the size of the land, the dwelling could have front yard, backyard and garden. outbuildings such as the house for livestock, poultry, toilet and bath could locate in front yard or garden. This type has been observed within vernacular and middle style dwellings.
		Type (1c)	The main entrance is from southern road		The dwelling is usually oriented toward south and elongated east-west, the entrance is into the front yard from the road located in south side of the land. Front yard, backyard and garden can be eliminated because of land scarcity.
		Type (1d)	The main entrance is from northern road		This type has been observed just within new dwelling. The house is oriented toward north which is not appropriate within this region and elongated north-south. The entrance is from north into the ground floor which is pilot having no wall around. The dwelling does not have front yard as the house did not set back from the street and has been constructed exactly at the edge of the land's territory. But it has backyard and garden like traditional style. Outbuildings such as the house for livestock, poultry, toilet and bath could locate in back yard or garden.

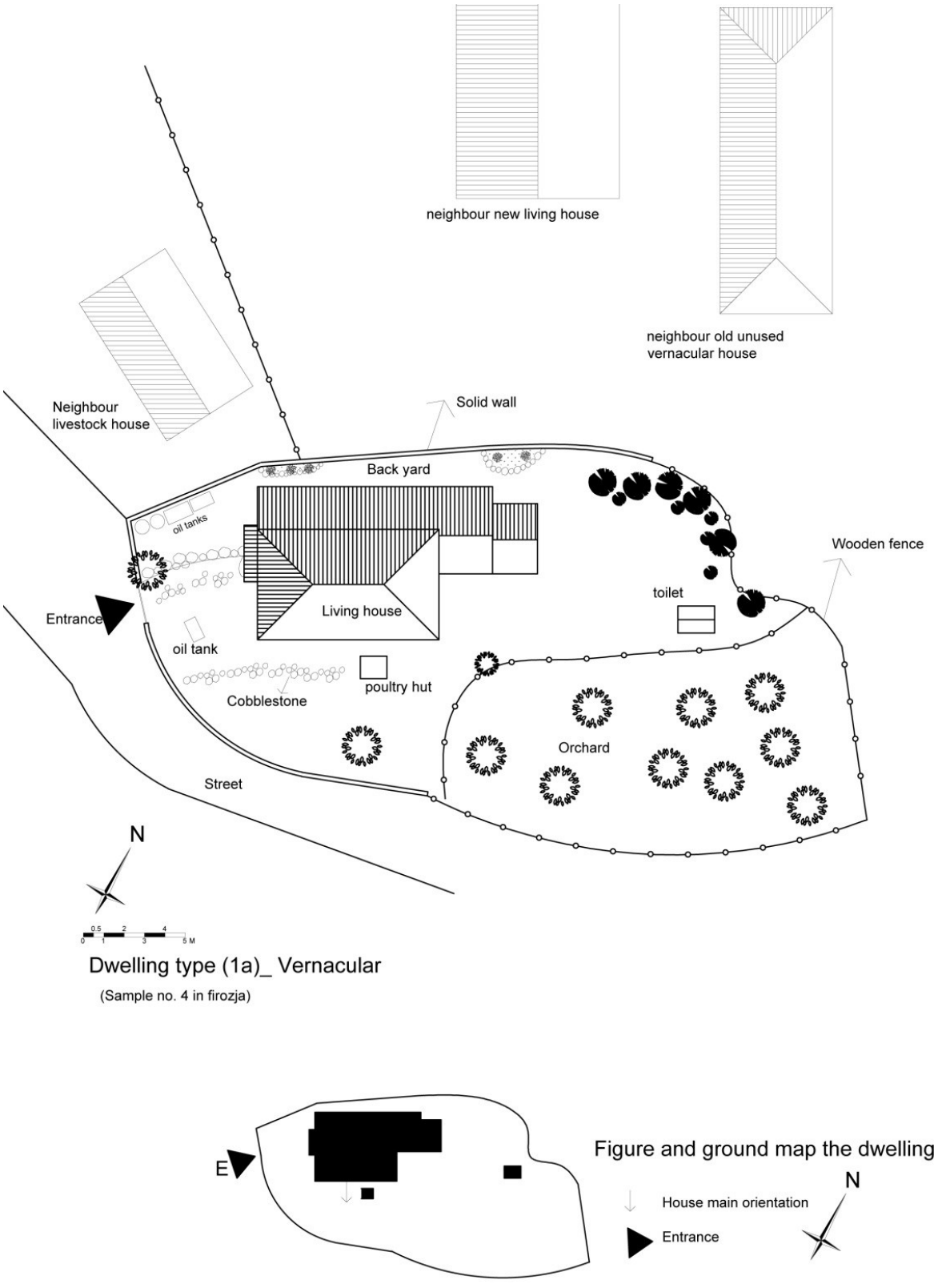


Figure 8.3: One sample of property type (1a) and its figure and ground map

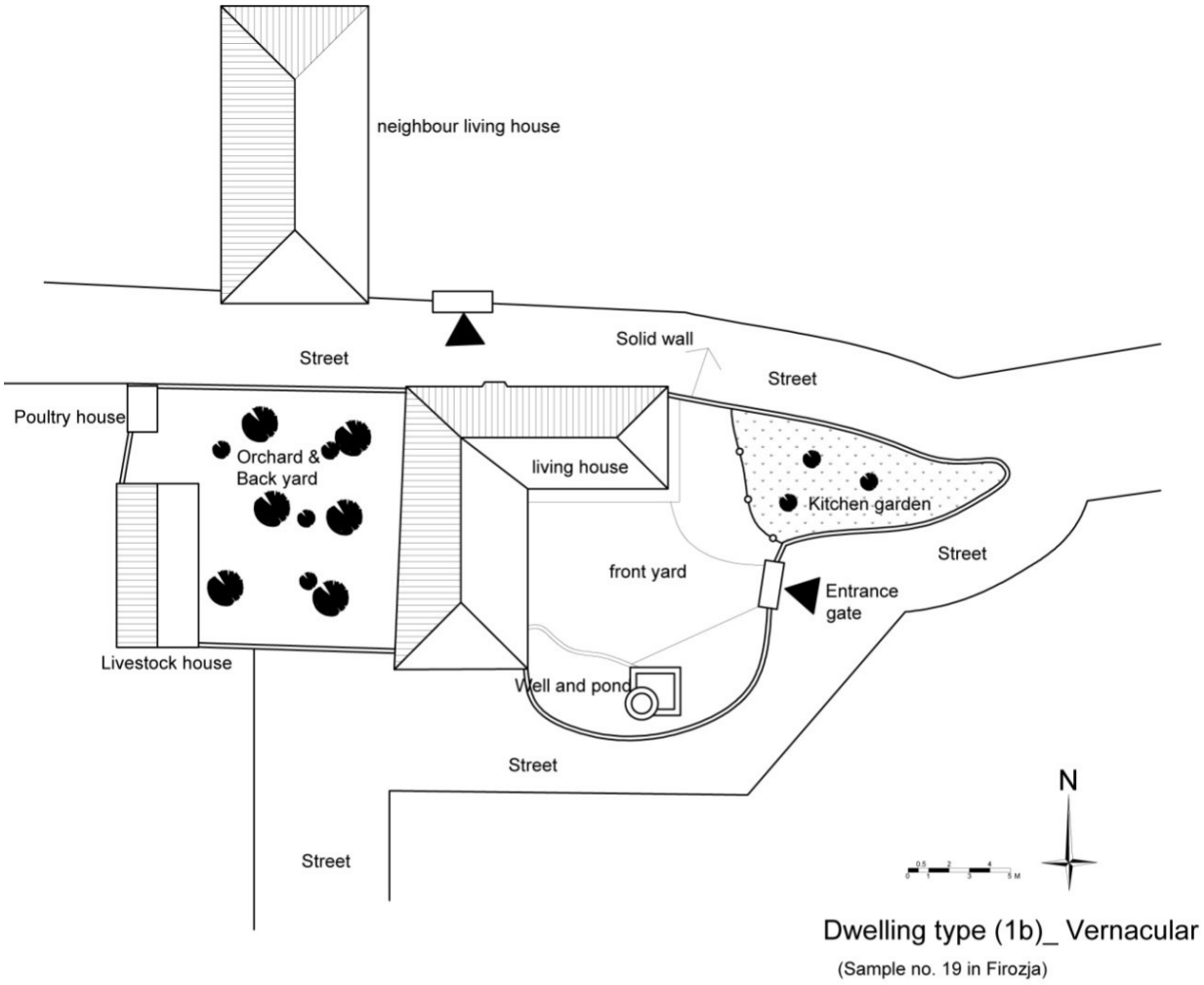


Figure 8.4: One sample of property (1b) and its figure and ground map

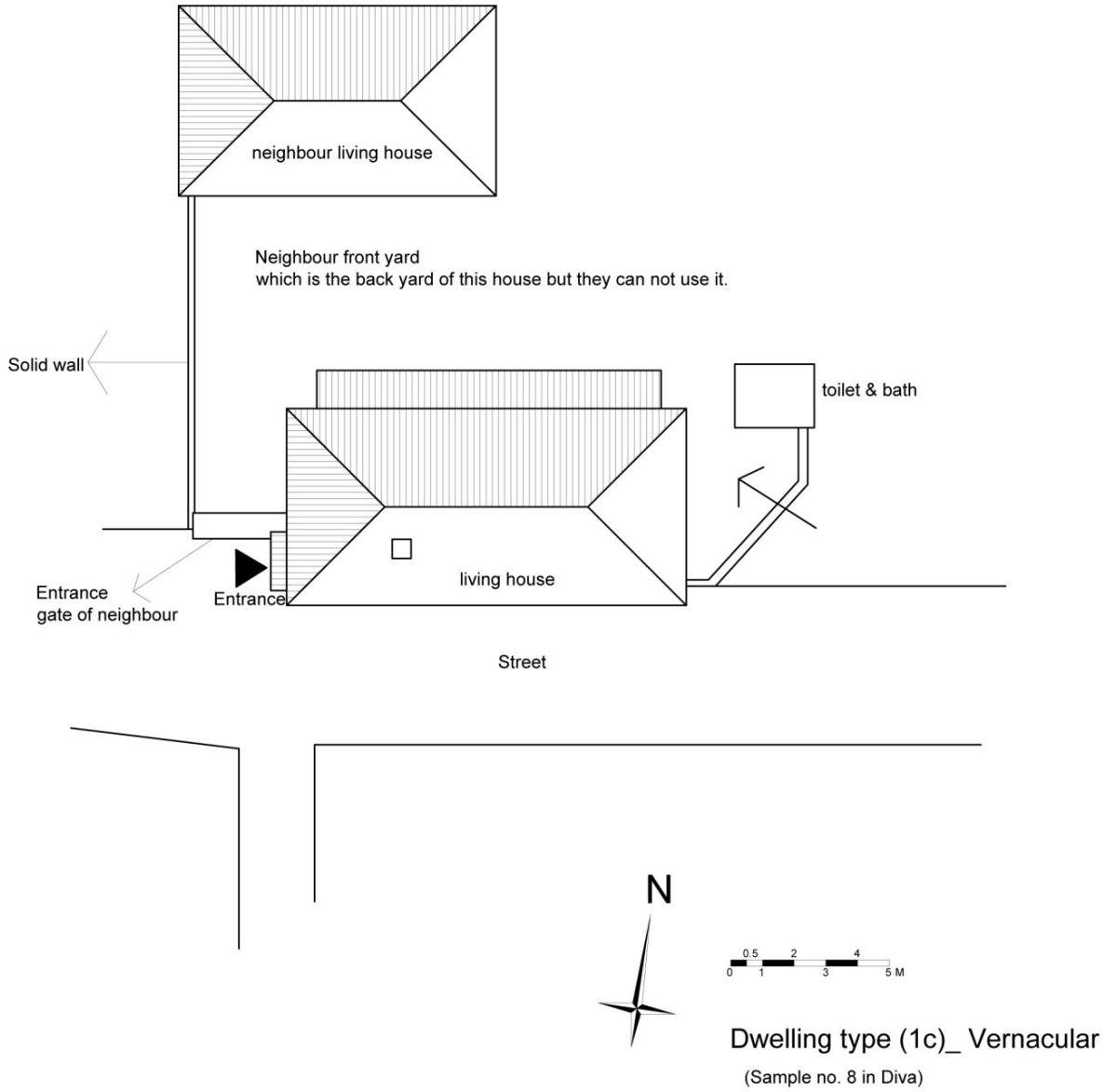
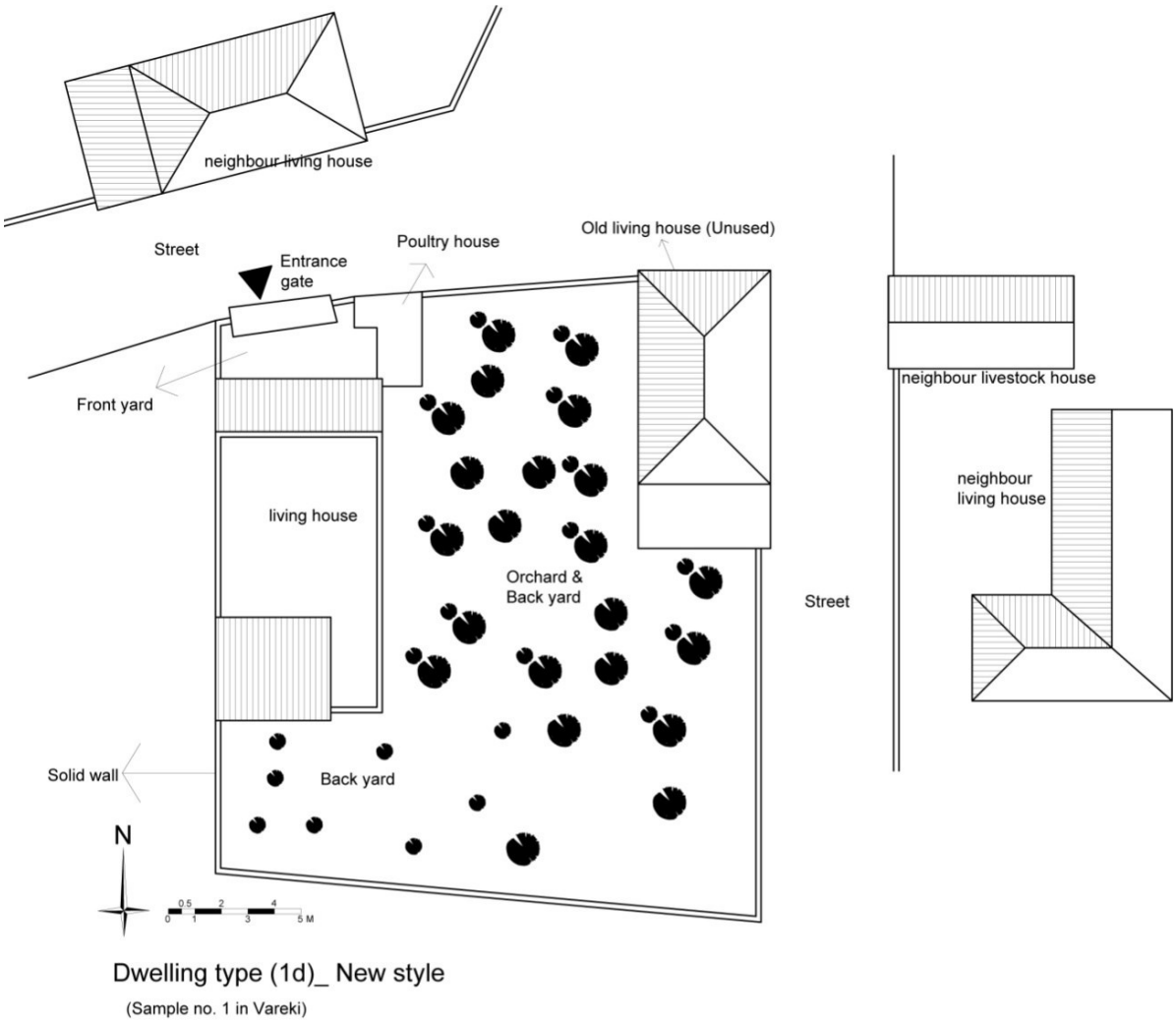


Figure 8.5: One sample of property type (1c) and its figure and ground map



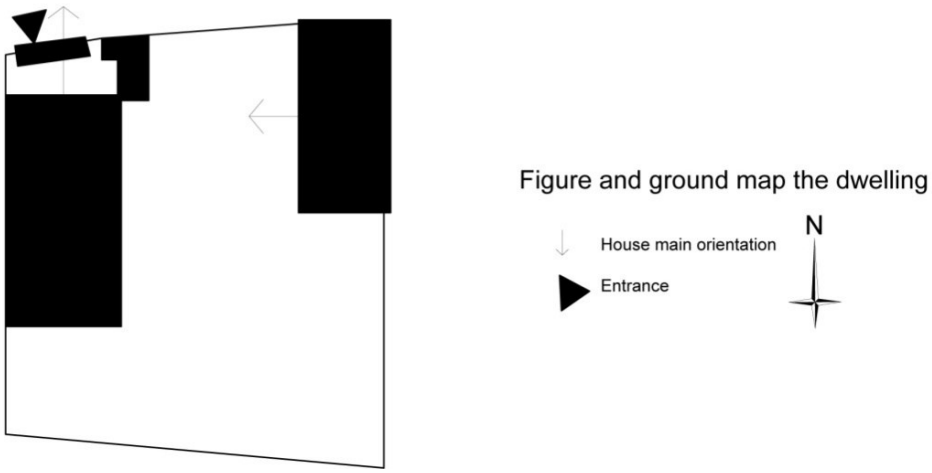
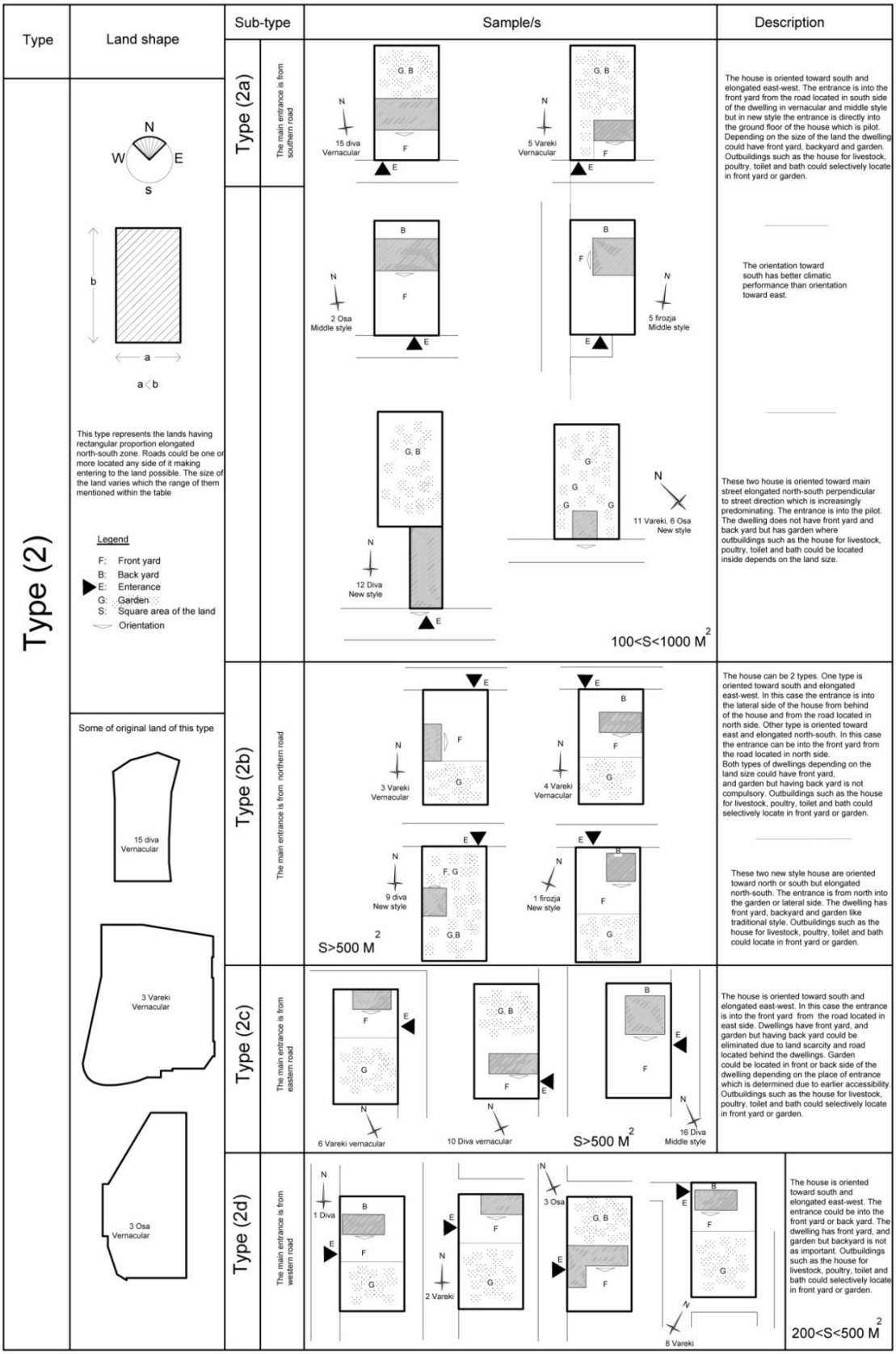


Figure 8.6: One sample of property type (1d) and its figure and ground map

Table 8.3: Table represents property type (2) and its sub-types



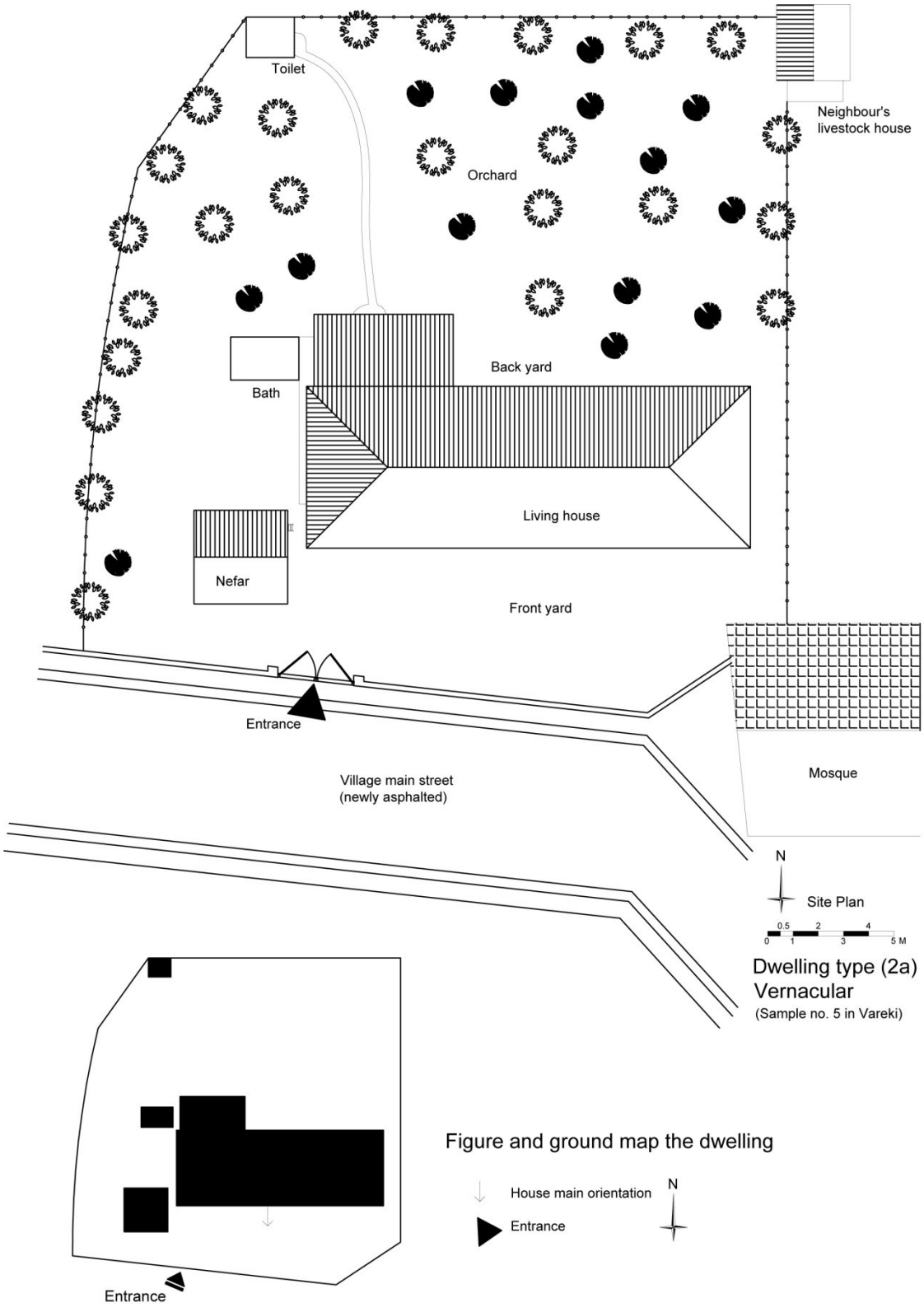


Figure 8.7: One sample of property type (2a) and its figure and ground

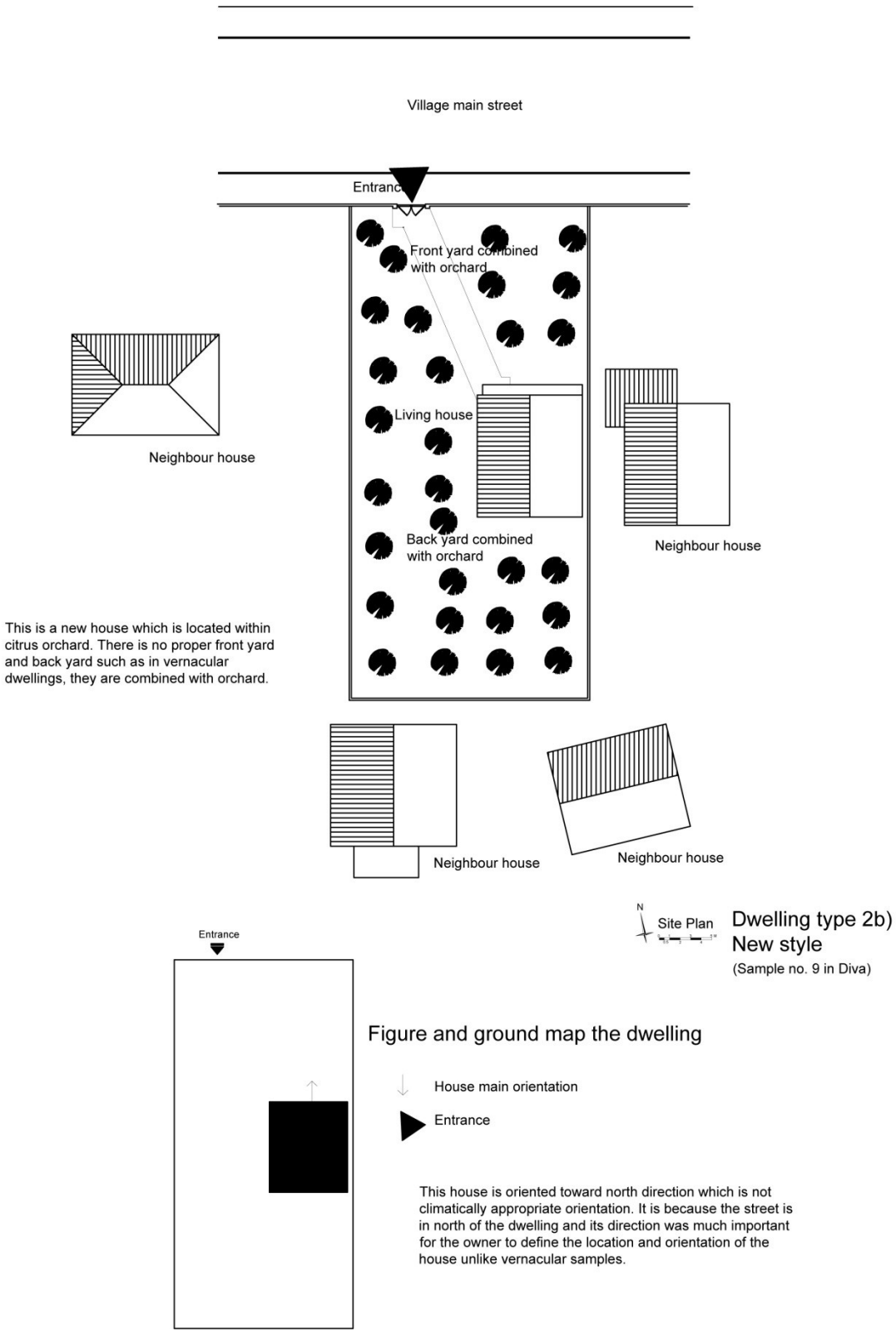


Figure 8.8: One sample of property type (2b) and its figure and ground

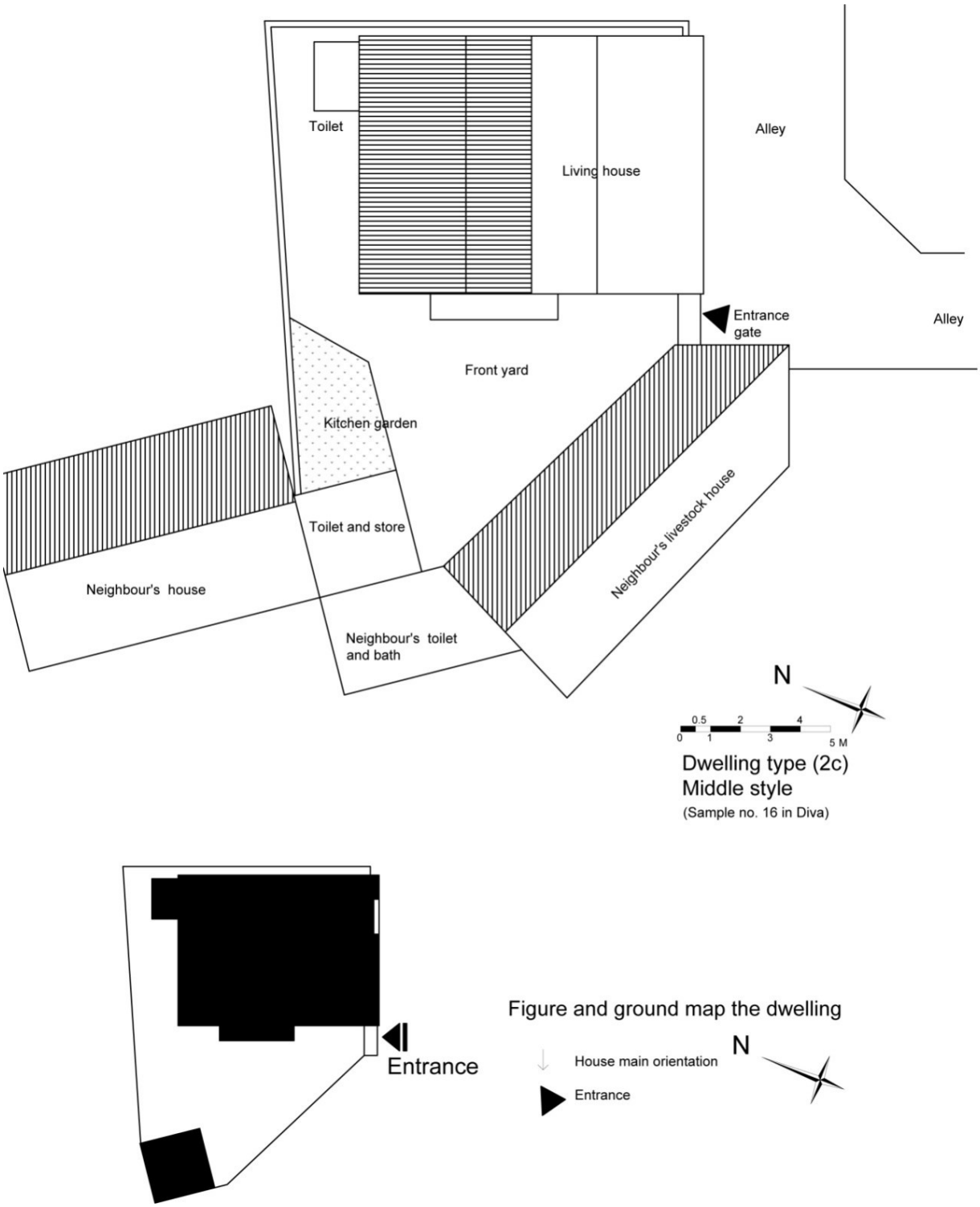


Figure 8.9: One sample of property type (2c) and its figure and ground map

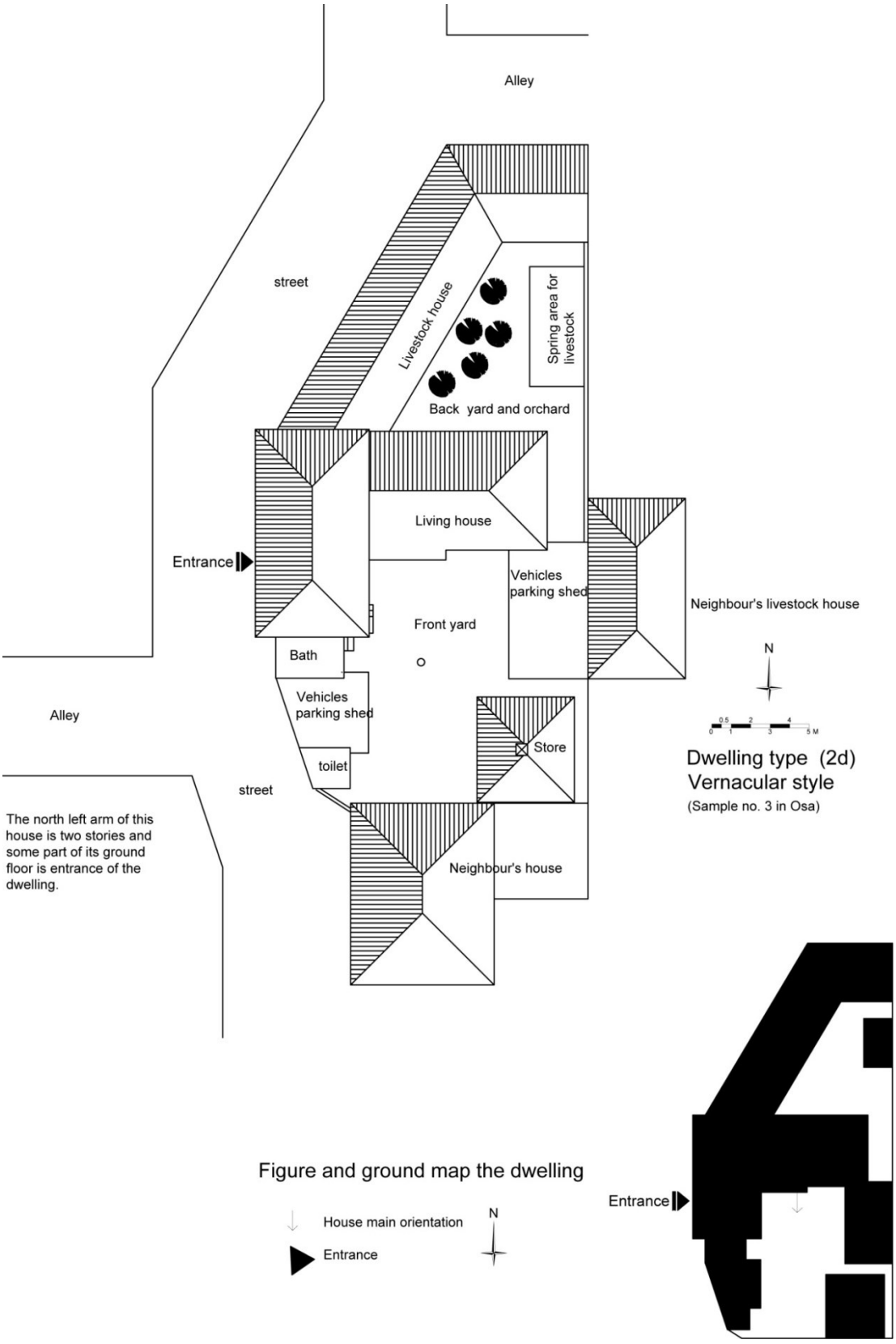


Figure 8.10: One sample of property type (2d) and its figure and ground map

_ back yard and existence of all of them depends on the size of the land. Unlike type (1), the length of the land determines the possibility of having these outbuildings and open spaces. According to the commonalities and differences, this type is also divided into four sub-types based on four different directions of entrance, which have been represented in table 14 and some samples have been introduced in figures 8.7 to 8.10.

The entrance could be from the front yard or lateral side of the land depending on the location of the street. Some new houses are built on the edge of land adjacent to the main street; in this case, access to the living house is not from open settings. Although the entrance is not intended as a route to access the living space in vernacular houses, the pattern of entering homes via the garden is becoming popular and resembles type 1. It should also be noted that, the area of houses and outbuildings within vernacular and middle style dwellings is bigger than in new style examples, sometimes there are no outbuildings dedicated to food production activity within these new examples. This is an indication that the role of food production is being weakened within new dwellings of the region.

8.2.3 Property type (3)

This type represents lands with approximately equal proportions and no significant elongation (table 8.4). The rules for elongation, location, and orientation of living houses, as well as location of the entrance, garden, front yard, back yard and other service buildings, are the same as within the previous two types. The only difference is the proportion of the land, which is not influential in configuration of the dwelling. According to the commonalities and differences within dwellings of this type, it is also divided into 4 sub-types based on four different directions of entrance, which have been represented in table 8.4 and introduced in figures 8.11 to 8.14.

According to those three main types of dwelling, major influential factors, which have played a significant role in the configuration of dwellings, are the size of the land, location of the street and climatic condition of the region. Within these

factors, the size of the land and climatic condition have prominent role in vernacular and middle styles while the location of streets is a particularly influential factor in the configuration of new.

These above factors mainly define the location and orientation of the house, the position of which then determines the location of other open and enclosed settings. Houses are usually set back from the street and are accessed from the open settings belong to the dwelling, and are located between the street and the house. This is common in vernacular and middle styles while in new styles due to the location and direction of the street, houses are located on the common border of the land and street without being set back. This is because most new houses are more than one story high, lifted the bulk of the structure off the ground, supporting it by *pilotis* dedicated to entrance, car and other vehicle parking or store, sometimes there are no surrounding walls. In this case, there is no open area between the street and the house, which means one needs to enter into the *pilotis* area and access to the inside of the house via using a staircase. In this regard, the role of open settings within new dwellings has diminished.

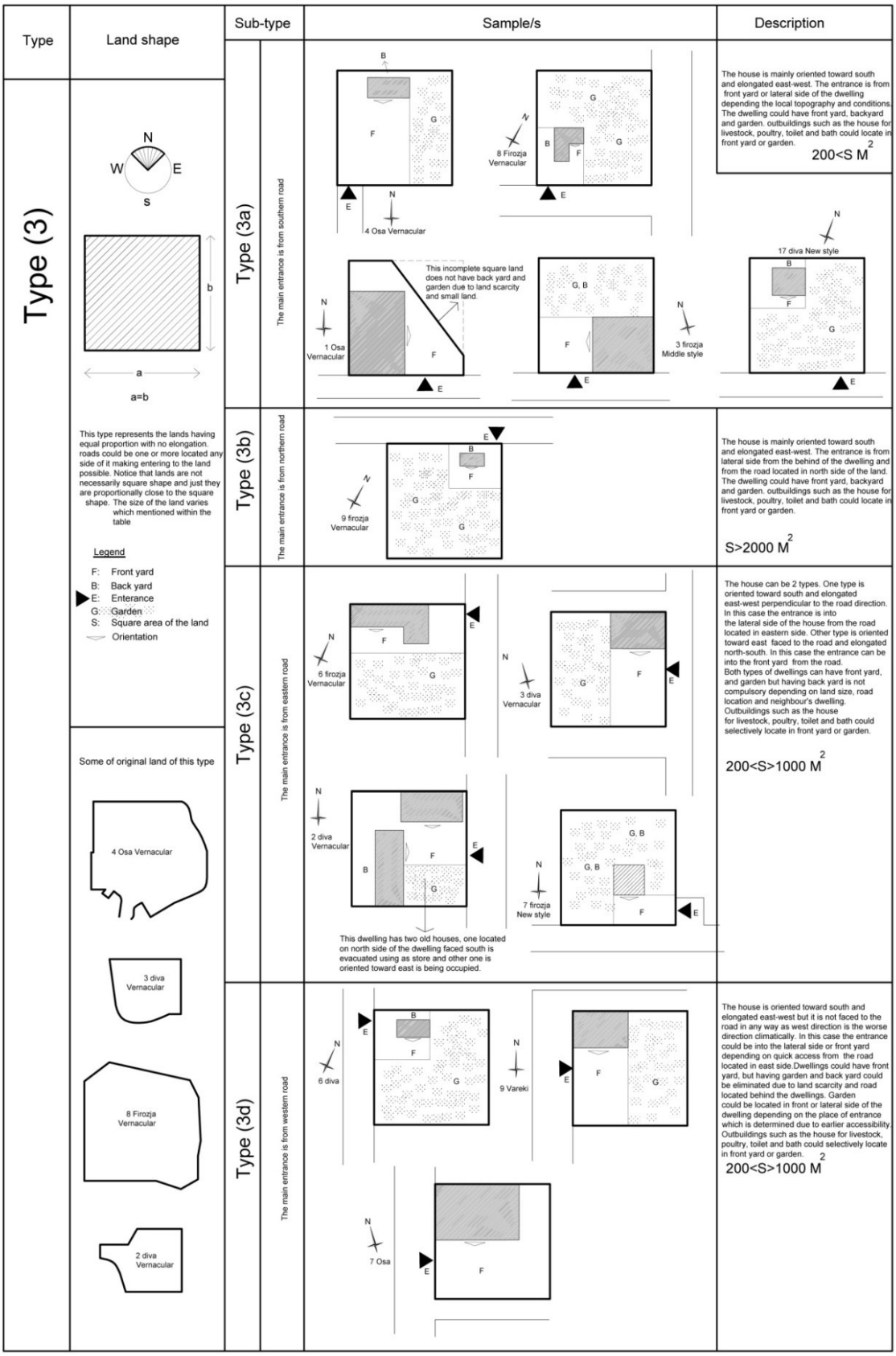
8.3 Open and enclosed settings

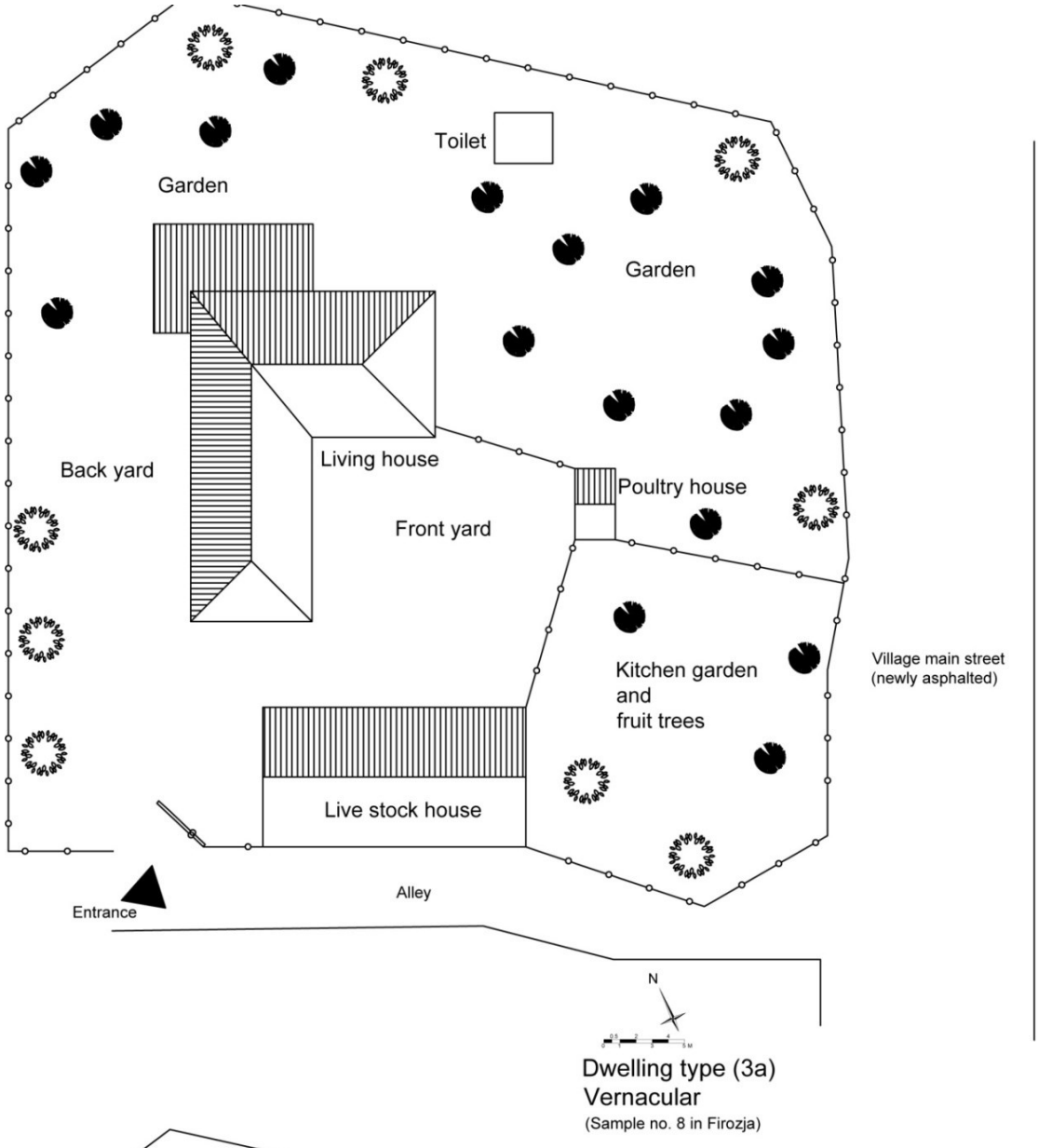
As seen in the typology, each dwelling has open settings and enclosed settings; this is common within all three styles and is the most important component of all types. However, the role and importance has changed due to transition from vernacular to new style. These settings are categorised within two main categories: open setting and enclosed setting.

8.3.1 Open settings and related systems of activities

According to tables 8.5, 8.6 and 8.18 representing 'Resident's activities and role of settings' within three different styles of dwellings, the main important open settings are front yard, back yard, and garden, of which a dwelling could have all or

Table 8.4: Table represents property type (3) and its sub-types





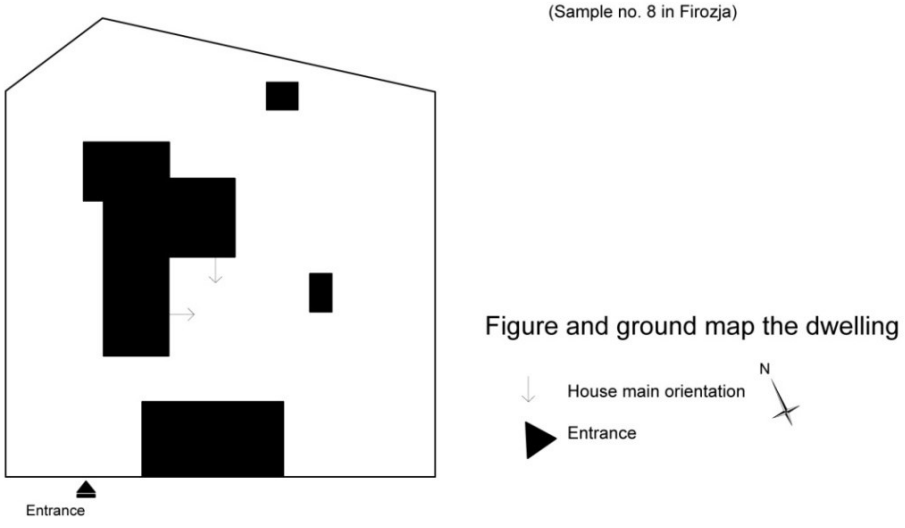


Figure 8.11: One sample of property type (3a) and its figure and ground map

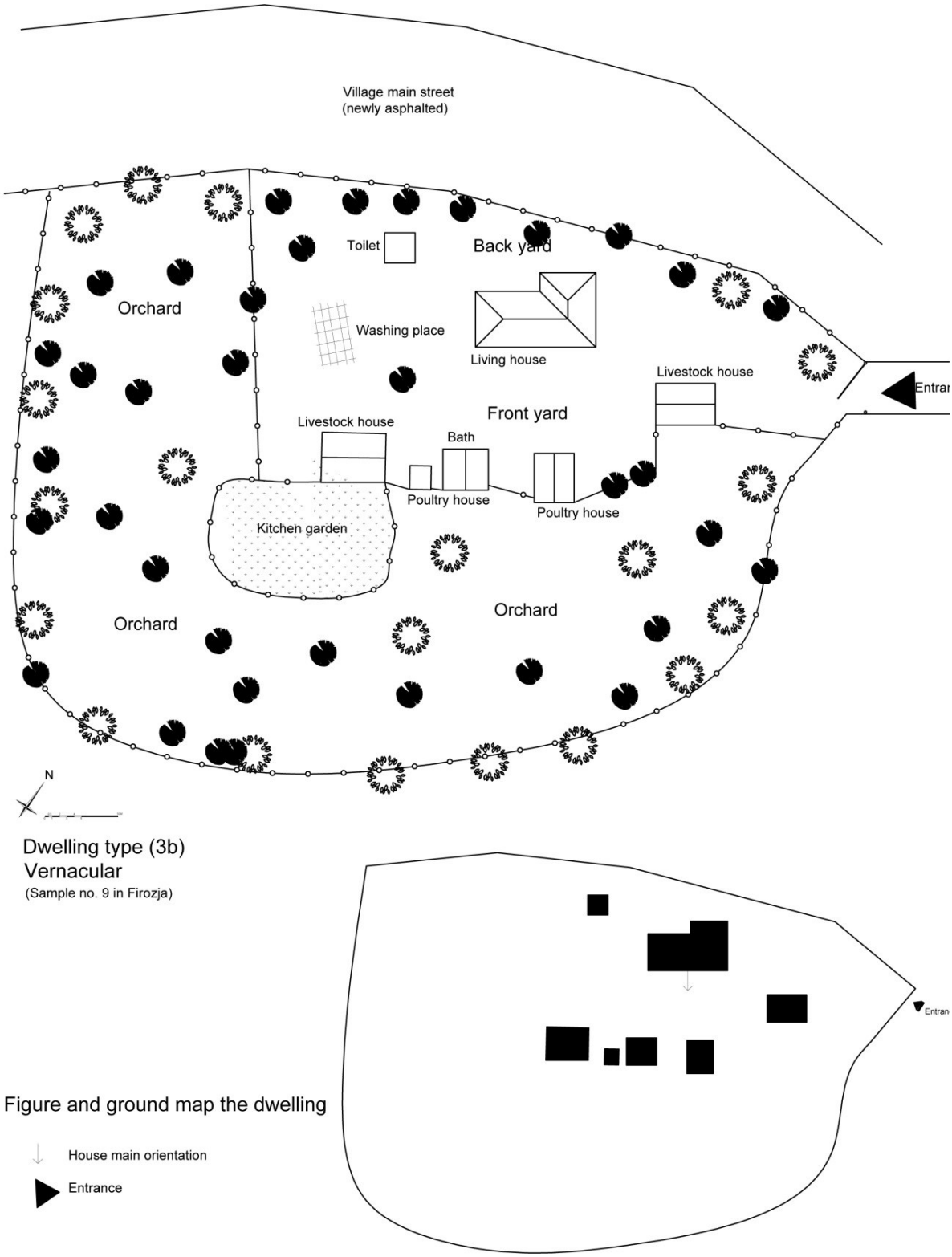
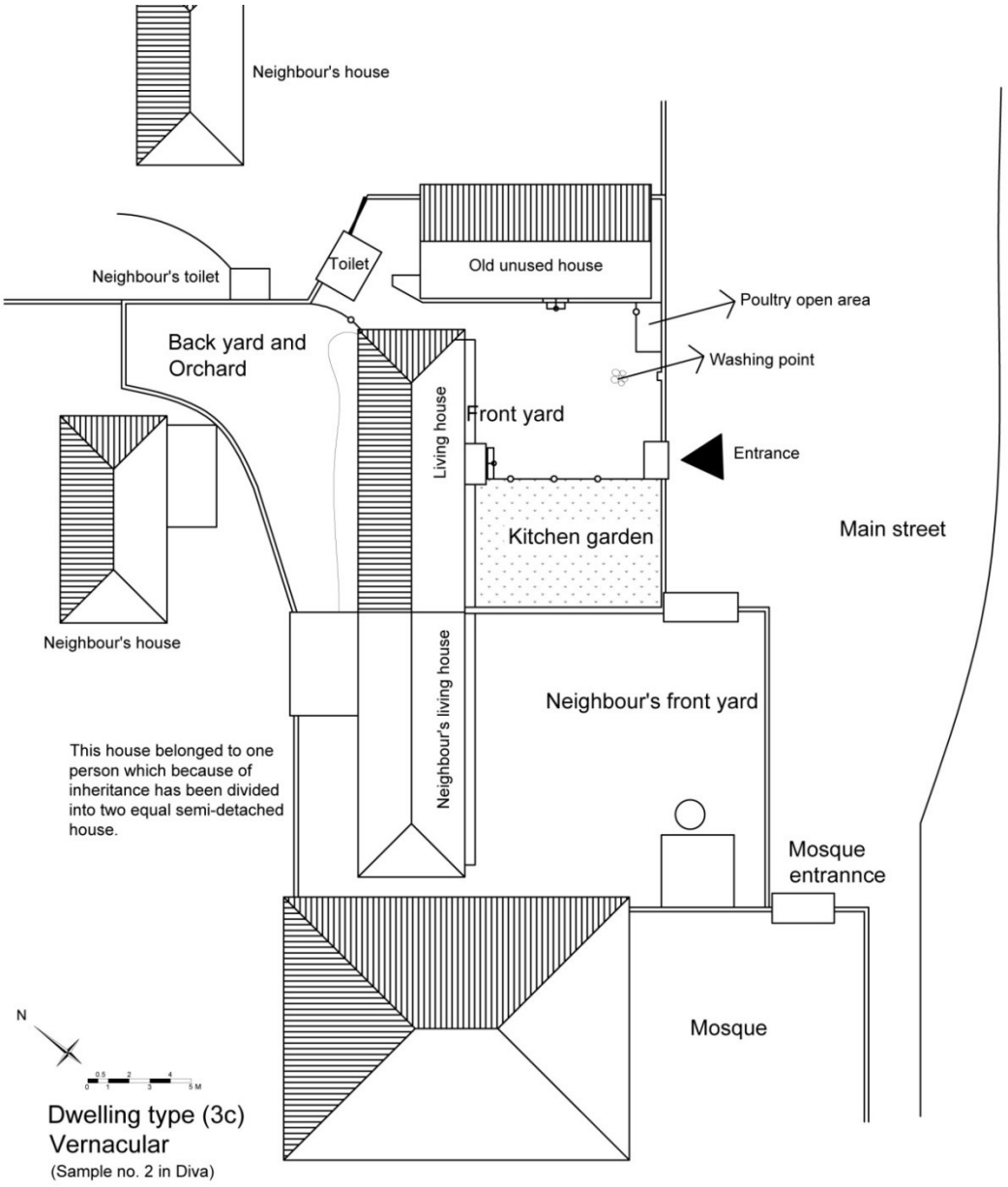


Figure 8.12: One sample of property type (3b) and its figure and ground map



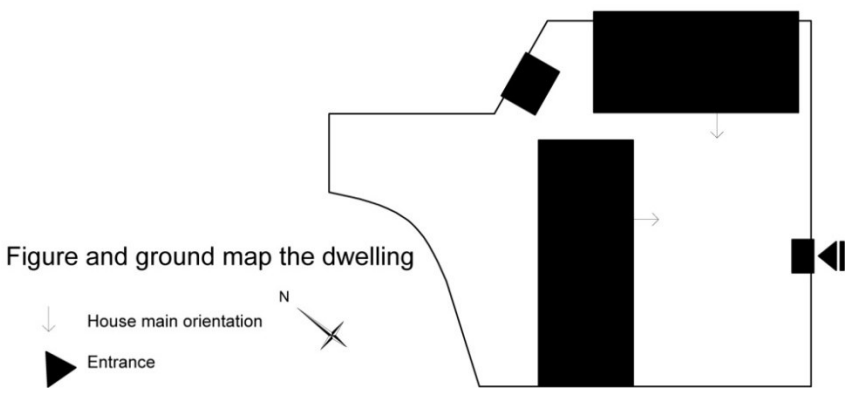


Figure 8.13: One sample of property type (3c) and its figure and ground map

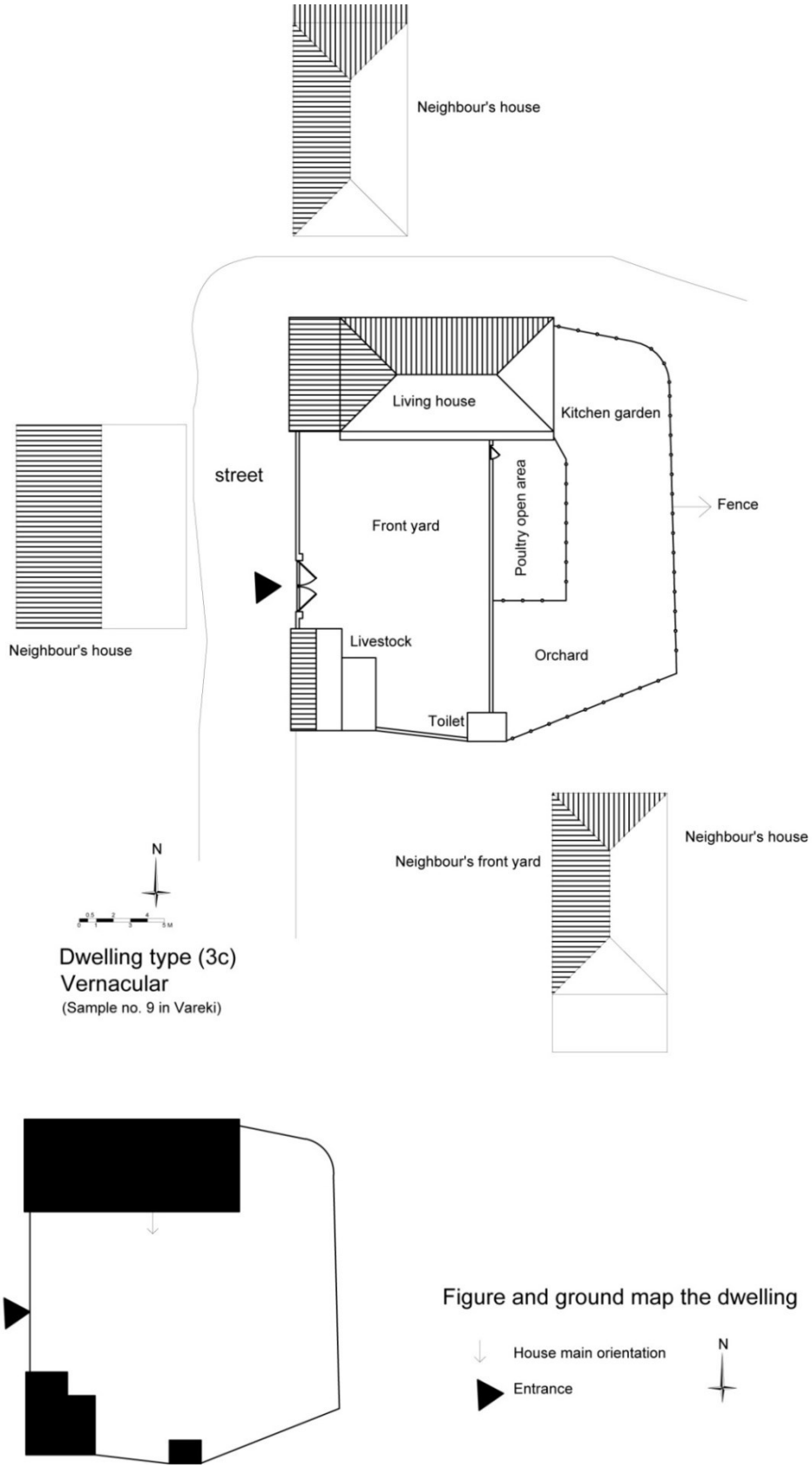


Figure 8.14: One sample of property type (3d) and its figure and ground map

Table 8.5: Resident's activities and role of settings within vernacular dwellings

Open settings of dwellings and the activities within them

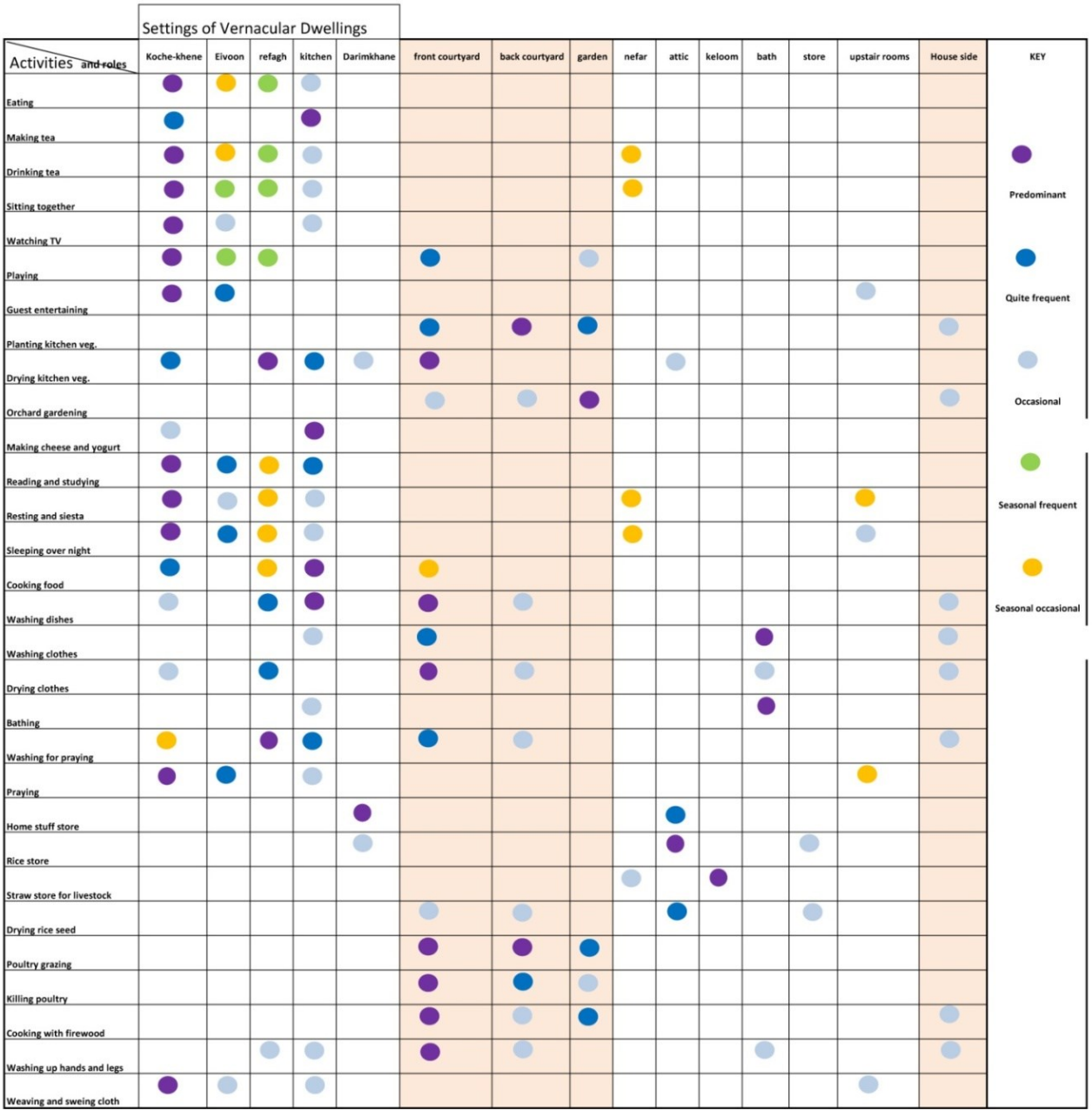


Table 8.6: Resident's activities and role of settings within middle style dwellings

Open settings of dwellings and the activities within them

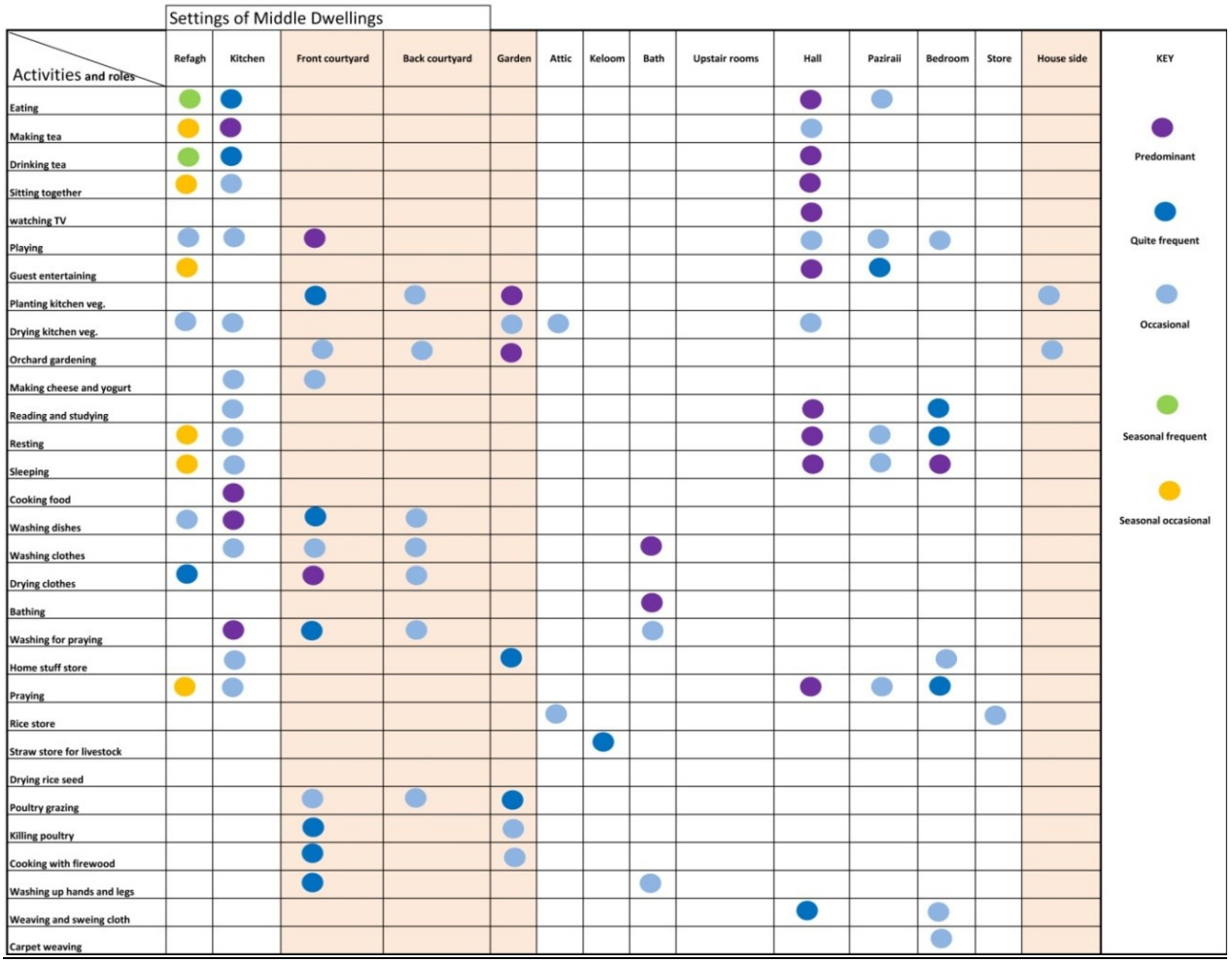
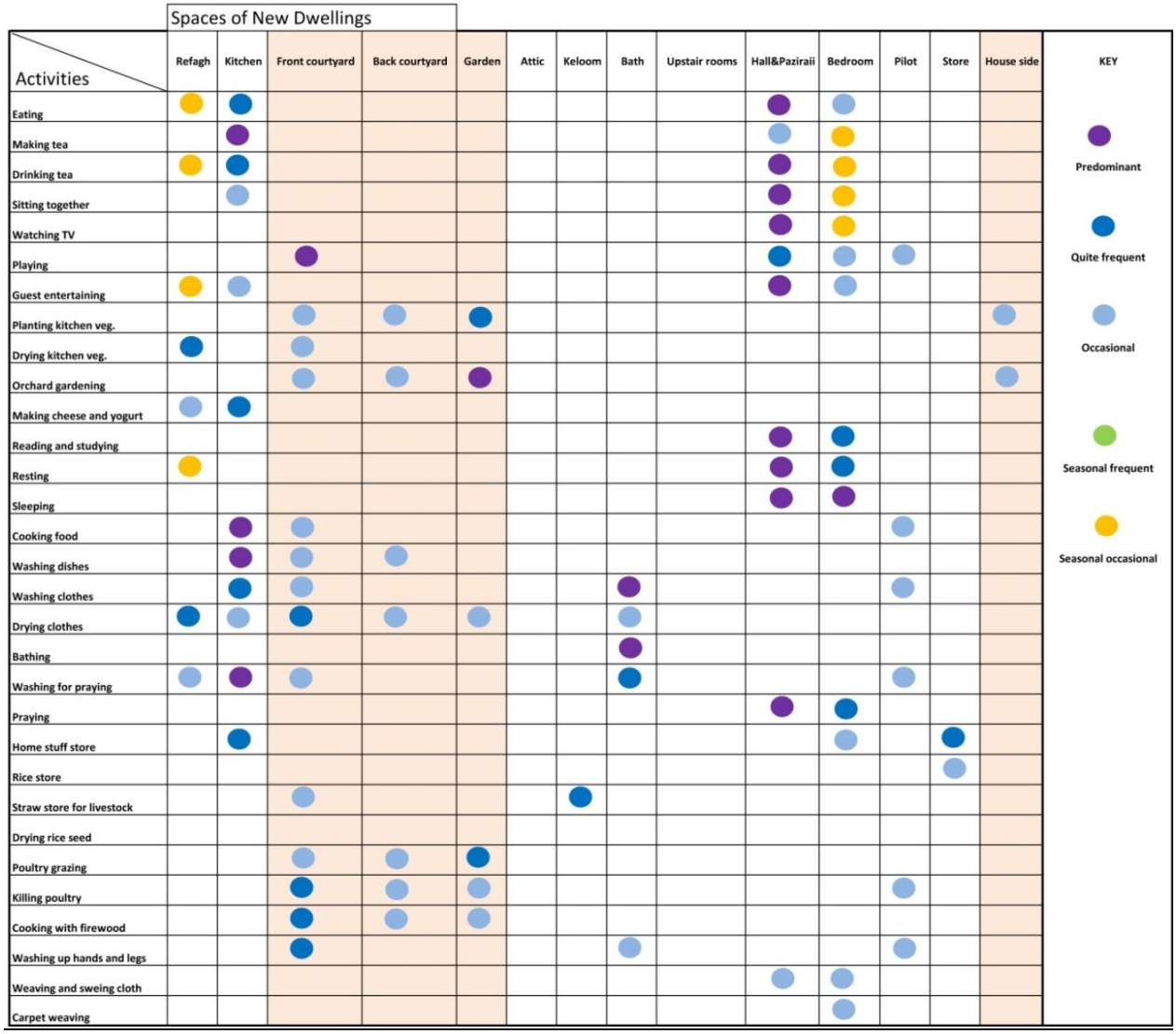


Table 8.7: Resident's activities and role of settings within new style dwellings

Open settings of dwellings and the activities within them



_just one of them. Another open setting located at the lateral sides of the house, called 'house side', is specifically positioned for better movement of wind and facilitating desired ventilation around the living house, which was common in the vernacular dwelling style. This particular open space setting is not as important as other open settings; its role and importance has been significantly diminished and has been eliminated within new houses.

The table 8.5 represents which activity takes place within which setting, and represents the level of occurrence ratio of all activities within specific setting. Accordingly, the main activities of residents and the main function of settings are obtainable. Those levels are 'predominantly', 'quite frequently', and 'occasionally', which have been stratified based on the amount of respondents' answers as the only criterion. Additionally, some settings have seasonal roles during summer and spring; these activities are entitled 'seasonal frequent' and 'seasonal occasion', leading the research to establish which settings have additional or purely seasonal roles.

According to the above tables, front yards are the main open settings within all three styles of dwellings where outbuildings accommodate residents' activities. The role of the front yard diminished gradually through evolution of dwelling styles within middle and new styles. The same happened for back yards and gardens, two open settings that have fewer roles than front yards.

8.3.1.1 Front yard (Sere pish)

In accordance with the meaning of its name, Sere-pish is always located in front of the living house building. The main facade defines the direction of the building and the house can usually be accessed from the street in this area. The front yards are often used for the neat activities and for buildings, which are allowed to be viewed by the public. This space is a pillar setting within vernacular and middle style dwellings accommodating different activities related to life and production. However, it is not as important as in the two other types and is

sometimes eliminated from the configuration of the dwellings; this creates some problems for residents, as mentioned during interviews.

Life activities include drying clothes and rugs, car parking, cooking special local soup and food during big parties and those cooking with firewood predominantly take place in this setting. Washing clothes, washing for praying and playing are performed quite frequently. Activities related to production such as preparing and colouring silk threads to be woven into fabric, and drying rice seeds occasionally take place while drying and cleaning vegetables and rice if the area has enough places predominantly executed within different sub-settings of this setting. Kitchen gardens sufficient for family consumption quite frequently are cultivated within this space. Poultry predominantly parade within this area, which can cause problems for the kitchen garden; this means a fenced open area setting should be used for poultry to parade in or to protect the kitchen garden. Although the kitchen garden provides a green pleasant view to the front yard, the presence and natural behaviour of poultry make it an unpleasant setting. In addition, women of the same community predominantly gather to chat and undertake activities together such as cooking and making orange and sour pomegranate pure, and children can play in this area (table 8.8).

Some outdoor buildings are exclusively located in the front yard, such as outdoor kitchens, and Nefar, which is a standalone structure, one storey building containing one room on each floor that are occupied during spring and summer and used as living spaces. This is also an appropriate setting for the cultivation of different kinds of trees including fruit trees, and mulberry tree for silkworm production. Consequently, this is an important open setting consisting of different settings giving opportunities for a range of different activities including private family life and productive, social and cultural activities (fig 8.15 to 8.19).

Table 8.8: Table shows different activities related to the front yard's settings (derived from questionnaire 04)

Different kinds of activities taking place within **front yard settings**	**Family life activities**	**Productive activities**	**Social and cultural activities**
	-Washing for different purposes -Cooking with firewood -Drying clothes -Living and sleeping in Nefar located within this setting - Car park -Washing for praying	-Kitchen gardening -poultry nurturing and their slaughtering -drying vegetable and rice -An area for preparation of some other productive activities such as fabric weaving, wooden dishes, and silkworm nurturing -Orchard production	-female gather together -Female work together -children play -holding cultural and social parties and ceremonies such as wedding party

Figure 8.15: Part of wedding party within front yard.

Figure 8.16: Neighbour women are cooking together within front yard

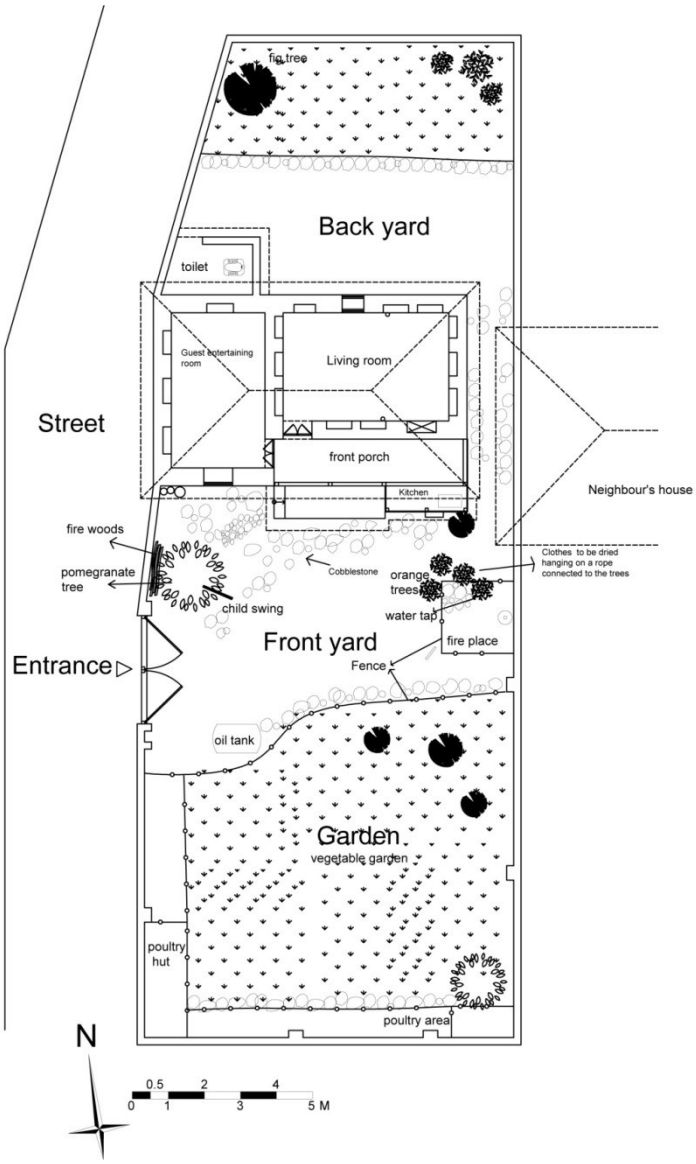


Figure 8.17: Distribution of different activities and settings within the dwelling (Sample no.1 in Diva)

The role of this setting is consistent within all three vernacular, middle, and new style houses supporting trends of the same activities, although the intensity and weakness slightly changed. Nevertheless, the front yard is still an important open setting within dwellings. In exceptional dwellings when it is not possible to arrange a front yard, lateral open settings or backyards play the role of front yard. Locals prefer larger front yards, their widths are usually between the ranges of 4 to 8 metres. This setting was the main subject of question 6h of questionnaire 02 about new demands. Remarkably, 94.7% of respondents prefer to set front yard

within the configuration of their new house (fig 8.20), this has been evident in interviews.

'Village house must have front yard. When you come in a village house you should be led to the front yard and then having possibility to enter the rooms. Its enjoyment is like that. (Focus group number 10 in Vareki)'.

In conclusion, this setting has sufficient efficiency as an open space, which can intensify the efficiency of a new dwelling.

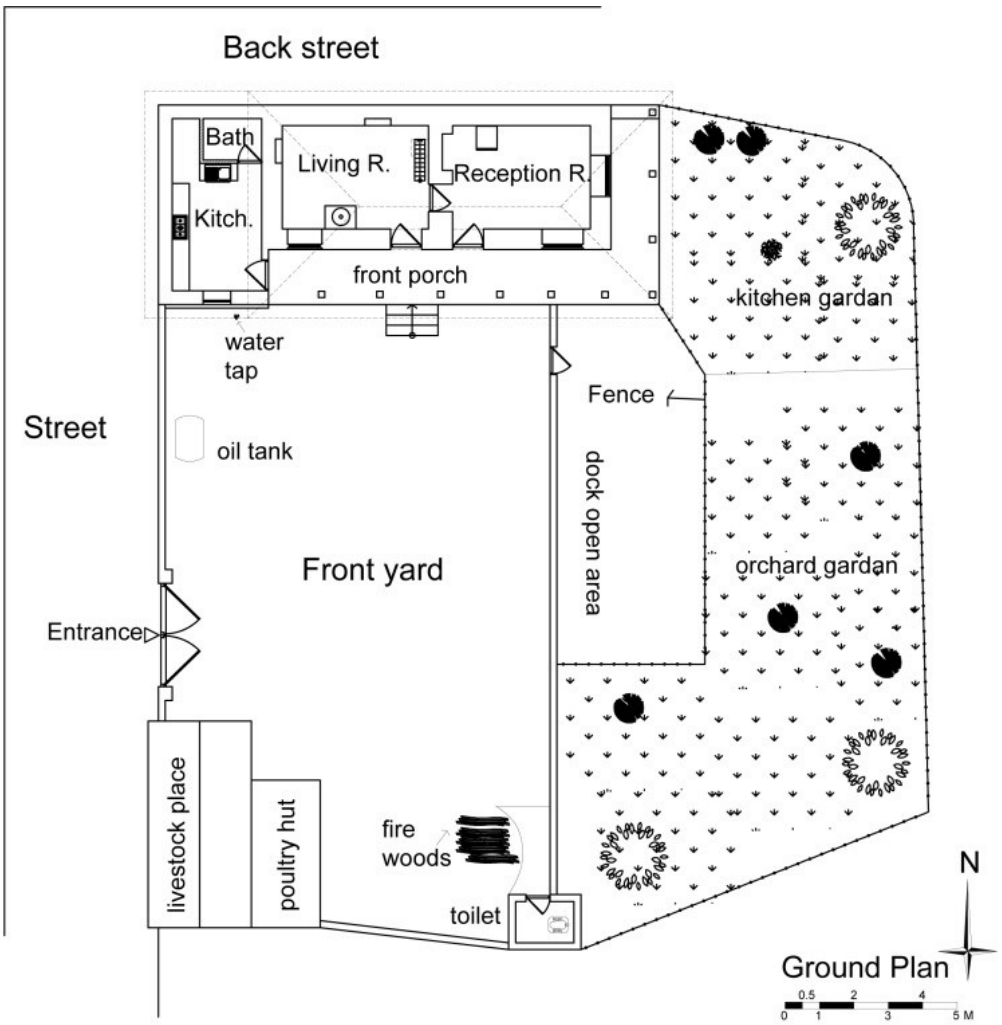


Figure 8.18: Distribution of different activities and settings within the dwelling (Sample no.9 in Vareki)

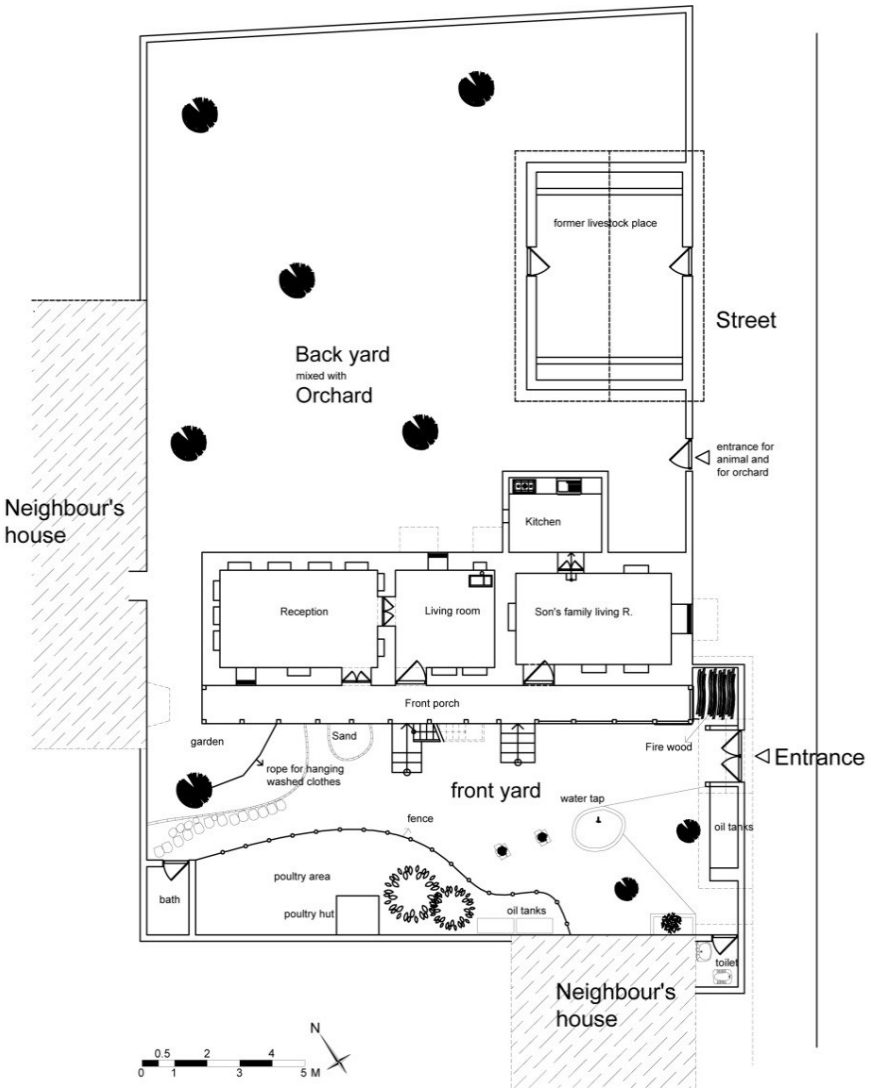


Figure 8.19: Distribution of different activities and settings within the dwelling (Sample no.9 in Vareki)

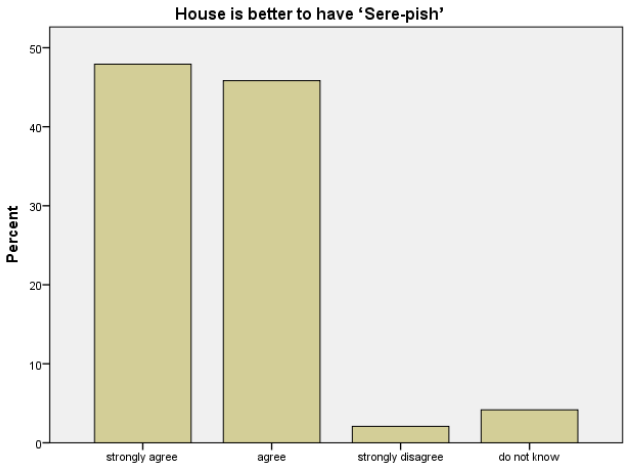


Figure 8.20: Graph captured from SPSS shows the importance of front yard for local from questionnaire 03

8.3.1.2 Back yard (Peshte sere)

According to the definition of backyard, it is an open setting located at the back of the living house. Often, activities and settings, which are better being hidden from public view, are located within this setting. These are toilet blocks, stables and livestock housing and areas, and bathrooms, although they can also be located in the front yard as well. Predominantly, women plant kitchen vegetables where poultry grazing also predominantly happens. All other activities mentioned within table 8.9 except slaughtering poultry which quiet frequently is performed, are occasionally done within this setting (table 8.5).

It should be noted that some of these activities and buildings such as livestock, toilet blocks and stables have an unpleasant odour therefore, locals make efforts to ensure they are not situated directly in line with the front or back axis of house to prevent transmission of odours into living spaces like smell into living rooms. It seems that this rule is not mandatory and seemingly, locals got used to these smells and find them as offensive to be hidden strictly from the sight. Usually, this setting is not pleasant because it is at the back of the house, facing a northerly direction without substantial sunshine, in most cases it is also a narrow space. Therefore, social activities do not take place within this setting however; it is employed for private family life and productive activities, which is useful for conduction of ventilation and light provision for inside rooms (table 8.9).

This setting is not as important and compulsory as the front yard. In the case of the dwellings with more than one street around and one street behind the living house, this setting is usually not present. Houses located besides the orchard of a close relative do not set up this setting within the configuration of their dwellings. Sometimes this setting is combined with a garden at the back of the house, which in is usually bigger than the front yard. This setting is at least one metre wide and when standing alone, is never bigger than the front yard in size.

Table 8.9: Table showing those activities taking place within back yard (Derived from questionnaire 04)

Different kinds of activities taking place within **back yard settings**	**Family life activities**	**Productive activities**
	-Washing for different purposes -Cooking with firewood -Drying clothes -Washing for praying	-Kitchen gardening -poultry nurturing and their slaughtering -An area for preparation of some other productive activities such as fabric weaving, wooden dishes, and silkworm nurturing -Orchard production

This setting still exists within all three-house styles with the same roles and activities (tables 8.6, 8.7). The importance of the backyard in villagers' opinion was the topic of question 6q within questionnaire 03. Most respondents, totalling a considerable 81.5% (agree and strongly agree) it is better to have and open area behind the living building and most of them 'agree' with it (fig 8.21).

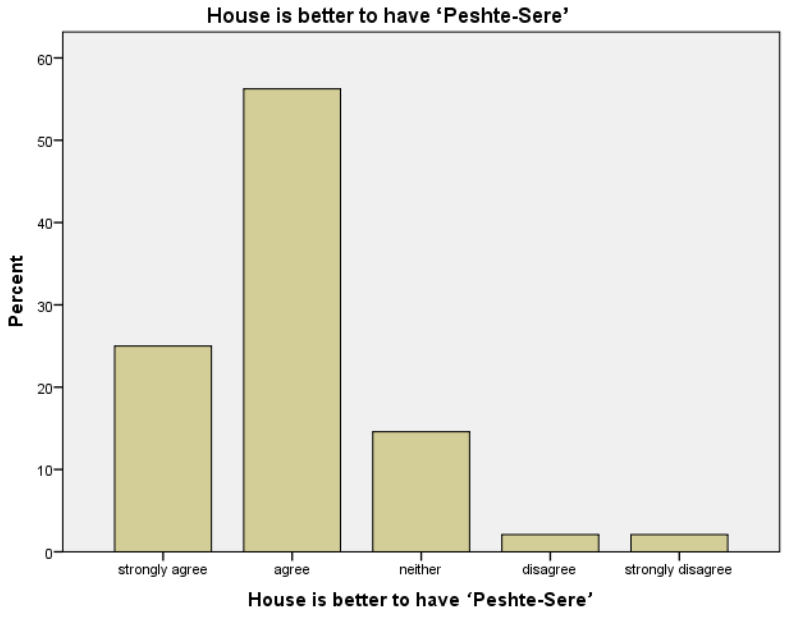


Figure 8.21: Diagram captured from SPSS showing the detail of answers to the question about front yard.

-The anti-backyard response is trivial in comparison to supporters of this setting. This emphasises the importance of backyards within the region.

8.3.1.3 Garden and Orchard

Gardens are another important open setting; these are generally located at the back of the living house. However, it can also be located at the front or lateral sides of the living house. Usually, when the garden is located at the back of the house it is combined with the backyard, and sometimes, when it is situated at the front of the house, it is joined with the front yard. This pattern is becoming popular within the region; entrance from the street into the house passes through this area.

Gardens are predominantly citrus orchards that produce various types of citrus; these are the main garden products of Mazandaran are produced mainly to be sold. They can have different kinds of fruit trees such as apple, fig, walnut, peach, nectarine, and bushes and trees that are strong enough for building construction. Most of the time, kitchen gardens are located in this place where they are protected from poultry and livestock that might be graze within this area. The size of the garden varies depending on the land of the dwelling. As a common role, Villagers tend to reserve more land by dedicating less land to construction in order to plant and maintain orchards. However, some dwellings have no garden due to lack of land but they still have an open area playing the role as a front yard.

The combination of the garden with the house makes the village greener, leading to the creation of a sustainable settlement (Moughtin and Shirley, 2005). Gardens provide a desirable opportunity for residents to produce fruit at least sufficient for their own consumption thus improving their budget and economy as well as nurturing livestock, poultry grazing and kitchen gardening. This improves one of the main roles of villages in Iran which is food production (Sartippipour, 2007; Zargar, 1998) and is potentially helpful in supporting villagers to be healthier and happier (Montgomery, 2013) and improves socialisation through gardening (Duany and DPZ, 2012). In this respect, dwellings within villages of the region are better having gardens as orchards in their configuration.

Consequently, the vernacular configuration of the dwelling is still in accordance with the rural villagers' lifestyle demands. Therefore, the considerations mentioned below should be taken into account within configuration of dwellings in the region of this study.

- Enhancement of food production within the dwelling and improvement of the dwelling's role in this activity
- Creating some open settings such as front and back yards within the configuration of a dwelling as main components
- Providing gardens independent or combined with front or back yards to support family consumption need
- Houses are better to be detached through having open settings around four sides.

8.3.2 Enclosed settings and the house

Enclosed settings include all buildings located inside the land of the dwelling: the living house, livestock house, poultry house, Nefar, shed or store, toilet, and bath. A dwelling could consist of all or just some of these settings according to the needs of the owner.

8.4 Characteristics and typologies of houses

The conduction of an investigation to define the cultural and social issues that influence the configuration and characteristics of settlements and dwellings in the region is one objective of this research. This objective sets out to define a set of compositional rules from the analysis that embody the cultural, social and sustainable characteristics that are useful when regenerating this type of vernacular dwellings.

In order to achieve this, 46 houses within 44 selected dwellings have been investigated, measured and mapped using AutoCAD software. Photography supported this documentation. 31 of these samples are of a vernacular style, 5 of them belong to middle style and 10 are new style houses. The owners of 38 of these samples have been interviewed through interviewed using 'structured

interview' techniques. Questionnaire 01 (appendix 2) aims to gather general information about the examined houses.

Most of the sample houses have been selected from vernacular dwellings in order to support this research to be informed from vernacular knowledge supporting new house design and construction to be sustainable and admitted by local villagers. Additionally, middle style and new style houses have been examined to establish changes in the configuration of houses from vernacular to new style. This has been conducted in order to clarify what villagers' new needs and demands are. This provides comprehensive information in addition to the achievements of the interviews. They support evaluation of compositional rules employed within vernacular houses in order to find out their appropriateness in the design of new houses. Therefore, this research principally concentrates on vernacular houses. All subsequent discussion continues on the subject of vernacular houses by highlighting the commonalities and differences with other middle and new styles of houses.

8.4.1 General architectural and statistical characteristics of houses

House in Mazandarani's language is called '*khene*', the same as rooms of the house. All of variations of vernacular houses have common architectural characteristics. These have been mainly influenced by climatic and natural environmental conditions of the region. These are illustrated and elaborated within chapter 9. These common characteristics, within two areas of the forest border and the forest areas are mentioned below.

Houses are predominantly detached from each other and other outbuildings. Unlike houses within central part of Iran, which have a central courtyard and all rooms face inward over the courtyard (Memarian, 1995; Pirnia, 1995), houses in Mazandaran face outward and the courtyard or open area surrounds the house. This is the same characteristics as in other provinces of north of Iran, besides Caspian Sea (Memarian, 1998) (fig 8.22). This characteristic is observed within middle and new styles houses; the only difference is that some of

new houses are attached or semi-detached multi-storey flats, and are attached to each other from side to side.

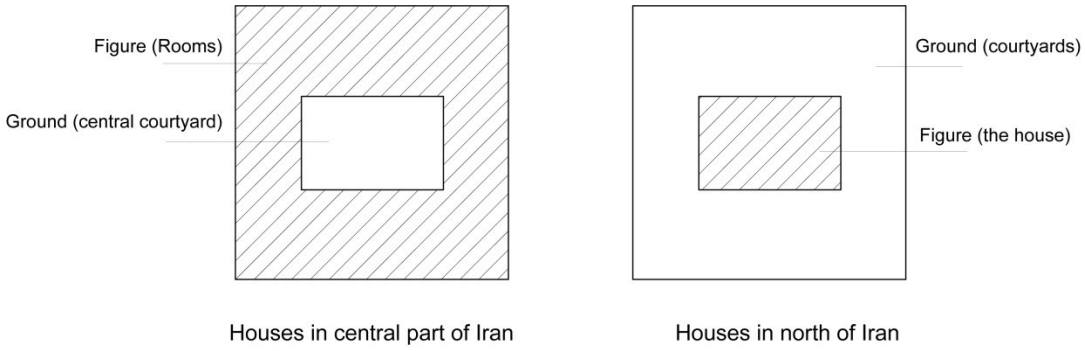


Figure 8.22: Two different patterns of houses within different parts of Iran

Houses are mainly one or two storeys, which according to this and to the orientation and location of the house within the land, four schemes are imagined for two-storey houses. They are front, back, dawn and up for two-storey houses and two directions including front and back for one storey houses, which are based on imagination of villagers (fig 8.23). This has also been noticed in houses within another province in the north of Iran (Bromberger, 1990). Residents of middle and new style houses also mentioned this scheme meaning that it is still meaningful within the region.

Houses are predominantly located on a raised platform constructed with a wall and filled up with soil. They are chiefly rectangular, one room deep with semi-enclosed space in the front and oriented toward the south zone. The external roof of the houses as steep slope and usually have a hip roof, which is projected from four sides adequately protecting the house from climatic conditions in different seasons. All of these common rules within vernacular architecture are increasingly becoming obsolete and forgotten within new house design and construction; this affects the configuration of the house.

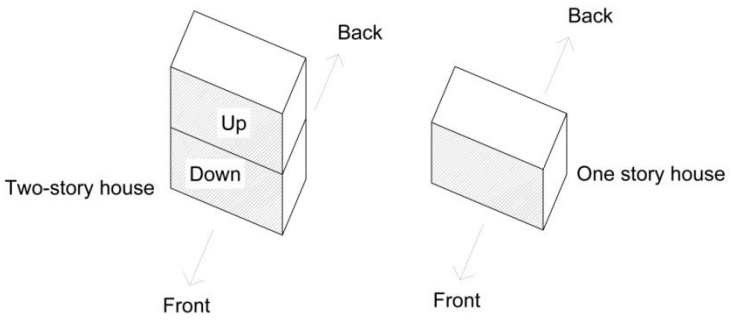


Figure 8.23: Different schemes of house according to villager's imagination

Houses are no more than two storeys high and predominantly exist within villages located in the forest border and no two-storey houses are observable within villages of the forest area unless it is new style house with four storeys of flats exist in some villages. Houses are not usually big. The smallest sample house is 56.8 metres square. It is a one storey, two-roomed house. The biggest sample house totals 396.4 metres square over two-storeys with eleven rooms. It belongs to a wealthy family and has significant differences in size and rooms. The average area of all sample houses is around 124 metres square; this is close to the average area of new individual houses and flats, which is 144 metres square. Therefore, as a result, a house having an area within the range of 60 to 150 metres square is acceptable by villagers.

Houses do not usually have many rooms. Three-roomed vernacular houses have the most frequency within all areas and houses with 2 rooms and 5 rooms have higher frequency than with 6 and 4; it means that the favourite houses for villagers are those with fewer rooms; affordable housing for those with average or low incomes. The less frequency belongs to 11, 7, 8 and 4-roomed houses. Families with higher incomes tend to have houses with more rooms. On average, houses have 4.5 rooms, which means that 3 to 5 roomed houses are preferred for locals. This outcome was confirmed by questionnaire 03 concerning about new demands. It demonstrates that respondents mostly prefer two-bedroom or one-bedroom houses consecutively, which means that a house with one or two bedrooms with a kitchen and a living room, in other words, a 3 or 4 roomed house is most favourable (table 8.10).

Table 8.10: Table shows how many bedroom houses local prefer

Favourite amount of rooms					
		Frequency	Percent	Valid Percent	Cumulative Percent
	One bedroom	17	35.4	35.4	35.4
	2 bedroom	24	50.0	50.0	85.4
	3 bedroom	7	14.6	14.6	100.0
	Total	48	100.0	100.0	

Further to these general common characteristics, conduction of typology has been carried out which also highlights the differences between them.

8.4.2 Typology of houses

This research primarily intended to conduct the typology based on the method proposed by Van Leuse (1996), which identified the shape of the volume of the building and spatial configuration as two main criteria. This research investigated the criteria from the culture through one to one interviews with local house owners and professionals including masons and carpenters. They have been asked if they had any criteria or fundamental pattern or shape for house design and configuration. The main criterion stated by local interviewees concentrates on the overall shape of the configuration of enclosed rooms, the process of typology and names of types emerged accordingly. Three main types have been identified entitled ‘row house’, ‘saddle house’, and ‘semi-saddle house’. Variations are based on the number of rooms, number of storeys and are all represented within appendix 5 and some pictures are presented in figure 8.36. It should be noted that some accessories such as baths, toilets, and kitchens have been added to the primary shape of the house after occupation, which have not been considered within typology as well as semi-enclosed space, which are usually located in the front of the house. Other semi-enclosed spaces, which could be positioned on any side of the house, have not influenced the typology either. This typology is the base data bank for definition of compositional roles of the houses and their evaluation towards setting up appropriate rules for new housing.

8.4.2.1 Type (1), Row House

Row house means a house that has its rooms attached side by side to each other on each floor in one straight linear row. A semi-enclosed front porch is located in front of all of them, of which three sides are open (fig 8.24). The orientation of the house and the main façade define the front of the house. Some of them are two storeys and predominantly with a hip roof projected from all four sides mounted on top. Extended spaces such as new set up toilets, baths or kitchens are attached to the body of the row house are usually covered with one direction sloped roof or occasionally with saddle shape sloped roof. The orientation is usually towards the south zone, which is a common characteristic between all types.

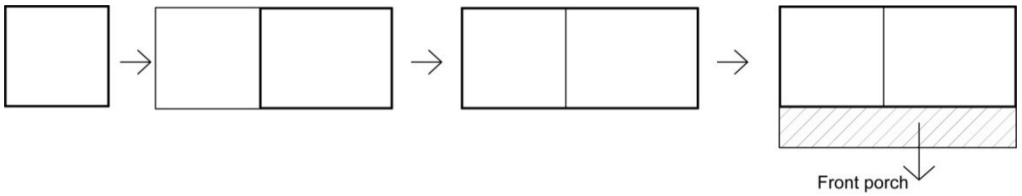


Figure 8.24: Schematising row house formation and location of front porch

The number of rooms is an important factor for villagers when they want to design and construct their houses so this is a significant criterion for house typology within the region as well as the number of storeys of houses, which influence the form of the house. Accordingly, four sub-types have been identified within this type including;

- Type (1a) one storey with two rooms.
- Type (1b) one storey with three rooms (fig 8.25).
- Type (1c) two storeys with four rooms.
- Type (1d) two storeys with five rooms (fig 8.26).

This type can potentially be extended from two sides creating new longer row houses or other types.

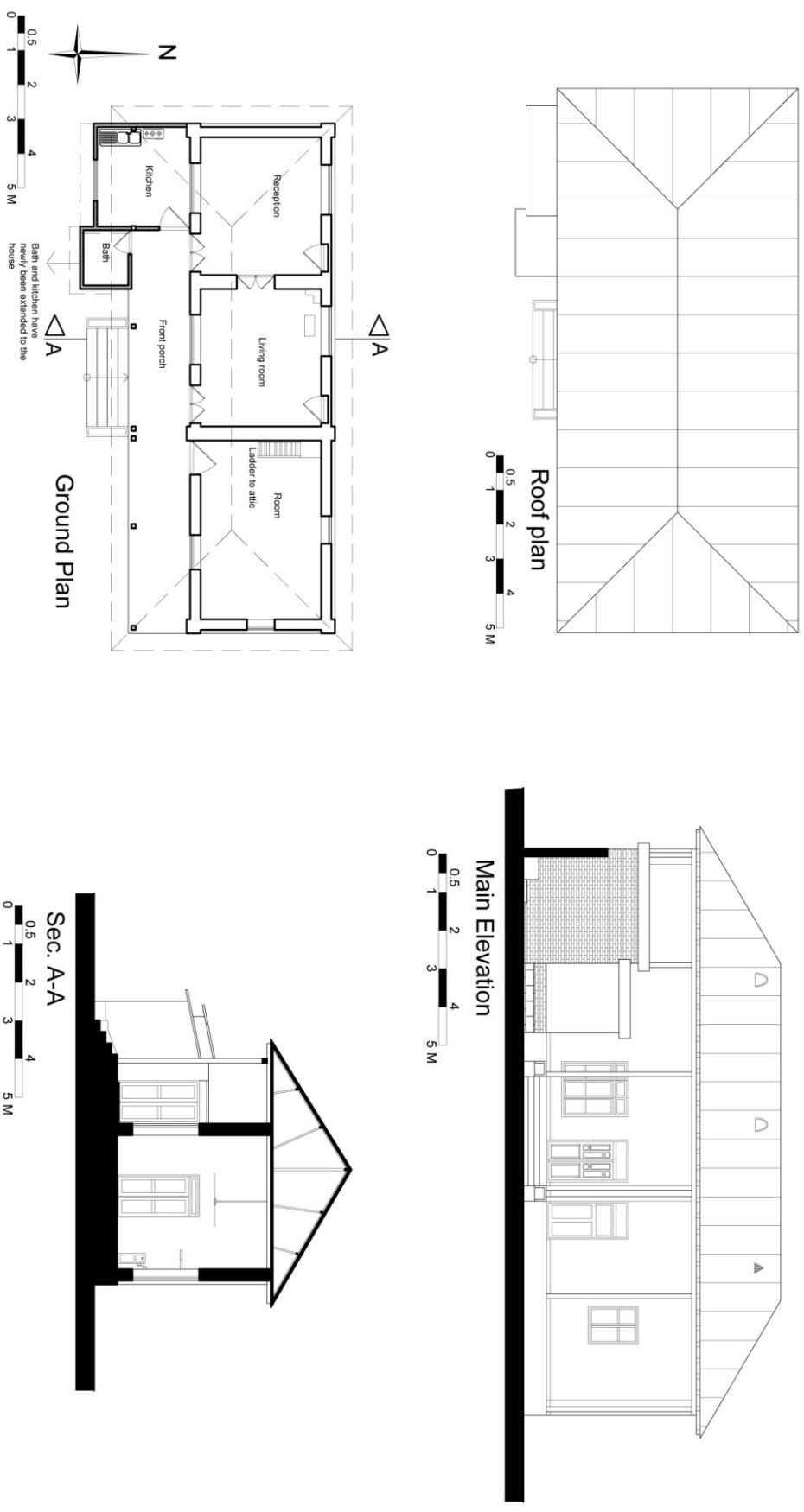


Figure 8.25: A sample of one story row house type (1b)

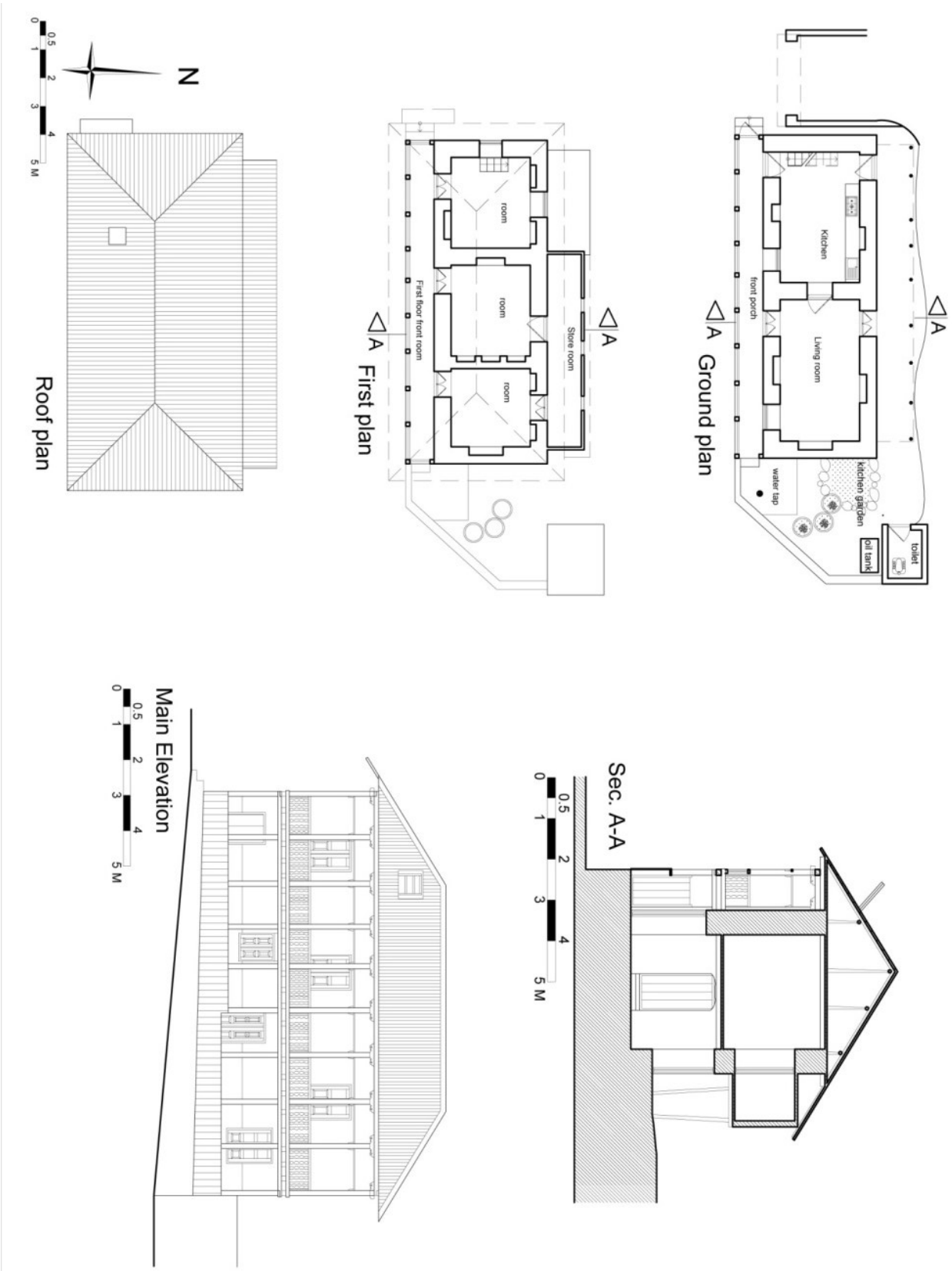


Figure 8.26: A sample of two stories row house (type 1d)

8.4.2.2 Type (2), Half Saddle House

The rooms within this house form an L shape, which villagers imagine as half of a horse saddle. In order to shape this type, one room is perpendicularly located at the end of another room or row house. A semi-enclosed space such as a front porch connects these rooms together, which accordingly, one side of the semi-enclosed area is blocked giving much more privacy and enclosure to this space compared to the front semi-enclosed space in row house (fig 8.27). This is another type of house, which is called as 'Vaziri house' in some parts of Mazandaran. This type contains at least two similar rooms on each floor, usually elongated east-west zone and oriented toward south zone.

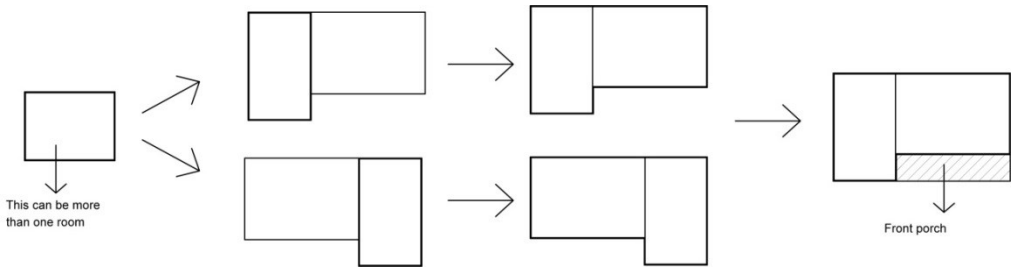


Figure 8.27: Schematising of half saddle type and location of front porch

Like the row house, it can be one or two storeys and covered with a hip roof projected from all four sides. While extended spaces attached to the body of the row house are usually covered with, one direction sloped roof or occasionally with a saddle shaped sloped roof. This type is more frequently used than all other types. According to the numbers of rooms and storeys, four sub-types have been identified including;

- Type (2a) one storey with two rooms.
- Type (2b) one storey with three rooms. This sub-type has the highest frequency within the samples, which means that this is the most favourite type across the region of the study (fig 8.28).
- Type (2c) two storeys with four rooms (fig 8.29).
- Type (2d) two storeys with five rooms.

This type can be extended to make a new longer half saddle house or different type with the addition of new perpendicular room on the other side of this type.

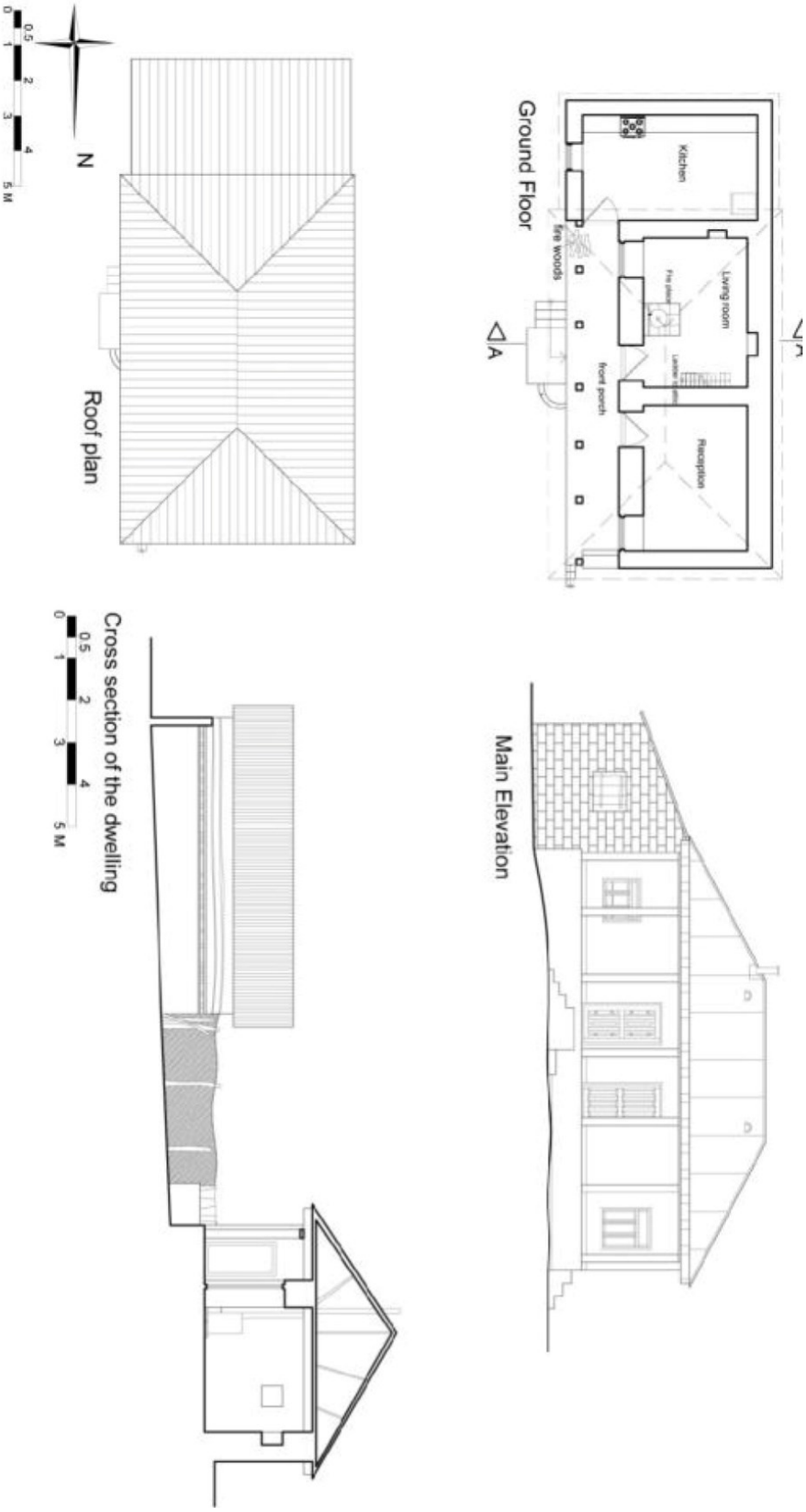


Figure 8.28: A sample of one story half saddle house (type 2b- House no.3 in vareki)

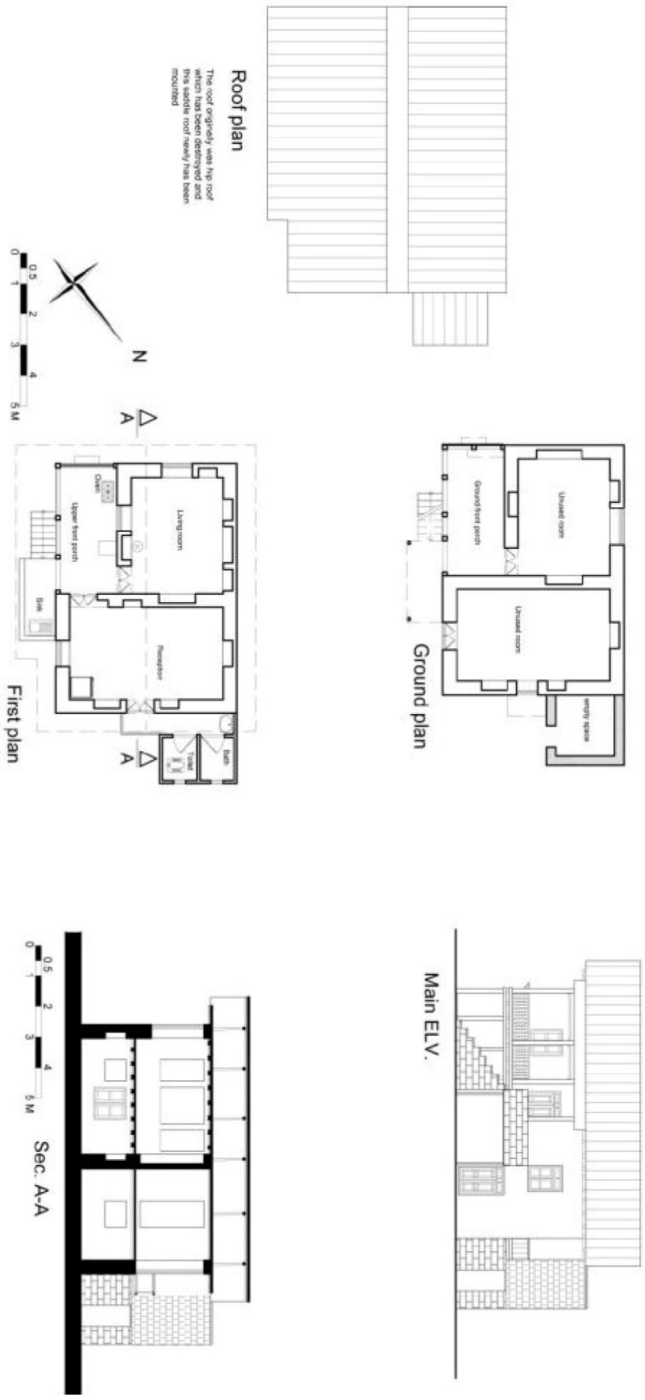


Figure 8.29: A sample of two stories half saddle house (type 2c- house no. 6 in Diva)

8.4.2.3 Type (3), Saddle House

This type of house cannot exist with fewer than three rooms. In this way, two rooms are located perpendicularly at the two ends of middle room or middle row of rooms (Row house) creating a U shape. This has evolved from L shape forms and locals image it to be the shape of a saddle. A front semi-enclosed space

fills out the gap between rooms in the middle of the house, which is only open from one side and the other three sides are blocked and so provide a higher degree of privacy and enclosure (fig 8.30).

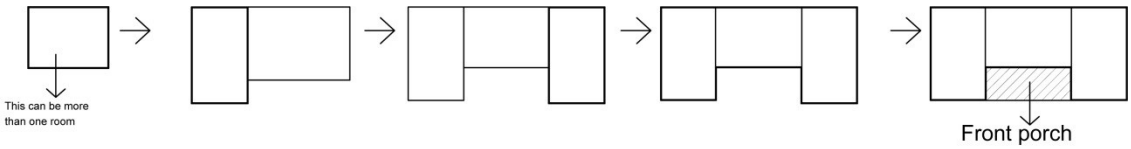


Figure 8.30: Schematising of saddle type and location of front porch

It can be one or two storeys high; other characteristics of this type are similar with two previous types. According to the numbers of rooms and storeys, two sub-types have been identified within this type including;

- Type (3a) one storey with three rooms (fig 8.31).
- Type (3b) two storeys with four rooms (fig 8.32).

8.4.2.4 Type (4), Composite form house

This type is comprised of a combination of more than two different or similar mentioned types. The house is one storey mixed of more than two types or it is two stories with different types on each floor (fig 8.33). Although it is a combination form created from a mixture of main types, the configuration of this type and the organisation of its spaces are different. The houses of this type are usually big with at least five rooms. This is the only type that has an L form with two hip roofs mixed together. Due to different combinations, this type has a greater variation in comparison to original types.

This type is mainly oriented towards a south zone direction and elongated east-west zone and is one room deep. According to the different potential variations of different types of house, six sub-types have been identified within this type including;

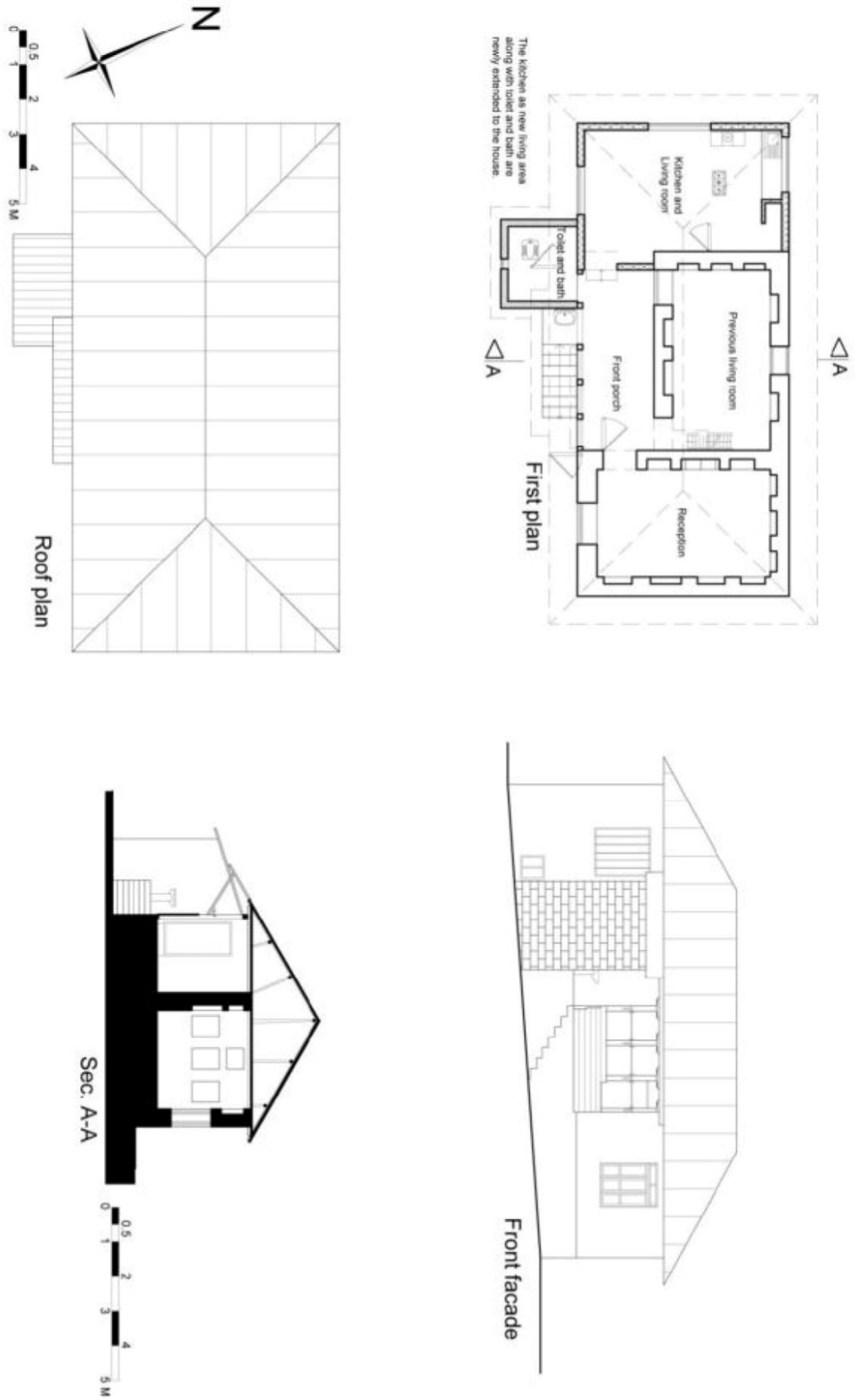


Figure 8.31: A sample of one story saddle house (type 3a_ House no. 3 in Diva)

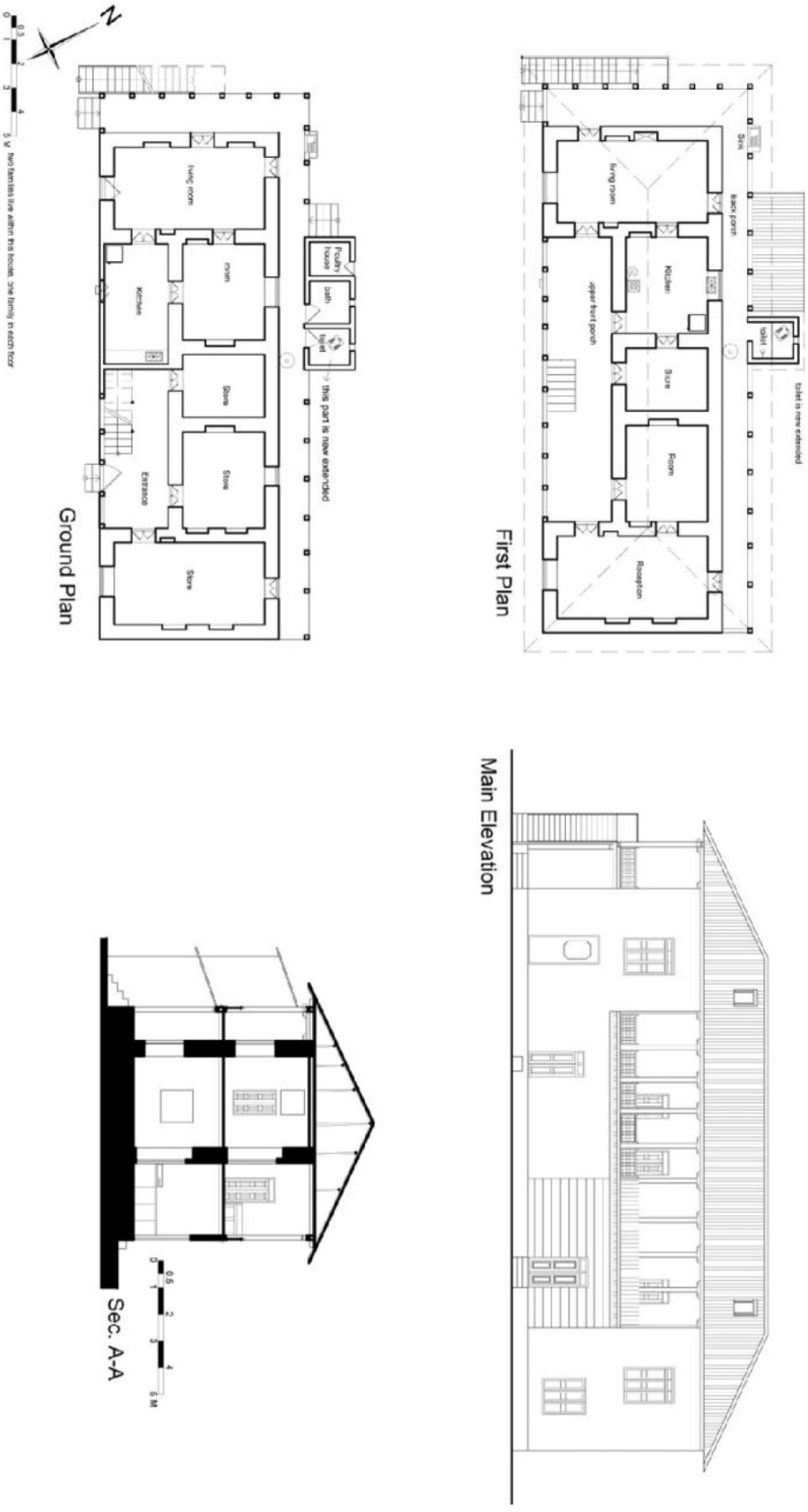


Figure 8.32: A sample of two stories saddle house (type 3b_ house no.15 in Diva)

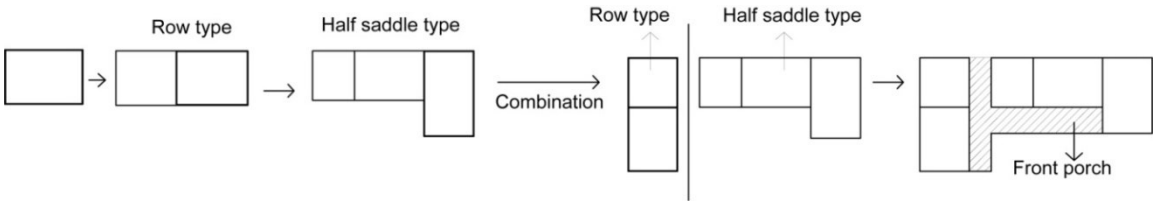


Figure 8.33: Schematising one sample of compositional type composed of row and half saddle types along with the location of the front porch

- Type (4a) comprised of row types, one storey.
- Type (4b) comprised of row type with half saddle type, one storey (fig 8.34).
- Type (4c) comprised of row and half saddle types, two storeys.
- Type (4d) comprised of saddle and half saddle, two storeys.
- Type (4e) comprised of saddle and row types, two storeys.
- Type (4f) comprised of saddle types, two storeys (fig 8.35).

It should be mentioned that, the maps of all sample houses are represented within the table in appendix 5. Some vernacular houses are represented in pictures within figure 8.36

8.4.3 Systems of settings within houses, their main role and systems of activities

To find out what activities residents do within which spaces and settings, a matrix questionnaire has been set up, entitled questionnaire 04 represented in appendix 2. A list of house settings constitutes the main top row whilst the main first column represents different major activities that residents perform. Based on earlier research, observing and interviewing about different activities, a primary list of all activities has been drafted, which could be added or pulled out during the main stage of research. The drafted activities put differently in rooms of the first column of the table while the rows were left blank, which have been filled out through observing the house and asking the name of houses' various settings and spaces from the owner. Accordingly, all over 16 years old members of 38 interviewed families have been asked through 'focus group interview' using the questionnaire 04 to find out which activity mentioned within the table they do

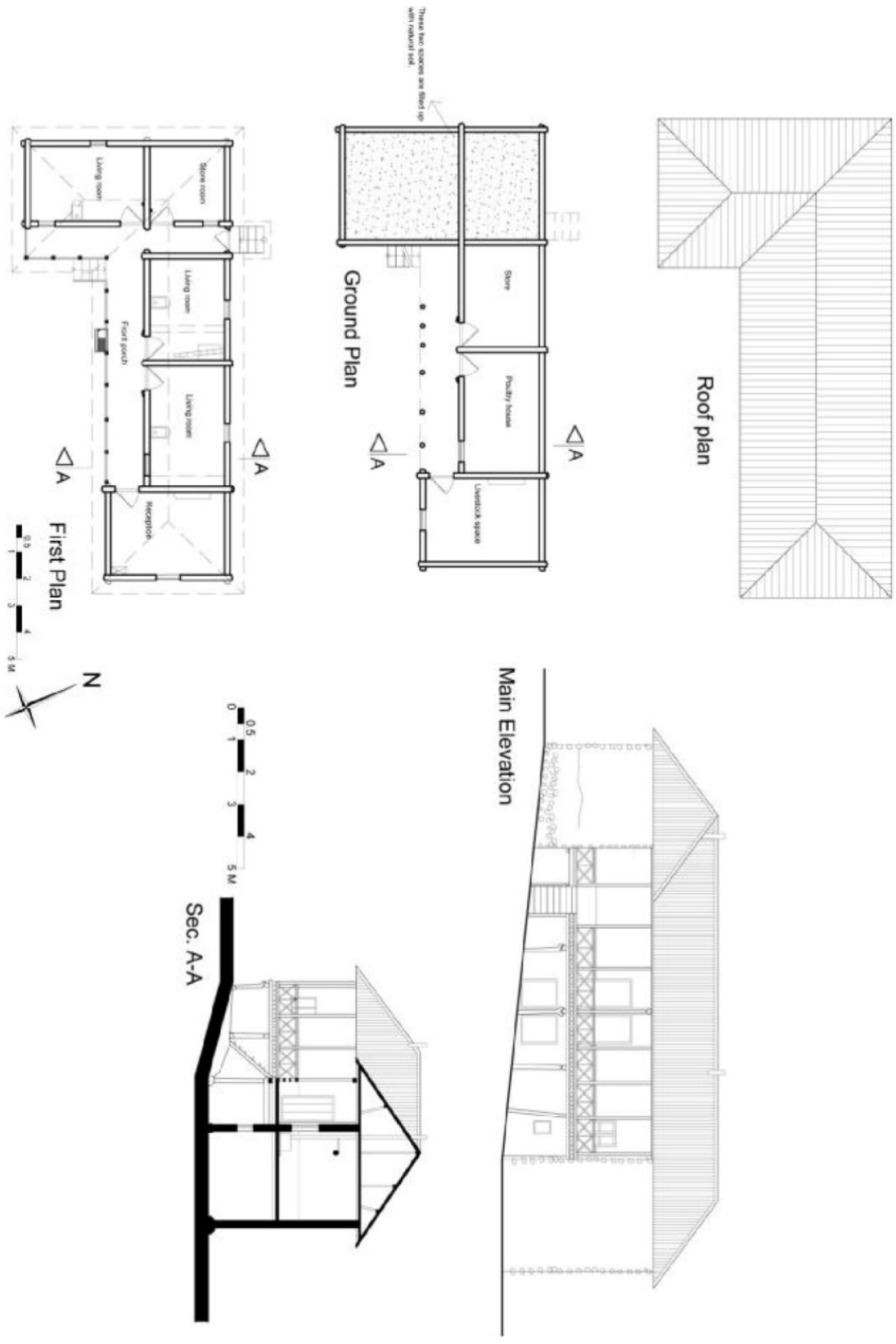


Figure 8.34: A sample of one story composite house (type 4b_ house no. 1 in Firozja)

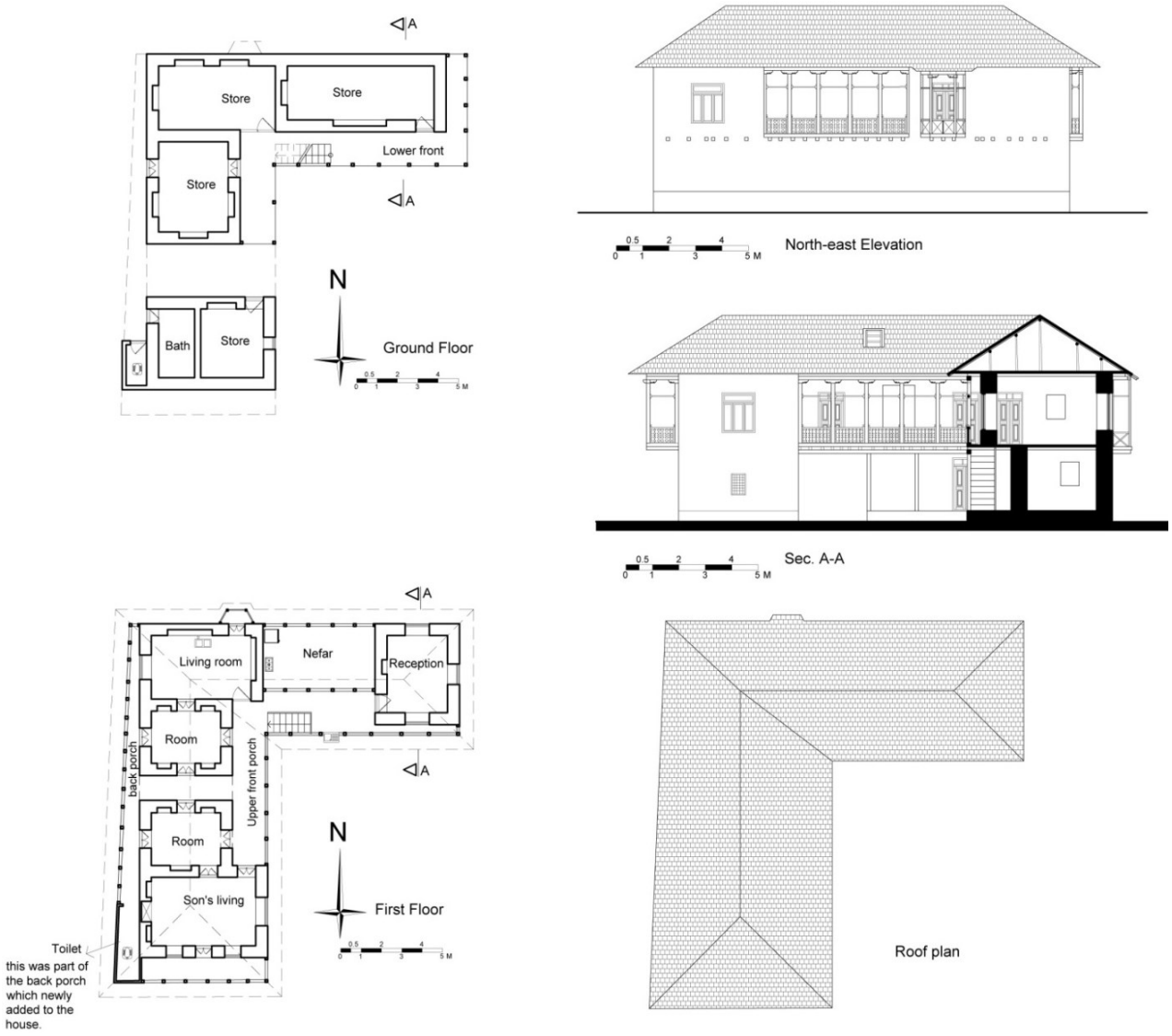


Figure 8.35: A sample of two stories composite house (type 4f_ house no.19 in Diva)

Figure 8.36: Pictures of some different types of vernacular houses within four villages of the region of this study

-within which spaces of the house. Additionally the group has been asked to discuss and indicate which activities they do at different times of the day and year, and in which particular part of that room or space; these answers have been noted down along the margin of the table finding out which activities take place within which settings. This process has been done for all three styles of houses including vernacular, middle, and new styles. The emphasis of this research is on vernacular

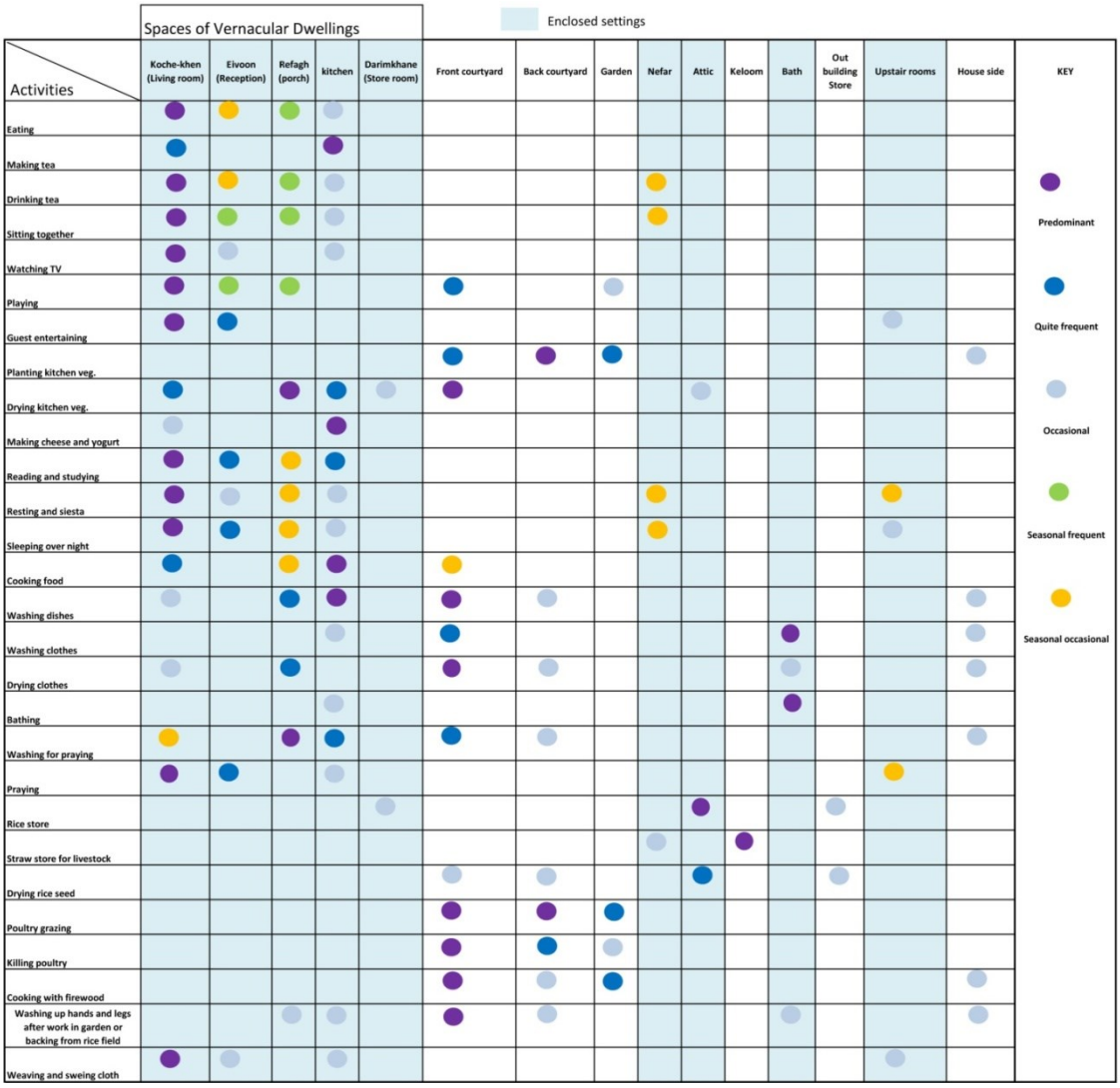
design; results of studying this particular design are summarised in table 8.12, while the results for other types have been summarised separately in different tables to support conduction of a comparative study to find out changes of lifestyle and patterns of behaviour within local houses over time. In addition to identifying all types of changes within the form of houses, their spaces and settings (Rapoport, 1983), this study also provides some authentic criteria to evaluate defined compositional rules derived from analysis of vernacular houses to examine their appropriateness for new housing.

The results show that rooms generally have flexible roles supporting different kinds of activities through different settings located within them. These activities are related to daily life needs; socialisation, and even food production, table 8.11 represents a list of them accompanied with their classification. According to table 8.12, the most common spaces within the vernacular houses are *koche-khene* (living room), *eivoon* (reception or guest entertaining room), *refagh* (front porch and other porches), *ashpaz-khene* (kitchen), *drim-khene* (store room), *nefar*, bath, upstairs and other rooms, and attic. The most important setting is *koche-khene* where all kinds of activities take place during different seasons and times of the day. Additionally, some settings are also seasonally occupied more often such as the front porch, Nefar and upstairs rooms.

Table 8.11: List of different identified activities and their classification within different identified settings of houses

Daily need related activities	**Social related activities**	**Food production related activities and other productive activities**
Eating dinner and lunch, cooking, making tea, drinking tea, sleeping, resting during the day and siesta, reading and studying, washing and drying dishes and clothes, bathing, washing for praying and prying, cooking with firewood, watching TV	Sitting together, drinking and eating together, guest entertaining, playing with children,	Drying kitchen vegetable, Boiling milk, making cheese and yogurt, weaving and sewing cloth

Table 8.12: Different activities taking place within different settings of vernacular houses are highlighted



These settings are common within all three vernacular, middle and new styles but have some changes in name and some other characteristics. Based on analysis of the vernacular settings, which is one objective of this research, the activities taking place within different main settings and changes within them according to villagers' needs and preferences are also discussed.

8.4.3.1 Living room (koche-khene)

This room has an important role within the vernacular house, where residents spend most of their time. This room supports most activities undertaken by residents doing different types of activities to take place. Common in two parts

–the forest and the forest border areas- this is the main room in each house and is only located on the ground floor. It is also called as *kele-si-khene* and *tash-kar-khen,* which means the fire room. Predominantly, activities including eating lunch and dinner, drinking tea, sitting together, watching TV, playing with children, entertaining guests, reading and studying, resting and siesta, sleeping, praying, and elements of weaving and sewing activities take place within this room. Activities including making tea, drying kitchen vegetables, and cooking food are quite frequently performed within this room. In addition, occasionally residents make cheese and yogurt, wash the dishes and occasionally do seasonal work such as drying the cloth and rice yield inside this room (table 8.12).

It is common that this room is architecturally and subjectively divided by a fireplace (stove) into two parts, upper and lower settings, which is located in the middle of the side of the room adjacent to the wall shared with porch (fig 8.37). Upper setting is defined as the masculine setting and lower setting is the feminine one (fig 8.39). Lower part is near the entrance door and upper setting is far from the door where it is warmer in winter and a cosy place to rest. The window of the room is usually located in this upper setting providing an unrestricted view of the front porch and yard also embracing wind blow in summer and enjoying sunshine in winter. This upper setting culturally belongs to the headman of family where he can control indoor and outside at the same time. The only one who can occupy this setting is the male guest or one with higher statues female from outside of the village, while sons of the family only have permission to sit beside or in front of the headman of the family. Therefore, everyone, including, stranger can easily find his or her place based on this cultural definition as soon as they enter to the room (fig 8.38).

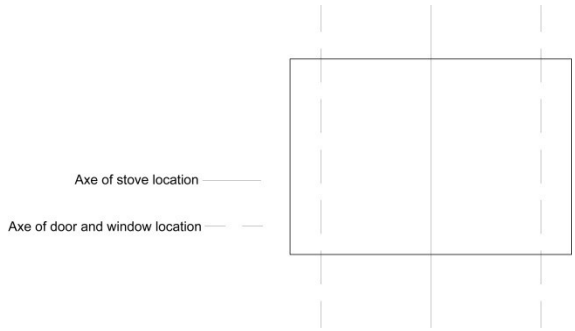


Figure 8.37: Definition of fireplace axe within traditional living room.

Picture captured from lower part of living room showing top part. Two wooden beams for rice hanging are above the wood stove.

Sitting zones, upper part belong to males and lower part is feminine territory.

Females shape their group in lower part of the living room by the door and stove.

Tea preparation for guests entertainment at lower part

Figure 8.38: Pictures show inside the vernacular living room, its different zones and using pattern

This room has a flexible role and is used for different purposes according to different times of the day and occasions. It acts as living room, dining room, kitchen, reception, guest entertaining area, and bedroom. Culturally, the upper part plays the role of living, dining, sleeping, and entertaining guests while its lower part accommodates kitchen activities including cooking food, making tea, washing dishes and some food production activities such as drying vegetables (table 8.13). This is the setting in which they welcome their guests, sitting together even late at night, this is called '*Shonisht*' (soiree) which is a cultural popular tradition of going to each other's house after dinner.

People in the region of the study culturally sit, eat and sleep on the floor as well as entertaining their guests. Males and females shape their own group within this small room, males in upper part and females in lower part also regardless of having guest. This is to some extend because of '*hijab*[1]' a cultural tradition influenced by the religion Islam, which generally limits relationships between males and females. At the time of eating, fabric is put on the floor and food is arranged on it. The arrangement of sitting around the food fabric is influenced by *hijab* and the special relationship between males and females, too. The figure 8.39 introduces some manners of sitting around the food fabric.

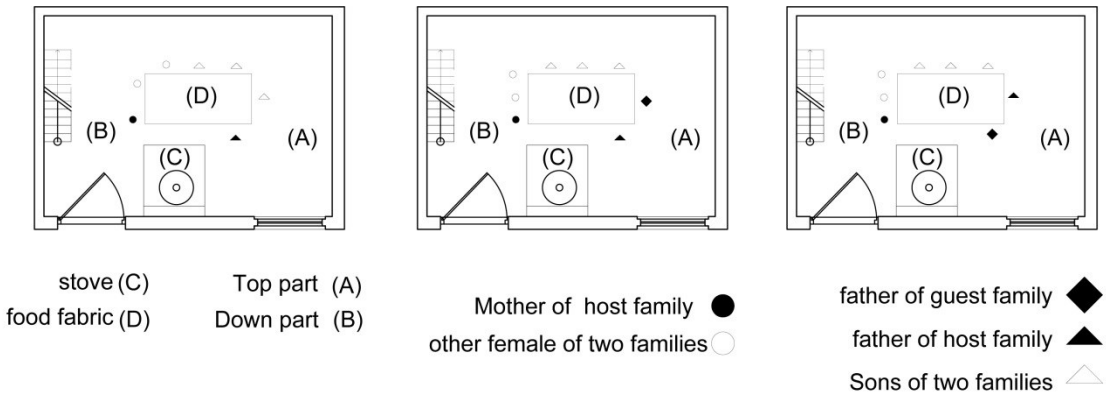


Figure 8.39: Different patterns of sitting around food fabrication within living room

According to these different roles, some pieces of furniture are juxtaposed including some pillows to lean, bed sets and blankets to sleep in upper part, and appliances and equipment for cooking and making tea are placed in lower part. Additionally, some shelves, racks, and niches are located around inside of this room are being used to put different things such as utensils on (fig 8.40, 8.41).

It should be noted that the fireplace is not only used to warm inside areas but also as an oven for cooking and making tea. It also warms the above attic area, which is a good store for preserving the rice yield, which provides opportunities

[1]: According to this religious tradition all female over 9 years old must cover herself from head to toe and must not touch a strange male except the husband, sons, father, brothers and nephews.

for residents to dry unpolished rice[1]. The aim of this, within some villages of the forest area, is to dry rice faster and better by putting it up on one or two timbers mounted inside the room along its length (fig 8.38).

Table 8.13: List of different activities taking place within living room

Daily need related activities	**Social related activities**	**Food production related activities and other**
Eating dinner and lunch, cooking, making tea, drinking tea, sleeping, resting during the day and siesta, reading and studying, washing dishes, drying dishes and clothes, washing for praying and praying , watching TV	Sitting together, drinking and eating together, guest entertaining, playing with children,	Drying kitchen vegetable, making cheese and yogurt, weaving and sewing cloth

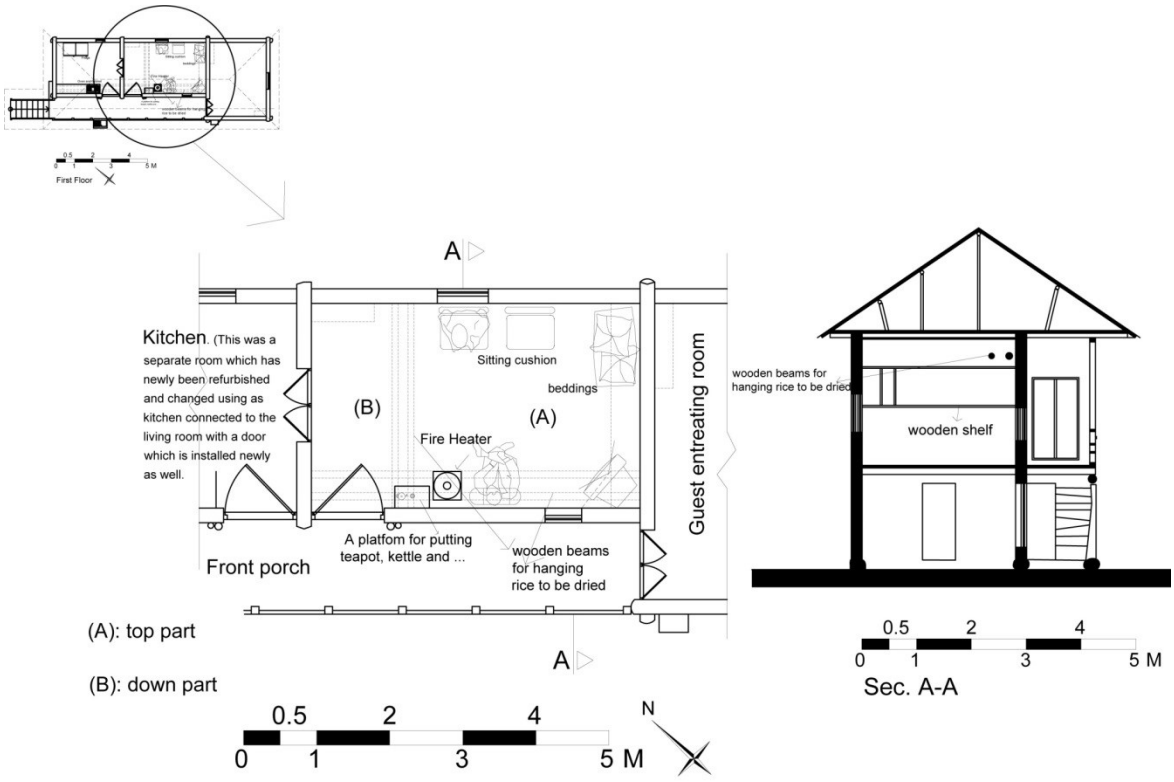


Figure 8.40: One sample of vernacular living room (House No.2 in Firozja)

1: According to ASHRAE, 'Rapid moisture removal or addition creates moisture gradients within kernels' (2001). Rice in attic can be dried gradually to be ready for threshing. By locals' belief, the quality of last year preserved rice and dried within attic is better than new achieved yield.

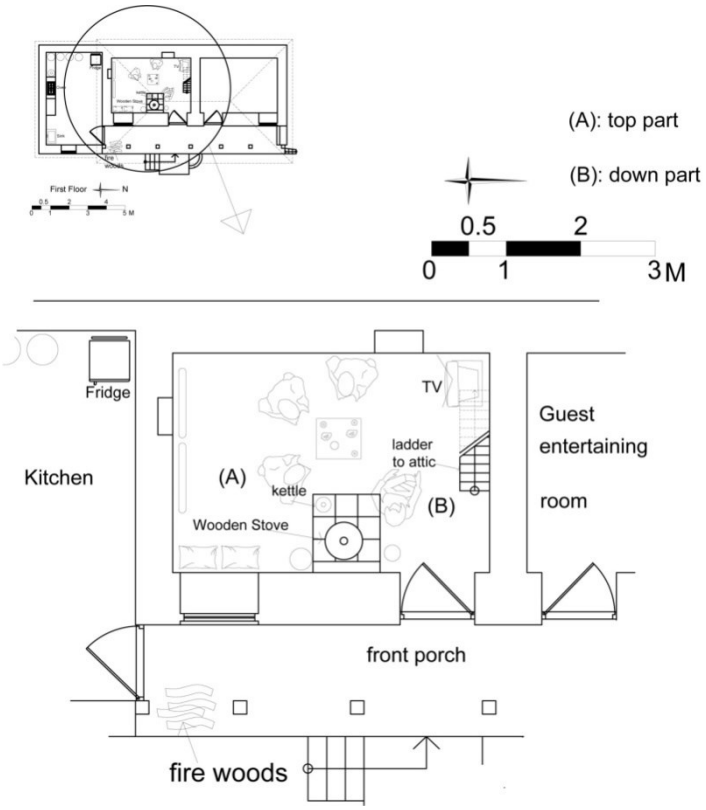


Figure 8.41: Sample of vernacular living room (House No.3 in Vareki)

Access to the attic is also possible from lower part of this room using a ladder made up of a carved of tree trunk, which is also furniture of this room (fig 8.38, 8.39, 8.41).

As a result, living rooms within middle and new styles still have the same role but settings and furniture have been organised differently. There is no fireplace or if there is, the location is different from most vernacular houses so that the meaning of upper and lower parts is slightly collapsed particularly with the advent of gas heating systems, which warms the whole space equally, sitting styles also changed because of the use of sofas, which need more space (fig 8.42).

Within vernacular houses, this room is always elongated in the same direction of the house, which is frequently towards the east-west zone and oriented to south zone thus having the best opportunity to celebrate the wind blowing from the north and south zones, and enjoying the sunshine. This elongation of the living area within middle and new styles is towards _

Figure 8.42: Two pictures of new living room, which are open plan with kitchen.

_a north-south direction letting more than one room to be located besides this area. This pattern still makes it possible to benefit from sunshine and wind (fig 8.41, 8.42).

Living setting is always rectangular in shape and are around 7 to 25 metres square area with approximate 1.9 to 2.2 metres in height. The length is one metre longer than the width or 1.3-2 times longer than the width. The width is between 2.4 to 3.50 metres and the length is within 3.00 to 6.70 metres long (fig 8.44). These sizes make this room relatively small, allowing it to be heated easier during winter especially within those villages where the main fuel is still firewood. But as a result of using gas as the main fuel for cooking and heating, warming bigger spaces is easily possible. This was an influential factor, which led to bigger living areas within middle and new styles. It is because they need a bigger living room to accommodate all of their guests within one space particularly at dinner or lunch times. Unlike the past, family parties are usually dinner parties and family members including parents, married brothers, and sisters usually gather in each other's home for dinner or lunch. Besides that, culturally all members should sit around fabric put on the floor to eat together, this necessitates a long and large living room (fig 8.43).

The shape of this room is still predominantly rectangular but the size and proportion have completely revolved. This new living room should be at least 15

metres square even up to 50 metres square and the size of its sides is different from 3-5 metres width by 5 to 10 metres length (fig 8.44).

Figure 8.43: A typical dinner party and the style of sitting and eating together within living room. All of big family members sit on the floor altogether.

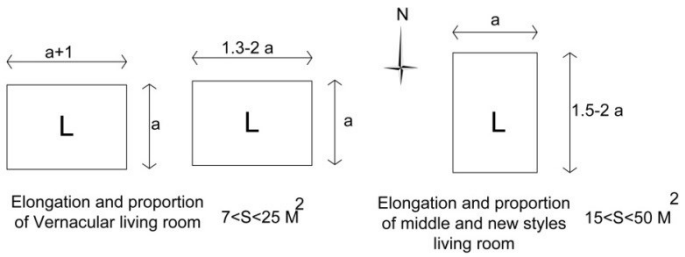


Figure 8.44: Some physical characteristics of vernacular, middle and new styles of living setting

This room in a vernacular house is often located in the middle of the house and between rooms, because of that, it is also called the middle room, this location helps this room to keep warm better and have closer access to all other rooms. One of these rooms, which support the function of living room is a store called '*darim-khene*'.

8.4.3.2 Darim-khene - store room

This room is located next to the living room and acts as a store or sometimes kitchen, which is just within the configuration of the vernacular house. Mostly it is accessible from the lower part of living room and not from the porch, which is usually full of wooden boxes to be used to store food and precious things (table 8.12). Any house that has this room sets up access to the attic from here.

This room is square or very close to this shape and the size and its sides are the same size as the width of the living room, with the same height (fig 8.45).

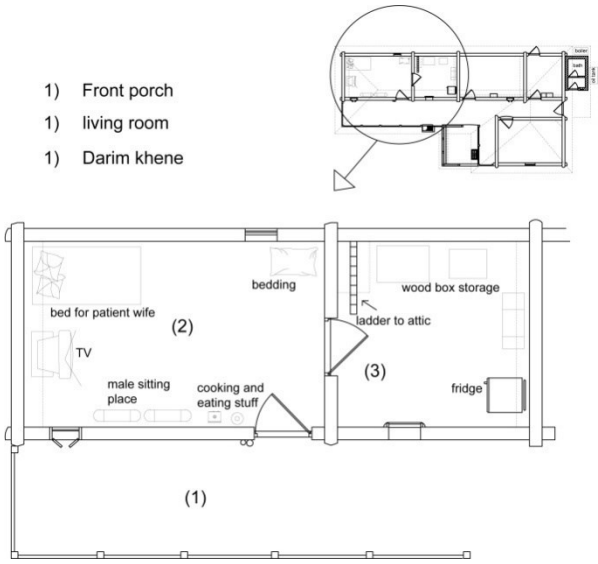


Figure 8.45: Location of *darim-khene* in relation to living room and front porch (sample No. 6 in Firozja)

So far, it acted purely as store but nowadays an oven has been located in this room and now performs as cooking area or kitchen. Accordingly, this room is capable of functioning as a kitchen and when combined with living area, making an open plan kitchen in vernacular house, this pattern can be employed within new housing. Open plan kitchen are a favourite spatial pattern within the region specially when equipped with modern kitchen appliances.

8.4.3.3 Kitchen

Traditionally, the kitchen was located within the courtyard or on the other side of front porch keeping a proper distance from living settings; this was due to the fuel, this wood fuel makes considerable smoke. Importing gas into the region in the forms of tank and pipe, combined with the prevalence of gas ovens made it possible to have kitchens closer to the living area or even inside. Within vernacular houses there is a separate room acting as a kitchen. However, residents can also employ different settings as a kitchen. This space is culturally a private area belonging to the women of the family where strangers are not allowed to enter so that most private activities of the family use to take place here. Even in one case

study village, Vareki, baths of some vernacular houses are located in the kitchen for provision of more privacy (fig 8.46).

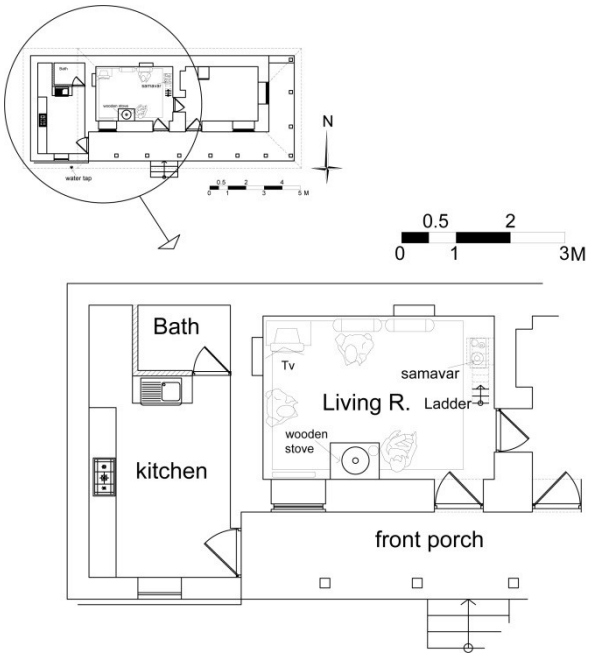


Figure 8.46: Relationship between living room and kitchen. Bath is located within kitchen.

Therefore, the Kitchen is not just a setting for cooking, eating and drinking but it is responsible for different types of daily living, productive and social activities such as living area. Tea is usually quite frequently ready inside the living room and predominately within kitchen. Cooking food, washing dishes, and making cheese and yoghurt predominantly take place in this setting. Residents dry kitchen vegetables, do reading and studying activities, and washing for praying here and occasionally utilise this setting for eating, drinking tea, sitting together, watching TV, resting and siesta, sleeping overnight, washing clothes, bathing, praying, washing hands and legs after working on rice field and gardening, and for weaving and sewing cloth (table 12, 14).

This indicates that the role of kitchen is very close to the role of living room or in better word, they complement each other. In effect, kitchens have been physically brought close to living areas within middle and new styles with a direct access door or in some cases; it has been open plan with living area. Kitchen is the second important setting after the living room for villagers of the region of this

study, which needs to be designed carefully. According to the result of questionnaire 03, an open plan kitchen has been mostly advocated (48%), _

Table 8.14: list of different types of activities taking place within kitchen

Daily need related activities	**Social related activities**	**Food production related activities and other productive activities**
Eating dinner and lunch, cooking, making tea, drinking tea, sleeping, resting during the day and siesta, reading and studying, washing and drying dishes and clothes, bathing, washing for praying and prying, cooking with firewood, watching TV	Sitting together, drinking and eating together, playing with children,	Drying kitchen vegetable, Boiling milk, making cheese and yogurt, weaving and sewing cloth

_ nearly half of the respondents want an open plan kitchen. Slightly less, around 44% of respondents, would not like an open plan kitchen but would prefer a kitchen close to the living area instead (fig 8.47).

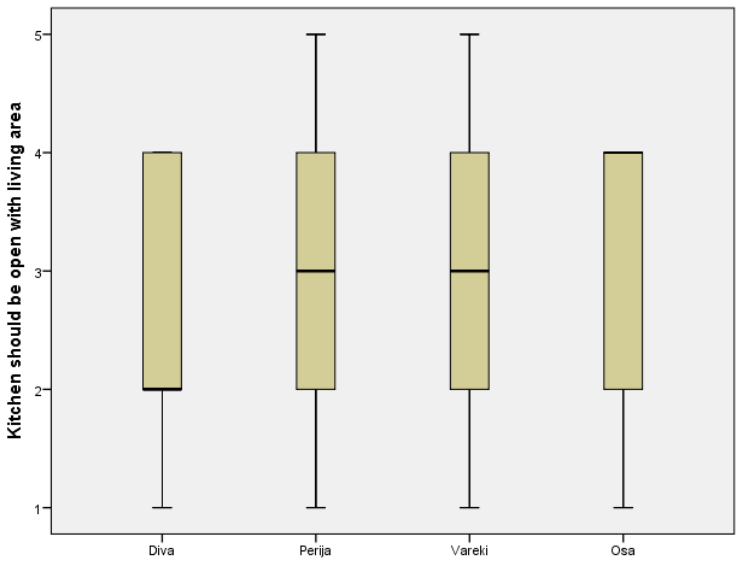


Figure 8.47: The question is about agreement with open plan kitchen. The answers are different within four case study villages but according to the box plot derived from SPSS, half of respondents agree and strongly agree with this pattern.

A separated kitchen with just a door connecting to the living area can help residents to warm the inside of the living room appropriately (Focus group interview no.42 in Vareki). Kitchen style has association with 'hijab' and generally with the special relationship between male and female and the specific culture of the family. Some families are sceptical regarding hijab and some are not, and in some families, female members could have free relationships and communication

with male members of the village letting them entertaining guests and working in the kitchen area simultaneously. They believe that this style is much more comfortable and suitable for a new life style (Focus group 13 Vareki) while others disagree;

'No, I disagree with that. Kitchen must have 'hijab' (Focus group no.10 in Vareki)

The boxplot derived from SPSS analysis of questionnaire 03 shows the distribution of answers for two villages of the forest area, Perija and Vareki is symmetrical, and the median is neutral meaning that villagers in these two villages prefer both design styles of kitchen, open plan and separated one. Although this distribution for two villages located in the forest border, Diva and Osa looks like the same, the median in Diva is 'strongly agree' while for Osa is 'disagree' which means villagers in Diva prefer to have an open kitchen plan with living room while in Osa is contrariwise (fig 8.49). Overall, half of respondents agree with this pattern.

Consequently, it seems that villagers generally prefer both styles including open plan kitchen with living area and kitchen separated from the living room but it is clear that they must be attached and close to the living room with direct access. In addition, many new modern kitchen appliances such as oven, fridge, freezer, sink are imported to the region, which make it possible to have open plan kitchen with no problem like in traditional kitchens. This new kitchen also needs to be bigger than traditional, which on average residents prefer a room around 12-20 metres square area functioning as kitchen (fig 8.48, 8.49).

8.4.3.4 Guest entertaining room (Eivoon) -Reception

This setting in vernacular houses act as a guest entertaining room but not predominantly, although it has been created for the purpose of guest entertaining. Predominantly guest entertainment takes place within the living room and only unfamiliar special guests are welcomed in the Eivoon; this happens quite frequently throughout the year. At other time, the single son or girl of the family

uses this space as their individual room for sleeping, reading and studying. Occasionally, it is used for watching TV, resting and siesta, and weaving and sewing cloth. It has also has seasonal role during spring and summer, it is frequently_

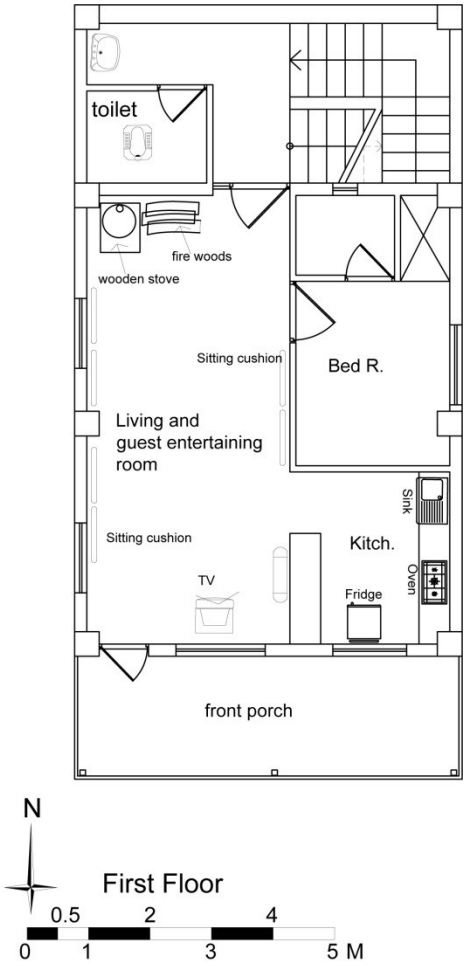


Figure 8.48: location of kitchen, its furniture, and relationships with other activities of other settings within a new style house(Sample No.1 in Vareki)

Figure 8.49: Two pictures showing open plan kitchen with living and guest entertaining area within new style houses.

_used for family gatherings; family members gather in their parents' home. In addition, eating and drinking tea occasionally takes place within this area during this season (table 8.12, 8.15). This room has less function in comparison to the living setting and kitchen.

Traditionally, this setting is also an individual room within the middle style but new houses usually combine it with the living area in order to provide a larger space to be furnished with sofa and other new modern home appliances.

Therefore, the size and proportion of this room dramatically changed. It used to be the same size of the living room within a vernacular style but is now at least 30 metres square and 3-5 meter by 6-12 metres. This room within new houses,_

Table 8.15: list of different types of activities within reception

Daily need related activities	**Social related activities**	**Food production related activities and other productive activities**
Eating dinner and lunch, cooking, drinking tea, sleeping, resting during the day and siesta, reading and studying, prying, watching TV	Sitting together, drinking and eating together, playing with children,	weaving and sewing cloth

_this room has the same role as living room within vernacular house, which culturally conforms to villagers' lifestyle. It performs as important space of the house configuration, most activities take place here and all rooms are accessed from this room. However, within vernacular houses all room are accessed from front porch as the main semi-enclosed setting.

8.4.3.5 Semi-enclosed setting

This space is a fundamental component of vernacular houses, its variations have been created based on different sizes and locations. It attaches to the main body of the house as a balcony or is detached from the volume of the house as *nefar*. It is predominantly columned with wood, the more porches, and the longer the columns are the greater indication of affluence of the owner. The most important semi-enclosed setting is the front porch from which all rooms are accessed. Additionally, this space acts as a living room during spring and summer, which means that most roles of this space are seasonal specially *nefar*. Regardless of season, in addition to using this space as a corridor getting access inside rooms from outside, drying kitchen vegetable and washing for praying predominantly occur in this space and quite frequently activities including washing dishes and drying clothes. Eating, drinking tea, sitting together, and playing are those seasonal activities that villagers enjoy to do here frequently during spring and summer (table 8.12, 8.16).

'Yes. Is not it. Now, we are sitting here and look how pleasant it is. Is not like that?' (Focus group, no. 08 Osa).

Within this area, the residents can talk and meet other villagers passing along the street because of its close relationship with the outside of the house and dwelling. Sometimes, it is even located exactly besides the street thus facilitating and improving socialisation of residents of the house with neighbours and other villagers. Besides that, residents could have eyes on the street controlling the safety of the street and watching out for their children playing here (Jacobs, 1961).

During seasons when villagers come out from inside into this setting, occasionally they do reading and studying, resting, sleeping and even bring out the oven and cook food in this space (fig 8.51 and table 8.12, 8.16). Additionally, it has prominent role relating to the climatic condition, which is mentioned and discussed later in chapter 9.

Table 8.16: List of different activities within semi-enclosed setting

Daily need related activities	**Social related activities**	**Food production related activities and other productive**
Eating dinner and lunch, cooking, drinking tea, sleeping, resting during the day and siesta, reading and studying, washing dishes, drying cloth, washing for praying	Sitting together, drinking and eating together, playing with children,	Drying kitchen vegetable

Most activities performed within the front porch have different names within different villages as '*refagh'*, '*katpe'* and '*darven'*. It is an inseparable component of a vernacular house across the region, which is usually narrow, long and located in front of the house, commonly oriented towards south or east zone and connects all rooms consolidating the bulk of the house and facilitating their access to each other. It is mostly linear but L and U shapes do exist. The minimum width of front porch is 60-centimetre and the maximum is 2.50 metres, an appropriate size conforming to its roles. These characteristics are common within all variations of semi-enclosed settings whilst the only difference is the location of

others and their roles. Usually, other semi-enclosed settings are employed because of climatic conditions in order to protect the house from rain and harsh sunshine in summer (fig 8.50).

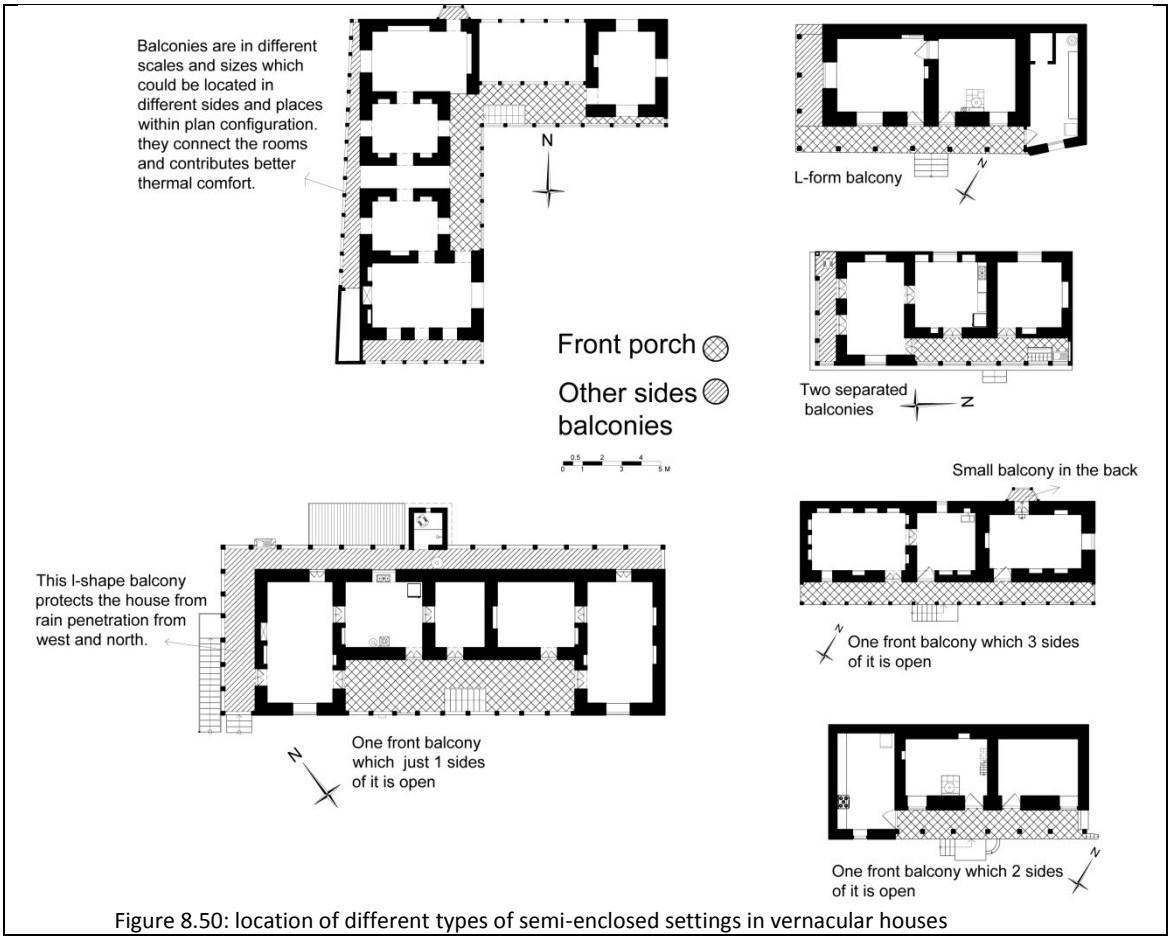


Figure 8.50: location of different types of semi-enclosed settings in vernacular houses

Figure 8.51: Pictures show different potential activities taking place within front porch including sitting and eating together, and socialisation with people on the street.

This space is not as significant within new houses as it is in vernacular samples. The use of it reduced and unlike within vernacular houses it does not connect the rooms. This role has been transferred to the central hall or living room in middle and new styles houses. The size and area of it has diminished insofar as some of the new houses particularly multi-storey flats do not have this setting within their configuration. Some believe that this setting is better to be smaller in size and area, which is financially affordable and allows larger closed spaces within the same total area of a house.

'…Because they want to have bigger living room. This porch is around 12 meter square, if it is added to living area, it will be bigger, will not it. Now people prefer this [style] but we are happy of this [our] porch. We use it a lot…. We also have front porch in our city house as well which is new constructed (Focus group, no. 11 in Vareki).

Despite of the reduction of its roles, 95.8% of respondents to questionnaire 03 according to different purpose advocate putting a front porch within the configuration of a new house.

'…the house without the front porch is tailless' (Focus group, no.14 in Vareki)'.

'Man: the house must have front porch.
Woman: A house without front porch is not a hose to live.
Man: front porch is very pleasurable space (Focus group, no. 15 in Vareki)'.

'A house must be equipped with that. Without front porch, life is not possible (Focus group, no. 10 in vareki)'.

'Of course yes. Without front porch, the house is ugly' (Focus group, no 11 in vareki)'.

The only semi-enclosed setting, which is detached from the volume of the house is *nefar*. This is usually a small rectangular (usually 2.5*3.5m) two storeys free-stand, and single-room building always located in courtyards besides the main body of the house, and is constructed with timber frame technology standing on wooden columns. The ground floor is usually encircled with thin wooden board while the first floor has no surrounding walls; it stands on wooden columns bearing the sloped wooden roof (fig 8.52, 8.53, 8.54). This configuration could direct wind from all directions as wind is now unblocked from local barriers. This setting is completely seasonally occupied during spring and summer taking the role of a living room. This setting has not been continued within middle and new style houses.

Overall, semi-enclosed settings are functional spaces according to the climatic condition and are favourable settings for villagers. The front porch should be included as an important component within the configuration of houses appropriate for this region.

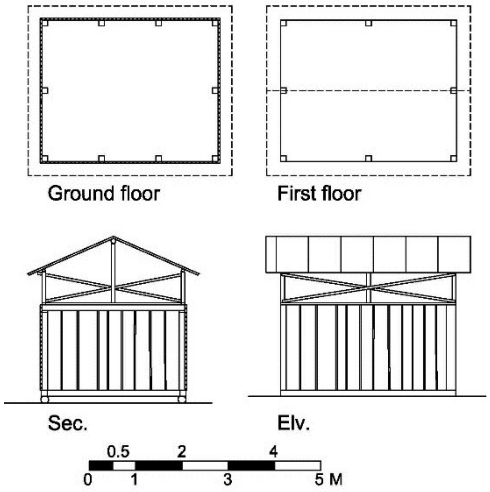


Figure 8.52: A sample of Nefar

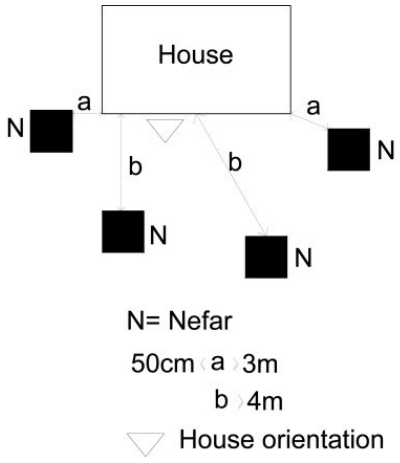


Figure 8.53: Location of Nefar according to the location of the house

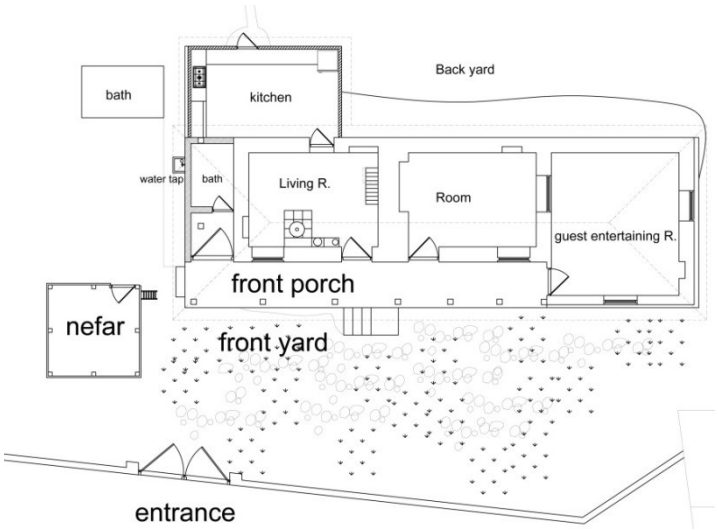


Figure 8.54: Location of Nefar within map and photography related to the house, front porch and front yard (Sample No.5 in Vareki)

8.4.3.6 Service rooms, toilet, and bath

The location of the toilet and bath is a controversial topic amongst rural villagers particularly after modernisation. Traditionally, the toilet was an outbuilding located within the dwellings (fig 8.55) but bringing it inside the configuration of the house is a modern phenomenon surrounded by differing opinions. Traditionally, in terms of bathing villagers used to go to public baths located within their own or the closest village. Because of the advent of new modern technologies for piping and heating up water using oil, gas or electricity, currently villagers now prefer private baths within the configuration of their house; particularly the private space of the kitchen area, which is quite private area. However, as it is a new space, there is a debate whether it is better to be located within the house configuration or just separate from the living building as an outside stand-alone structure.

The Question 6f of the questionnaire 03 according to villagers' opinions addresses the location of toilet. 33.3% of villagers 'agree' and on the other hand 33.3% 'disagree' with the statement of 'Toilet should be inside the house configuration' whilst 29.2% 'strongly disagree' with this statement and just 2.1% 'strongly agree'. The boxplot derived from SPSS shows the median for two villages

is answer 3, which means that respondents equally agree and disagree with bringing the toilet inside the house configuration.

Unlikely, residents of other 2 villages do not like to put the toilet within the configuration of living house, as the median is the answer 'disagree', however, four samples within these villages as outliers agree with this statement (fig 8.56). Oppositions are anxious about the smell, damp and ventilation of this room However, new modern technologies mean these conditions are not as bad as they were in the past. In total, 62.5% do not accept constructing the toilet within their new house however, they prefer that this service is better to be close to the living house as the newly added toilets, which are very close to the house and even attached to it (fig 8.57). Similarly, a considerable amount of interviewees propose having two toilets; one inside for exclusive use of family members and another_

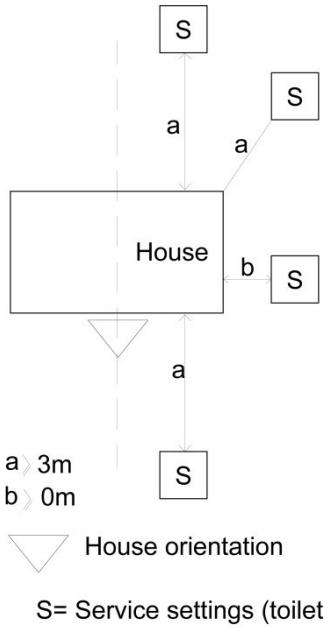


Figure 8.55: Location of toilet within vernacular house

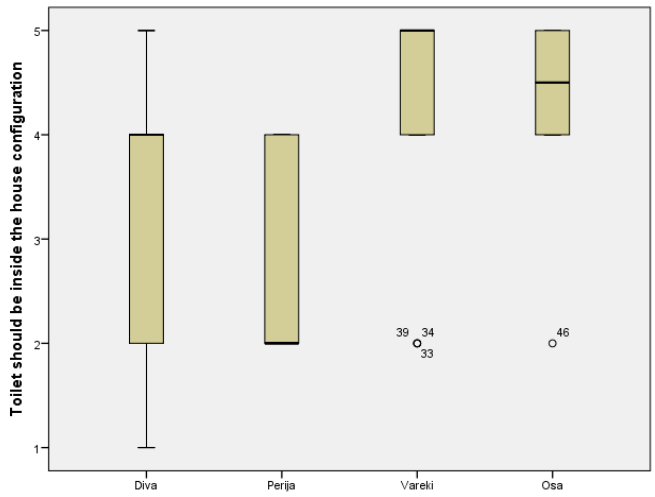


Figure 8.56: Most of residents disagree with having toilet within the house according to the boxplot derived from SPSS analysis of questionnaire 03.

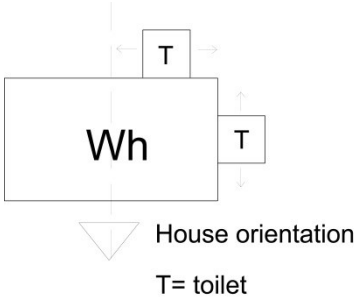


Figure 8.57: Possible location of new added toilet in relation to the house.

_located outside for family and guest use (e.g. Focus group no.13 in Vareki; sample houses, no.5 in Diva; House no. 33 in Vareki).

Different on toilets, most of respondents have a modern approach towards bath as new space of the house. 56.2% of the respondents 'agree' and 12.5% 'strongly agree' to put the bath inside the house configuration (totally 68.7%) while on the other hand 25% of respondents 'disagree' (fig 8.58).

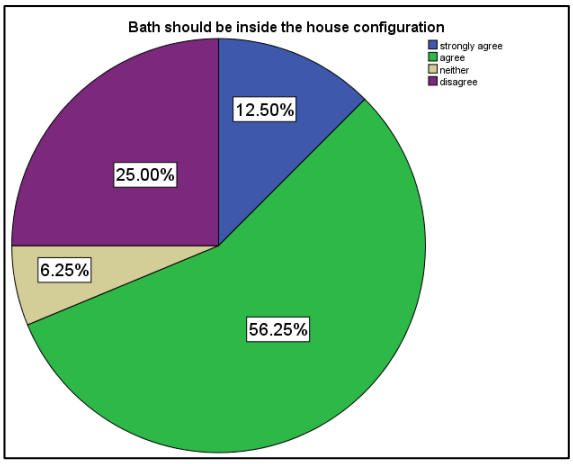


Figure 8.58: The result of question about putting the bath inside the house configuration.

According to the three correlation tests, Pearson Correlation, Kenadall's tau-b and Spearman's rho, it has significant correlation with 'Level of literacy' (0.349, -0.289, -0.339 respectively) which means that people with a higher level of literacy prefer to allocate a room for 'Bath' inside the house configuration to be accessed from living room (table 8.17).

Table 8.17: The table derived from SPSS represents the correlations between to questions of questionnaire 03.

		Bath should be inside the house configuration	Level of literacy
Bath should be inside the house configuration	Pearson Correlation	1	-.349*
	Sig. (2-tailed)		.023
	N	48	42
Level of literacy	Pearson Correlation	-.349*	1
	Sig. (2-tailed)	.023	
	N	42	42

*. Correlation is significant at the 0.05 level (2-tailed).

Consequently, the bath is preferred to be located within the configuration of the houses and accessed from the living area, whereas with regard to toilets, no general rule can be issued and it is better to ask each client to find out whether to set it up inside or outside.

8.4.3.7 Commonalities and differences within different house types

According to principals of represented typology and characteristics of their main components, these types have some common characteristics, which made them appropriate for locals to adopt as their home whilst these types have some differences, which provided diversity of selection for users.

Common characteristics include; common proportions of rooms, existence of some common spaces with same characteristics such as front porch, living room, and attic, the shape of sloped roof, which is usually hip roof. They are all located on a raised platform, they are one room in depth, their orientation, elongation and other responses to the climatic condition are the same or similar, and their construction technology is similar. On the other hand, space organisation and location of rooms in relation to each other are different within different types, which is the main criterion for definition of different types by locals as Row, Half-saddle and Saddle house. Accordingly, main commonalities, which embody the main characteristics of houses within the region, are more numerous than differences.

8.4.4 Transformations of dwelling and houses from vernacular to new style

Introduction of new technologies in the construction industry of the region have influenced the characteristics of dwellings and houses. These technologies include electrical and mechanical technologies such as arrival of electricity, piping water, heating systems and equipment providing warm running water and keeping warm inside easier and cheaper, new modern mechanical technologies for toilet and bath construction accompanied with import of construction materials such as concrete and steel, and construction technology such as concrete and steel framing. These technologies coupled with the introduction and employment of

new home appliances such as kitchen modern devices including oven, fridge, and washing machine and living room equipment such as sofa, dining table, TV and the like have influenced the lifestyle of the villagers. This has changed the systems of activities, the pattern of using house spaces and more importantly physical aspects of systems of settings of dwellings, and configuration of houses. Accordingly, two styles have been identified besides the vernacular style in this research titled middle and new style. Moreover, as it has been mentioned in the discussion about dwelling and house, the changes occurred in house scale while in whole property scale the changes were trivial. In this respect, these styles have been examined to identify and introduce these changes.

8.4.4.1 Orientation and changes in sizes and proportions

South zone direction is climatically the most favourite direction within the region, most vernacular houses have been oriented accordingly. The north zone and west zone directions are the worse. This appropriate direction is not important as the orientation of middle and new styles as it is for vernacular house. Some new and middle style houses are oriented towards the north direction with no proper sunshine because the street was located on this side and an entrance was only possible from this direction and so houses faced onto the street, which was not an influential factor for vernacular house orientation. Despite this, a considerable amount of samples belonging to the middle and new styles are oriented towards south zone (appendix 5), which indicates that this direction is still culturally the most favourite direction in order for the house to conform to regional climatic condition.

The average area of the house has not changed from vernacular to new style but the proportion of the house has changed remarkably relating to the preferred orientation within the region which is towards south zone direction. Vernacular houses were predominately rectangular, while according to the orientation, the length is always longer than the depth. The proportion of middle style houses is relatively square with no elongation. New style houses are rectangular like vernacular style houses however, in terms of orientation, the length is always

smaller than the depth and its proportion is perpendicular to the house orientation (fig 8.59).

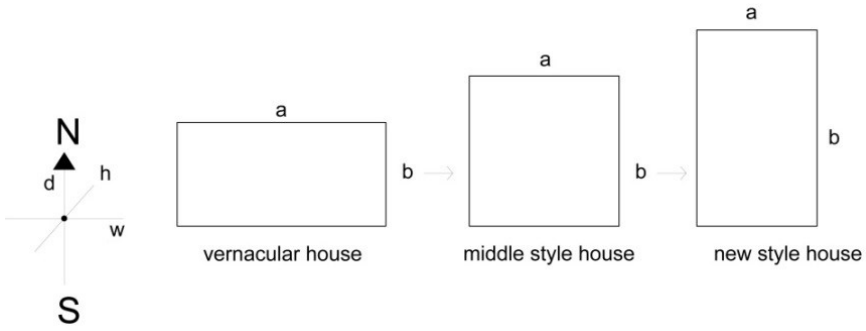


Figure 8.59: Change of the proportion of the house in the region from vernacular to new style

The predominant shape of rooms is rectangular within all three styles and the size and proportion of rooms has not substantially changed. According to table 8.18, the average, median, mode, and minimum sizes of windows are close to each other with no considerable change or difference. The only difference is associated to the maximum size of the room, which became bigger in middle and new styles consecutively. This maximum size in table 8.18 indicates the size of living room, which is the main room of the house and sometimes combined with a guest entertaining room. Within vernacular houses, the length of the living room is one metre longer than the width or 1.3-2 times longer than the width. The width is between 2.4 to 3.50 metres and the length is within 3.00 to 6.70 metres long, which the construction technologies, climatic conditions, the size of carpet and residents' need were influential factors in room size determination (Memarian, 1998). New living rooms in middle and new styles are bigger as they serve as guest entertaining rooms needing to be furnished with sofas and related furniture. They are at least 15 metres square and up to 50 metre square and the size of its sides differs from 3-5 metres wide by 5-10 metres length, even the height is bigger from 2.5-3 metres making it a large space. The mechanical systems of warming and cooling specially those running with piped gas and electricity, accompanied with new modern construction methods and new bigger carpets allow creation of this massive area particularly keeping the inside desirably warm and cool.

Table 8.18: The table shows statistical analysis of the size of rooms within three styles of house.

Traditional dwelling

	Room	
	Length (m)	Width (m)
Max	7.6	4.1
Min	2.6	2
Average	4.37	2.98
Median	4.3	3.4
Mode	4	2.8

Middle style dwelling

	Room	
	Length (m)	Width (m)
Max	9.1	4.2
Min	3	2.2
Average	4.54	3.18
Median	3.9	3
Mode	4	3

New style dwelling

	Room	
	Length (m)	Width (m)
Max	9	6.5
Min	2.6	2.4
Average	4.52	3.42
Median	4.1	3
Mode	3.8	3

7.3.4.2 Changes of the function of rooms and configuration of the house

Some changes have occurred within the constructed vernacular houses during their refurbishment. Expanding the size of living rooms to be appropriate for new furniture and lifestyle is the main change, which is usually coupled with adding a new room as modern kitchen, or changing the function of adjacent room to be used as modern kitchen whether open plan or connected with a door. Someone also planned toilet and bath adjacent to the house accessed differently from front porch, kitchen or living area (fig 8.60). Through the extension process, the type and the configuration of the house possibly changes. The role of front porch reduced and has been added to the living room's role, in that the living room connects most of other settings and rooms together instead of the front porch. The house becomes more than one room in depth, which particularly within the forest border areas produces some difficulties for rooms to be well ventilated.

Rooms within middle and new styles, unlike in vernacular houses, do not have flexible roles and have just one major function, in this respect some new rooms are set up and the functions of some others have changed. The kitchen is a new room usually furnished with modern appliances located inside the house with close connection with the living area. Besides that, the bath and toilets have been brought into the house configuration. The living and guest entertaining rooms have been combined, which made this area bigger and the main room of the new houses performs as a joint connecting all rooms together. Front porch, which is the one of the most important setting in vernacular houses has been eliminated or is_

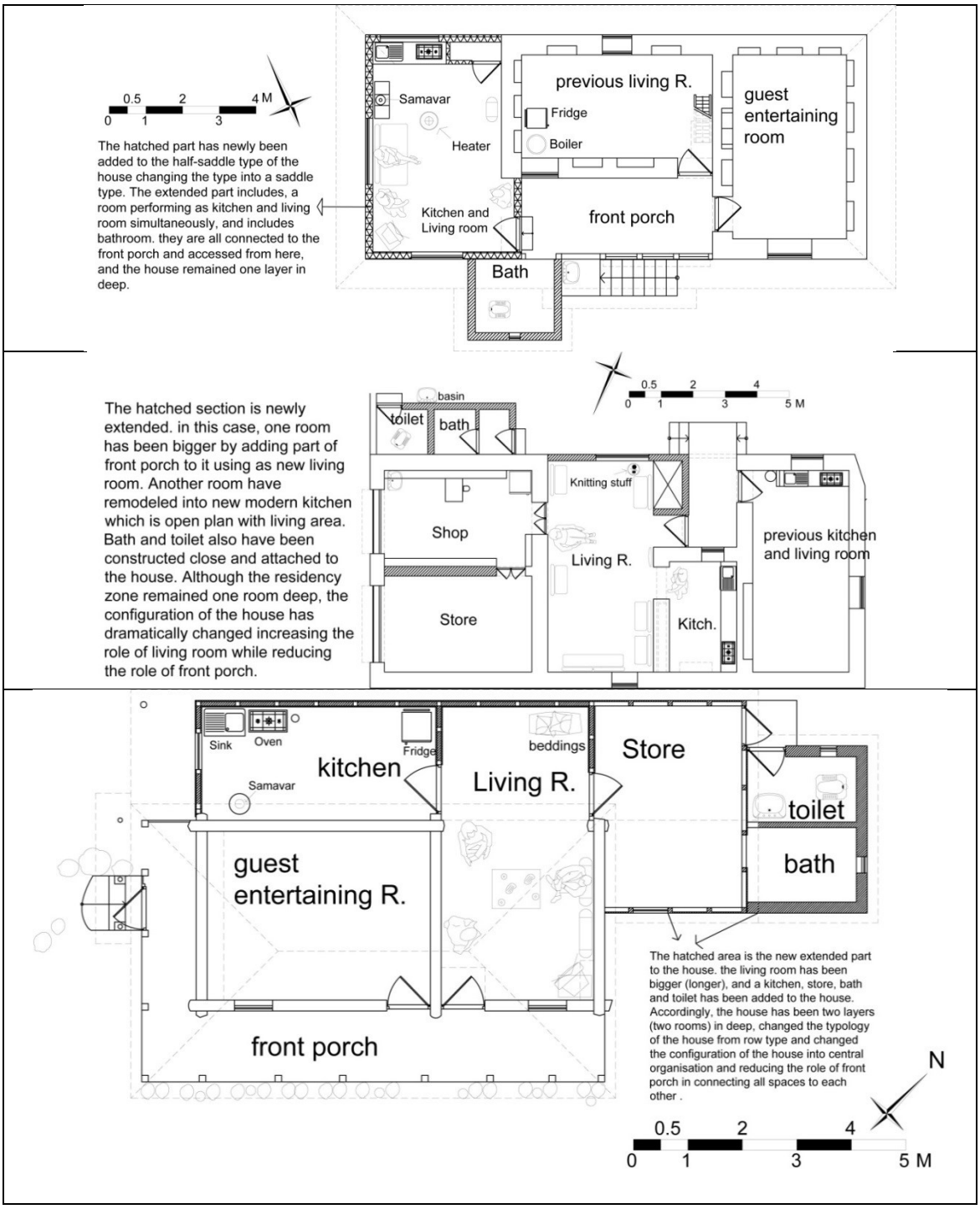


Figure 8.60: Three samples showing different changes have taken place within vernacular houses.

_an unimportant setting with no significant function simply employed for drying washed clothes. Additionally, each member of the family prefers to have an individual room as their own bedroom, which is a new modern phenomenon and space imported into the housing culture of the region. Accordingly, question 6a of

questionnaire 03 asked '*it is better to provide one individual room for each member*' 79% of respondent agreed with this statement but they mentioned that it depends on family needs and the number of children. On the other hand, in response to the question 8 of this questionnaire about '*numbers of bedrooms'*, half of respondents selected reputed modern name 'two bedroom house' and 35 % selected 'one bedroom house' while just 14.6% selected '3 bedroom house' and no one selected more than 3 bedroom house. Generally, the average family population is 3.3 in Mazandaran (Statistical centre of Iran, 2015) and within the sample population of this research is 3.15 (table 8.19) derived from questionnaire 01 aiming to collect information about general aspects of family life and the house represented within appendix 2. It means that on average 3 to 4 persons live within a house proving that 'one or two bedroom house' is generally a suitable size for villagers of the region conforming to their family size and lifestyle.

All of these changes influenced the configuration of the houses. Firstly, rooms are located behind each other related to the orientation and houses have become more than one layer unlike vernacular house, which is one layer or room deep (fig 8.61). This climatically makes some issues particularly associated with wind circuit within rooms, which is necessary within living areas due to the most amount of time spent in them.

Average population			
Number of population		Frequency	total
V	1	4	4
	2	10	20
	3	12	36
	4	6	24
	5	4	20
	7	1	7
	8	1	8
	Total	38	119
	Average		**3.13**

Table 8.19: Total sample population and average population within a family within sample population.

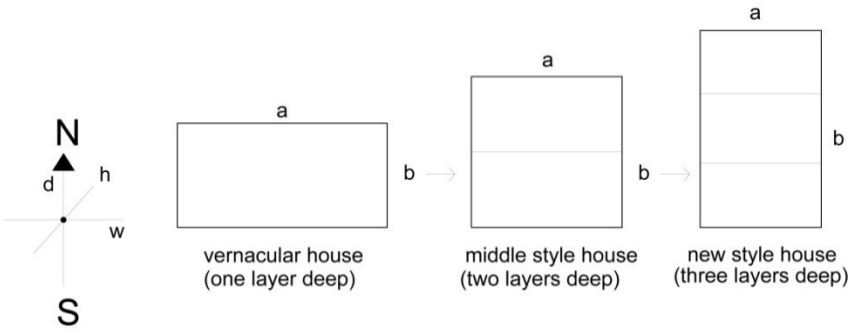


Figure 8.61: Figure shows different layers of different styles of house.

The role of connecting these rooms transferred from the front porch to the living space, changing the organisation of the house from linear to be centrally organised. It should be mentioned that some new houses do not have a front porch within their configuration. As a result, living room is the one of the most important space within middle and new styles of house within the region where most family activities take place. This area is favourable for villagers allowing them to have convenient access to all rooms without going outside like the vernacular style. It is also useful to keep inside areas warm and so it is better to be within new housing configurations (fig 8.62).

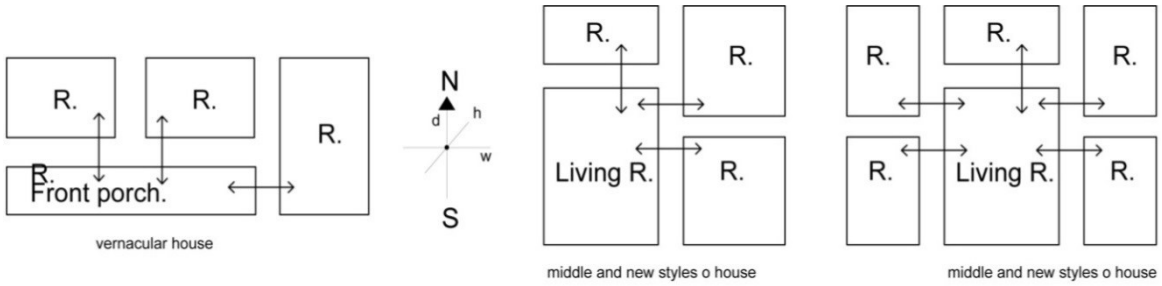


Figure 8.62: Spatial organisation of different styles of house, from linear in vernacular to central organisation in new style houses.

One of the other transformative changes within the house construction is prevalence of constructing houses on *pilotis* space, which is inspired by modern style architecture which is common in new style houses providing the possibility to construct multi-storey flat while vernacular and middle styles houses are predominantly one but a maximum of two storeys. '*House should be on the pilotis'* is question 6p of questionnaire 03. In total, 43.75%of villagers do not prefer to have

the house on pilot (27.1% 'disagree' and 16.7% 'strongly disagree') because they believe that it makes house construction expensive, longer, and importantly going up and down is hard. On the other hand, the maximum percentage of response of 33.3% belongs 'agree' to this configuration and 2.1% 'strongly agree' which means that despite of total maximum opposing (disagreement), house on the *pilotis* is a favourite style for around 35% of people (fig 8.63).

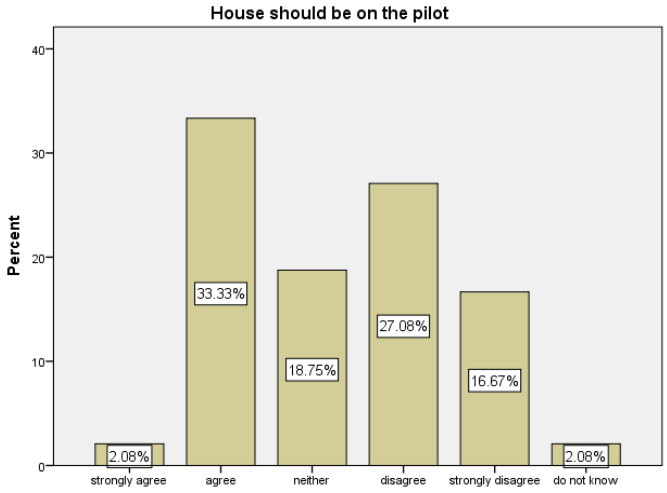


Figure 8.63: The bar chart shows the percentage of pros and cons with on pilothouse. Disagreement is scored more.

According to The Pearson correlation test, it has significant correlation at rate 0.297 with age group, which means that more respondents belonging to the younger age group within all villages prefer houses with *pilotis* underneath. On the other hand, older respondents mostly disagree with it. This also has been confirmed by other two correlation tests. This highlights that one important factor when deciding whether to design pilot houses is the age of the owner (table 8.20).

Table 8.20: Table represents the correlation between age and on pilot house

		Age group	House should be on the pilot
Age group	Pearson Correlation	1	.297*
	Sig. (2-tailed)		.041
	N	48	48
House should be on the pilot	Pearson Correlation	.297*	1
	Sig. (2-tailed)	.041	
	N	48	48

*. Correlation is significant at the 0.05 level (2-tailed).

The other change, which influenced the external appearance of the house, is the form of the external roof of the house. Vernacular houses are double roofed having a sloped hip roof externally and flat wooden ceiling internally above the rooms, between the attic spaces, as a dry store area for rice. This is one of the main climatic characteristics of vernacular buildings of the region. New houses particularly new flats employing a concrete frame do not take advantage of this useful feature and these new houses have just one flat roof on the top of the flat/house, which according to the climate of the region, does not seem suitable or they have a saddle roof or one way sloped roof. Question 6g of questionnaire 03 concentrates on this issue, 66.7% 'disagree' and 'strongly disagree' with the statement '*House is better to be with flat end roof outside*' while just 14.6% 'agree' with it (table 8.21). According to the boxplot, the mean of residents disagree with an external flat roof (fig 8.64). It means that although this type of roof is quite dominant in city areas and is visible on top of new houses in rural areas, it is not appealing for most villagers and it is not better climatically to have a flat roof on new houses within the region.

Table 8.21: The table represents the result of the responds to the question about outside ending flat roof

House is better to be with flat end roof outside

	Frequency	Percent	Valid Percent	Cumulative Percent
Agree	7	14.6	14.6	14.6
Neither	9	18.8	18.8	33.3
Disagree	19	39.6	39.6	72.9
strongly disagree	13	27.1	27.1	100.0
Total	48	100.0	100.0	

Materials employed for house construction have also dramatically changed, is the main topic of the next section. All of the examined middle and new style samples have been classified and presented in the table introduced in appendix 5. At the same time, some of their physical characteristics such as their area, material and technology have been introduced. Maps of some samples representing different examples of middle and new styles are exhibited (fig 8.65 to 8.70).

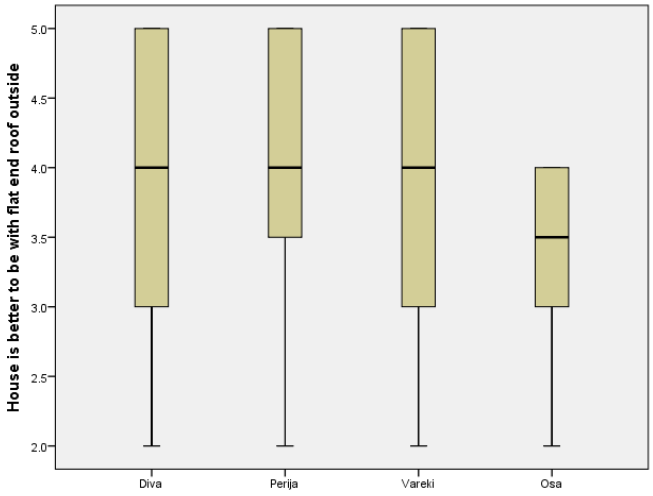
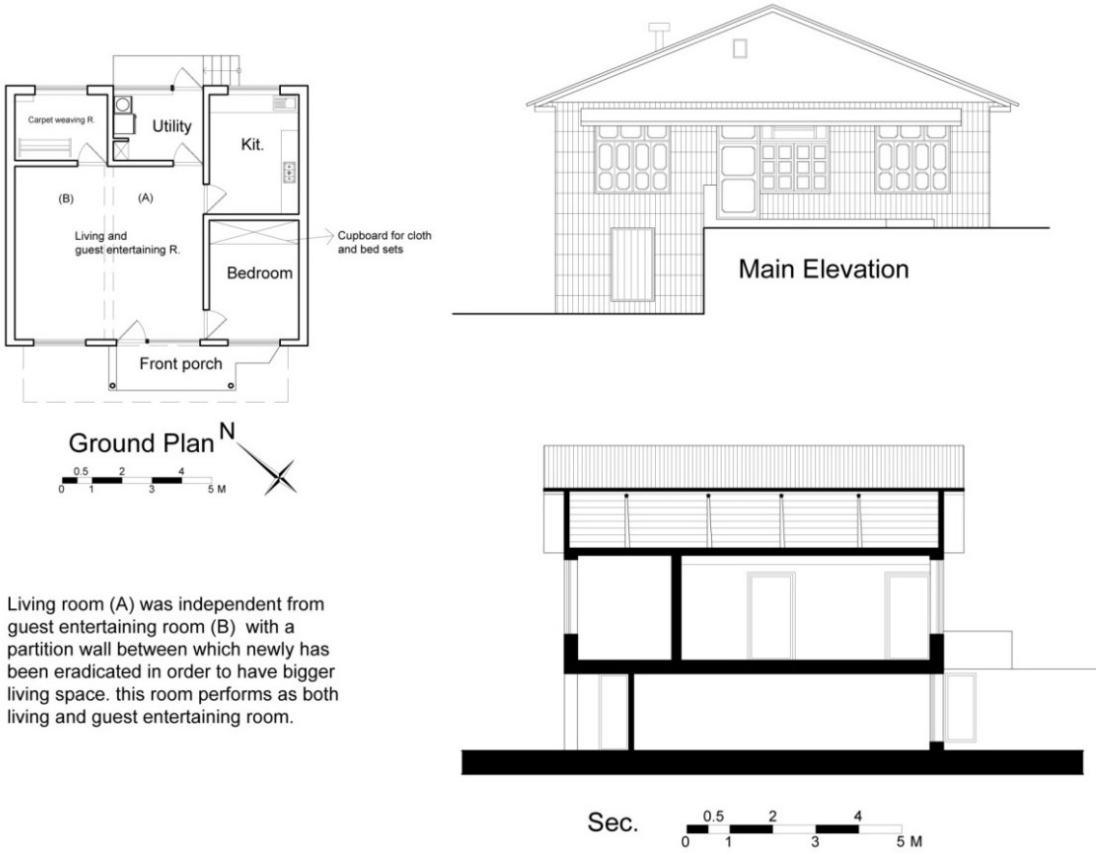


Figure 8.64: The boxplot derived from SPSS shows that most of respondent disagree with the question.

Consequently, these three different vernacular, middle, and new house styles have common spatial needs. In other word, systems of activities within these three styles similarly taking place within systems of settings, which accommodate roughly the same activities and perform the same function although their physical characteristics are different. In respect of these commonalities and results of questionnaire 03 introducing new villager demands with regards to house spatial elements, general requirements including spatial and physical characteristics related to new houses are achieved. They are:

- House is better to be rectangular and oriented toward south zone direction.
- At least one room must be one layer in deep according to the orientation of the house in order to set up cross ventilation and benefit from sunshine from a southerly direction. This room is better to be the living area within which residents spend most of their time and undertake most activities.
- House is better to be on the ground rather than on pilot plan, however the age of the owner is still significant.
- House is better to be a maximum of two storeys and on the ground.
- House is better to have sloped roof.
- House should have a setting of appropriate size for whole family to sit together, eat, drink and entertain the guests, which should have close connection with all other settings and rooms.



Living room (A) was independent from guest entertaining room (B) with a partition wall between which newly has been eradicated in order to have bigger living space. this room performs as both living and guest entertaining room.

Figure 8.65: Middle style house (sample no5 in Diva)_ one story with bricked load bearing wall

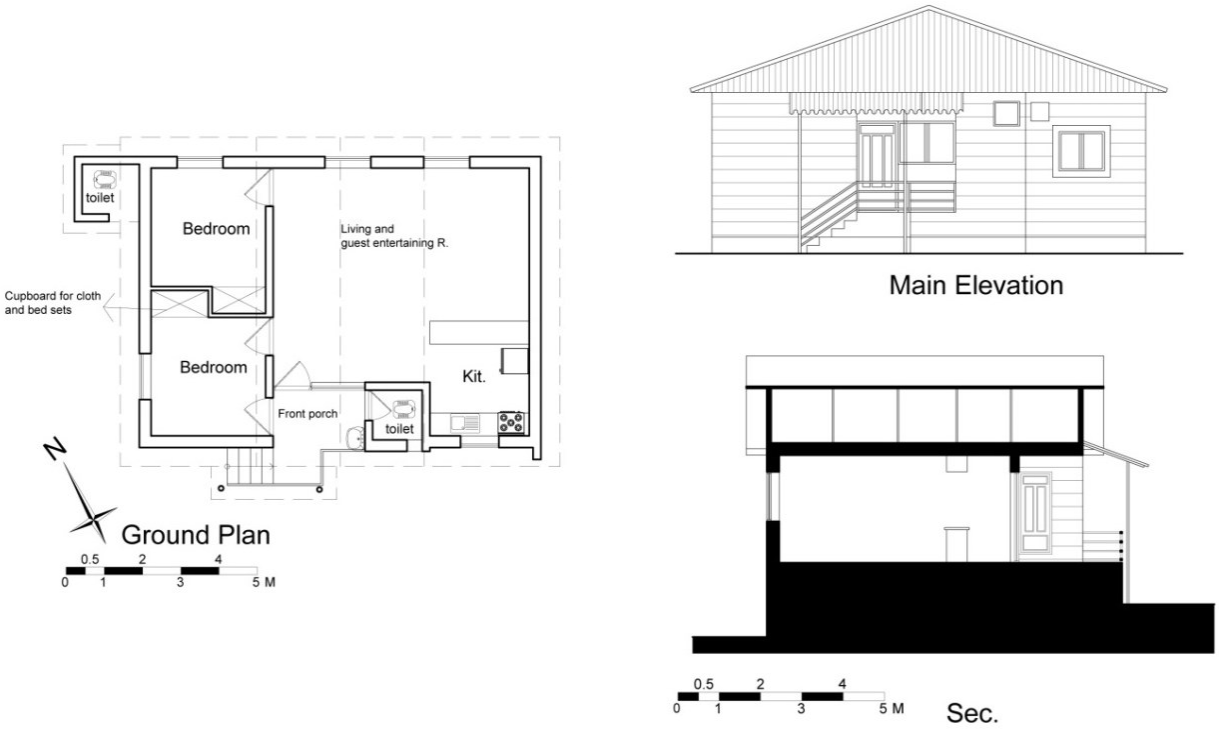


Figure 8.66: Middle style house (sample no.16 in Diva) _ one story with bricked load bearing wall

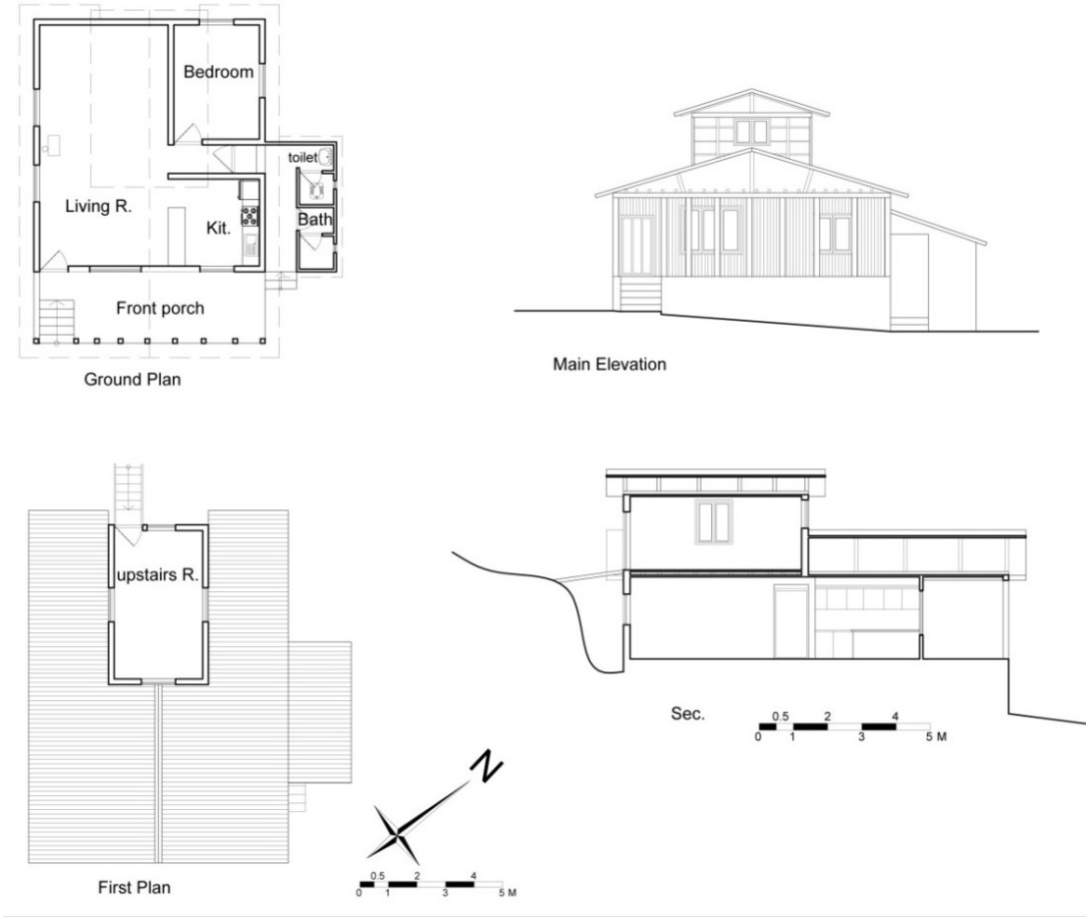


Figure 8.67: New style house (sample no.17 in Diva)_ one story, timber frame house

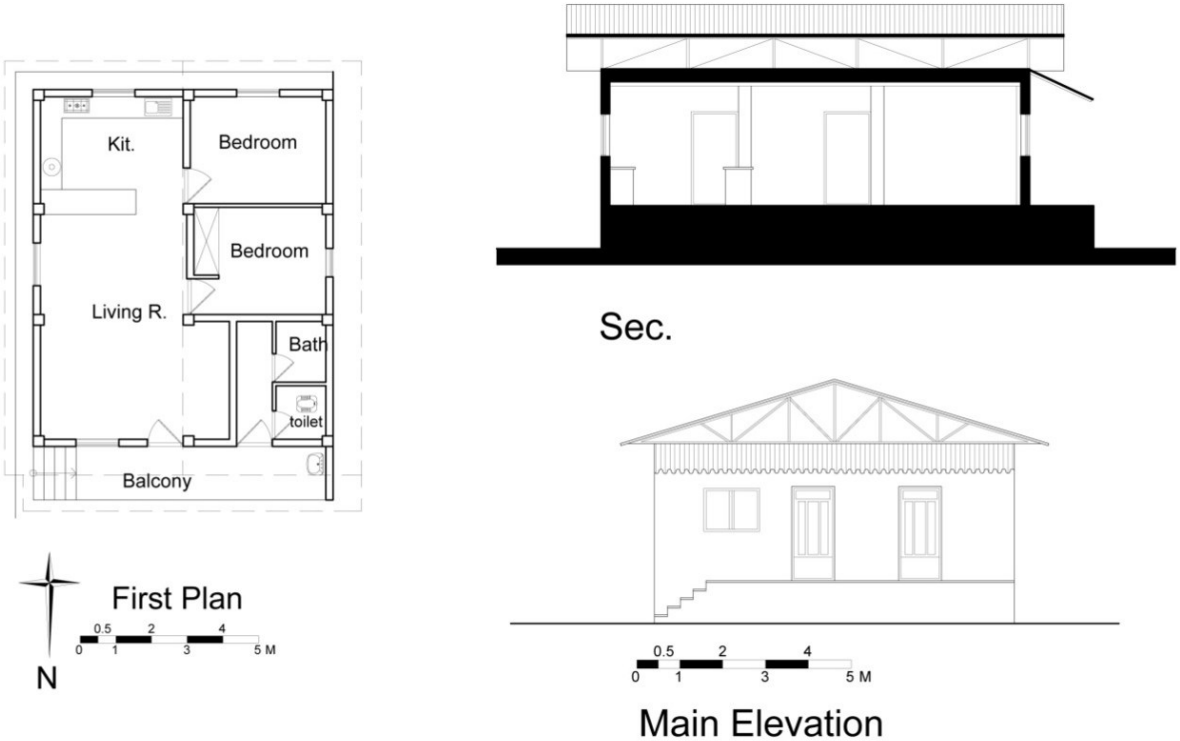


Figure 8.68: New style house (house no.9 in Diva) _ one story, concrete frame house

Figure 8.69: New style house (sample no. 1 in vareki) _ on pilot with concrete frame

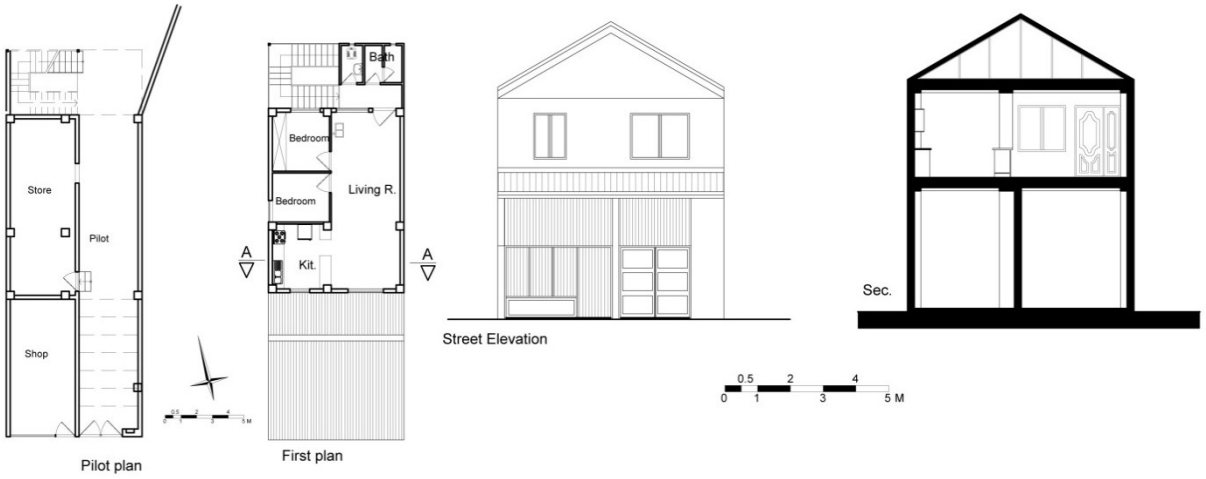


Figure 8.70:New style house (sample no.12 in Diva) _ on pilot with concrete frame

- House should have a setting as kitchen for cooking food, tea preparation, sitting and eating together, which needs to be close to the living setting of the family. It could be open plan or separated and connecting with a door.
- Children and family members are better to have individual rooms. Villagers on average stated two extra rooms are applicable however; one extra room and three extra rooms have been stated as applicable, too.
- At least one semi-enclosed setting must be set up within house configuration, located in front of the house toward south. It should be an appropriate size for sitting, drinking and resting activities.

- The toilets and baths are best located outside but very close or even attached to the main body of the house. The bath can be located within the configuration of the house but it is very private area, and needs to be out of the stranger's sight. However, the location of the toilet and bath has correlation with age and level of literacy, which means that should be designed specifically according to users' opinion.

According to the result of the questionnaire 03, it is generally concluded that respondents agree to the most important characteristics of vernacular houses including the arrangement of front and backyards within dwelling, designing the house on the ground, containing a front porch, and the instalment of a slope roof on it. Overall, it proves that designing new houses based on patterns derived from the vernacular style responds to residents' preferences within the region but simultaneously above-mentioned items need to be considered.

8.4.5 Construction technology, materials, and methods

The information related to the material employment has been gathered through filling in self-questionnaire 02 containing 44 sheets; each of them collected data about one house selected as a sample for this study. The questions were about employed material for different components of different styles of house, which is presented in appendix 02. The results of these questionnaires are explained in this section.

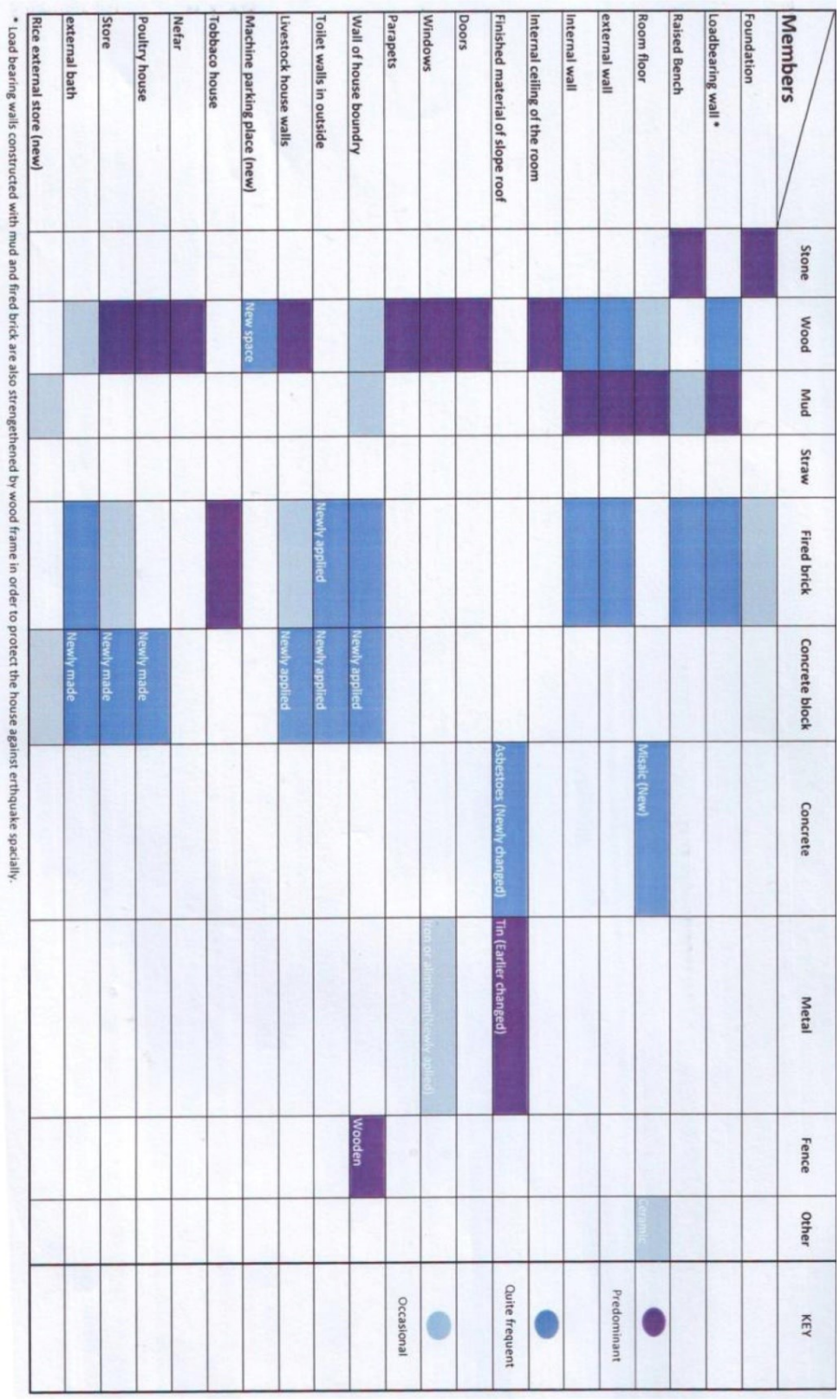
The region of the study has high rainfall rate and high humidity. On the other hand, the frequency of earthquake is high (Iranian regulation 2800, 2014) and landslide is widespread particularly within the forest area (shad, et al, 2010). According to these environmental restrictions, locals shaped the vernacular construction technology based on employment of natural sustainable resources. Much the same as the configuration of the house, the pattern of local employment of construction technology and materials, have remarkably evolved. These evolutions were based on employing construction technology and materials imported from outside of the village from the city or even from abroad, which local villagers were not properly trained to work professionally with. The result is a

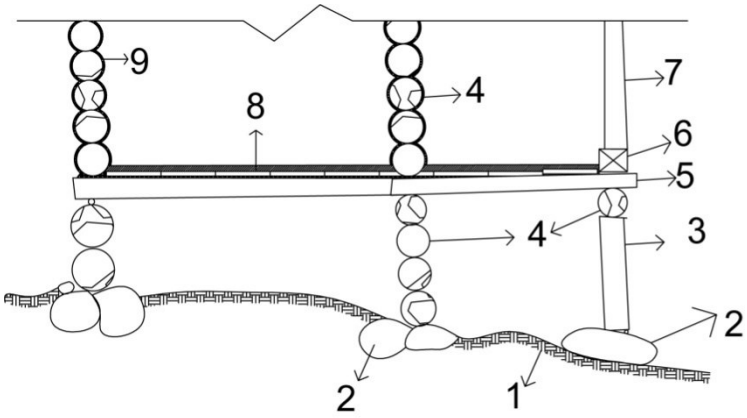
remarkable change in house configuration, and construction of houses, which are not sustainable.

8.4.5.1 Load-bearing systems and materials of vernacular houses

Traditionally, houses were built based on load-bearing wall systems, their materials were derived from natural environment resources (table 8.22). The main natural material predominantly employed for load bearing walls was wood obtained from the forest area, which was also used for construction of other components of a building. The other main material for erection of load-bearing walls was mud, which was abundant in the natural environment. Clay or wooden walls were used as the only materials to directly bear the load, or in order to reinforce the load-bearing wall constructed with mud or fired-brick. Within a village, Perija, wood is employed for log-on-log technology, which is the vernacular technology of construction in this village located within the forest area (fig 8.71, 8.72). Unlike log-on-log technology, all walls in Diva, including load bearing internal and external walls are made from a technology using a combination of mud and wood. In this wall, which is a sort of wattle wall is made of tree branches with performing like the timber frame technology. Mud is used as the filler that is daubed into the interstices of wattle walls is then usually mud-plastered outside and gypsum on the inside (Fig 8.73, 8.74). This technology has been recognised as a sustainable technology, which has the potential to be used even for new modern construction (Vellinga et al, 2007; Edwards and Turrent, 2000). Another loadbearing wall system is use of mud processed from a mixture of clay and rice straw prevalent in Vareki, these walls are strengthened with wood. Mud actually bears the load and wood reinforces the efficiency of the wall to be sufficiently resistant against an earthquake. This is the same technology employed within load-bearing wall construction, as seen in Osa, but with application of fired brick.

Table 8.22: Table of material variation employed in vernacular house and its outbuildings' construction

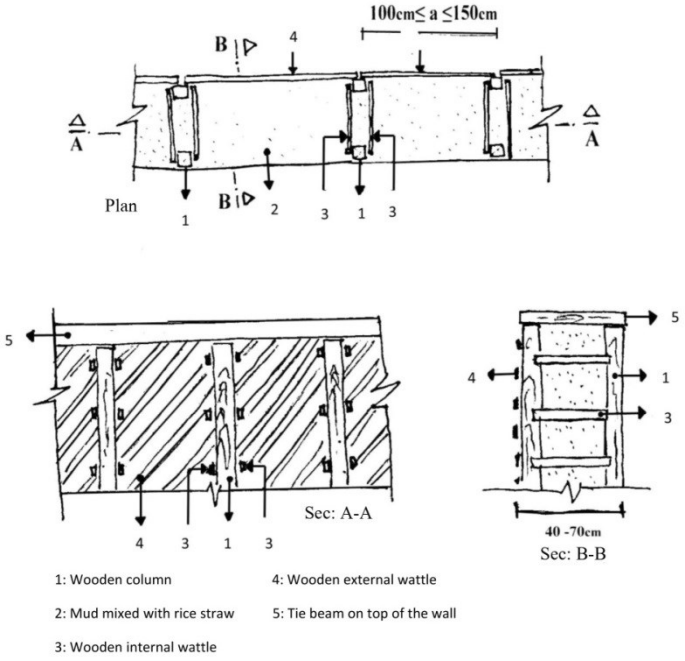




1: the ground
2: round stone
3: wooden round column
4: wooden logs
5: wooden squared beem
6: wooden squared tie
7: wooden squared column
8: Floor, soil on the wooden board
9: white clay applied on logs

Figure 8.71: Detail of log on log wall of the vernacular house

Figure 8.72: Log-on-log house



1: Wooden column
2: Mud mixed with rice straw
3: Wooden internal wattle
4: Wooden external wattle
5: Tie beam on top of the wall

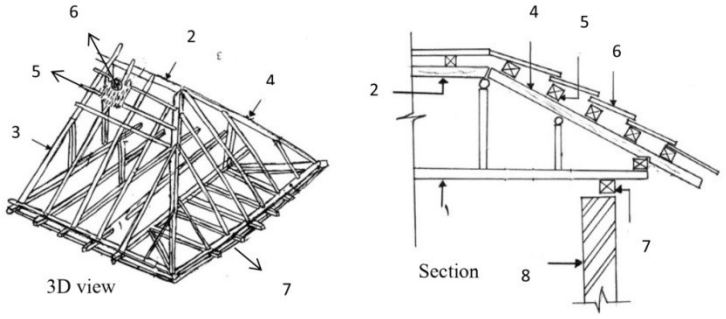
Figure 8.73: Detail of wall in timber frame technology (*larde*) belongs to the vernacular construction.

Figure 8.74: Two pictures of a house constructed with timber frame (wattle and daub or *larde*) technology.

Additionally, wood is the main material that shapes all components of vernacular houses within all villages. Windows and doors of all of vernacular houses are wooden with no exception and manufactured by local carpenters. Wood is also used for internal flat ceiling over all rooms in the form of timbers and sloped roof trusses. For covering the roof, timber is arranged alongside the width of the rooms (fig 8.75, 8.76). Because preparation of a long timber frame for house coverage was not possible, the width of rooms in vernacular houses is maximum 4 metres long while the length is not limited to this construction restriction, measurement of up 7.6 metres have been observed (table 8.18).

Figure 8.75: Internal wooden ceiling

Sloped roofs were usually covered with wooden shingles in the forest area and with thatch (made up of rice straw derived from rice fields) in the forest border. Much durable material including metal tin sheet at the first mode of change and corrugated asbestos sheet more recently imported from city areas has replaced them. It was because shingle and thatch used to deteriorate over time due to high amount of rain and humidity of the environment, as a consequence regular annual maintenance was essential.



1: wooden beam of the ceiling
2: wooden beam connecting trusses
3: slope wooden member of truss
4: wooden member of the corner of hip roof
5: wooden Perlin
6: roof coverage (Thatch, shingle, Tin
7: Main wooden tie beam over all walls
8: Load bearing wall (log on log, timber frame, mud or fired brick)

Figure 8.76: Detail of wooden components of hip roof in the vernacular house.

Stone sourced mainly from nearby riverbed is the main and proper material for house foundations and for building up the raised platform as a bench for the house, thus creating protection from raised damp, rain, and surface water. Foundation of houses is usually rooted in the ground, maximum 50 centimetres, except in Perija with log-on-log houses, which appear to have no foundations. Large stones are directly located on the ground shaping a balanced base for logs to be set up on. This deliberate kind of technology for foundations with no rigid connection with the ground is an efficient solution addressing the issue of earthquakes (Memarian, 1998).

Walls in vernacular houses became internally and externally covered with clay derived from rom surrounding natural resources and processed to be used as finishing plaster. Brown or dark clay are sourced from the land of the dwelling, mixed up with rice straw, cow dung, and little water. White clay is another type of applied clay, which is used purely for decoration purpose as a plaster. This kind of clay is not usually achievable within the villages but the mine is accessible in the outskirt of these villages. Preparation of all clay and their application on the wall are usually the responsibility of women.

Wood and rice straw covering externally the sloped roof in vernacular houses have been replaced with new materials such as metal tin sheet and more

recently, corrugated asbestos sheets. Metal sheets need a light substructure like traditional materials, which are usually made up of wood (quoted from carpenter in Diva through interview) but can be noisy during rainy days. Asbestos sheets are much heavier than metal needing a stronger substructure and trusses consuming more wood or new stronger material such as steel. Besides that, asbestos has been classified as a known human carcinogen; a substance that causes cancer and asbestosis due to long exposure and breathing in asbestos fibres (the U.S. Department of Health and Human Services, 2004; NHS UK, 2015), this characteristic of asbestos sheet, makes it necessary to be avoided to be used in construction.

Wood and mud are also the main materials of other buildings and structures located within vernacular dwellings allocated for food production activities such as livestock and poultry buildings. New types of fired brick and concrete block have been substituted for new construction of buildings including toilet, bath, livestock building, store, and poultry building. Fired brick is brought and imported from city area but in terms of concert blocks, they are produced within the village while sand is also provided from the sand mine close to villages and cement is imported from the city area too.

8.4.5.2 Load-bearing systems and materials of middle style houses

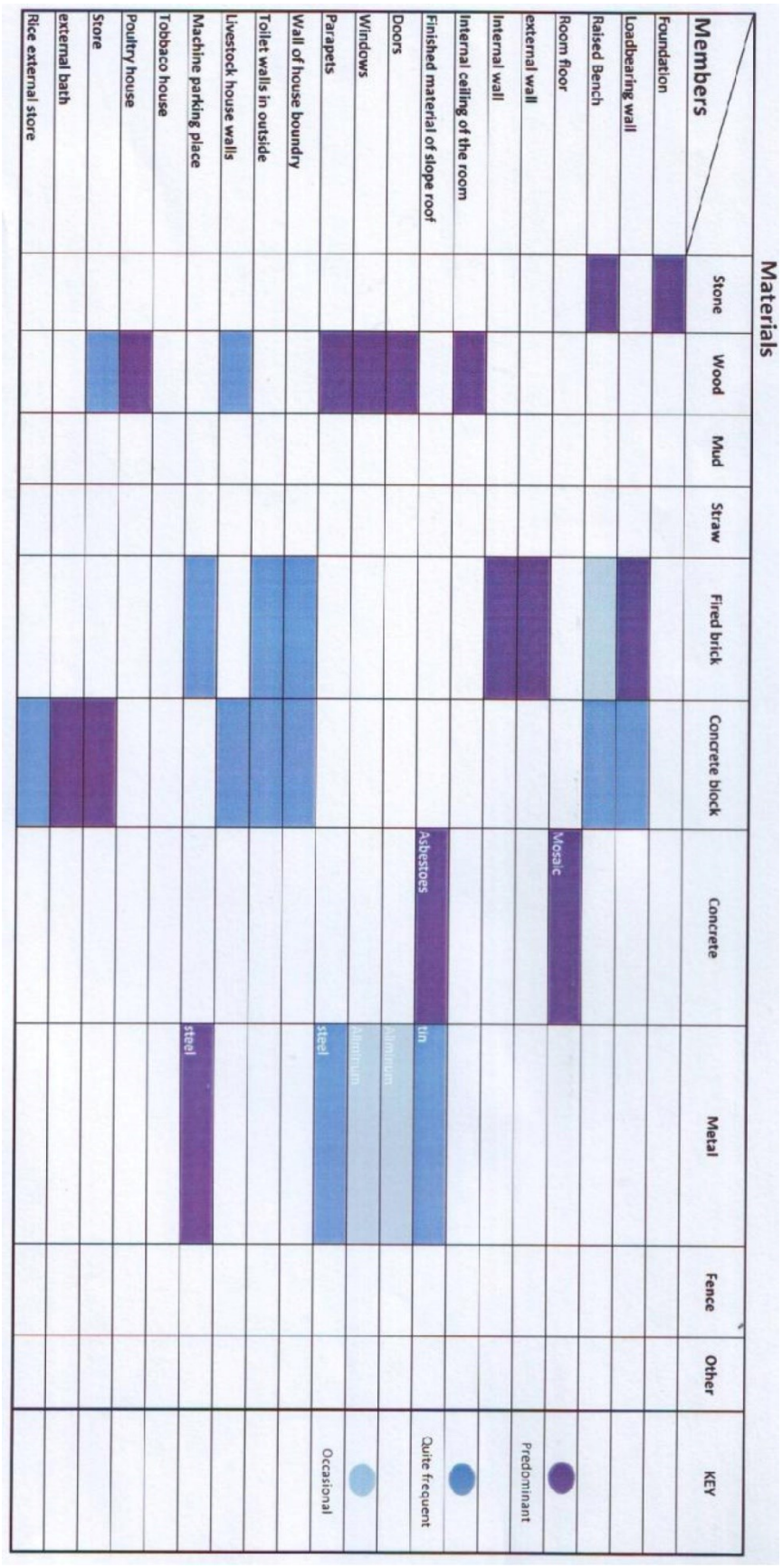
As in the vernacular style, Load-bearing walls are the main technology applied for erection of middle style houses but fired brick and concrete blocks are used instead. Wood and Mud are two major materials applied for construction of all load bearing, internal and external walls. This common technology of load-bearing system within vernacular and middle styles, which was not strong enough for construction of multi-storey structure, was one factor that restricted the number of storeys; no more than two storeys. Wood is still the main material for windows, doors, structural trusses of sloped roof and internal ceiling coverage. Stone is still the material used for foundations and the walls of raised platforms.

8.4.5.3 Load-bearing systems, materials of new style houses and some related issues

For new style house construction, 'concrete frame' is the most prevail and popular technology. This method is encouraged by governmental offices and organisations associated with housing either for passing the rules or responsible for giving villagers permission for new house construction. This technology, using a concrete frame enforced by ribbed rebar as the main skeleton of the house, have all been imported from city areas, both groups of villagers and local experts are still not sufficiently trained to work with them properly. On the other hand, this technology made it possible for villagers to construct more than two-storey flats accommodating more than two families within one flat and consuming less land. Accordingly, more land could be saved for food production such as orchard and rice field. Besides that, this technology offers the opportunity to have bigger rooms, around 6-metres width has been observed within new style houses while this was 4 metres for vernacular and middle styles (table 8.18).

In addition to structure frames, walls of new houses are made of atype of fired brick also imported from city areas. The thickness of internal walls is usually 10 centimetres and the thickness of external wall varies from 10-20 centimetres within all villages with different climatic conditions. This thickness does not have adequate performance regarding thermal comfort particularly as they offer no thermal insulation. Windows and doors of new style houses, unlike vernacular and middle styles, are all constructed from iron, aluminium or more recently double glazed UPVC. Most of these windows and doors are prefabricated within cities or other bigger villages, imported and installed by professionals from outside of the villages. Steel frames are not common as its construction price is higher than concrete frames although steel is employed in construction of internal doors, windows, and parapets.

Table 8.23: The table of material employment in middle style house and its outbuildings' construction. Wood is still one of the main material accompanied with fired brick. some new materials are entering to the house construction process.

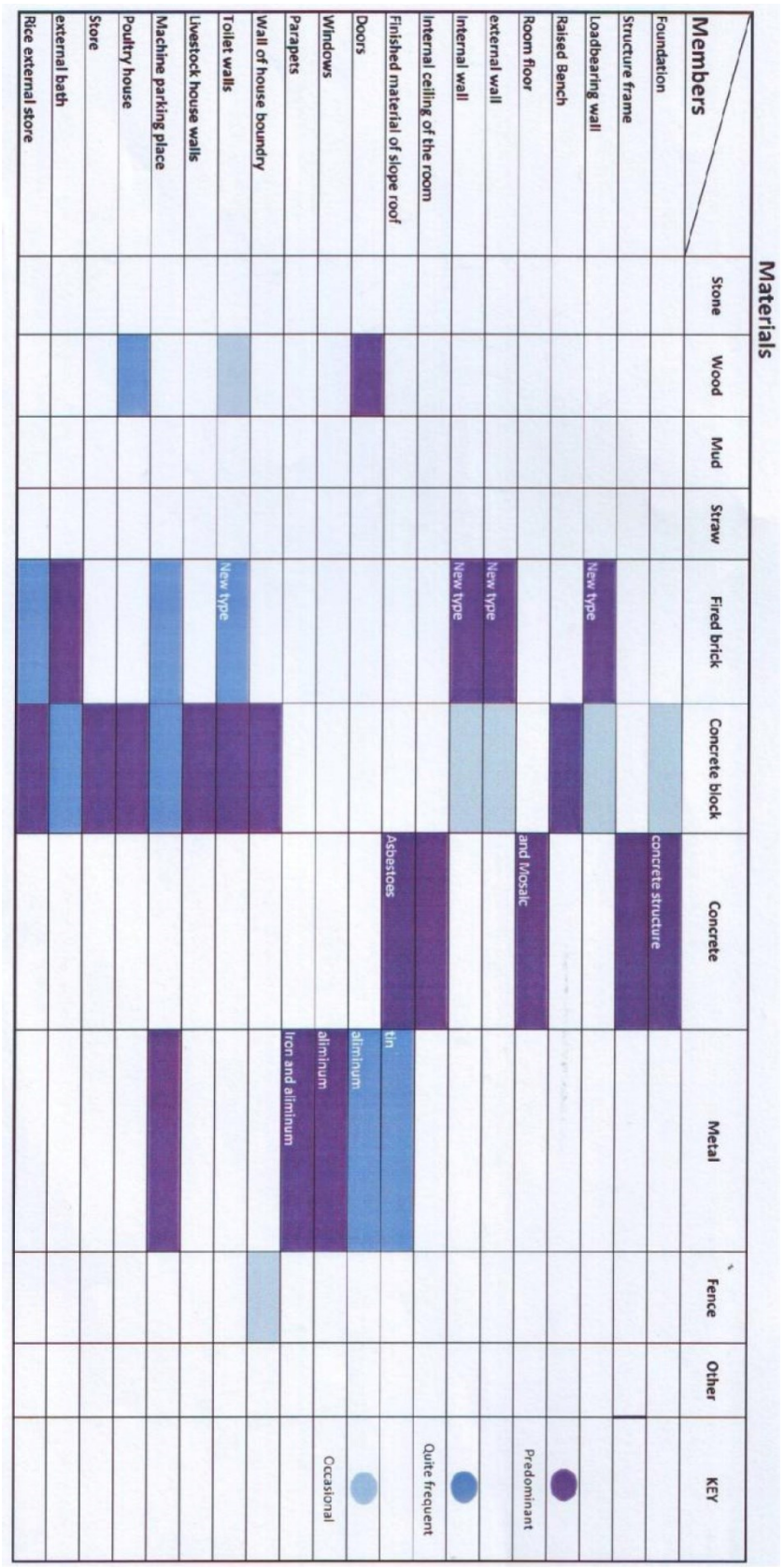


Following a severe earthquake in Iran that led to considerable loss of life, the Iranian government decided to designate concrete frames as the only suitable technology mandatory for house construction (housing foundation of Iran, 2000). This was without any attention to other possible local solutions, diversity of climate, and geography or house style within different parts of the country. Influenced by this imposing decision, locals also postulate it as the best technology of house construction. It is strong and resistant to earthquakes however, they still believe that their traditional construction technologies are strong enough in terms of durability during earthquakes and more importantly with low fatality after earthquake.

'…they are very well. When there was an earthquake in year 36 [1336 according Iranian calendar around 57 years ago] none of wooden houses has been demolished. Except those houses that the space between the raised wall from the ground were filled with soil that the movement of the soil caused damage but in terms of those house which the space between the raised wall from the ground were empty remained undamaged because they were lighter…. (One to one interview with carpenter in Perija)'.

'…the old wooden one was really better than our new house regarding to earthquake. We made mistake, you know, wooden log house are not destructed in any way by earthquake or other thing as they can move on the ground and the logs could glide on each other rather than to be very rigid and stiff. Besides that if it becomes destructed because of very strong and heavy earthquake, it is not such debris such as concrete frame houses. It is such as light wooden box which walls just will be crooked that one could shelter under it with any hurt even a scratch. It does not kill any one like new wrecked houses... (Interview with one villager in Perija)'.

Table 8.24: Table of material usage within new style house and its outbuildings' construction. Wood is not the main material anymore. Concrete and concrete block have been substituted and used as main materials Approximately, all of other using materials are new.



'Iranian Regulation 2800[1]' (2014) introduced technologies including log-on-log, timber frame, mud and fired brick load-bearing wall reinforced by wood timbers as resistant technologies against earthquakes. Despite of all of these facts, constructions employing wood and mud have stopped being used within the region and residents are no longer interested in employing these vernacular technology and materials. Residents stated the following reasons through the focus group interview that justifies them abandoning the vernacular style of construction and demolition of their old house and constructing new one;

- Lack of access to appropriate wood for housing construction from the forest area because trees are not officially allowed to be cut. Additionally, wood is scarce in wood market.
- Difficult maintenance regarding the application of nondurable materials such as clays, thatch and shingles on sloped roof, which need to be renewed and refurbished yearly.
- Currently, because of lack of dexterous experts and masters to construct new wooden and mud buildings in vernacular style.
- Traditionally, residents used to construct those houses with cooperation and help of all of villagers, which nowadays has been relinquished.
- Because of proposed housing patterns from official governmental offices which are in new modern style and very different from vernacular style.
- Vernacular wooden and mud houses are a sign of poverty and misery associated with life of the past, which is a sign of backwardness. Mostly literate villagers have stated this reason.
- The size of the rooms are small, particularly the living room which is not appropriate for new lifestyles. Besides that, rooms in the vernacular houses are a few in number, which cannot support new lifestyle.

Some major concerns and issues have appeared with new modern construction within the region, which are going to be critical. Unlike traditional

[1]: The Iranian Regulation 2800 is a collection of introducing thumbs up and standard criteria for building to be resistant against earthquake, which is the main reference for civil engineers and governmental offices to pass any new rules, or giving new construction permission.

style construction, disposal of waste produced by new modern houses is one of the incremental environmental issues (Poon and Jaillon, 2010). New style-constructed houses employed a concrete frame for structure and new fired brick for walls, produces a huge amount of debris; its disposal is a major concern for the future within Mazandaran (Haieri, 2014). One of the other issues could be water scarcity, an incremental worrying concern of Iranians that is going to become a crisis even for the life in Iran plateau where historically water scarcity and drought is a major issue with low amount of precipitation and limited water resources. Kalantari (2015) a former minister of agriculture in Iran, stated that the environment in Iran has reached a point where 70% of the population has to make-do with less than 900 cubic metres of water per capita per year. It means that this consumption trend continues almost, 70% of the population, or 50 million people, will have to "emigrate from Iran to survive". Someone believes that Iran is going to be desert. Even Mazandaran, with high amount of precipitation compared to other parts of the country, which will be dried out in 20 years' time (Gashtasb, 2015; Amini, 2015; Nosrati, 2015). Despite of the current unfavourable conditions, Ebtecar (2015), the head of environment organisation of Iran, announced that based on prediction until 2050, the draught could be 11 times worse in 35 years' time. Yakhkeshi (2015) the general director the 'irrigation office' in Mazandaran said that with current situation 48% of rice farms will be experiencing drought and 50 hectares might be confronted with serious problems. Despite of this, Chitchian (2015), the current minister of 'Energy ministry of Iran' believes that if accompanied with management of the water consumption pattern, the country will not be confronted to any serious water shortage specially regarding the provision of healthy drinking water. However, residents need to reduce pollution of the water resources such as rivers, springs, and deep wells. Consequently, the issue of water scarcity is going to be a major challenge in Iran and could be end up as a 'Water War' (Rannani, 2015). Constructing water efficient green buildings based on low water consumption can be one way of managing water consumption patterns in order to prevent or alleviate this problem.

Concrete frames are a water intensive building construction needing higher amount of water consumption during onsite the construction process compare to traditional styles of the region of this study. Water is essential in the production of concrete frame; blending cement and sands and most importantly keeping the concrete wet after its execution is essential in order to have best quality of concrete helping the concrete to reach its highest resistance. During hot sunny days of Iran, high amount of water evaporate during the irrigation of the concrete, which increases the consumption of water during construction process. In this respect, traditional styles of construction have less water usage particularly wooden constructions, log-on-log and timber frame with no significant need to water during erection of the structure of the building, which could help reduction of water usage. However, it should be noted that, no research has been found which assesses and compares water consumption in different construction methods within Iran and the region of this study.

8.4.5.4 Time of construction, labour force provision and role of male and female

Traditionally, most villagers were rice farmers. Rice farming roughly finishes at the end of summer or around the beginning of autumn. This time was the best time for local villagers to start construction of the house; it was an appropriate time for cutting down trees required as timber for house construction according to the housing technology. To do this, they had to get special permission from the government. The weather at this time is rainy and cold, harsh for house construction but the duration of this process was short and lasted between two weeks to maximum seven weeks for log-on-log house, two to four months for mud, and fired brick houses, which made this concern inconsiderable (from interview with carpenters). Construction duration was roughly the same for middle style houses, as well. New style house construction usually starts and is undertaken during any time of the year.

Traditionally, members of family design the house themselves and in some instances two main professionals of the house construction of the region including

master mason and master carpenter offered them consultations or design skills instead. Similarly, villagers used to do most of their work cooperatively and they had a tradition known as '*kayyeri*[1]' (Mahjorian, 2005). House construction was also a cooperative activity as well as rice farming that all family members were involved (result of questionnaire 01). All inhabitants intimately interfaced with the context and construction process. Rarely, there were specific professions to handle particular responsibilities and due to the lower, financial sources compared to the cities, they need to make the most of available resources and facilities. Accordingly, all members including male and female belonging to different generations were familiar with and involved in house construction and subsequent maintenance (fig 8.77). One day the owner called the family members, relatives, friends, and neighbours to give him a hand for house construction, which was started by sacrificing of a sheep or a cow. Materials were Materials were sourced from the natural environment and provided by men and processed with the help of women. After men erected the body of the house, women executed the plastering. One carpenter or mason from the same village or neighbouring one managed process. Housing was less expensive and facilitated cheaper maintenance and reparation of the house because locals mainly did house design related jobs themselves and materials were easily derived from the natural environment.

Middle style house were designed mainly by master masons and master carpenters designed doors and windows. It means that family members have been to some extent, put aside for their house design. However, in terms of construction, their involvement and cooperation was still prevalent however most materials were imported from the city and employment of professional master and labour was essential for some sections such as wall construction, roofing, piping, and tiling.

[1]: According to this tradition, villagers helped each other without obtaining any wage or expectation to be helped in reverse.

In these instances, the owner and his family could just lend a hand to the professionals in order to hire less labour.

Figure 8.77: The woman repairing the external coat of a timber frame wall with mud mortar. Maintenance and reparation of vernacular house is of female responsibility.

Employing professionals is more essential for new style houses for performing design and construction process because a normal villager has no idea about new spatial configuration and cannot manage house space organisation in accordance with family needs. This is coupled with the issue of having no knowledge about working with new concrete frame technology, tiling, and stonework, electrical and mechanical work. University educated professionals including architects and civil engineers are those who design the houses, and concrete framers are those who construct the concert frame and sometimes design the house. Sometime a master mason does this role after construction of the concert frame, designing spatial configuration of the house and constructing the rest.

The process of construction has become professional without any kind of involvement of the owner, so that they need to hire professional masters and labourers from their own village, the neighbouring one or even from the city. Therefore, because the owner himself and his family are not involved in house design and construction, it is much more expensive. On the other hand, it can be performed any time of the year by employing professional labourers and masters. This method creates more jobs for villagers; however, they need to pay for house design and construction, maintenance and its reparation employing professionals and materials.

Overall, it is better to apply construction technology that villagers are familiar with and employ local and natural materials that they can work with them knowledgably. In this way, villagers can be involved in the design and construction process of their own house enhancing their cooperation and participation as well as saving money for the family. Based on the different mentioned issues associated to new style housing and according to different methods, technology and materials of house construction within the region, timber frame has much sufficient capability to solve these issues. Villagers still have the knowledge of working with wood; the material is local and renewable with less harm for the environment, cheaper than the other options, providing opportunities for locals to repair it themselves. This improves the sustainability of the society too. (Edward, 2000).

8.5 Conclusion

Within this chapter, a typology of vernacular houses has been presented and their principles, their spatial configuration and space organisation, which are different from the new modern style of houses, have been introduced and discussed. Results of questionnaires and interviews show that as whole, locals are interested in putting main components of vernacular houses within the design of new houses such as sloped roof, front porch and front yard. However, they believe that the quality and principles of vernacular houses must be modified to conform to their new lifestyle. For instance, living room needs to be bigger, kitchen needs to be bigger and equipped with modern appliances, the front porch should be smaller and the space organisation is better when centralised. Overall, vernacular house configuration, spaces and components can still support local current systems of activities according to their new lifestyle.

Additionally, vernacular houses built sustainably with employment of local materials derived from the nature such as wood, mud, and stone, which most of residents belonging to different genders and ages were able to work knowledgably. The construction process was a communal cooperative activity involving of family members, relatives, friends and neighbours in a way that each person, male or female played specific role. Importing new materials such as concrete, which are

not sustainable, renewable and environmentally friendly, made new houses harmful for the nature and made house construction expensive. Accordingly, new technology has to be sustainable and familiar for villagers; this is necessary in order to make the house construction sustainable, communal, and cheap. Timber frame technology inspired by vernacular housing has the capability to be employed for new house construction within the region of this study, however with some modifications.

Chapter 9

Sustainability and Responses to the Climate

9.1 Introduction

Human responses and strategies regarding climatic conditions are currently grouped into two physical and behavioural sets (Ashrae, 2001; Rapoport, 2006 & 1980; Fathy, 1986). These approaches may be adopted wholly or individually depending on cultural and personal preferences (behavioural responses), and the micro-climatic conditions (Fathy, 1986; Oliver, 1987; Weber, et al, 2014) which can be an important source of inspiration in the creation of new houses (Oliver, 1987 and 1997; Rehwal et al, 2010; Forster et al, 2014). New dwellings within the villages of Mazandaran are designed and constructed based on modern instructions without giving consideration to the specific climatic and cultural characteristics of the region. Local populations use modern material imported from city areas rather than sourcing local sustainable materials derived from natural resources. However, vernacular buildings as a whole, and more specifically within this region, have been identified as good models for sustainable design. Locally and regionally, these examples demonstrate adaption to specific conditions within natural environments and the interaction between humans and the environment.

On the other hand, fossil fuels including wood, oil, and gasoline are the only energy sources for locals to use to cook and heat their accommodation. They are also the major source to heat up water for different purposes including washing and bathing. Electricity is also used to warm up water for different washing purposes but it is the only fuel, which can also be used to cool temperatures inside (table 9.1).

Table 9.1: The tables represent different fuels for different purposes within the region. [Derived from SPSS analysis of questionnaire 01 (appendix, 2)]

Fuels for warming inside the house

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	wood	12	31.6	31.6	31.6
	oil	18	47.4	47.4	78.9
	gasoline	8	21.1	21.1	100.0
	Total	38	100.0	100.0	

Fuels for cooking food

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	wood	1	2.6	2.6	2.6
	gasoline	6	15.8	15.8	18.4
	Gas tank	31	81.6	81.6	100.0
	Total	38	100.0	100.0	

Fuels for warming water for washing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	wood	1	2.6	2.6	2.6
	gasoline	17	44.7	44.7	47.4
	Gas tank	11	28.9	28.9	76.3
	electricity	6	15.8	15.8	92.1
	none	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

It is well known that climatic conditions are influential factor on human behaviour and built environment solutions; issues around sustainability have been vital in the emergence and development of built forms and proposed models as examples in sustaining social cohesion. The vernacular house design and construction within the region conveys useful inspiration to reduce fossil fuels consumption and to shape new houses within the region to be sustainable in terms of design, material usage and energy consumption based on local experience and performance, which is coupled with their behavioural responses to climatic conditions of the region. They are topics of this chapter.

9.2 Climatic important variables of the region

Based on the represented discussion, table 5.2, and figure 5.5 in part 2 and chapter 5 of this thesis, some climatic variables have been deduced. These variables play an important role in shaping the architecture of the region. These variables are high humidity (aggravates the hot summer and its harshness could be diminished by using natural wind blow), high temperatures and hours of sun

during the summer (protection from direct sunshine at this time is crucial), and high ratio of rainfall and intense rainy periods (makes protection of the house from its impact critical). They are all major critical climatic variables of Mazandaran.

It should be mentioned that some other local natural factors such as; topography, hills or valleys, vegetation condition, location and types of the bushes and trees, fences and the walls surrounding the lands are not the focus of this research and have not been considered. This research reveals physical and behavioural responses to the above-mentioned climatic conditions of the region, which locals adopted in order to sustainably provide personal climatic comfort inside the rural vernacular houses.

9.3 Responses to the climatic condition

Responses adopted by local populations with regard to the climatic conditions and variables are both physical and behavioural.

9.3.1 Physical solutions

Physical sustainable solutions are those responses, which influence physical characteristics of the houses. They aim to solve climatic concerns and provide climatic comfort based on regional climatic analysis. Reduction of building heat loss during the cold period, permanent provision for ventilation (employing natural wind), reduction of indoor humidity, use of solar radiation for heating, protection of the indoor space from sun radiation during hot period, provision of indoor exposure to the outdoor climate, and protection of buildings from rain are those physical sustainable solutions (Kasmaei,1983). Accordingly, physical implications to these variables within this region are discussed.

9.3.1.1 Detached characteristic

Traditionally, all types of buildings in the residential area of the villages, including houses, are totally detached from each other and combined with gardens and orchard. This kind of configuration allows the wind to circulate around the buildings; this is necessary for cross ventilation and simultaneously ensures

maximum absorption of sunshine for the buildings. This characteristic also keeps the walls dry, reducing the impact of rising water (rising damp) from the ground and keeps indoor furniture dried. Culturally, this pattern provides a suitable distance between houses allowing for desired privacy for villagers based on their cultural norms (fig 9.1).

Figure 9.1: Figure/ground map of village Vareki shows detached characteristic of buildings.

9.3.1.2 Location on raised platform

Houses are typically elevated from the ground on a bench-shape raised platform; its height varies between 50 to 150 centimetres depending on local topography and damp ratio (fig 9.2). This is to reduce the impact of rising damp and simultaneously provides the opportunity to capturing natural breeze above local obstructions (Szokolay, 2014; Kasmaei, 1983). Inhabitants sit and sleep culturally on the floor and this problem forces occupant to use special carpets made of matting or straw to help alleviate the damp conditions. This problem is not as critical for log on log-constructed houses in the forest area where this platform is usually elevated on wooden walls and wooden posts make a wooden floor detached from the ground[1]. The space below is usually left empty, thus

[1]: Mounting of the house above wooden posts is very similar to or might be a replication of the way that rice farmers temporarily build structures to protect the collected rice yield against any potential suffering

allowing the air current to flow beneath the building and so alleviating the impact of the rising damp; however, the floor temperature can often be colder than the temperature inside the dwelling causing discomfort during cold season[1].

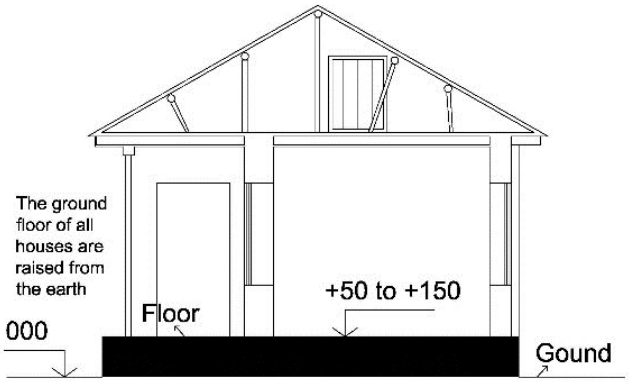


Figure 9.2: Ground floor is usually raised from the ground because of damp and rain.

9.3.1.3 House orientation

The most common orientation of linear houses (including row, half saddle and saddle types of houses) is within the angle between south-west and south. Villagers are Muslim and they pray five times a day toward Makkah known as Qibla, which is located in Saudi Arabia towards south-west of Iran exactly within this angle. This is not the only reason for the house orientation, simultaneously the house takes advantage of the prevailing wind directions, which varies from the mountain areas (south zone) at night and in reverse coming from the sea (south zone) during the day. This is favourable when reducing the humidity of the air and creating thermal comfort[2] inside. With regards to the sun, these orientations are especially suitable for obtaining the most solar power heating especially during the cold weather in winter when the sun angle becomes lower (fig 9.3).

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from the ground and surface water. Harvested rice clusters are stacked on a bench with four wooden posts and tree branches.

[1]: The feet have direct contact with the floor this could cause discomfort. For example if the floor is cold and occupants feel cold in their feet, they raise the heat temperature in the room as a common reaction (ASHRAE, p.8.14)

[2]: According to ASHRAE standard 55 (2001) the accepted definition of thermal comfort is that 'condition of mind that express satisfaction with the thermal environment. This definition emphasises that the judgment of comfort is a cognitive process' (p 8.1).

L form houses (compositional type of house) come typically with an added wing attached to the original building, which is usually oriented towards the east zone. This shape allows the house to gain sun heat from all suitable directions within several rooms during different times of day and seasons. This also enhances the ability of the house to capture possible breezes from various directions (fig 9.3).

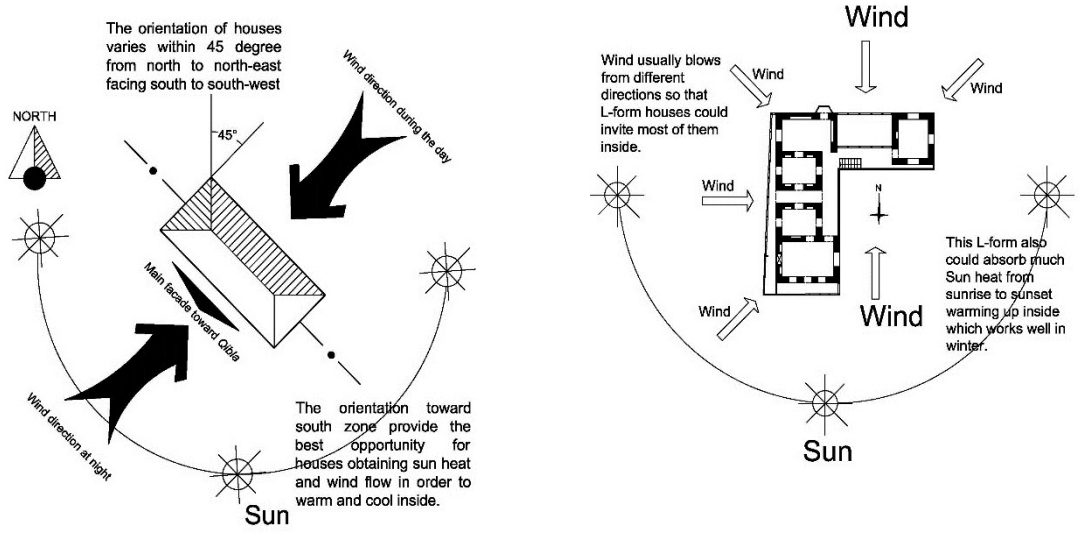


Figure 9.3: Orientation of houses; linear house in left and L form in right hand side

9.3.1.4 House elongation

Houses are predominantly narrow and elongated; the average length is at least 1.5 times bigger than the depth (width). This allows all rooms to gain maximum solar power in winter and maximises the benefits of the favourable winds blowing at night and day during hot seasons (fig 9.4). This characteristic of being narrow means the smallest surface of the house faces towards east and south-east and the north-west or west, which are the directions of the harmful, pluvial[1]wind. This drives rain inside the rooms and penetrating into the walls; rising damp is particularly damaging to clay and timber, the dominant materials of vernacular houses. Shorter elevation facing west or north-west accompanied by

[1]: This wind has the maximum blow rate and mainly during rainy season and from north to north-west. Because of its relation with rain, it is known pluvial wind, which is used within this paper by this name.

the absence or lesser area of windows helps to protect houses from potential damage caused by the rain and from harsh western sunshine. It has been observed that houses with an added wing oriented towards an easterly direction use a balcony at the back to protect the westerly-facing wall from potential damage especially against rain penetration.

9.3.1.5 One layered rooms

All rooms within vernacular houses are usually arranged in one row or one layer deep and are located side by side attached to each other. Most rooms are used as a kind of permanent living area and so absorption of sunshine and encouraging favourable winds is necessary for all rooms 24 hours a day. There is no room or enclosed space attached to them in the front or back sides except a semi-enclosed space such as a front porch or other type of balcony, which with transparent characteristics, does not make the rooms deprive from taking advantage of these natural cooling and heating resources (fig 9.5).

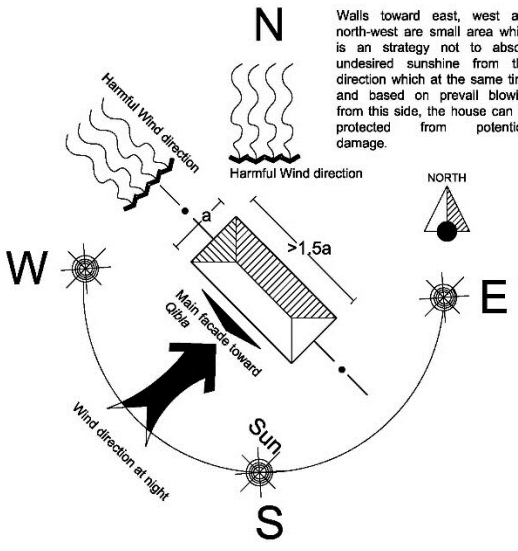


Figure 9.4: Elongation from north-west to south-east and harmful wind directions

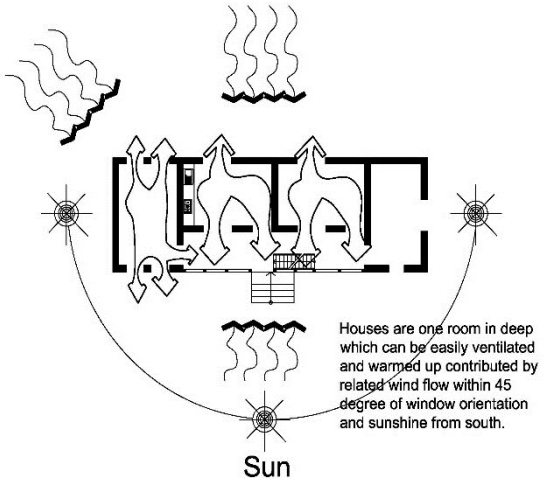


Figure 9.5: Cross-ventilation and sun heat absorption in one-layer deep room houses

9.3.1.6 Fenestration

Fenestration is organised differently within the villages of the forest border and the forest areas. Doors and windows are two common types of fenestration within all villages; these are typically constructed with wood contributing to less

heat loss and gain. All are vertically pivoted and 100% openable vertically inside the room.

All rooms within villages located in the forest border area often have at least one window or door facing towards the south or east, absorbing sunshine to provide heat and light during the day. This is accompanied with having at least one window or door facing towards the north zone contributing to cross-ventilation, which inlet and outlet windows are swapped daily according to breeze direction. Windows installed within 45 degrees deviation from wind directions can let in all breezes blowing within this angle (Szokolay, 2014; Kasmaei, 1983). Accordingly, a window installed on the north wall can conduct north, northeast, and north-west winds inside and the same applies for the south zone window.

The forest area has cooler and less humid weather in summer and with colder conditions in winter, rooms usually have just one window on the south wall with no opening at the back towards north zone directions. In terms of lateral sides of the houses, the west sidewall commonly has no opening, whilst east wall is not necessarily with no opening. Unlike in the forest area, windows within villages of the forest border area are more in number and bigger in size (table 9.2). Some rooms have different windows or doors set up on walls of four sides, this configuration of fenestration makes the space configuration of the house, porous, similar to a sponge, collecting natural all possible heating and cooling resources providing as much cross-ventilation and sun absorption (fig 9.5).

Table 9.2: Maximum and minimum sizes of windows within two different areas of this study

Window size		Height(cm)	Length(cm)
The forest border area	Max.	255	240
	Min.	70	40
The forest area	Max.	145	130
	Min.	50	40

One other influential factor on window configuration is the season in which the room is occupied through. Any room, which is used as a living area during the winter (cold weather) often, has fewer windows (openings) with smaller sizes in order to minimise the heat loss. In contrast, rooms used as a living area during the summer (hot weather) have more windows that are bigger in size, maximising wind catching to operate cross-ventilation better. This is mostly common in the forest border area where inhabitants usually have seasonal-specific space. The height of windows in the forest border is at body height elongated from floor to ceiling, thus contributing appropriate cross-ventilation and sunshine across the room and activity zone within rooms (fig 9.6).

In terms of inside lighting, in the forest areas, due to the small size of openings, rooms are not bright enough for new introduced light-dependent activities such as studying, writing and sewing, which make using electric light compulsory during the day particularly during rainy cloudy winter days.

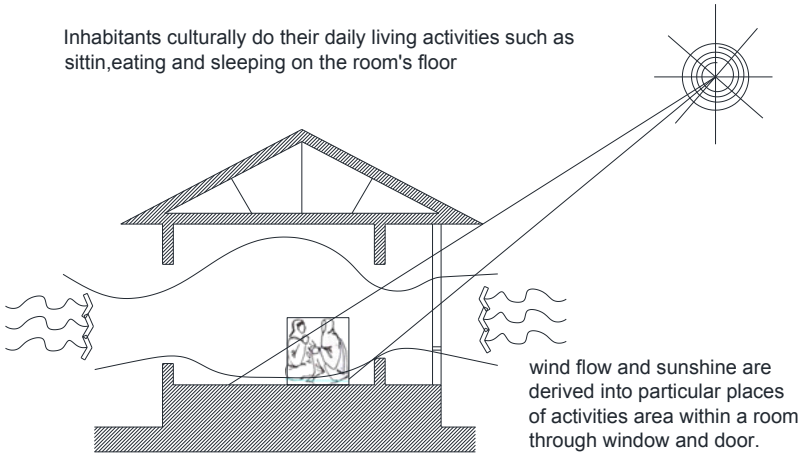


Figure 9.6: Both of door and window operate for ventilation, light provision, and absorbing sunshine leading them toward activity areas.

Enjoying from wind has no significant effect on front and back window sizes but relating to sun heat absorption, front windows towards south zone direction are bigger than the north side one. They are almost installed at the same level as the floor (window door) or a maximum of 50cm above the floor area. Therefore, ventilation can occur at floor level and sun shines in this area to which is the area of systems of activities (Rapoport, 2006) such as sitting together, eating and sleeping, which helps occupants have a better sense of thermal comfort too

(Ashrae, 2001; Szokolay, 2014). At the same time, this presents the occupants with a better opportunity to watch the front yard, the street, and the surrounding scenery whilst having control on the outside of the room or even house (fig 9.6).

9.3.1.7 Size of rooms

Rooms are usually small (4.37m*2.98m on average) and separated with solid walls. In the forest border area, rooms allocated as summer accommodation are relatively big (Maximum 7.6m*4.1m) while winter-use rooms are small (table 8.18). Apart from the technological restrictions of the house construction and lack of availability of appropriate carpet in terms of its size, the small size of rooms in vernacular houses was efficient in winter and allowed rooms to be sufficiently warm using minimum fuel consumption.

9.3.1.8 Balcony, semi-enclosed space

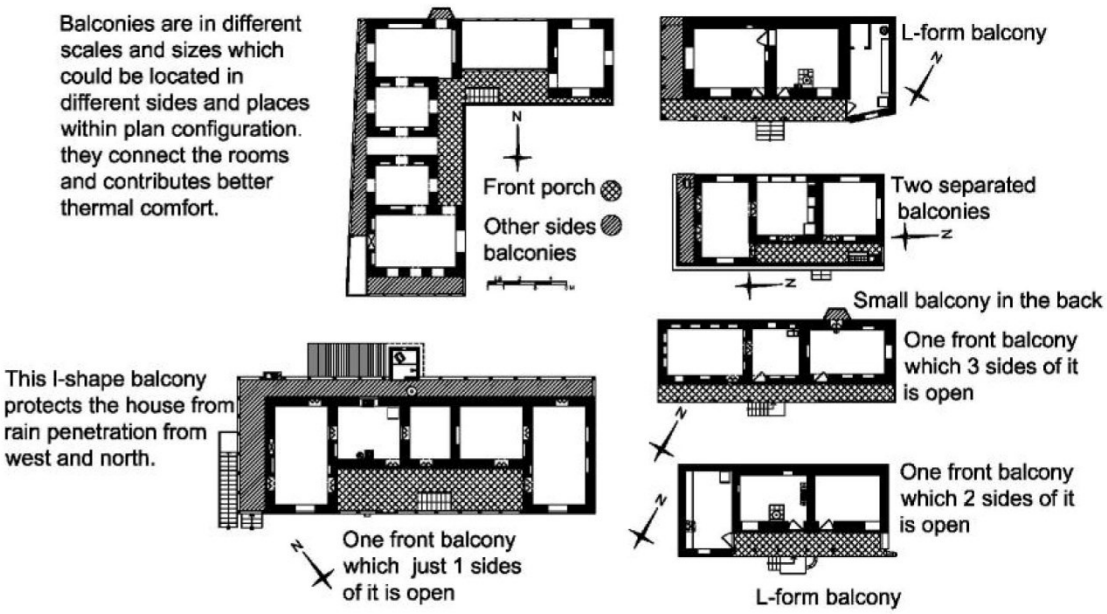


Figure 9.7: Different types of Balconies and their location

Semi-outdoor (Kasmae, 2010) or semi-enclosed spaces are one of the main pillar spaces of the vernacular dwellings in Mazandaran (Kasmaei, 1983; Tahbaz et al, 2009), which can be observed in different sizes, scales and locations within the region of this study. They are used during nice weather in spring, autumn and summer. The variations of this space are represented in figure 9.7.

In terms of climatic function, this space protects the walls and windows from potential water leakage during rainstorms. This space mainly located in the south or south-west side of most of the rooms, providing proper shade to protect rooms from harsh sunshine during the hot season particularly in summer when the degree of the sun's angle increases. Since the angle of the sun lowers in winter, a balcony is not a barrier against the sun to penetrate inside the rooms. The balconies located in the west and east that cannot block penetration of these sunshine directions (fig 9.8). This area also captures the greater percentage of wind flow due to its porous characteristic, conducting breeze into the enclosed living areas instead of directing them around the building.

9.3.1.9 Hip roof with projected deep eaves

Traditionally, all houses in Mazandaran have a hip roof, which projects equally from four sides of the body of the house making overhanging deep eaves. While the slope roof sends rain downwards once it rains, the eaves on all four sides protects the walls of the house from the rain. During hot summers when the angle of sun raises up, these eaves keep the house fully shaded and keeps it cooler (fig 9.8). The size of the extension of eaves has a relationship with local climatic conditions. In the forest area, it is often 35 cm on average and between 30cm-40cm. It is because there is no need for shade and only protection from rain damage is wanted. The size in the forest border area is always higher than 70 cm-1m due to requirements of both shade and protection from heavy rains within this area.

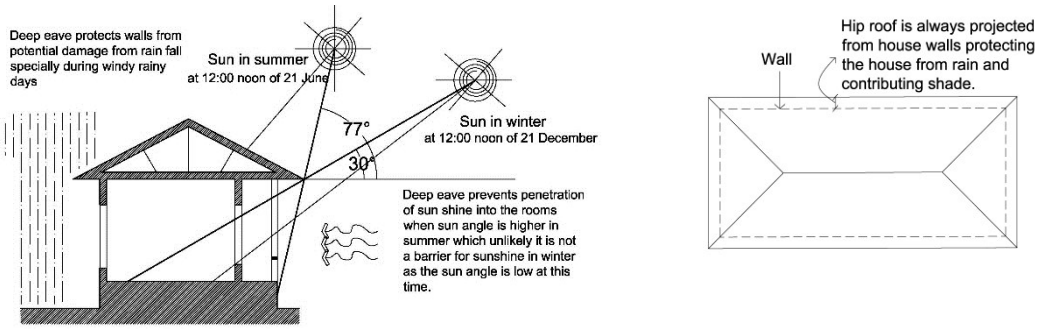


Figure 9.8: Most parts of the house is shaded during the summer protected from the rain in favour of hip roof.

Houses usually have a hip roof outside and a flat ceiling inside. Between these two levels is a spacious attic area, which is usually used as a store to keep rice yield. This area can reduce exchange of heat and cold from outside to inside and vice versa. Szokolay (2014) suggests that in a hot climate this area is like foil insulation reducing downward heat flow, but allowing the escape of heat at night, thus permitting the building to cool down (fig 9.9). Escaping heat intensifies within this region due to having some openings on the slope component of the attic hip roof (fig 9.10).

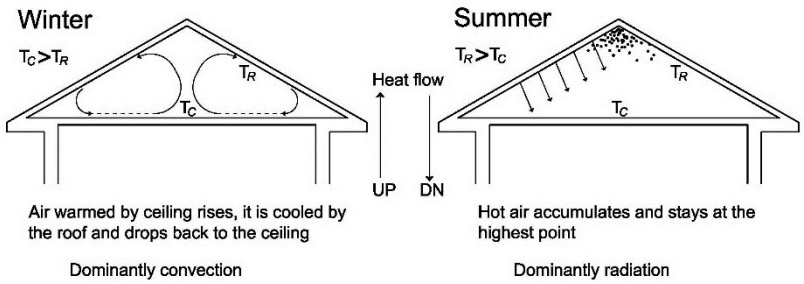


Figure 9.9: Climatic role of two layers of the roof (Szokolay, 2014)

Details of the inside ceiling play an important role in sealing the internal space of the rooms and house spaces. Within vernacular houses, it is usually made up of wooden boards of 2 to 3 centimetres thickness laid upon wooden beams; this is then covered with a layer of soil mortar. This material is around 10 cm and is made from a mixture of mud and straw. Villagers confirm its performance to be acceptable (fig 9.10).

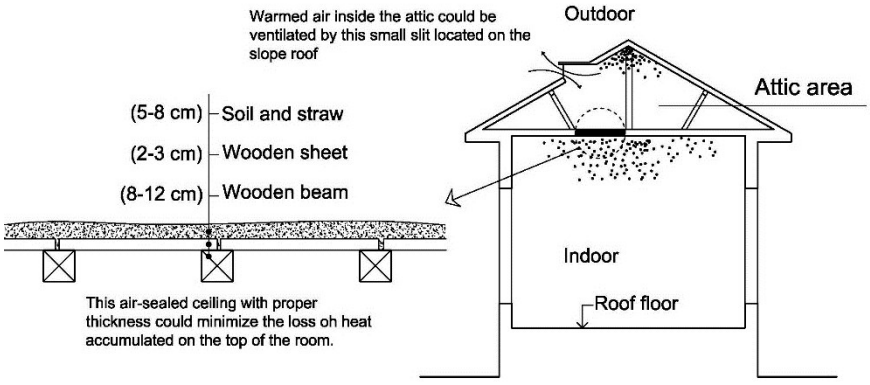


Figure 9.10: Detail of internal ceiling improves performance of attic as an insulator space

9.3.1.10 two stories houses

Constructing two storey houses is another strategy purely found within the forest border area. This kind of configuration offers the upper storey the opportunity to capture breezes above obstructions in the local area. This upper storey is usually used during the summer. Apart from its climatic role, two-storey houses provide more rooms while occupying a small area of land. This makes it a good solution within villages with scarce land and is a good strategy to use to have more land left for food production purposes.

9.3.1.11 Nefar

Kasmaei (1983, 2010) suggests that lightweight external walls with low thermal capacity are recommended for houses of the forest border area .The region of this study. Nefar is a semi-outdoor space and is usually small and rectangular (usually 2.5m*3.5m) freestanding two storeys and single room building, which is located besides the main body of the house, it is constructed with timber frame technology standing on wooden columns (fig 8.52, 8.53, 8.54). The ground floor is usually encircled with thin wooden board while the first floor has no surrounding. It stands on wooden columns bearing the sloped wooden roof. Because of climatic benefits of this configuration such as allowing possible unblocked winds blowing from all directions, and low thermal capacity, Nefar stores a little amount of sunshine heat during sunny hot days.

Another type of Nefar prevails in one studied village. It is as an ordinary room located within the house space configuration, which unlike the ordinary Nefar, just two sides of it, including north and south sides, are columned with no wall which operates the same as a stand-alone Nefar (fig 9.11).

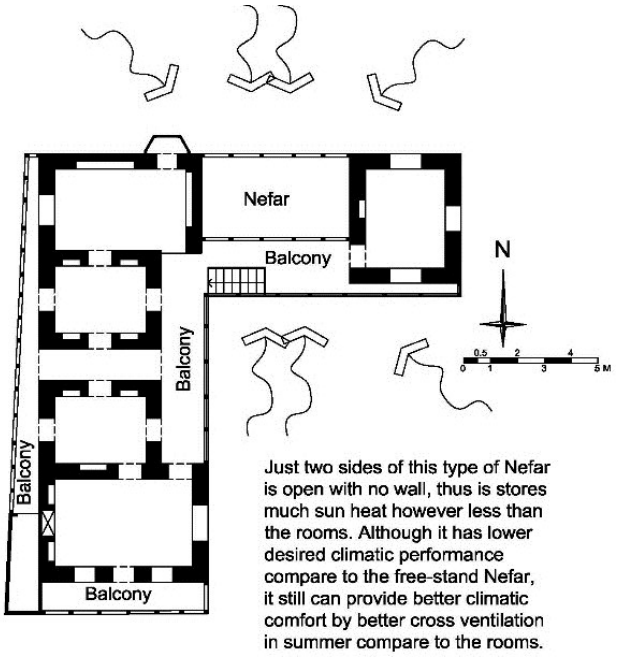


Figure 9.11: Another type of Nefar located within configuration of the house (sample No. 19 in Diva)

9.3.1.12 Materials and thicknesses of walls

All vernacular houses have been mainly constructed based on employing local natural materials, easily accessible from the surrounding nature of the villages; these are mainly wood and clay (table 9.3). All of flat ceilings inside the houses and external sloped roof structures are wooden within the vernacular houses as well as windows, doors, columns and parapets. Load bearing walls, as the main construction technology, are wooden or reinforced by wood, strengthening their performance and improving the house's resistance to earthquakes, which are a frequent occurrence within the region (Iranian building code series standard no: 2800, 2014).

Table 9.3: Main material employed for construction of walls of the houses within four case study villages

Selected villages	Log on log wall	Clay wall reinforced by wood	Brick wall reinforced by wood
Perija(In the forest area)			
Diva(In the forest border)			
Vareki(In the forest area)			
Osa(In the forest border)			

Wood and clay production and application are low-energy processes extracting from the natural environment and directly using for house construction, which villagers are skilled when working with them. These materials are recyclable and could be re-used for a new construction project, which makes these two materials sustainable and minimal harm to nature (Vellinga et al, 2007). Besides that, these two materials minimise building waste, which is one major concern of modern construction technology having modern high-energy needs and irretrievable materials for both production and application processes (poon et al, 2010).

Unlike wood, clay and fired brick have a high thermal capacity (Encyclopaedia Britannica, 2015). High capacity material is not suitable for this region (Kasmae, 1983, 2010), so that external walls made from these materials are not too thick. Regarding width, they are between 30cm to 70cm. These thicknesses seem efficient in providing resilient structures that are not vulnerable to earthquakes and provide thermal comfort according to local experience and preferences. Relatively all local occupants agree that the climatic performance of these houses is good. They get warm quickly with low energy consumption in winter while during the summer are mostly cool enough without the need for considerable mechanical aid.

Wood is a low capacity material (Encyclopaedia Britannica, 2015) that is used as log on log technology for traditional house construction in one village located in the forest area -Perija. The thickness of the wall depends on the diameter of the trunk of the tree, which varies between 20cm to 50cm and on average is 25cm. This wall is not heavy enough for the necessary 8-hour time lag for this region (Kasmae, 1983, 2010), but the inhabitants of this village are all satisfied in respect of their thermal comfort. This satisfaction could be as a result of the adoption of a collection of strategies aiming to provide desired thermal comfort containing physical responses supported by behavioural reactions.

9.3.2 Cultural and behavioural solutions

Behavioural responses to the climatic conditions are various including dressing style such as reducing or adding clothes, eating or drinking warm or cold food and drink, and swimming but the most important response to the climatic condition in this region, which influenced the life style and house configuration is migration. It could take place within the house configuration or by leaving the village.

9.3.2.1. Dressing style

Locals' reactions to cold and hot weather, such as putting more or less clothes or tucking in a heavy or light duvet is the same as other humans across the world and they have no specific dressing style. However, about women, it is different. They are subjected to covering their head with a scarf in public areas because of Islamic rule '*hijab*', which is uncomfortable during hot times. During this time, they usually change the scarf fastening style to cover just their hair and head keeping the neck and ears uncovered whilst working outside, thus alleviating any discomfort from hot weather.

9.3.2.2 Eating and drinking habit

Local population slightly changes their eating and drinking habits based on changes of the season. Unlike in winter, locals drink cold drinks and eat special foods processed in vinegar during hot summer to cool their body down. In winter, different types of beans are added to main meals to keep the body warmer according to locals' beliefs.

9.3.2.3 Seasonal migration within house spaces

In the one-storey house, locals usually move to semi-closed spaces on the same level. 70 percent of interviewed locals (20 out of 28) living in vernacular buildings of all villages stated that they usually migrate partially to front porch when the weather turns hot; they sit and eat there but do not use it for sleep overnight.

'… We usually do [going to front porch] for eating, drinking tea and sitting together when it is warm in summer, during spring an also autumn. It is really very pleasure. Is not it? (House No.4 in Diva)

In two storey houses, traditionally the downstairs is usually dedicated to winter use and so the rooms are smaller, the area of windows are in lower ratio, and it is easier to warm inside with less fuel consumption. On the other hand, the upstairs with bigger rooms, larger ratio of window invites more unrestricted breeze into the rooms, is usually the destination for inhabitants relocating to live up there when the weather turns hot. Nine of the studied houses are two storey houses, all of the residents stated that they had this lifestyle in the past but they no longer do it because the transportation of all of new modern home appliances such as TV, kitchen appliances is not as easy as in the past when they had none of these pieces of equipment.

Within some houses, migration led to the design and construction of a stand-alone structure separated from the house body. Nefar, a free-stand building is traditionally the destination of locals who moved there to use it as a living room during the summer but not now. Mobility got harder or impossible for inhabitants based on new lifestyle.

'… In the past and during summer we used to sleep in Nefar which were located in front yard and we demolished it…' (House No. 11 Vareki)

'… When my mother in law was alive using this house, they went up into the Nefar living there during summer… (House No. 16 Osa)

9.3.2.4 Migration to mountain

Leaving the house and village to go to the mountain area is the other type of migration in this region as a behavioural solution, which had been adopted by British who lived in India too (Weber, & Yannas, 2014; Rapoport, 1980). Ten out of thirteen residences of vernacular houses in one village (Diva), around 76% stated, that they used to go to the mountain area early in summer and stay there for up to

three months. They have another house in their mountain village where the weather is cool and dry at this time of the year.

'…We go to mountain [in summer]. The weather there is as cold as we have to tuck in duvet at night… (House No.4 Diva)

'…for us going upper [toward mountain] is better…we have house there going there during summer. When we are there, we are healthier… (House No.1 Perija)

9.3.2.5 Swimming

Swimming was a communal activity that enhanced social interaction between villages but unfortunately not anymore. Irrigation network for rice fields including some streams as branches of the river pass through the residential area, cross local streets, alleyways and orchards. Historically, and before these streams became polluted with different types of contaminations mainly with household rubbish, these rivers and streams operated as social places and a favourable place for children to play, swim and fishing in summer. Adults also joined the kids, cooling the body down, enjoying the time of communal activity accompanied with providing a safe environment for children, so there were different eyes to watch out for kids (Jacob, 1961). This activity does not happen anymore as residents think that the water of the rivers is badly polluted.

'…When the river was clean during our childhood, we usually went there for fishing and for swimming as well but not anymore. Sometimes our fathers joined us for swimming in summer when it was too hot specially at the time of threshing rice yield…' (A man in Vareki derived from the interview)

9.4 Conclusion

Vernacular houses located close to rice fields of Mazandaran have employed physical solutions in order to create sustainability through employing local renewable materials and consuming less energy. These solutions were related to the specific climatic conditions of the region and were environmentally friendly which, accompanied with traditional lifestyle and adoption of supplemental behavioural responses, provided desired thermal comfort. These responses

influenced the configuration of the houses; most of these physical implications are still adopted and admired by villagers according to their new lifestyle. Pertaining to the result of questionnaire 03, about the new demands of local population, most of the vernacular features such as, orientation and elongation, employing semi-outdoor spaces, sloped roof and attic area, platforms raised from the ground have been approved by local interviewees to be suitable for new lifestyle too. Local villagers have admitted the major features of the vernacular houses of this region to be employed within their new housing. Employment of these solutions, particularly physical responses to climatic conditions can reduce energy consumption and provide thermal comfort to new houses.

Chapter 10

Compositional Rules and Model Development

10.1 Introduction

Rural houses within the region, on the whole, are based on a long tradition of applied rules and regulations linked to residents' way of life. Their system of housing, particularly their methods of design and construction make it eminently possible for formal analysis. In this chapter, a parametric shape grammar is developed for vernacular houses and dwellings of the region of this study. It is based on actual design and construction processes according to professional masters' opinions and villagers' views as derived from the conduction of several interviews. In addition, grammatical rules of middle and new styles of houses have been introduced in order to find out the changes within configuration of houses for conduction of a comparison analysis towards verification of better rules appropriate for new life style of villagers. This research does not consider the grammatical rules for generation of village and its components except the houses, although considerable parts of villagers' social activities take place within the context of villages and the village is important part of villagers' 'home environment (Rapoport, 1985)'. These are not aim and objectives of this research and they would need separate independent research studies.

Definition of grammatical rules is illustrated based on three dwelling types and four house types introduced through typology of vernacular dwellings and houses within the region in chapter 8. Types of houses include Row, Half saddle, Saddle and composite types. Defined rules have not been set up for each individual type of house; they are constantly redefined and so are able to relate to all four types. The process of rule definition is divided into two distinctive phases following to the actual house design process. The master at the first phase determines the rules that influence the configuration of dwelling design in property scale, including definition of the approximate territory of construction such as the house as the main building and the location of other outbuildings and open areas. The second phase articulates the set of rules that embody the design and construction of different types of the building of houses.

Identified rules and their characteristics are described below, accompanied with an evaluation of their efficiency for locals' lifestyle according to the cultural, social, and climatic criteria obtained from previous chapters. As a result of this evaluation, appropriate rules for design and construction have been selected, this has led to appropriate rule set up and designing new houses accordingly.

10.2 First phase; rules to design the property's configuration

Land of dwellings within the region often have no geometrical shape but according to their proportions, they are assumed to be rectangular or square in this research. Accordingly, typology of the dwellings has been conducted and presented in chapter 8. This section builds on this typology and identifies rules that embody the configuration of the land plot design including location of house and outbuilding, and open settings including the front yard, backyard, and garden for vernacular, middle and new styles of dwellings. The process of designing a property requires the application of 31 rules introduced below.

10.2.1 Defining the geometry of the land

The first step must be to find and define the approximate assimilated geometrical shape of the land plot. If one side of the land is longer than the other side, it can be assumed to be a rectangular shape (rule 1) and if all sides are approximately equal, the land shape is assimilated as square (rule 2).

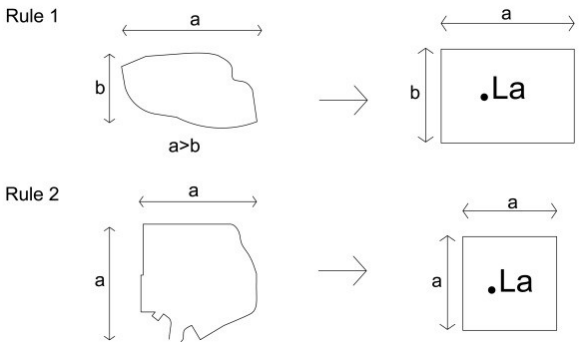


Figure 10.1: Rules to define the geometrical shape of the land

This assumption helps the designer (master builder and the owner) better understand the proportion of the land for further design processes (fig 10.1).

10.2.2 Defining north direction

The next step is the definition of north direction, which usually defines the backside of the land and has a determining role in designing the configuration of the dwellings (rule 3) (fig 10.2). The north direction is mostly recognised as back labelled *b*; although rarely, because of orientation of the house, it could be to the lateral side of the house. North direction within the region means a direction within northeast to north-west, which has been named in this research as north zone direction. Therefore, in this step the north zone direction is defined.

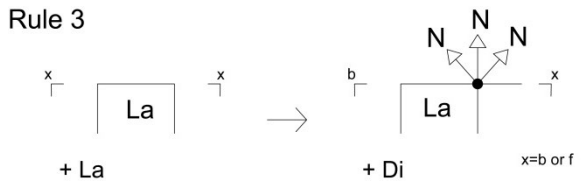


Figure 10.2: Rule to define the north zone direction

10.2.3 Defining the location of construction setting and the garden

In the next step, the builder, in consultation with the owner, determines the territory of construction labelled as C and garden labelled as G, its location is influenced by north direction (rule 4, 5,6,7,8) (fig 10.3).

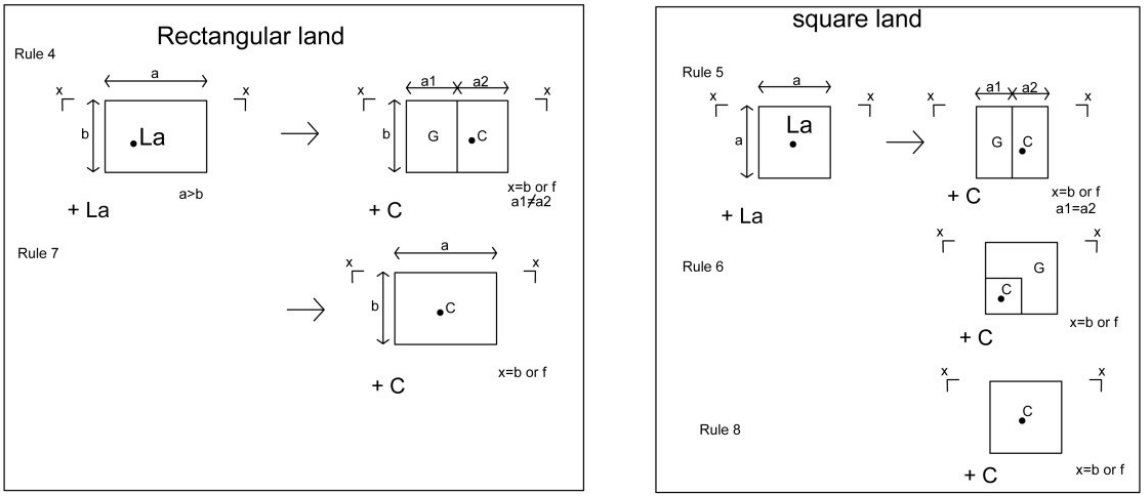


Figure 10.3: Rules to define two main parts of the dwelling, construction area and garden area

In this regard, the land is usually divided in two main parts of different sizes according to the size of the land including a section planned for the garden, and

another section where all construction takes place. Setting up an area as a garden provides the opportunity for villagers to have an orchard, to nurture poultry, or even livestock, and cultivate a kitchen garden thus increasing food production and their income. In this regard, these rules are efficient within the region.

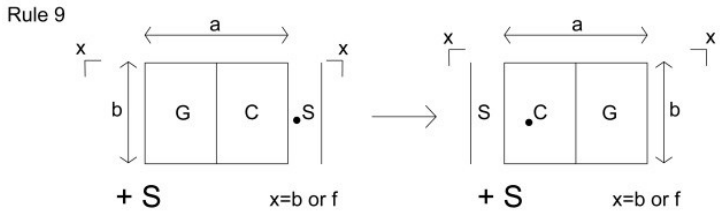


Figure 10.4: Rule to define location of construction area and garden according to the location of the street in rectangular shape land

If the land is not large enough to have an open area (smaller than 100 metres square), only the territory of construction is determined (rule 7, 8) (fig 10.3). The location of *C* or *G* in left hand side or right hand side of the land, according to the picture and eastern, western, northern or southern side according to direction of the land depends on the location of the street. Within rectangular shaped land, the location of the street plays no role if the street is located along the longer side of the land but if it locates on shorter side, it mirrors the defined territories of *C* and *G* by application of rule 9 (fig 10.4).

10.2.4 Defining territory of construction of the house, front yard and back yard

In this step, the approximate location and territory of house construction, labelled as *HC,* is defined according to the north direction and approximate square area of its size derived from consultation of the master and the owner. Accordingly, the open settings around this territory, labelled as *ON,* are articulated through application of rules 10 to 22 but their definition as front yard, backyard and their sizes will be determined later according to the orientation of the house and location of the entrance (fig 10.5). One of the main aims of this division is to provide opportunities for houses to get maximum benefit from sunshine and breezes, which are essential in this region. In addition, provision of one open setting whether within the front, back or lateral yard is necessary according to the lifestyle of the villagers. They can do many of their activities within this setting.

10.2.5 Definition of the location of the entrance

The location of the entrance, labelled as *E*, into the dwelling depends on the location of the street. It can be arranged in the front yard, backyard or any of the lateral sides of the house as a result of the application of one rule from 23 to 28, however the entrance is mostly preferred to be located in front yard according to the application of rules 23 and 26 (fig 10.6). Within vernacular dwellings, if the land of the dwelling is very small, the entrance is directly into the house instead of going to an open area. In this case and by application of rule 29, a semi-open setting is defined, and attached to the house on each side next to the street (fig 10.7). This setting connects the street and the house, which acts as an entrance and socialisation setting between residents and neighbours.

All of these rules are common within all three dwelling styles, and are efficient in relation to the climatic conditions and villagers' lifestyle. Just one other rule prevails within new style of dwellings; the location of the house is not determined by the north direction but in accordance with the location of the street with no consideration to the arrangement of a garden or any other open setting (rule 30). Usually, the entrance is directly from the street into the ground floor, which is *pilotis* allocated for car parking (rule 31) (fig 10.8). Locals do not agree with this rule, according to questionnaire 03, and additionally it is not suitable and efficient enough for this region because sometimes houses are oriented toward north direction as a result of the street location. This is climatically the worst orientation within the region, and *pilotis* houses affect residents' connection with the earth and reduces their relationships with the front yard.

After designing the spatial configuration of the land, the results should be transferred into the real plot land according to the rule 1' and 2' in order to evaluate the integrity and precision of the design and assess its feasibility (fig 10.9).

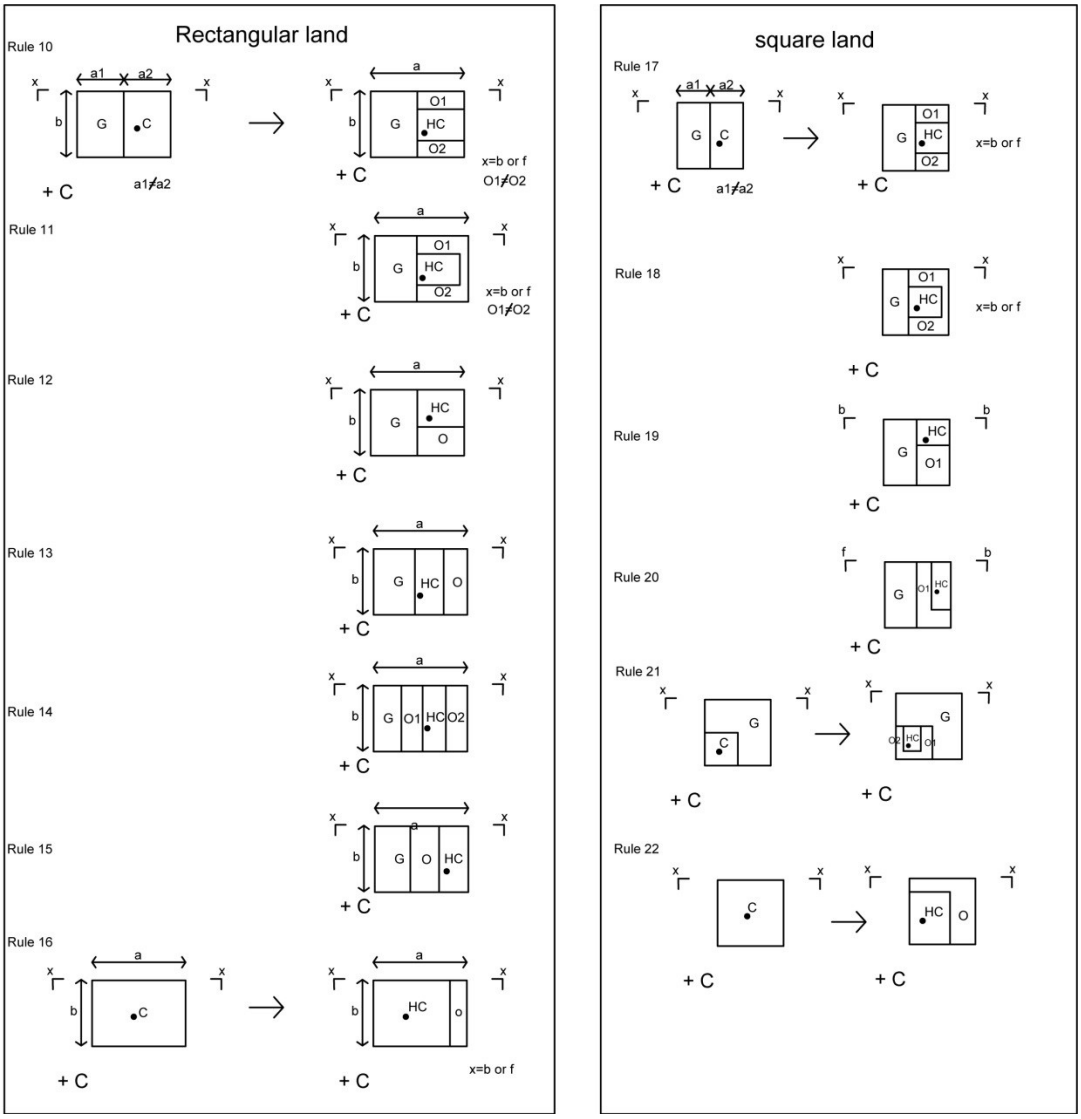


Figure 10.5: Rules to define the approximate area of a house erection and open settings including front and backyard.

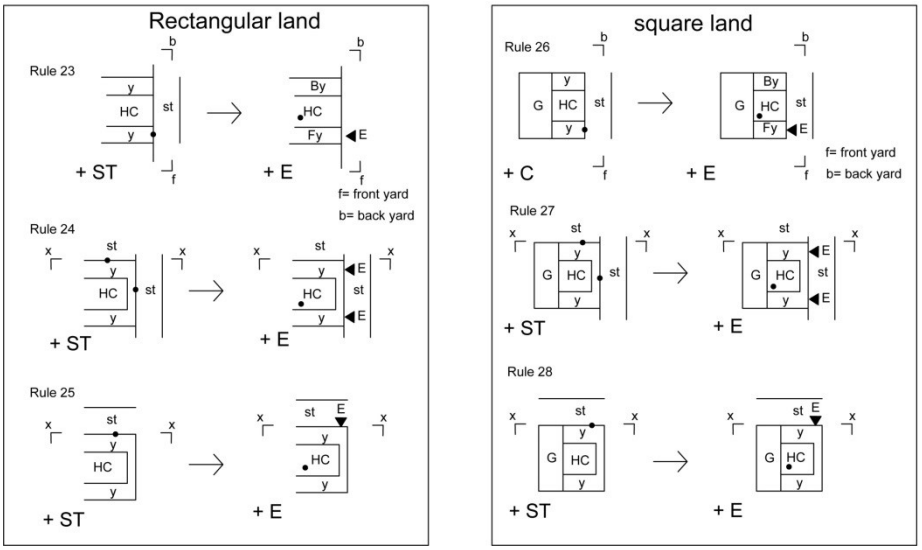


Figure 10.6: Rules to define the location of the entrance into the land.

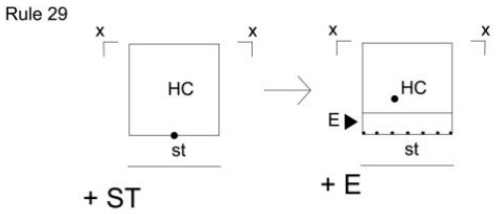


Figure 10.7: Rule to define a semi-open setting and the location of the entrance shared with street area in very small land of vernacular dwelling.

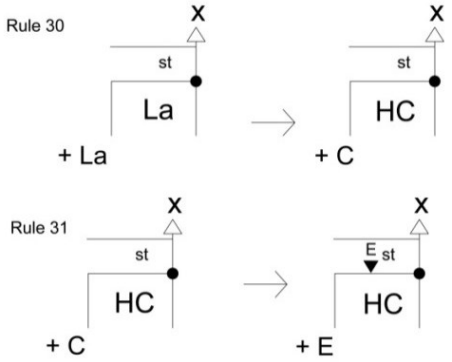


Figure 10.8: Rule for defining location of the house and its entrance within new style houses.

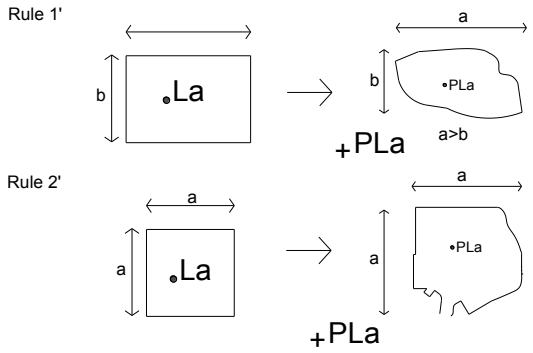


Figure 10.9: Rule to transfer the design of the plot land into the real land.

10.3 Second phase; rules to design the house

After designing the property and defining the territory for construction and the house, the next challenge is to define a new set of rules to design the house. In this section, rules applied for house design are illustrated, from which one can design all mentioned styles of houses. Regarding the typology of houses, Half-saddle type is an evolution of the Row type and Saddle type is an evolution of Half-Saddle type, and the composite type is an evolved version of all or combination of them. Therefore, these types have considerable common characteristics so that many rules are common within all types too, this being the case; they have been set up through one common package in this section. In this hierarchical process,

specific rules have been added in order to enable the grammar to define and generate different types.

10.3.1 Defining initial shape

The builder starts with a point indicated by label *DH* that marks the key point, a location that the master determines within the predefined construction area through design of the property as the base point for house construction (fig 10.10). Its definition is related to the size of the house, number of rooms, the entrance and desired type of the house. It should be noted that, in order to generate realistic layouts, information about the context, particularly the shape and size of the lot have been already taken into account through designing property scale. For example, it has been confirmed that the layout of the house fits within the boundary of the land and keeps required setbacks for different purposes.

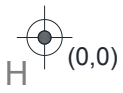


Figure 10.10: Initial shape

After the definition of the base point has been confirmed, the owners sacrifice a sheep, cow or poultry to celebrate the construction of a new house. All workers including family members, friends and relatives involved in construction of the house pray and wish good fortune for the owner, his family and the house.

10.3.2 Computing the dimensions for the living room

The first step is to decide upon the general layout and style of the house during a consultation between the master and owner. Next, the master will compute the dimensions for the living room, which is the main room of the house. Rule 1 specifies three measurements: height, *h*, width, *w*, and depth, *d* (fig 10.11).In this regard, the width is usually 1.3 to 2 times longer than the depth. The width is between 2.4 to 3.50 metres and length is within 3.00 to 6.70 metre long, and height is no more than 220 centimetres within vernacular houses. These measures depend on the family population and needs, and the construction technology, particularly the size of timbers and logs for house ceiling implementation.

Figure 10.11: Rule for dimensions definition

10.3.3 Identification of important climatic directions

Identification of north direction is the first stage for making decisions about house orientation, which is defined according to the rule 2. Absorption of maximum sunshine is desired within the region towards provision of thermal comfort, which accordingly south is the best direction and east is in the next best.

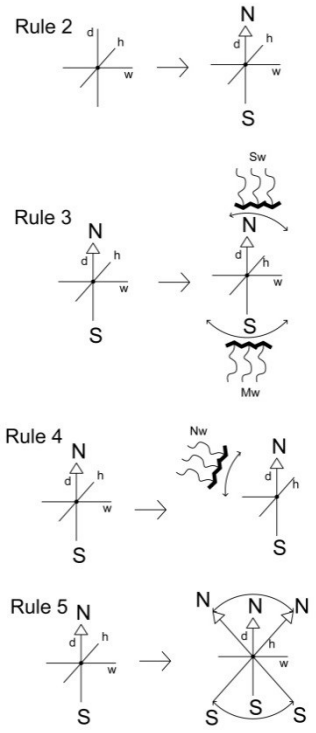


Figure 10.12: Rules for identification of important directions

In addition, definition of the best orientation also depends on an understanding of proper and improper directions of wind, which is essential because of the high humidity of the region. It is defined according to rule 3 for wind directions, which are from the sea (approximate north) during the day and from the mountain area (approximate south) during the night. Rule 4 defines the

inappropriate wind direction, which blows from the north-west (fig 10.12). According to these climatic factors, determination of the best direction for the house is possible in result of rule 5 application; this is according to the climatic conditions and the orientation of the house is better to be towards one angle of south zone.

10.3.4 Generating living room

The master generates this room by applying rule 6, based on acceptable defined measures and the proportion, which by being labelled as *L,* it cannot be applied again (fig 10.13). This room is used for sitting together, eating, entertaining gusts, making and drinking tea, and sleeping at night, which make this room the focal space of the house. Other rooms will be added to the configuration of the house with the same proportion and condition of the living room. These rooms are attached to the living room and are generated according to the rule 6.

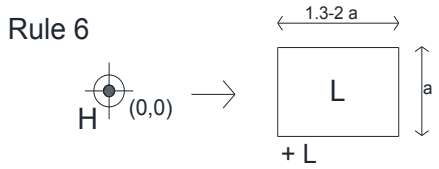


Figure 10.13: Rule for generation of vernacular living room or other rooms

Generally, living rooms within middle and new styles of dwellings, called '*hall'* are bigger than within vernacular houses. It is at least 15 metres square even up to 50 metres square and the size of its sides are different from 3 to 5 metres width by 5 to 10 metres length. The size range is appropriate for the new lifestyle of the villagers and their new furniture, and is much more suited when compare to the size of vernacular living rooms. In terms of proportion, the size of depth is always 2 to 3 times bigger than its width, according to rule 6' that makes it too long and disproportionate (fig 10.14). Consequently, the appropriate living room is an incorporated model including the same size and area square as living rooms within the middle and new style while it appears with the same proportion as vernacular living rooms. This is possible according because of rule 6", which is better rule for the generation of living rooms within new housing. (fig 10.15).

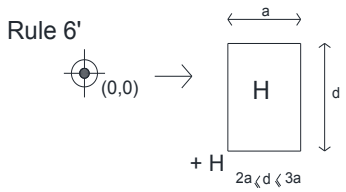


Figure 10.14: Rule for generation of Hall within new and middle styles of houses

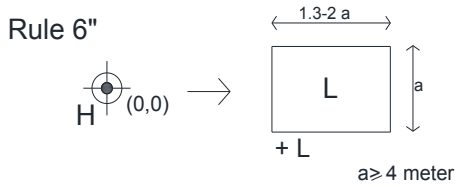


Figure 10.15: Rule for generation of living room appropriate for new housing (propositional)

10.3.5 Defining the orientation of the house

The best orientation of the houses within the region with attention to climatic conditions is towards south zone (SW-SE) which is possible by application of rule 7 (fig 10.15). This rule defines the orientation of the living room, the orientation of which dictates the orientation of the rest of the house. This is the most common and desired orientation within vernacular houses. The next best orientation is towards east and is applied by rule 8 (fig 10.16). This orientation is responsive to the climatic conditions. Houses oriented towards this direction cannot absorb maximum sunshine and benefit from cross ventilation provided by breezes from north and south. As a result of the application of this rule, the orientation of the living room and subsequently the orientation of the house is determined, accordingly the front of the house labelled (*f)* and back of the house labelled (*b)* are determined. Usually, the house and the living room do not extend towards front and backsides to keep being one room in deep. Rule 7 provides the opportunity for the living room and the house to gain maximum sunshine, to invite appropriate winds blowing from north and south whilst offering more possibility of having better relationships with outside conditions, which is more beneficial for new housing. It should be noted that from this point, within this report the use of the symbol (◗) on each side means that the development of the building can take place on that side and the meaning of other symbols are explained within figure 10.16.

The orientation of middle and new style houses depends on street direction rather than closely dependent on climatic factors. Therefore, according to rules 7' and 8', the living room and subsequently the house are orientated towards each direction but are planned to be oriented towards south zone (fig 10.17). The other main difference with vernacular orientation is that the front and back sides of_

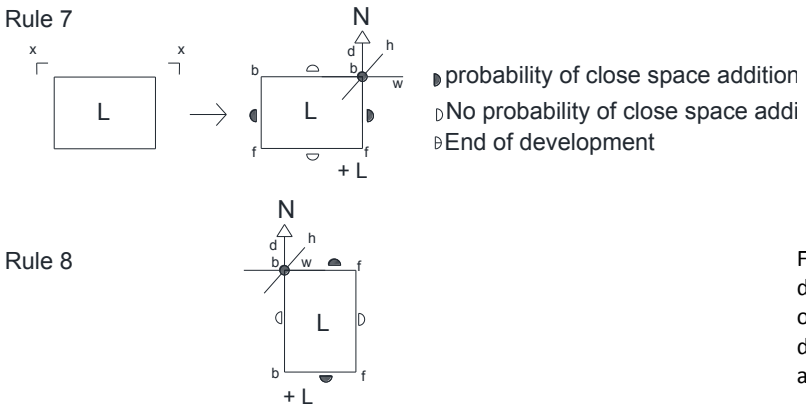
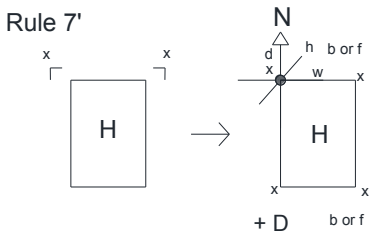


Figure 10.16: Rules for definition of orientation of two different living room and the house in result.

-this room within new and modern style of houses are of a smaller size. This means that *hall* is deeper than a vernacular living room in relation to front and back sides. In addition, except from the front, this room can be extended from all two lateral sides and the back however, an extension from the backside would restrict cross-ventilation within this area. If the hall is orientated towards south zone with no closed space in front and behind, it has a climatically favourable performance whilst, because of the size, it can support all the family's activities, and because of the location, it connects all rooms together as they are accessed from this room. In addition, two rooms are usually extended next to the hall along the depth, making it possible to arrange more rooms beside lateral sides. This organisation of more rooms located close to a central room is necessary according to the villagers' new lifestyle and opinions when creating central space organisation. Consequently, rule 9 is another appropriate rule for the definition of orientation of living rooms within new housing construction (fig 10.18).

10.3.6 Extending the building generating different types of houses

Once the living room has been designed, the master extends the building laterally on one or both sides until the total desired number is achieved and is according to the owner's intended value. The master applies rule 10 and adds a room with the same the principals as the living room on the lateral side of it with the same orientation and elongation direction. This kind of juxtaposition is called '*head to head* joint' in the region (fig 10.19). This new room is allocated for different purposes, and rule 10 can be applied many times, more rooms can be-



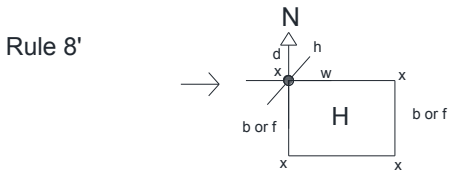


Figure 10.17: Rules for definition Hall and in following the house orientation within middle and new styles.

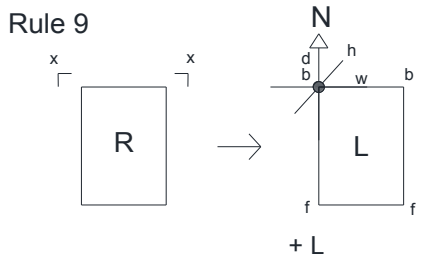


Figure 10.18: Rule for definition of appropriate location and orientation of living room for new housing.

-added until it meets owner's expectations. Within this room and the living room is a divider wall, its thickness defines the distance between two rooms. The thickness of the wall depends on the construction technology. Accordingly, it varies from 10 centimetres when constructed from wooden logs to 55cm shaped from mud. By application of rule 11, a square room with sides the same size as the depth of the living room is extended from the living room and is used as store called *'darim-khene'*, which is labelled as *S* (fig 10.20). Just one *darim-khene* can be attached to the living room and another room as a result of the application of rule 10 can be added to other lateral side of living room or *darim-khene* as well. It should be noted that each room, which has the same principals as the living room could also have a *darim-khene* by application of rule 11 again. Application of rules 10 and 11 make the Row type house (*RH)*, which can be further extended laterally. This type provides the best identical opportunity for all rooms taking advantage of sunshine absorption and wind celebration. On the other hand, it has the smaller side towards the less favourable west direction, which is a suitable response to protect the house from harmful conditions from this side.

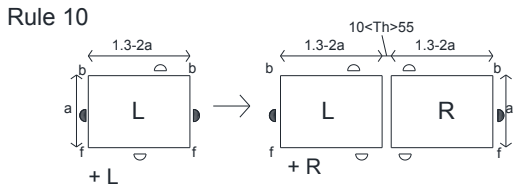


Figure 10.19: Rule for extending the building generating row type house.

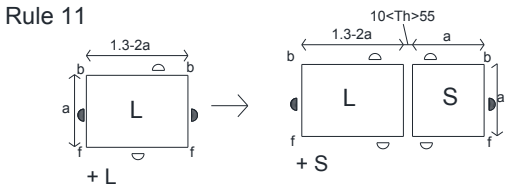


Figure 10.20: Rule for extending the building by adding a store and generating another row type house.

If one room is added perpendicularly to one lateral side of the Row house or living room in result of the application of rule 12, Half-saddle type (*HSH*) is created, which stops house development on this side. Moreover, when it is applied to both sides following rule 12 being applied twice on a Row type, or once on a Half-Saddle type, a Saddle type (SH) is generated, which stops development of the house towards both lateral sides (fig 10.21). Extended rooms and their locations are defined according to prevailing proportions.

Within middle and new style of houses, the addition of extra rooms is according to different rules, and unlike vernacular houses, new rooms can be added at the back of the *hall* in addition to the lateral sides of this space. This kind of extension provides more rooms for various purposes and family needs. According all added rooms are accessed from *hall*, exhibits bigger *hall* appropriate for arrangement of sofa and big carpet, which are prestigious within the region.

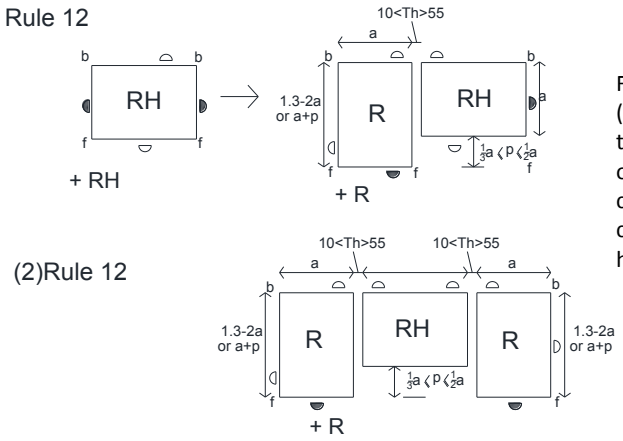


Figure 10.21: Rule for generation saddle (SH) and half-saddle (HSH) types of house through extension of row type house (RH) or just living room. Therefor the label (L) can be replaced by label (RH) which in this case generates two rooms' half-saddle house and three rooms' saddle type.

However, location of two or three rooms behind each other reduces the efficiency of the cross-ventilation performance and affects the sun absorption of all

rooms. This extension takes place by application of rule 10' and 10'' adding one or two rooms to the small sides of *hall*, either lateral or at the back, and by application of rule 10''', two rooms are laterally added to the *hall* (fig 10.22).

Rule 10''' with no need to implement any modification is climatically efficient enough to be used for new housing because it does not weaken cross-ventilation in *hall* spaces as it is the main and mostly occupied setting.

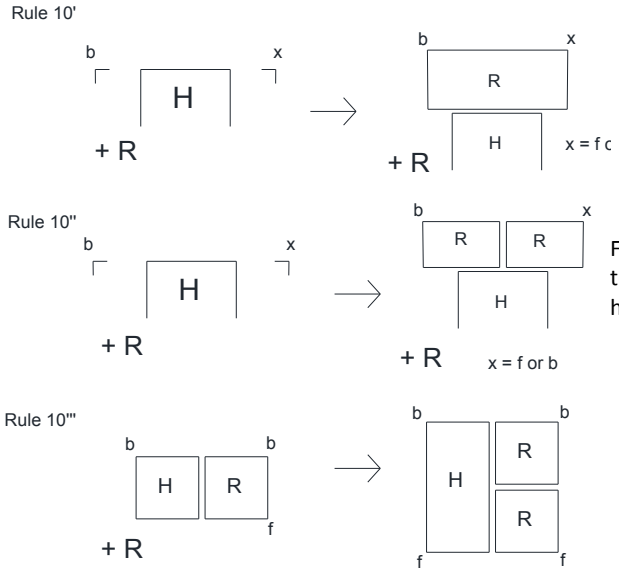


Figure 10.22: Rule for adding new rooms to central hall in middle and new style of houses.

It is also culturally favourable since occupants can put long fabric on the floor for a dinner party sitting and eating all together. In the meantime, architecturally more rooms can be arranged around the *hall*, which are used for different purposes during different times of the day.

In addition, rules 10' and 10'' are also suitable for new housing design because they can arrange more rooms around the living room whilst ensuring that rooms do not block the front and backsides of the living room oriented towards south eliminating cross-ventilation. Aiming to achieve this, the living room should only extend laterally along smaller side of the *hall*, which means that the label (*x)* should be replaced by (*f)* within these two rules creating new rules 13 (fig 10.23) and rule 14 (fig10.24).

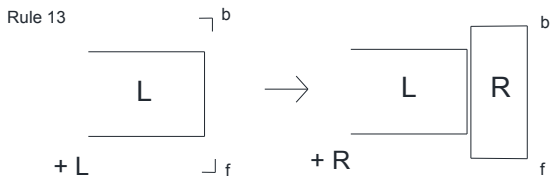


Figure 10.23: Rule for extending the building from lateral sides of the living room with one big room.

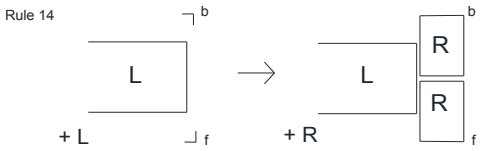


Figure 10.24: Rule for extending the building from lateral sides of the living room with two rooms.

10.3.7 Allocation of guest entertaining room and kitchen

One method for allocation of guest entertaining room and kitchen is to change the label of rooms within the vernacular house. After extension of new rooms to the lateral side of the living room, the label of these rooms can remain unchanged and are used as multipurpose room or can change according to initial intention for its addition; occupied for guest entertainment or kitchen with application of rule 15 and 16 within vernacular houses (fig 10.25, 10.26). This room added to the lateral side of the living room can be employed as guest entertainment room or kitchen, which usually has no access from the living room.

According to rule 11, the function of store area with square shape remains the same from the beginning steps of design. This is an appropriate rule and location for allocation of the kitchen and can even be incorporated with living room as an open plan kitchen. This is because villagers do not need such a big storeroom besides living room to protect and preserve their foods due to keeping foods within fridges and freezers, which can be accessed from the living room; This is functionally convenient.

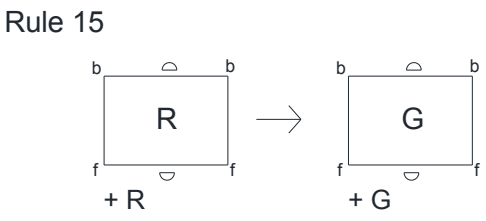


Figure 10.25: Rule changes the label of the room to generate guest entertainment room.

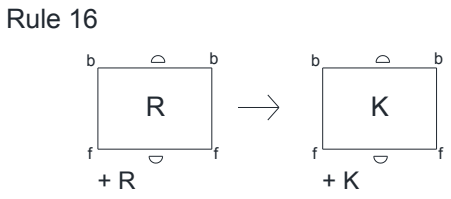


Figure 10.26: Rule changes the label of the room to generate kitchen.

It should be noted that traditional allocation of a kitchen within the house configuration was not critical for all villagers, some houses put it within house

configuration, and some of them even did not have a kitchen within the house configuration, just as an outbuilding located independently within the dwelling land plot. As another type, the kitchen has later been annexed to the backside of some houses, accessed from the living room as a peripheral space by application of rule 17 (fig 10.27). This type, which can be applied within all house types, has only been observed within one case study village, Vareki, where cross-ventilation is not desired because of climate conditions or at least it is not perceived necessary for the kitchen in addition to sunshine absorption. No relationship has been explored between the size and proportion of this room with the living room. It varies within all houses; its addition stopes any other extensions to the house. Sometimes, the bath, labelled as *B,* is allocated within this room in result of application of rule 18 (fig 10.28).

Unlike vernacular houses, the kitchen is one important room within middle and new style of houses. It has been important as a result of new modern kitchen appliances, new technology and fuel for cooking food, which produce no smoke and big fires. In addition, these appliances are perceived as decorative, which can make the kitchen and house interior attractive. This is essential, cooking food is one major activity of all families that takes place at least twice a day with slow cooking techniques, this takes up considerable time of the females who are culturally responsible for cooking.

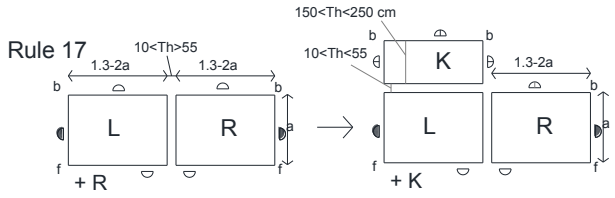


Figure 10.27: Rule for extension a peripheral room as kitchen at the back of the living room.

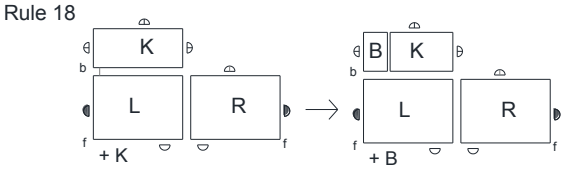


Figure 10.28: Rule for definition of a space as bath within peripheral kitchen located at the back.

Applied by rules15', 15'' and 15''', one room connected to the hall can be selected as the kitchen, which is better to be located at the backside of the house (fig 10.29). If it is open plan with the living room, it will not block the cross-ventilation within both of these settings.

Open plan kitchens, labelled as *OK,* with the living room are increasingly becoming popular and as an important setting within the houses of the region. Some villagers destroy the wall dividing the hall and the kitchen to make a new style of living room open plan with the kitchen.

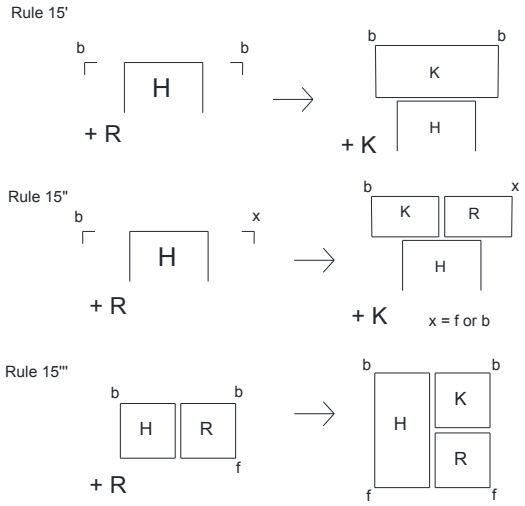


Figure 10.29: Rule to allocate kitchen within middle and new style house.

Although rules for its allocation do not differ with enclosed kitchens, this pattern exhibits the interior design of the kitchen and its appliances better. Questionnaire 03 shows that a significant amount of villagers advocates this type of the kitchen as a culturally and functionally favourable pattern. Therefore, its location is achieved like a normal kitchen but in application of rule 19, the wall can be taken out between the kitchen and living area making an open plan kitchen within new housing or even constructed ones (fig 10.30).

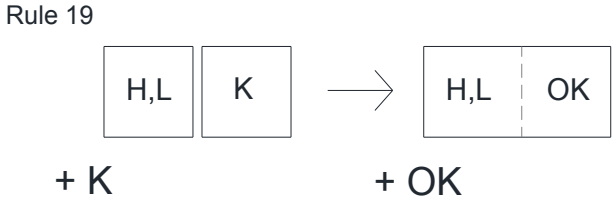


Figure 10.30: Rule for definition of open plan kitchen.

Guest entertainment areas and the living room (*hall)* are favoured by locals to be unified in much the same way as open plan kitchens by pulling out the common wall in between. This is in order to make a bigger space that provides the opportunity to do different activities more conveniently and according to the

requirements of new lifestyle. Residents can furnish this space with sofas and other furniture, put bigger fabric on the floor thus entertaining more guests at the same time, family members can sit together at the same time, entertaining guests and watching TV. In addition, because of modern mechanical heating and cooling systems along with availability of cheap energy, keeping an indoor level of thermally comfort is not the concern and challenge of villagers when configuring such a unified massive space. By application of rule 20, the living room or hall and guest entertainment room can be unified with each other. A significant number of villagers agree with and consider it as an essential pattern according to the result of questionnaire 03 (fig 10.31).

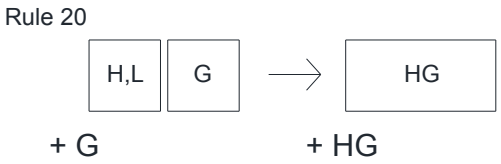


Figure 10.31: Rule to unify *hall* and living room with guest entertainment room.

One other modification, which is mostly common within Saddle and Half-saddle types, is the changing of the function of rooms.

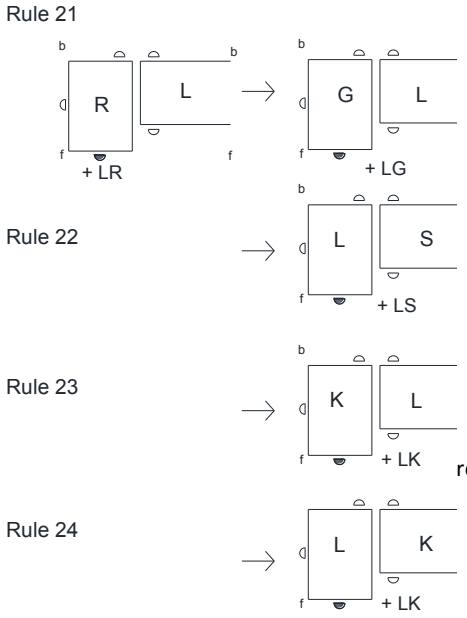


Figure 10.32: Rules for changing the label of the rooms for changing their function.

Rooms within vernacular house have flexible roles, functions, similar characteristics, and principals, which makes them able to accommodate various

types of role and function. This is possible just by changing the label of the rooms following the application of rules 21 to 24 on each room (fig 10.32). This is not likely to be possible within middle and new style houses because rooms within their configuration have fixed functions, characteristics, and they are not sufficiently flexible to be adapted for newly required functions.

10.3.8 Exterior wall definition and exterior boundary of close spaces

After designing the layout of the house, the exterior walls need to be extended. To do this, the master offsets the interior boundary line, which is in contact with outside applying rule 25 (fig 10.33). The size of offset depends on the thickness of wall; the thickness itself depends on the material of house construction. This is 10-25 centimetres for log-on-log house depending on the diameter of employed logs, 45-55 centimetres for mud house strengthened by timber frame, and 25-35 centimetres for fired brick load bearing walls in vernacular houses. Within middle and new styles, it is 15-25 centimetres. After definition of exterior wall, any addition of closed space for house development stops.

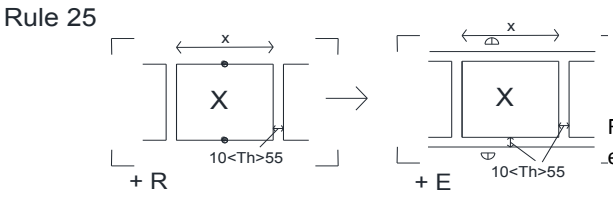
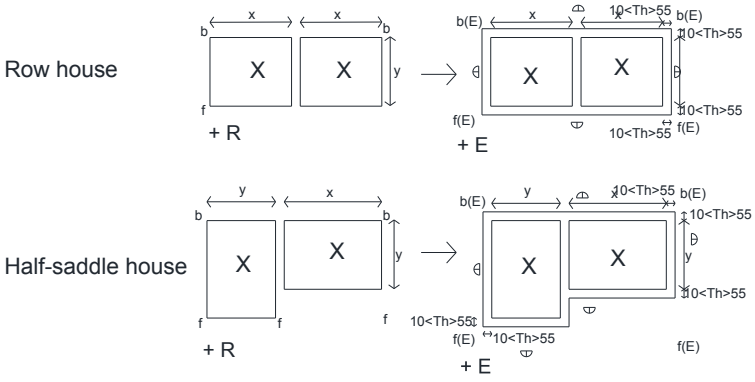


Figure 10.33: Rule for definition of exterior wall.

The result of this step defines the exterior boundary of different types according to the figure 10.34.



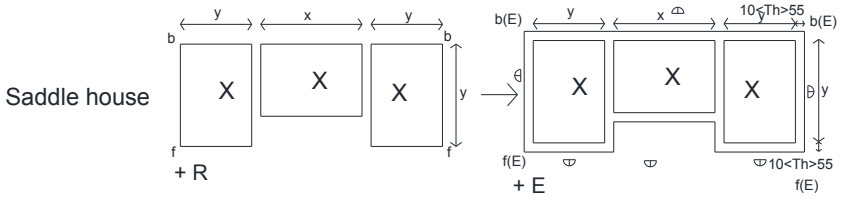


Figure 10.34: Exterior wall definition of different types of house based on rule-25 application.

These three main vernacular types of houses combine with each other and generate new type of house, which has no name within the folklore of the region. This is called '*Composite type*' within this research. The variation of this type is generated based on mirror action, in which the axe of mirror is the axe of common wall or mostly a corridor made after this action (figs 10.35, 1036, 10.37, 10,38, and 10.39).

This corridor, which is usually a semi-enclosed setting, performs as entrance into the front porch or connects the front porch to the other porches and balconies of the house. This corridor can be changed into a closed setting climatically suitable and practical. It connects rooms together according to the new lifestyles of residents. Different variations of this type are generated by application of one of the rules from 26-47 (fig 10.35 to 10. 40). It should be noted that these rules have the capability to be applied to all types with more than two rooms within the region and throughout this research just with those two rooms have been observed.

This type allows more rooms to meet the needs of occupants and climatically has been shaped according to sun and wind considerations. These rooms are oriented toward different directions to absorb as much sunshine as possible from south and east and benefit from as much breeze as possible from these directions. On the other hand, these houses are compact and although they have more rooms, they occupy low level of land. These characteristics make this type appropriate for new housing but with some modifications. The most useful functional change was to change the created corridor into a closed space. This

closed space can be modified to be used for different purposes within new housing such as acting as a new small

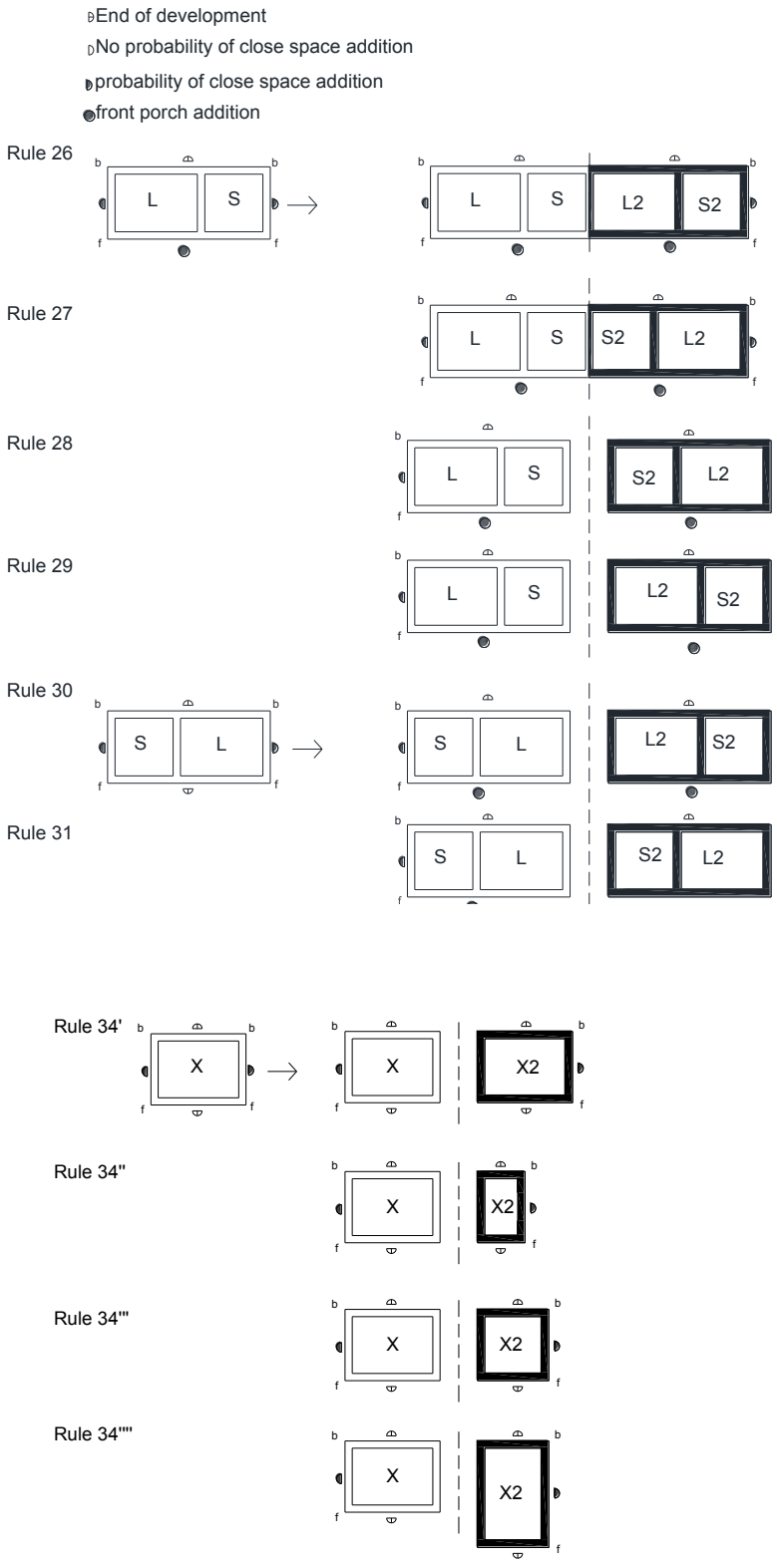


Figure 10.35: Rules to generate variations of Composite type from combination of Row types with

two rooms from rule 26 to rule 31 and one room with another room making Row and Half-Saddle types by application of rules 34' to 34''''.

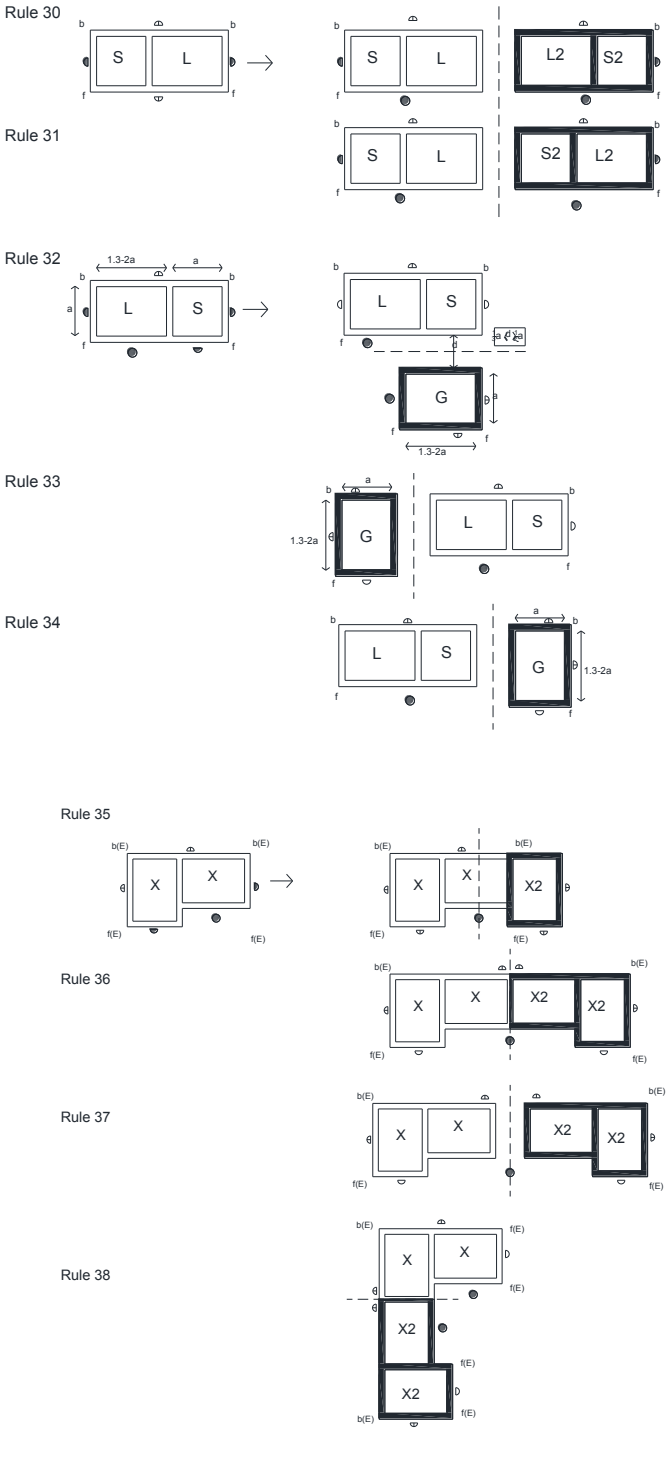


Figure 10.36: Rules for generation of Composite type from combination of two-room Row type with one room.

Figure 10.37: Rules for generation of Compositional type from combination of Half-Saddle types with two rooms.

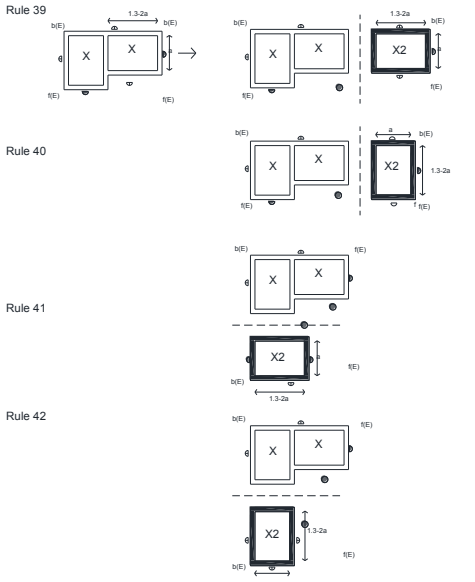


Figure 10.38: Rules for generation of Composite type from combination of Half-Saddle type with two rooms with one room.

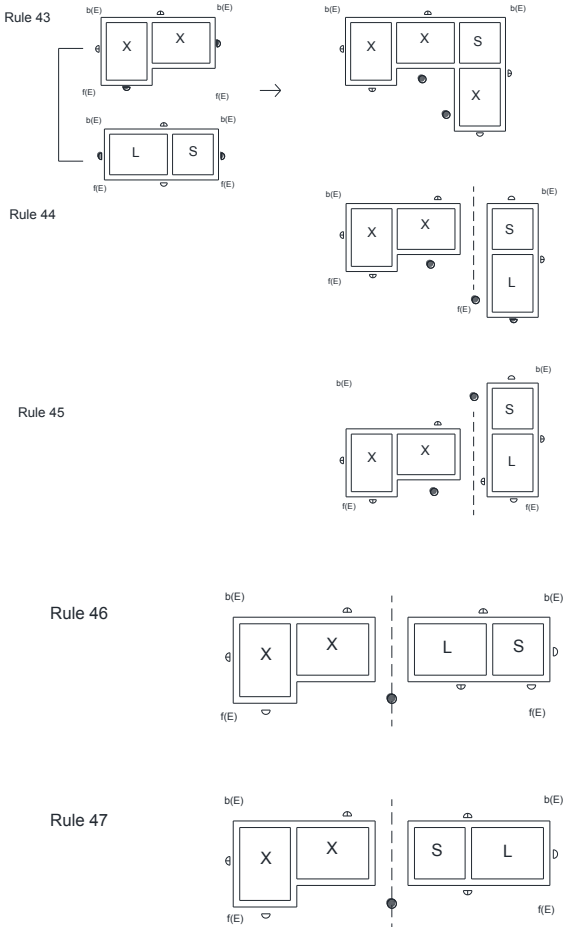


Figure 10.39: Rules for generation of Composite type from combination of Half-Saddle type and row types both with two rooms.

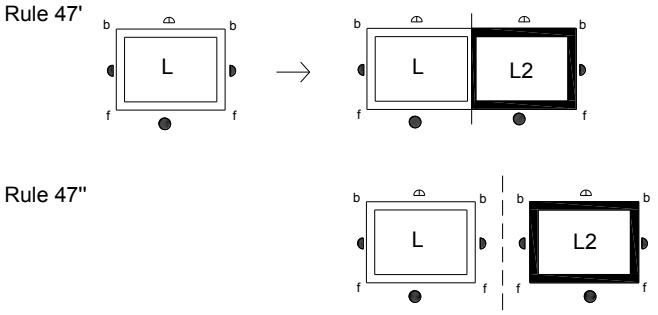


Figure 10.40: Rules for generation of Composite type from combination of two rooms. These rooms could be whether with the same shape and proportion or not.

-room or store, an entrance to the house connecting the front porch to the living area, as service space including the bath and toilet, or allowing a staircase to reach the first storey. This is possible according to the rule 47''' (fig 10.41).

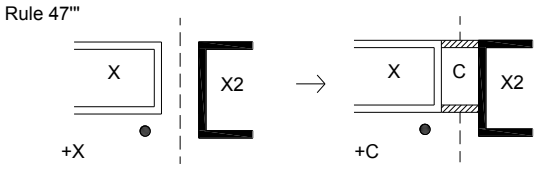


Figure 10.41: Rule for changing the characteristic and function of corridor within compositional rule to be adapted for new lifestyle

This space could be occupied as a store, which can be accessed from the living room or as a stairs case allowing access to upper floors as a result of rules 47'''s (fig 10.42) and 47'''st (fig 10.43) respectively.

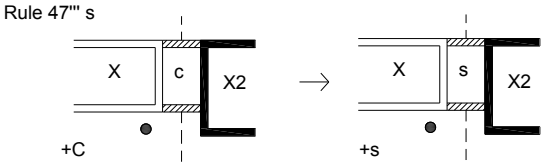


Figure 10.42: Rule to use the corridor as store room case

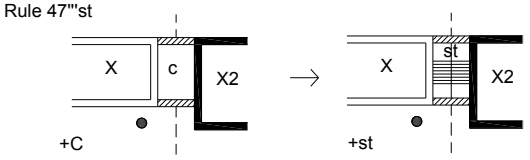


Figure 10.43: Rule to define the corridor as stairs

10.3.9 Rules for definition of front porch and other types of semi-enclosed space

Initially and before any addition of semi-enclosed spaces, the whole exterior boundary of closed spaces should be defined for different types. In order to do this, all interior line of walls and exterior walls need to be erased according to rule 48 (fig 10.44).

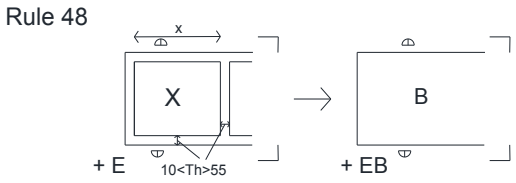


Figure 10.44: Rule for definition of exterior boundary of house.

Figure 10.45 represents the result of the application of this rule in order to define the whole exterior boundary of four types of the houses.

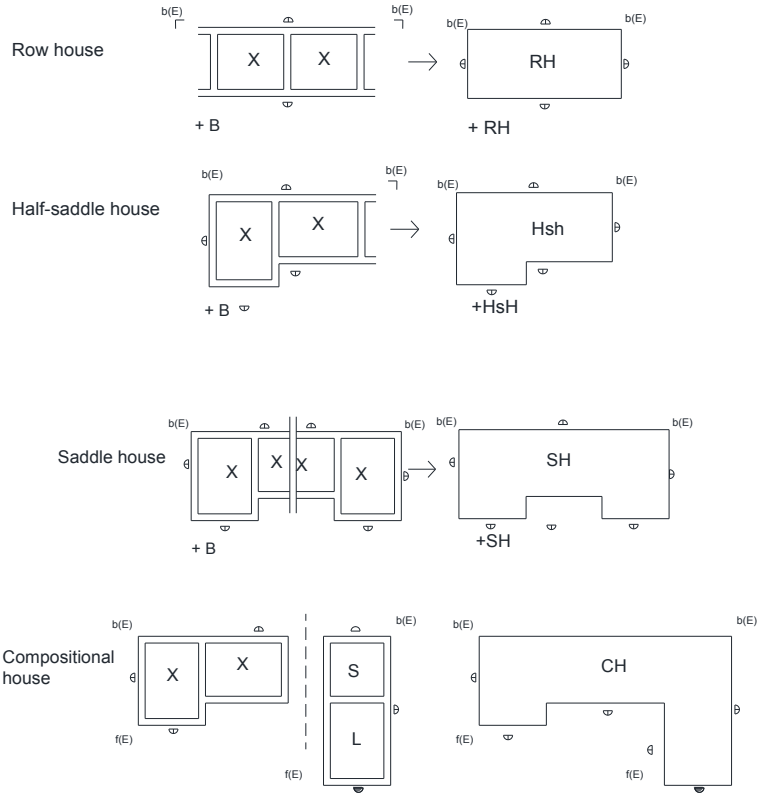
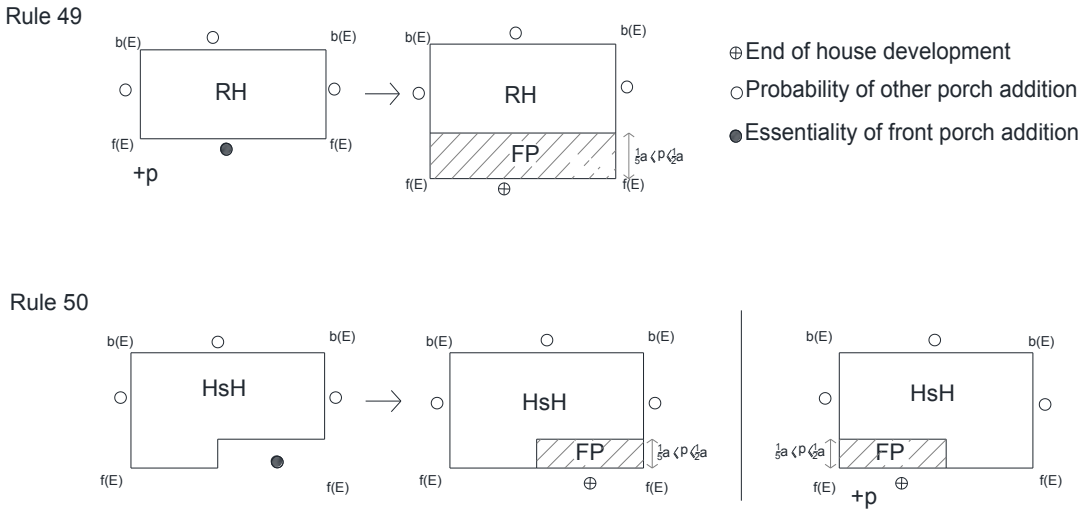


Figure 10.45: Definition of exterior whole boundary of different types.

After this step, the front porch is added, which is one of the most important spaces of the vernacular houses within the region. The longer the front porch with more columns, the higher social status and this particularly indicates the financial status of the owner. It is usually oriented towards south zone direction obtaining sunshine and wind of this direction that blows from the mountain area during the day; this intensifies the relationship with the natural environment. All rooms are accessed from this space and occupants can enjoy from socialising with neighbours and other residents of the village. This columned setting is one beauty aspect of the vernacular houses. This space has a seasonal function and is used as the living room during warm seasons. This has been advocated by 95.80% of respondents to question 6e of questionnaire 03 about residents' spatial demands. The size of this space is between 1/5-1/2 times the widths of the house, which is usually around 70 to 250 centimetres. It is added by application of rules 49, 50 and 51 just on one edge of different main types of houses including Row, Half-saddle and Saddle, respectively and in parallel to the house elongation (fig 10.46).



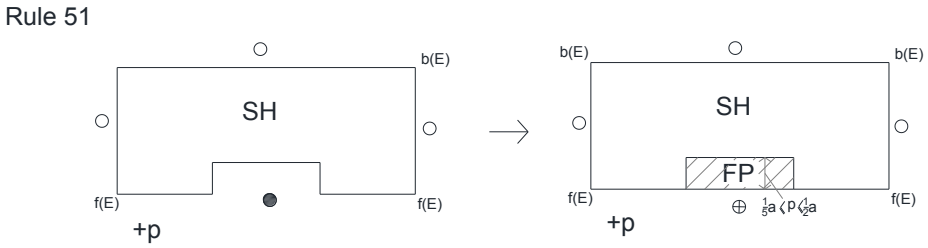


Figure 10.46: Rules for definition of front porch within three main vernacular house types.

For composite style, which outside of their boundary is the same as the three main types, the addition of a front porch follows one of the rules mentioned in figure 41 but the boundary shape for this type is as represented in figure 10.47, this space is added on two edges applied by rule 51c.

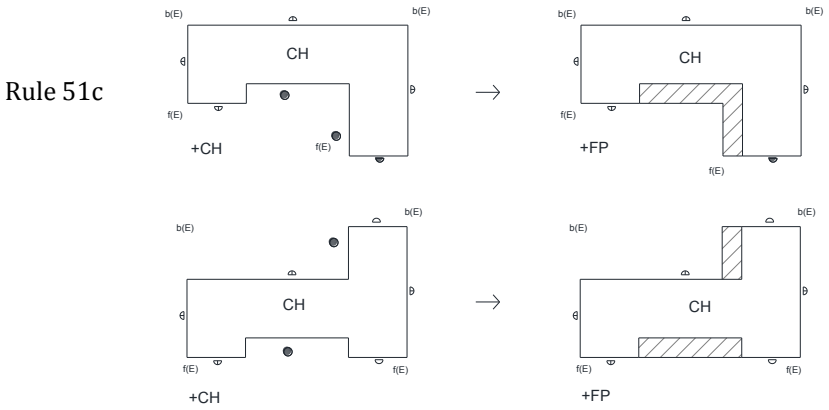


Figure 10.47: Front porch addition on compositional rule with different whole boundary with three main types.

After front porch addition, other porches with the same characteristics might be added to other sides of the house to enjoy other pleasing views or to protect the house from damp conditions and harmful sunshine of the west and north-west. This is possible by respective application of rules 49', 49'' and 49''' on Row house (fig 10.48) and application of 50', 50'' and 50''' on Saddle house (fig 10.49) and application of rules 51', 51'',51''', 51'''' and 51''''' on Half-Saddle house (fig 10.50). It should be noted that, although a landslide number of respondents agree with having a front porch, they prefer to allocate less area to it in order to have bigger enclosed space within the same particular square area of the house. It is financially going to be reasonable saving money since front porch in vernacular style needs significant amount of wood for provision of its column and timber,

which makes construction of this area expensive. Accordingly, some of those porches are too long and big in square area to be adopted by villagers for new housing whereas front porch itself is preferred. The front porch is needed to be shorter especially in Row type house, which is possible by application of rule 49n. This rule allows new housing to have front porches with the same depth as vernacular houses. Shorter and smaller front porch needs less expenditure but ensuring it retains some of the popular vernacular characteristics, functions and appearance (fig 10.51).

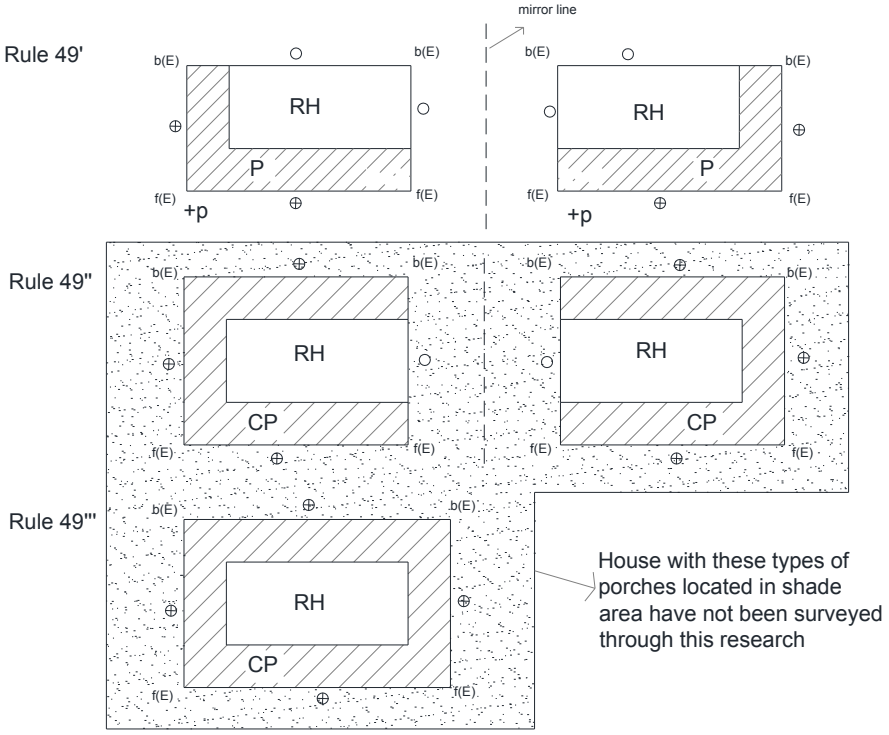


Figure 10.48: Rules for possible definition of other porches in different directions of Row type house.

The layouts located within the shaded areas were not included in the research samples.

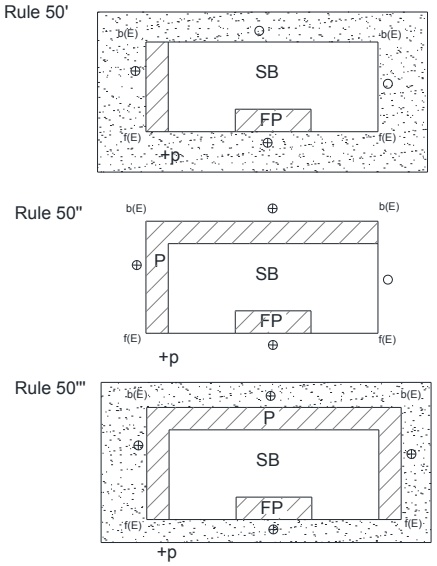


Figure 10.49: Rules for possible definition of other porches in different directions of Saddle type.

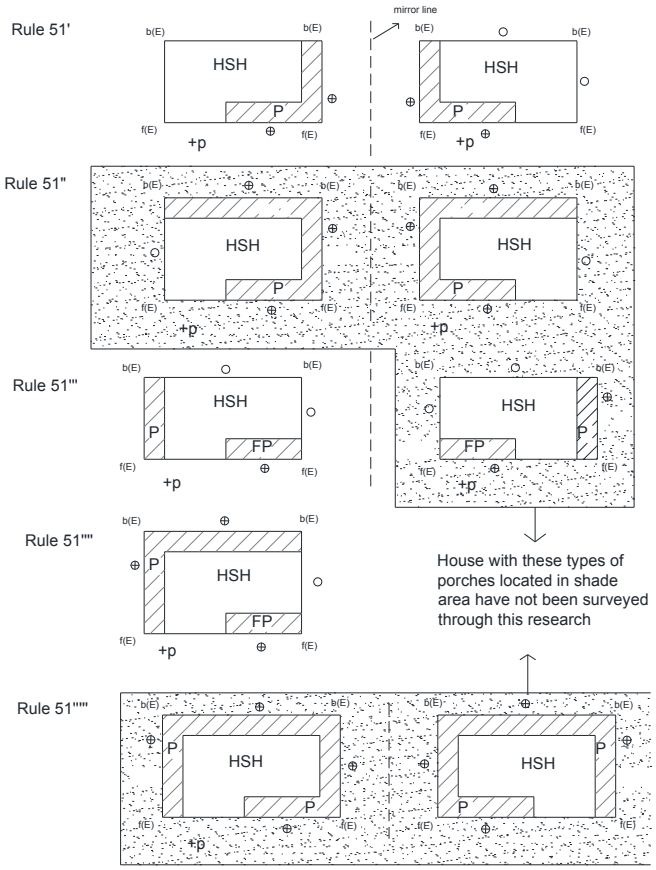


Figure 10.50: Rules for possible definition of other porches in different directions of Half-saddle type.

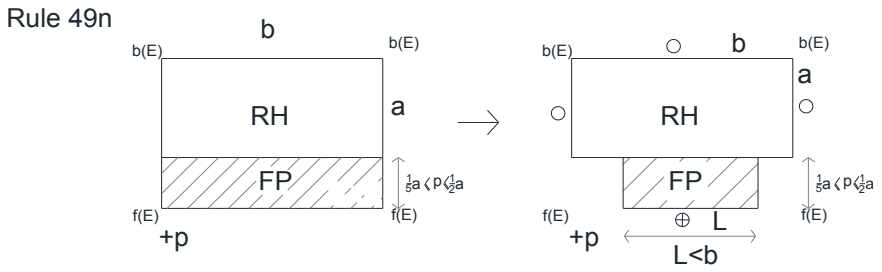


Figure 10.51: Rule for shortening the size of the front porch.

Another small type of semi-enclosed space is prevalent within one case study village, Diva. This is a type of balcony located only on the second floor in front of a window, and with the same width of the window, 70 to 120 centimetres deep, which is always made from wood. It is projected from the body of house over the street, garden or yards thus offering the opportunity to enjoy nice views, having better relationships with street, neighbours, and surrounding environment. The master carpenter can extend it by application of rule 52 on every type of house and towards each direction (fig 10.52).

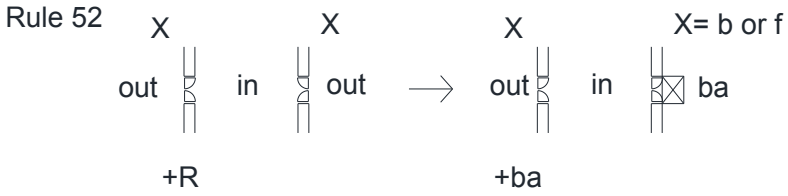


Figure 10.52: Rule for definition of small balconies on first floor.

After definition of the location of the semi-enclosed space, the master carpenter articulates the number and location of wooden columns, which have a structural role in house construction and prominent role in shaping the facade of the house. In this respect, he allocates one column for every corner of that semi-enclosed space applying rules 53, 54, 55 on linear form with three, two and one open side respectively and applies rule 56 on composite L form house (fig 10.53).

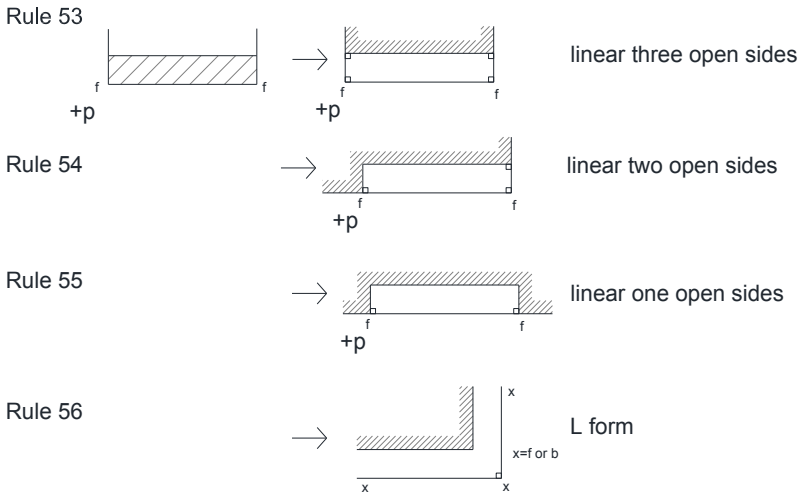


Figure 10.53: Rules to define wooden columns at the corners of semi-enclosed space.

After application of columns at the corners of semi-enclosed spaces, location of other columns are arranged with 70 centimetres to 1.50 centimetres distance from each other as a result of the application 57 (fig 10.54).

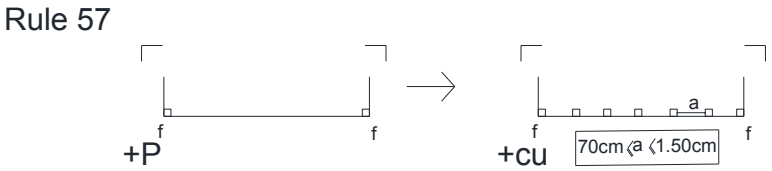


Figure 10.54: Rule for definition of row of columns in semi-enclosed spaces between columns located at the corners.

10.3.10 Adding doors to the rooms

The location of the door defines the location of other components of the room. According to rule 58, access into all rooms is possible from the front porch and located at the corner of the room (fig 10.55). Vernacular doors are wooden with 80 to 100 centimetres width and 170 to 190 centimetres heights.

Doors of adjacent rooms, particularly the living room and guest entertaining spaces or storerooms are usually located close to each other because it is practical and encourages quick access between rooms; this is climatically efficient in winter and increases house security. This is achieved in result of rules 59 and 60 applications (fig 10.56).

The small store room (*darim-khene*) located attached to the living room functioning as a utility room is the only space which is usually accessed from the living room (rule 39) while all other rooms are accessed from the front porch within vernacular houses. Residents now prefer central spatial organisation for their new house in order to have all rooms accessible from the living area because it is convenient, climatically comfortable, and they feel more safety and security.

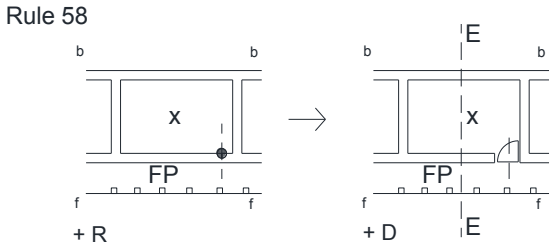


Figure 10.55: Rule for adding a door to a room.

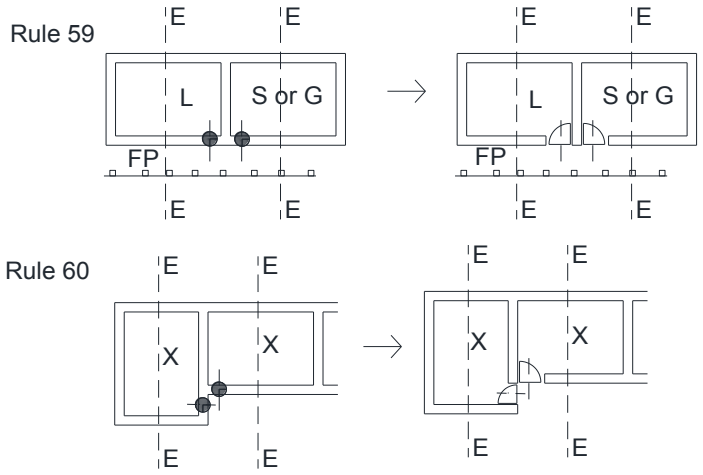


Figure 10.56: Rule for definition of the location of doors of the adjacent rooms.

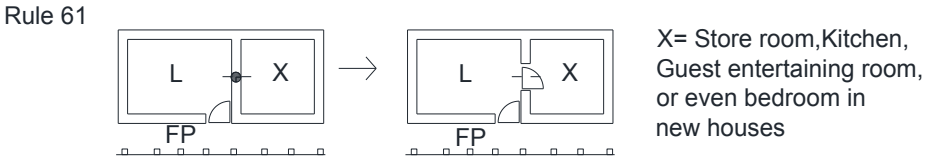


Figure 10.57: Rule for definition of internal doors connecting two rooms from inside of the living room.

According to the rule 61, it is currently applied on common wall between the living room and guest entertaining area or kitchen specially within Row type

vernacular houses to define a new door connecting these rooms (e.g. sample no. 2 and 8 in Dive, sample no.2 in Firozjah, samples no. 8 and 9 in Vareki). Therefore, within new housing, after application of rule 58 for entering into the living room, rule 61 is more admitted by residents to access into adjacent rooms from the living room, which is practically, climatically and socially much efficient, convenient and secure than rules 59 and 60 (fig 10.57).

10.3.11 Addition of windows to the rooms

In the villages of the forest area, each room needs to have at least two windows. One window is located on the wall facing towards the south to get sunshine and breeze from this direction and another one is located on the wall facing towards the north to benefit from breeze coming from this direction. These two windows provide cross-ventilation, which is essential according to climatic conditions during warm and hot seasons. Nevertheless, within the forest area, just one window is orientated towards the south enjoying sunshine, which is sufficient in this area because the colder weather means there is no need for cross-ventilation. This allows the house to be more than one room in deep by locating another space behind the main spaces such as the living room. At first, within rooms elongated along the length of the house, such as the living room, the front window opened to the front porch is defined at other corner of the wall where the entrance door is located by application of rule 62 (fig 10.58). The location of this window is sometimes symmetrical with the door in respect to the central axe of the room, which divides the room into upper and lower parts. The upper part of the living room belongs to the males group while the lower part, closer to the door, belongs to the females group.

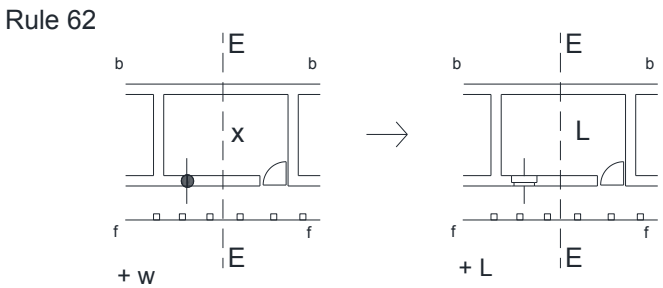


Figure 10.58: Rule for definition of front window.

After this stage, and purely in the forest border area, another window located at the backside wall is essential, its location is defined in upper part of the living area by application of rule 63 (fig 10.59).

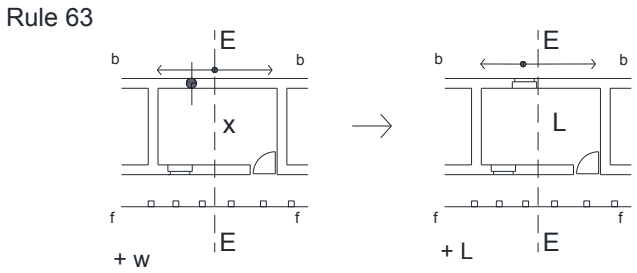


Figure 10.59: Rule for definition of backward window.

For the lateral rooms of Half-Saddle and Saddle types, these windows are situated in the middle of walls at the front side and in the forest area. Windows are also situated on the backside for the creation of cross-ventilation in result of rule 64 (fig 10.60) and 65 (fig 10.61).

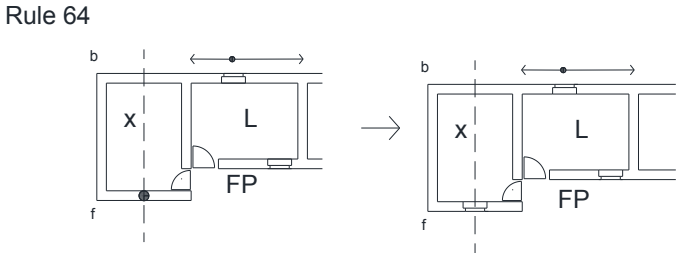


Figure 10.60: Rule for definition of front side window in lateral room of Half-Saddle and Saddle types.

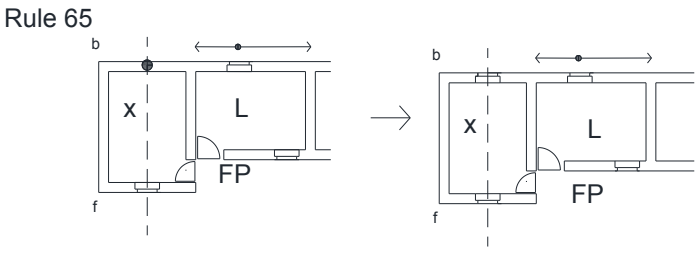


Figure 10.61: Rule for definition of backside window in lateral room of Half-Saddle and Saddle types.

Houses usually do not have any windows on lateral walls except south oriented houses, which desire to enjoy views and benefit from sunshine towards east direction. Similarly, south facing windows are essential for east orientated houses, this is made possible by application of rules 66 and 67 adding one or two windows respectively (fig 10.62). It should be noted that all types of houses,

including vernacular, middle and new styles, do not have any windows located at the west orientated wall because of climatic conditions including harmful sunshine and pluvial wind of this direction.

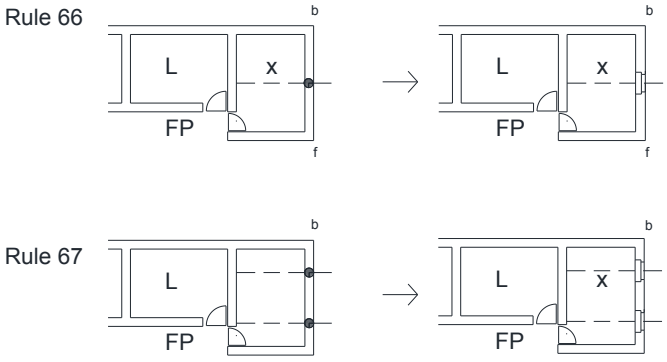


Figure 10.62: Rule for definition of windows on lateral wall of the house.

The window located on the front wall of the living room, in addition to providing day light, sunshine and cross ventilation, provides the opportunity for the males to sit in the upper part of the living room controlling both inside and outside of the house. This enhances the feeling of security and offers a good view of picturesque scenery while sitting next to it. Accordingly, the height of window from the room's floor is supportive, the size of these windows specially, the front one is a size within 30 to 55 cm articulated in result of rule 68 (fig 10.63).

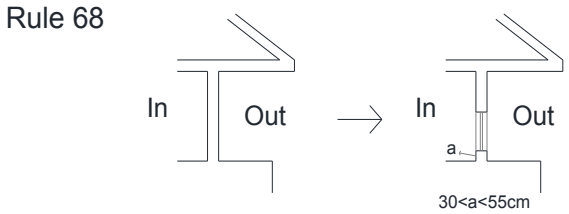


Figure 10.63: Rule for definition of window O.K.B.

Sometimes these windows start exactly from the floor level, which is called door-window. This style of window, which is prevalent in the forest border area, provides better views towards outside, conducts better cross-ventilation from the top of the house to the floor level where human activities take place and residents sleep. Door-window can be generated by application of rule 69 through changing the window (fig 10.64). This is appropriate for new housing and is advocated by locals.

The height and width of windows are various depending on the climatic conditions. The forest area has a colder climate and smaller windows and the forest border area has a warmer climate and so has larger windows. Regardless of the climatic conditions of the region, within middle and new style houses, all windows are big, which provide good views, relationships with the outside and better daylight for new daily activities such as reading and studying. Despite being large, due to new technologies, most windows used in new houses are double-glazed, which supports these large windows to exhibit an acceptable climatic performance. Therefore, the location of windows, according to the vernacular rules, is climatically and functionally efficient but the size of windows needs to be bigger than vernacular and according to the size of windows employed in-

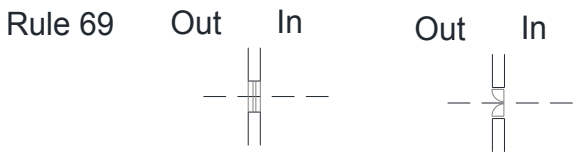


Figure 10.64: Rule for definition of door-window opening.

-middle style and new houses providing more daylight. However, the efficiency of the size of windows, in terms of daylight performance within the region of this study has not yet been examined requiring an independent study. In addition, windows within new houses are better to be double-glazed according to the standard codes and rules of construction in Mazandaran (Engineering organisation of Mazandaran, 2011).

10.3.12 Access to the attic

The attic is an important space within vernacular houses, which is employed as a storeroom for food and a place to keep and dry the rice yield. Therefore, keeping this space safe and secure from thieves is important alongside the feasibility of daily access to this area. In this respect, access to the attic is possible from the living area or store area connected to the living room using a wooden ladder as a result of application of rules 70, 71 (fig 10.65). This ladder is maximum 40 centimetres wide and is a kind of living room decoration, which is

always located in the lower part of the living room in the females' territory and close to the entrance door. Bedding and the oven are often stored underneath the ladder (fig 10.66). Within two-storey houses, this ladder is used to connect two floors of the house (sample no.8 Diva), this has the capability to be used within new housing connecting new two storey houses and supporting central organisation of the house, which makes it possible for the living room to have access into all rooms.

10.3.13 Access to the second floor

Some houses within the forest border area are two storeys, which are accessed by a wooden ladder approximately 40 centimetres wide which is located outside of the house within the front porch or outside of it applied by rules 72 and 73 (fig 10.67). Front porches located on the ground floor and first floor, are connected by this ladder and access to the rooms are only possible from these front porches (fig 10.68). Currently, residents are not interested in this style of having access to the first floor. They prefer to have access to the second floor from the internal space of the house, from the living room or the like. Therefore_

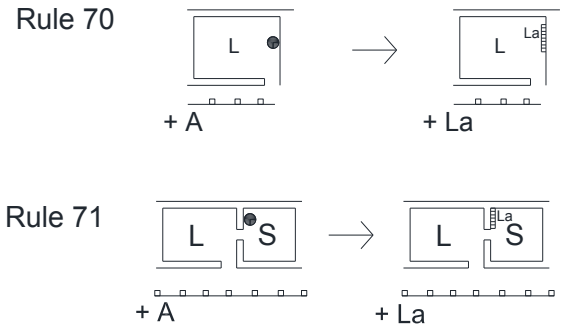


Figure 10.65: Rule for definition of ladder location to the attic

Figure 10.66: Two types of wooden ladder used going to the attic area located within living room.

_the rules 72 and 73 are not efficient to be used within new housing for the region. Instead rules 70 and 71 are suitable and efficient for new housing. In this regard, instead of the ladder, an appropriate satire case for new lifestyle is applied.

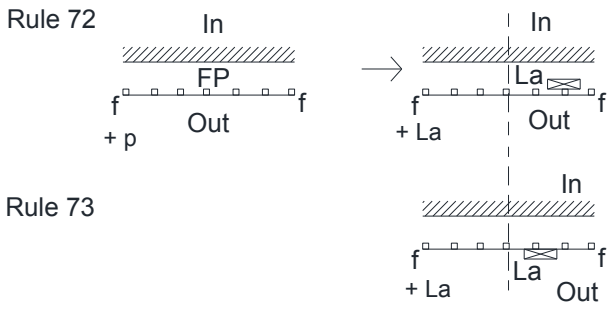


Figure 10.67: Rules for definition of access to the first floor.

Figure 10.68: Wooden ladder connecting two stories.

10.3.14 Generation of raised platform

The first step for construction of the house is to build the raised platform. This platform is located underneath each room and is constructed with durable materials such as stone and fired brick, which protects the house, its components and equipment from penetration of raised damp from the ground and from surface water within this rainy region. This is executed in application of rule 74 on each room of the house, which is going to be constructed on flat ground. The height of the walls around the platform is 50 to 150 centimetres, the inside of the walls is usually filled with soil in application of rule 75 (fig 10.69). However, soil is not perfect the material to stop damp penetration. Currently locals employ a material comprised of sand, stone and shingle to fill the gap within the platform, which has better performance in terms of eliminating damp penetration.

For house construction on sloping ground, this platform is necessary to both to protect the house and to provide a flat balanced surface for the house. The house construction is possible both perpendicular to slope direction or parallel to it according to the rules 76 and 77 respectively (fig 10.70). When it is perpendicular, the deep side of the house, which is usually low and smaller than width of the house, is perpendicular to the slope direction needing low rise from the ground (rule 76). The bigger height is located in the front of the house with a-

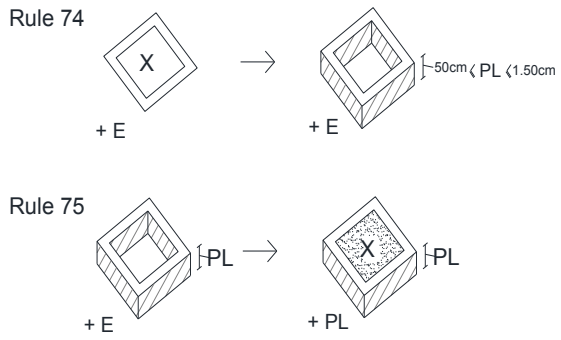


Figure 10.69: Rules for generation of raised platform on flat ground underneath each room and the house ultimately.

-maximum 160 centimetres, which sometimes is left empty and employed as a store or house for poultry or livestock. This is most favourable but is possible only while the direction of the slope is towards south zone direction. On the other hand, when the slope direction is perpendicular to the south direction, the house needs to be built parallel to the slope direction according to the rule 77. In this case, depending on the slope ratio, the height of platform on down side of the slope needs to be bigger than usual size, a size of 100-220 centimetres. Because it is high enough is sometimes used as normal room. Designation of the platform for house construction is still necessary especially those that are located on the ground. For those are located on the *pilotis*, it usually acts as the platform for the house above.

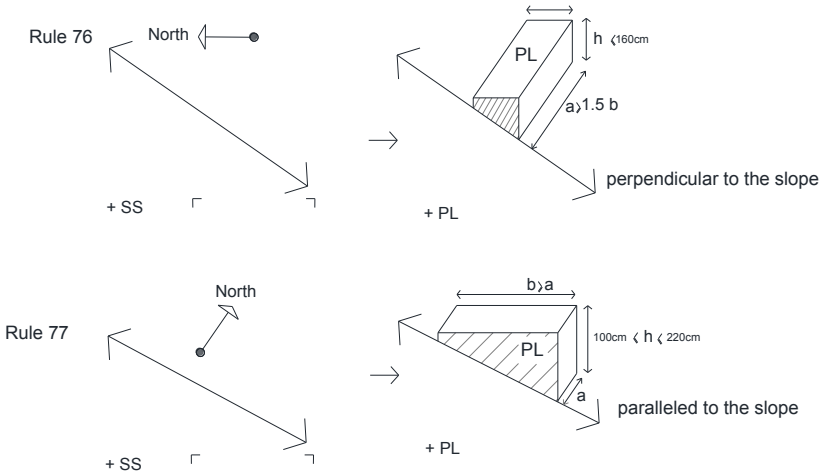


Figure 10.70: Rule for generation of raised platform on slope ground.

10.3.15 Extrusion of the walls for generation of the body of the house

After construction of the platform, the master generates the three-dimensional form of the house according to its layout and by extrusion of the walls

based on designated height. Application of rule 78 on each room makes the body of the one storey house, which is followed by construction of the ceiling and hip roof (fig 10.71). If the house has two storeys, by application of rule 78 the ceiling of the first floor is added, this is constructed with wood. By application of rule 80 on each of these extruded rooms, another room with the same size is located on top of the lower room thus shaping the two-storey house, in this case the layout of both ground floor and first floor are the same.

Sometimes the layout of the ground floor of the vernacular house and its first floor are different from each other according to rules 81, 82 and 83, which is only possible in houses constructed employing timber-frame technology (fig 10.72). In this technology, the load bearing walls on the first floor are just wooden studs, which unlike the walls on ground floor, are not filled with mud. They have no remarkable weight making these different layouts possible unlike other types of construction technology. To do this, application of rules 78 and 79 on the layout of the ground floor make a flat floor, which is the ceiling of the ground floor, the layouts in result of rules 81, 82, and 83 are extruded in result of rules 84, 85, and 86 (fig 10.67).

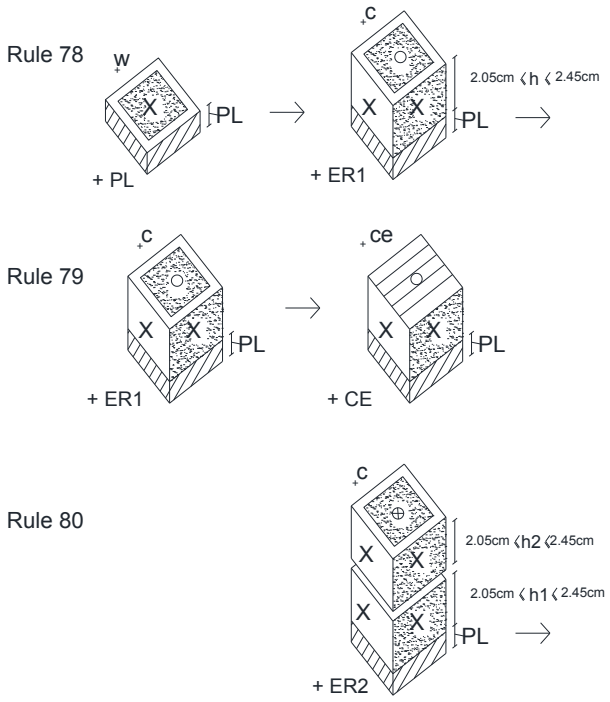


Figure 10.71: Rules for extrusion of the walls toward generation of the form of the house.

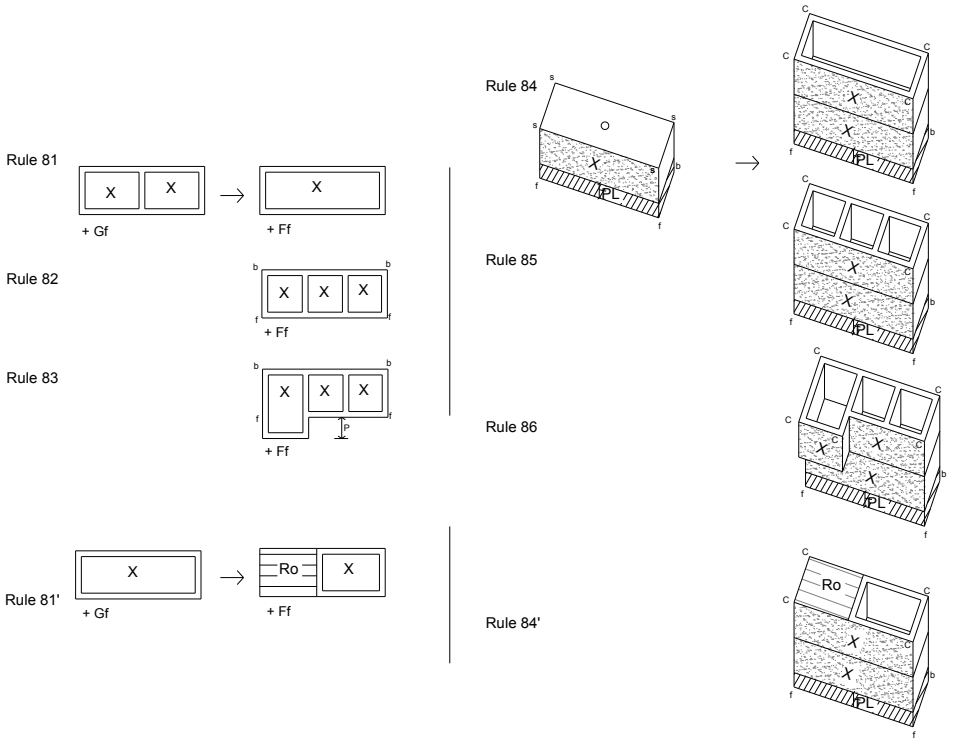


Figure 10.72: Rules for definition of compositional type according to different layouts within store of the house.

No middle style house within the region has two storeys but most new houses are two storeys or more, and their layouts are different within storeys. These rules make it possible to have different layouts within two storeys; this helps the designer to design the house differently but only in accordance with the needs and demands of the occupants. As a result, these are efficient rules to be employed within new two-storey housing.

10.3.16 Generation of slope roof

The last part, which completes the form of the house, is the sloped roof. Roof is predominantly a hip roof located on the whole body of all types of vernacular houses. The hip roof is projected from the walls of four sides of house making eaves; this kind of hip roof keeps the house in shade during hot summer days, and keeps the house protected from the rain. It also provides attic space appropriate for storage of rice yields and other stuffs while supporting the climatic performance of the house in relation to heat loss and gain while being technologically stronger than other types of sloped roofs (Bromberger, 1990). The slope of the hip roof depends on the rainfall of the region; the more rainfall, the the

greater the slope. For sloped roof definition, first the four edges of the eaves are defined according to the size of eaves projection (rule 87), then the wooden ceiling is executed (rule 89) which is followed by execution of hip roof (rule 90) (fig 10.73).

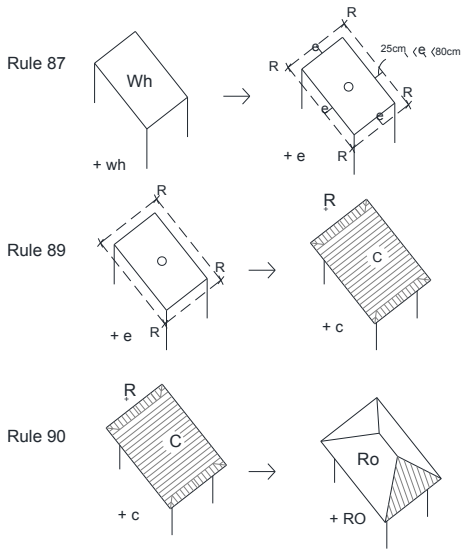


Figure 10.73: Rules for definition of hip roof.

According to the above-mentioned advantages of the hip roof, it is still the best type of roof for new housing within the region. Some fringe and new added spaces such as a kitchen, bath, or toilet, which are attached to the main body of the house, are covered with one-sided sloped roof. According to rule 91 the four edges of the projected eaves are defined and then the roof executed by application of rule 92 (fig 10.74).

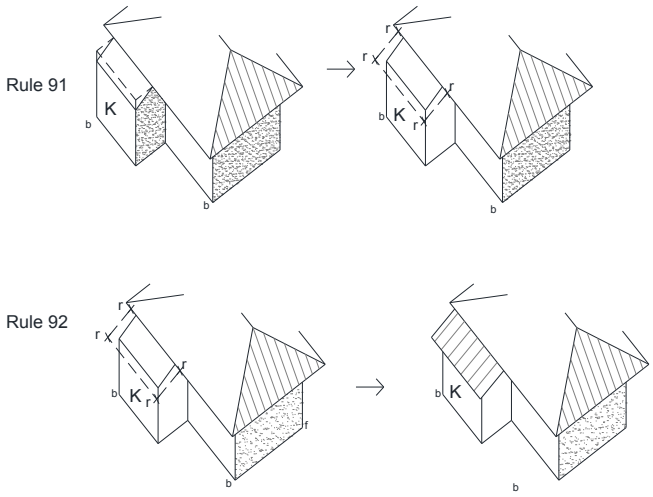


Figure 10.74: Rules for definition of extended spaces attached to the main body of the house.

For composite type of houses, in which one of their arms are projected from the body of the house, two intersectional hip roof cover the house according to rules 93, 94 and 95 (fig 10.75).

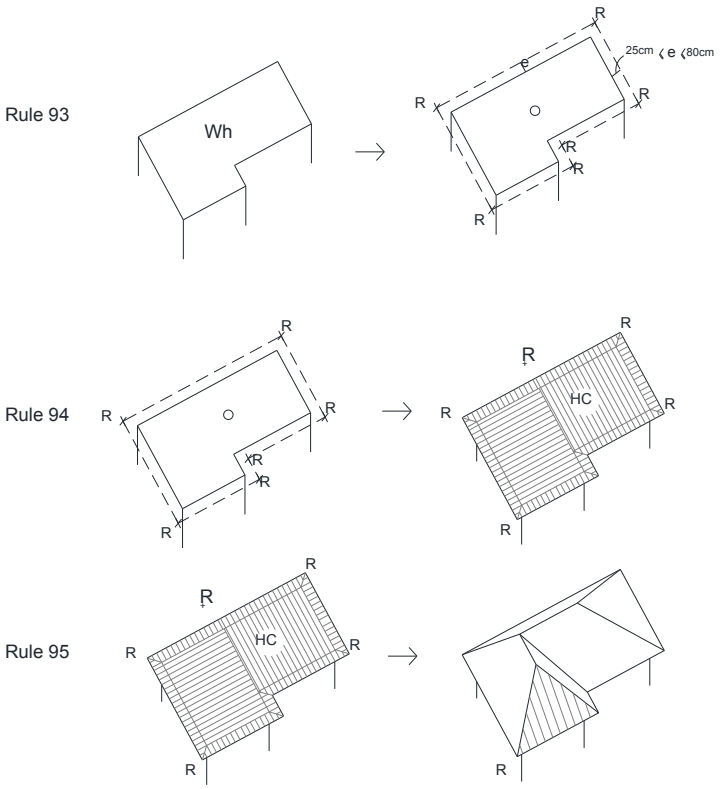


Figure 10.75: Rules for definition of L form composite house.

After erection of the sloped roof in a vernacular house, the owner of the house usually holds a party with masters, labourers, neighbours, family and relatives at the site of house construction. This celebration is called '*tirek-sari'* and the wife prepares some traditional sweets, fruit and drinks to entertain the guests. This party tradition is forgotten within new house construction. It has been said by interviewees that it is because of the elimination of sloped roofs within new house construction and in addition to elimination of wood from construction that were two motives of these particular party. In addition to this party and after completely finishing the house construction and moving into the house, the owner arranges another party inviting relatives and best friends. Invited guests usually present the owner with a precious gift in return. This party is still common within the society of the region.

10.3.17 Extension of outbuildings

After completion of the house, the locations of outbuildings are defined according to the location of the house and land characteristics. According to the needs of the owner, the location of one or all of those outbuildings is defined by application of rule 96 (fig 10.76). After that, the label of locations changes by application of rule 97, allocating that particular place to a poultry or livestock house, bath or toilet (fig 10.76).

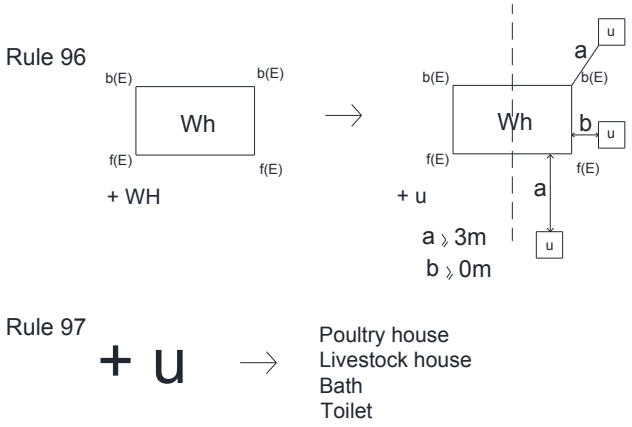


Figure 10.76: Rule for definition of the location of outbuildings.

The kitchen used to be an outbuilding but is currently designed within the house configuration taken from middle style housing. Within vernacular houses, the kitchen is not within the house configuration but brought closer, located attached to the body of the house, and accessed from the front porch or in attached at the back and access through the living room according to the rules 98 and 99 respectively (fig 10.77).

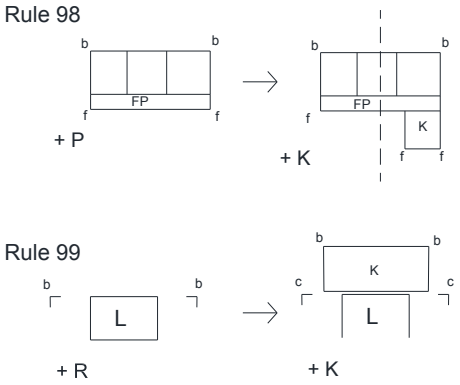


Figure 10.77: Rules for definition of location of the new kitchen within vernacular houses.

Rule 99 is appropriate for new lifestyles and is efficient to be used within new housing although its location should not block the cross-ventilation in the

houses of the forest border area. For this purpose, the kitchen can be open plan with a living area. However, rule 98 is not appropriate for new lifestyles as access to the kitchen is not possible from the living room, which is not acceptable for local residents.

Along with this extension, the bath is sometimes located besides or within the kitchen according to rules 100 and 101 respectively. The appropriate rule must be specified by the owner for the design of his house as locals have different opinions about its location which is also achievable by a designer according to the questionnaire 03 (fig 10.78). Most of the new constructed bath and toilets are located within one service space. This space is located whether within house configuration, which most residents do not agree, or outside of the house in front or behind. An outbuilding is detached from the house (rule 96), or attached to the house and accessed from the porch (rules 103, 104,105,106) or within a yard (rule 102). Location of service space outside of the house but attached to it is prevalent within middle and vernacular houses, which are newly extended (fig 10.79).

Within some samples of middle and new styles, service rooms are brought into the configuration of the house, this has been particularly confirmed by some literate and old age respondents. Within these two types, after definition of the rooms' location, which predominantly are two rooms, besides central hall and as a result of application of rules 13 and 14 working as the bedroom; location of the service room is defined_

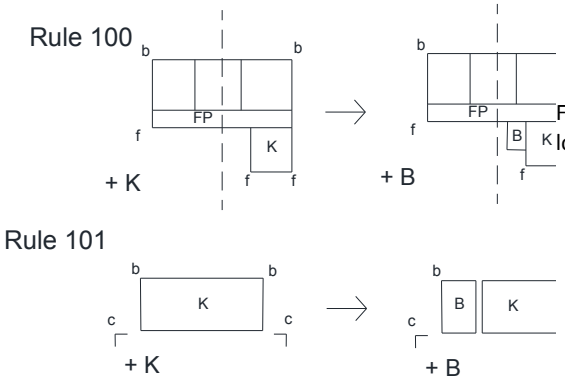


Figure 10.78: Rules for definition of bath location besides the kitchen.

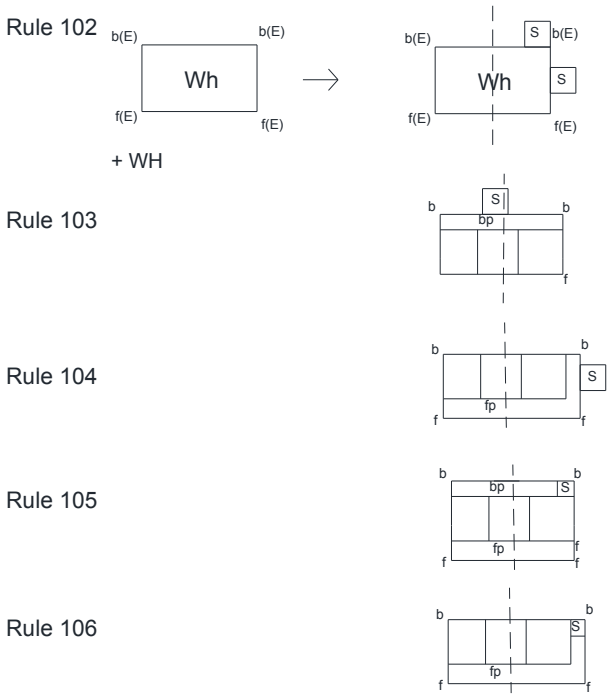


Figure 10.79: Rule for definition of new location for service space containing bath and toilet.

_between these rooms including bath and toilet. This service room is accessed from a corridor connected to two bedrooms and hall according to rule 14' that is suitable to be employed within new housing (fig 10.80). The toilet within the house configuration is preferred to be used solely by occupants and not by guests so that, this rule provides some sort of privacy for bedrooms, toilet and bath by positioning them within a corridor whilst keeping them out of guests and strangers' sight.

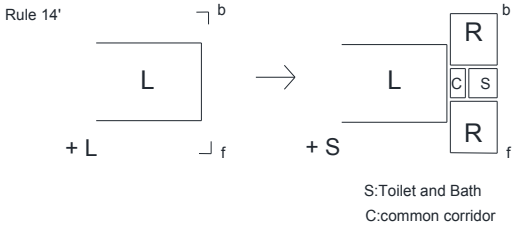


Figure 10.80: Rule for definition of bath location within house configuration.

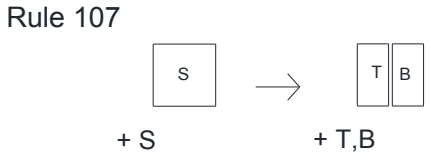


Figure 10.81: Rule for separation bath and toilet.

After definition of the service room's location, by application of rule 107, the toilet and bath are divided from each other because culturally these two spaces

must be separated from each other (fig 10.81). Their proximity is mostly because of frugality in consumption of water piping as well as the proximity of kitchen and bath.

10.3.18 Extension of Nefar

Nefar as an outbuilding is a part of living space but has seasonal purpose and as such, its rules are independently defined. This setting is a stand-alone building, detached from the body of two storey house, the first storey is always semi-enclosed, and is always located in the front yard of the dwelling according to rule n1 (fig 10.82).

Generally, the process of construction of Nefar is similar to the construction process of the house but with a few differences. After finding the location of Nefar, the base point is defined labelled as *BP*. After that, the dimensions of Nefar are computed for three measurements: height, *h*, width, *w*, and depth, *d* according to the rule n2. Then the front and back of the Nefar is defined in such a way that the front is toward the house and front yard and the other side are back side_

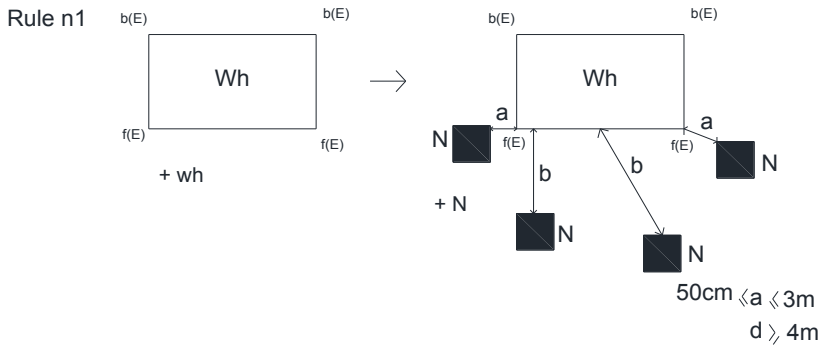


Figure 10.82: Rule for identification of location of *Nefar*.

_according to the rule n3. By application of rule n4, the approximate area and shape of Nefar is generated (fig 10.83). By application of rules n5, n6 and n7 the layout of ground floor of Nefar is defined producing Nefar with one square or rectangular room or with two square rooms according to the defined proportion based on defined dimensions (fig 10.84).

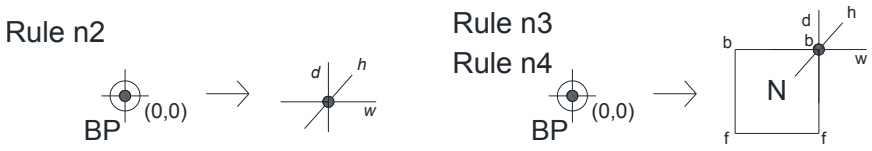


Figure 10.83: Rules for definition of the dimensions and front and back sides of Nefar

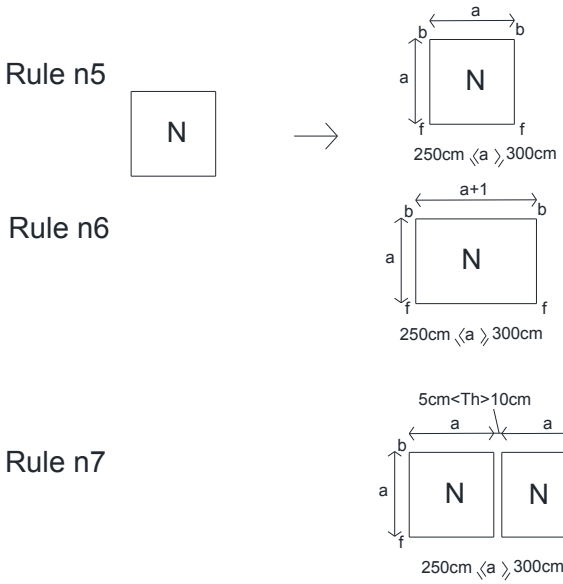


Figure 10.84: Rules for definition of the layout of Nefar in ground floor.

After definition of the layout of the Nefar, by application of the rule n8 the surrounding external walls and their thickness are defined, which are predominantly made from wood and timber frame technology. (fig 10.85).

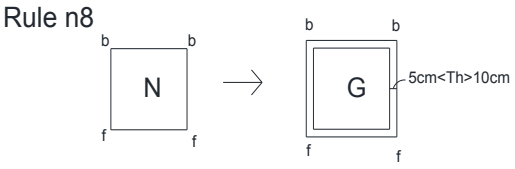


Figure 10.85: Rule for definition of surrounding wall of Nefar.

The first storey of all Nefars is one room, even within those with two rooms on the ground floor. Doing this needs one rule, which is possible by application of rule n9 (fig 10.86).

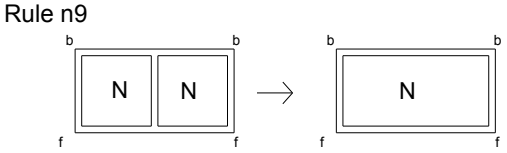


Figure 10.86: Rule for definition of second floor.

Nefar does not have a raised platform, actually the ground floor that is employed as a store, outside kitchen, or poultry house, performs as a raised platform. Therefore, for shaping the form of Nefar, the walls of ground floor are first extruded by application of rule n10, and then by application of rules n11and n12 shaping two types of Nefar is achieved (fig 10.87).

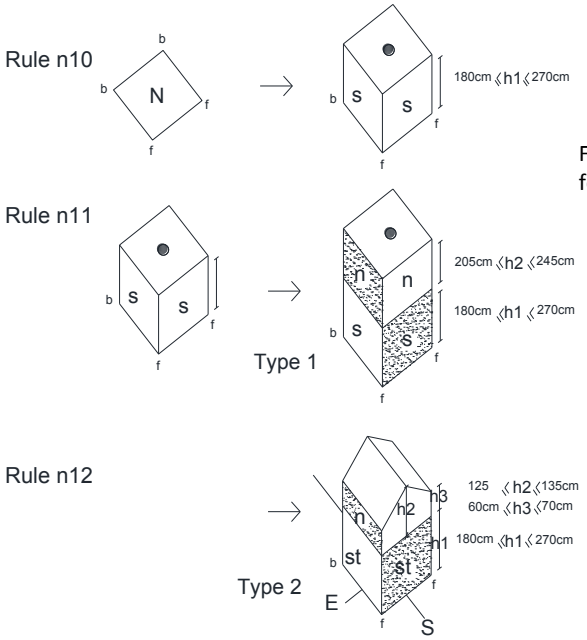


Figure 10.87: Rules for shaping the form of Nefar in two types.

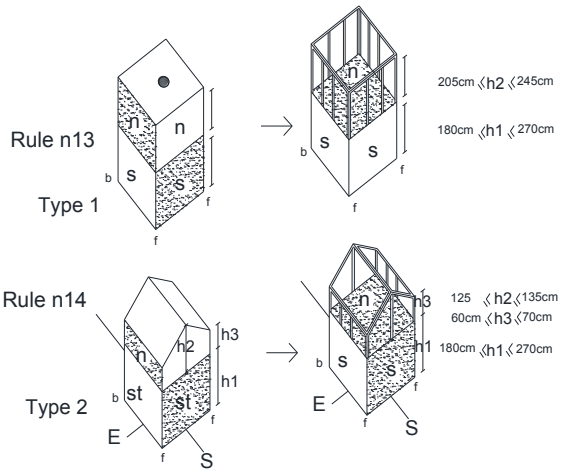


Figure 10.88: Rules for changing of the solid walls into columned walls in first floor of Nefar.

Figure 10.89: Rule for definition of saddle slope roof on Nefar type 2.

The first floor of Nefar does not have solid walls. This floor is a semi-enclosed space. Wooden columns make all sides of the floor and bear the loads of

the roof. By application of rules n13 and n14 respectively on shapes resulted from application of rules n11 and n12, the first column wall is defined and at last roof is defined, it is always a two-sided sloped roof called as Saddle roof (fig 10.88). Roofs are projected from the body of Nefar making eaves around all four sides. Within type two, the sloped roof is only installed on the predefined structure of the building by application of rule n15 finishing the process of making the form of Nefar type 2 (fig 10.89). In this type, the roof shapes the internal ceiling, unlike type one in which the internal ceiling is flat wooden.

In type one, four corners of the projected ceiling is firstly defined by application of rule n16, followed by application of rule n17, the ceiling and eaves are subsequently emerged. The instalment of the Saddle roof, as a result of application of rule n18 finishes the process of making the form of Nefar type 1 (fig 10.90).

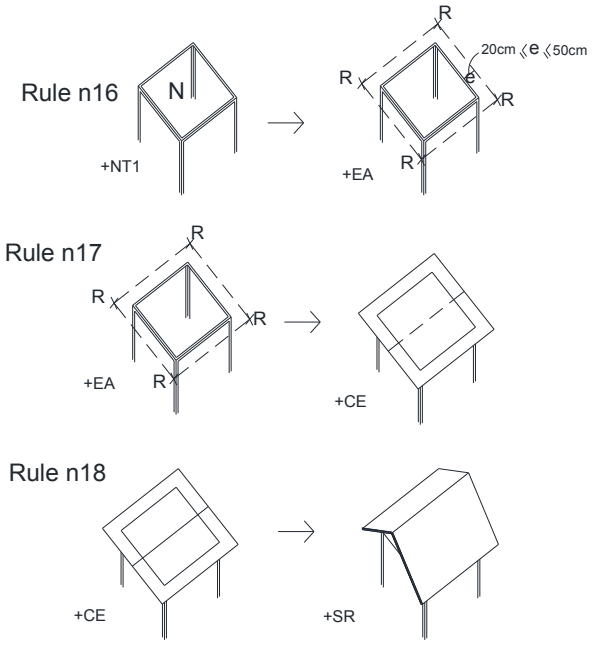


Figure 10.90: Rules for definition of Saddle roof on Nefar type1.

10.4 Derivation of new design

The identified rules are concentrated first on the generation of the design of the land of the property in order to define the best place to site living houses and

other closed and open settings of the dwelling. This is followed by identification of rules embodying the configuration of different types of vernacular houses and some new widely used rules. Rules for the definition of the location of outbuildings have been presented but those rules embodying the form of these buildings have not been introduced. This was not the objective of this research and needs further survey and study.

This research does not represent the rules that created the context of the villages defining location and characteristics of streets, residential area, Central Square and other components of the village. This needs an independent study, which will support designing new settlements within the region and will enhance the development of existing villages and settlements. Note that, this is an area, which has rarely been considered within shape grammar literature.

This research developed a shape grammar for different types of vernacular houses within the villages of the north of Iran and at the same time introduced other types of rules, which embodied middle and new style houses. Identified rules can be used to generate designs in the same way as vernacular styles and *new* ones employ and are acceptable to villagers. This study has discussed the efficiency of those rules with regards to their responses to climate conditions, and according to new lifestyle and the cultural characteristics particularly those activities villagers do within specific settings. Accordingly, some rules have not been changed, some rules have been rejected, some modifications are proposed in order to improve the efficiency of vernacular rules, and some new rules have been recognised as appropriate rules for new housing borrowed from middle and new styles of houses. The results seem culturally and climatically appropriate for new rural housing. However, another research study focusing on a collection of the villagers' opinions about the proposed designs within this research as new houses is likely to be necessary for further confirmation and modification.

In order to test the method proposed by this research, two real land plots within two case study villages have been selected. One of them belongs to Perija, a village with sloped land, which is located within the forest area. The other one is from Diva, which is located within the forest border and has flat land (fig 10.91).

Two sets of appropriate rules have been selected according to the shape and conditions of the plot lands. Selected rules, and the process of application of those rules, produce outcomes, which seem appropriate designs for shaping the configuration of plot lands. These include the definition of the location of open spaces such garden, front and back yard and enclosed spaces (out buildings) such as living house, livestock and poultry house.

By application of rule 1, the approximate geometrical shape for lands, which are organic with no geometrical shape, is defined. Application of rule 3 identifies the north direction, from which the front side and backside of the land are defined. This followed by the application of rule 4, subsequently, the area for living house construction and location of the garden are defined.

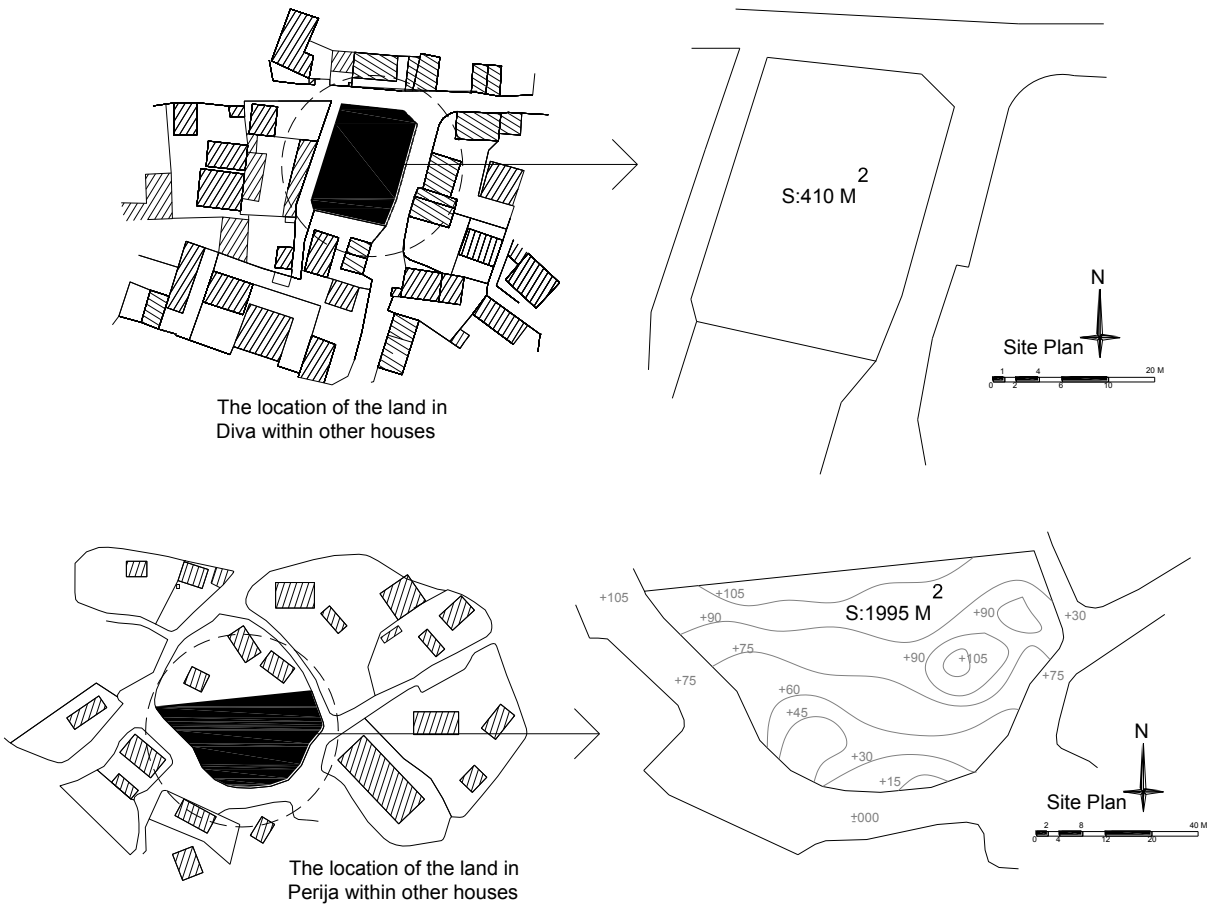


Figure 10.91: Two selected real lands for designing new rural house in order to test the proposed methodology of this research. The upper one belongs to Diva, a village in the forest border area and the lower one is located within the forest area, Perija

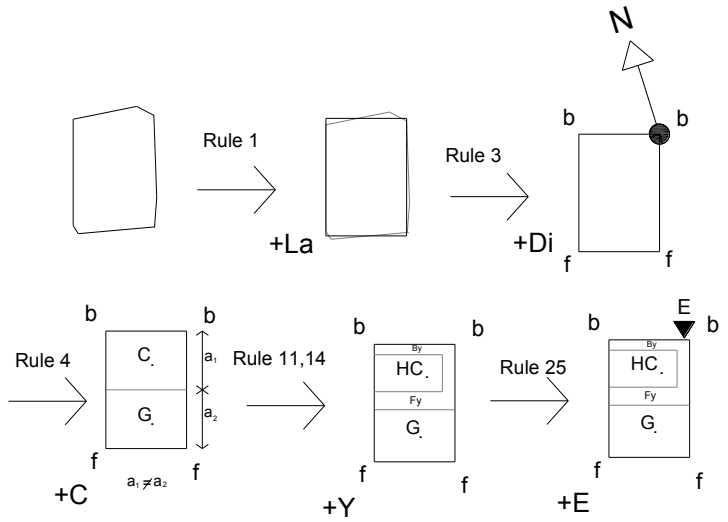


Figure 10.91: The process of application of rules 1, 3, 4, 11, 14, and 25 to design a new rural house on the flat land within Diva. Up to this stage, the area for location of the living house, garden, entrance and outbuildings are defined. (C) Construction area, (G) Garden, (HC) living house construction area, (Fy) front yard, (By) back yard, (E) entrance, (f) front of the land, (b) back of the land.

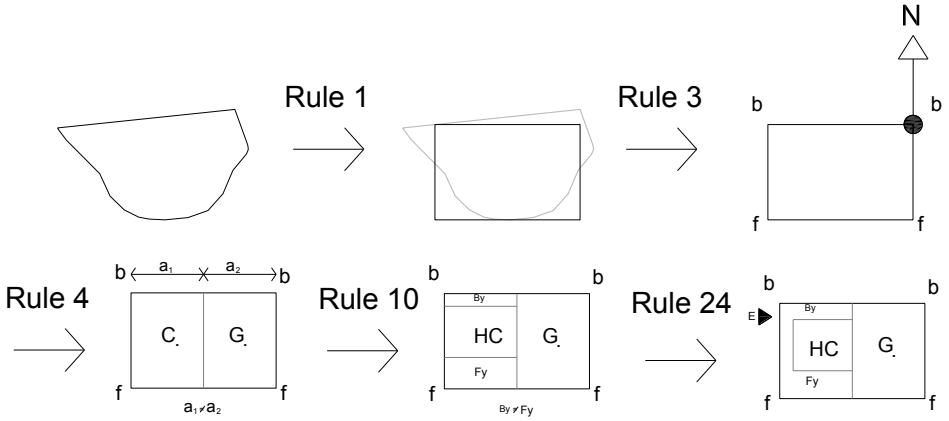


Figure 10.93: The process of application of rules 1, 3, 4, 10, and 24 to design a new rural house on a steep slope land within Perija. Up to this stage, the area for location of the living house, garden, entrance and outbuildings are defined. (C) Construction area, (G) Garden, (HC) living house construction area, (Fy) front yard, (By) back yard, (E) entrance, (f) front of the land, (b) back of the land.

The location of the living house depends on the size of the land, size of the proposed house and its type. This determines the locations of other features of plot lands. The approximate area for the construction of the living house is defined by application of rule 10 in Perija's case, 11 and 14 for Diva's case, which is bigger than the size of the living house. Accordingly, the location of an area for front and back yards is defined. In the next step, the location of entrance is defined. This is particularly according to the location of main road, which is achievable in result of the application of rules 24 and 25 for Perija and Diva cases respectively. They are shown in figures 10.92 and 10.93.

Application of rule 1' transfers designed alternatives from supposed geometrical land applied by rule 1 into real land. Then, after application of rule 96 and 97, one is able to determine the location of an outside toilet or bath, livestock and poultry house whether in the garden, front yard or back yard, which terminates the process of land plot design and proposes appropriate configuration for plot lands. It should be noted that these two rules could be applied more than one time. Accordingly, proposed designs for two cases are shown in figures 10. 94 and 10.95.

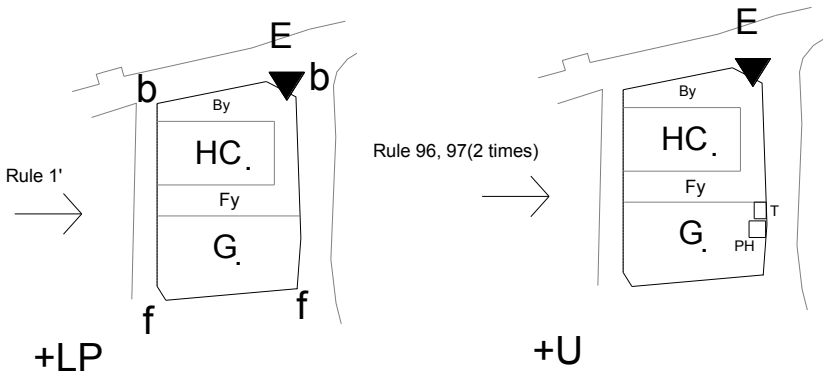


Figure 10.94: Design of land plot in Diva as a result of the application of rules 1', 96, and 97 in 2 times. (G) Garden, (HC) living house construction area, (Fy) front yard, (By) back yard, (E) entrance, (f) front of the land, (b) back of the land, (T) outside toilet, (PH) poultry house.

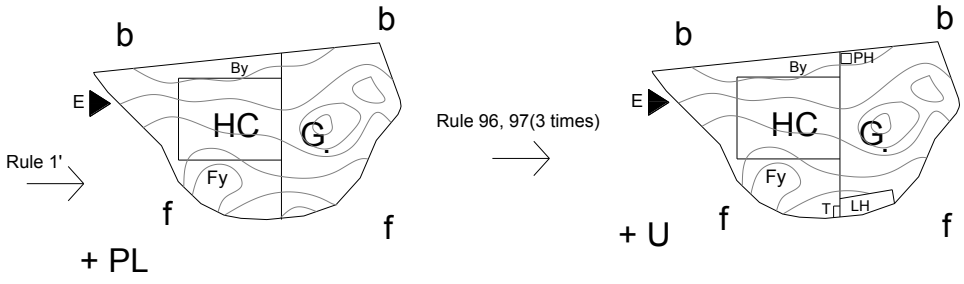


Figure 10.95: Proposed design of land plot in Perija as a result of application of rules 1', 96, and 97 in 3 times. (G) Garden, (HC) living house construction area, (Fy) front yard, (By) back yard, (E) entrance, (f) front of the land, (b) back of the land, (T) outside toilet, (PH) poultry house, (LH) Livestock house.

The process of application of another set of rules to design a new rural house begins after determining the territory of the area for house construction. The process of designing the vernacular house in the region begins with designing the living room. The first step is to determine a point on the land within the

construction area as a benchmark in order to start construction of the house from that point. This point must be selected very carefully. Traditionally, it is better to be located on the back edge or corner of the house; otherwise, the living room extension could not happen. The next step is to define the proper proportions, shape, orientation, size and location for the living room, which is the main determinant space of the desired house for locals and is where most of their residential activities take place. The proper proportions are defined by application of rule 1 considering most acceptable proportions within vernacular houses of the region. This is followed by analysis of the site (construction area), subsequently, the north direction and wind directions are established as a result of the application of rules 2, 3,4 and 5. Rules 6'' defines the preferred shape for the desired living room, which in the region is rectangular. Additionally, this rule defines the appropriate sizes of living rooms for new vernacular houses, which -

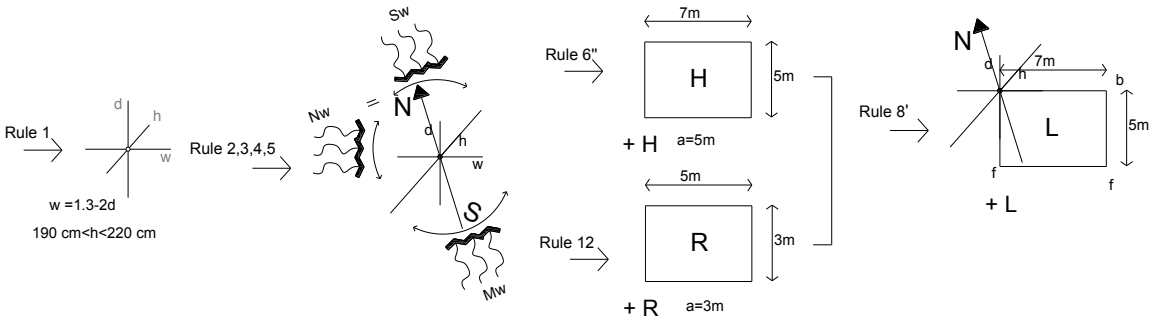


Figure 10.91: Definition of proper shape, size, and orientation for living room of the new house in Diva.

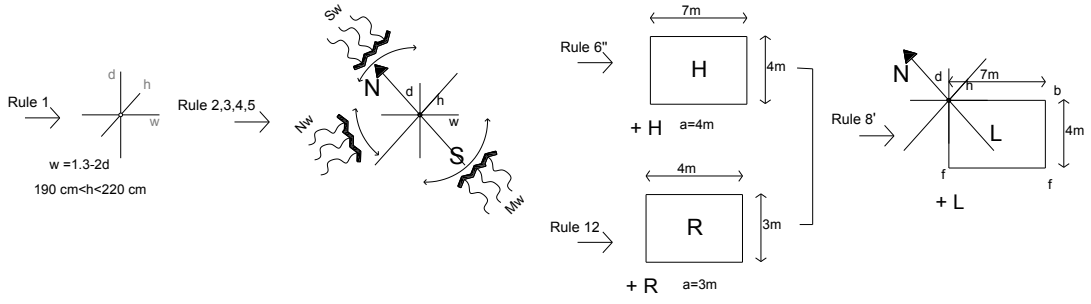


Figure 10.92: Definition of proper shape, size, and orientation for the living room of the new house in Perija

_ should be bigger than vernacular samples. Besides that, rule 12 determines the appropriate sizes of most other rooms. These sizes are defined according to predefined proportions by the application of rule 1. The best orientation of the living room and the orientation of the house are defined by application of rule 8'.

Figure 10.96 represents the appropriate size, shape and orientation of the living room in Diva and figure 10.97 shows the same result for the house in Perija. The design of the living room must be transferred into the real land plot design to check the credibility of the outcome in order to endorse of the future of the design. This is essential in order to find out if the house could be fitted within the pre-designated area. Figure 10.98 shows the location of the living room within the two land areas. Accordingly, both designed living rooms, their size, orientation and location seem to be appropriate to the lands' conditions. If they are not appropriate, the design process for a definition of their size, orientation and location must be revised.

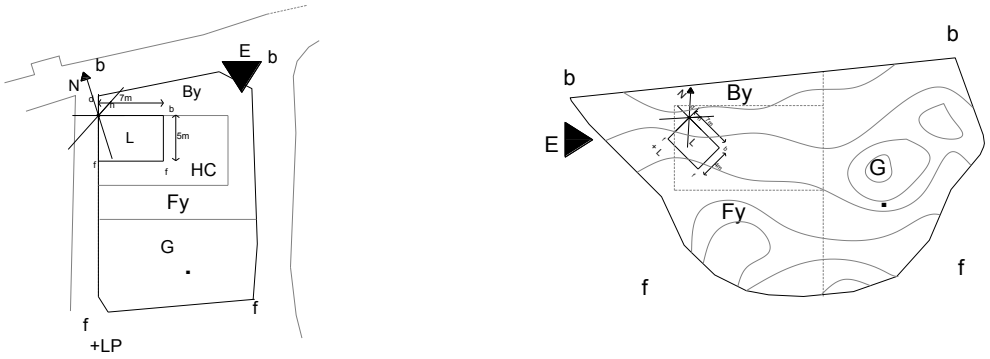


Figure 10.93: Location of designed living rooms within two real lands. Left one represents the case in Diva and right side figure represents the case in Perija.

In respect to the findings from interviews, questionnaires, cultural and climatic studies, and analysis of vernacular houses within different areas of the region, appropriate types for new houses within two villages have been selected. Accordingly, local residences in Diva prefer to have a two-storey house with two bedrooms. This two-storey house should have a front porch, kitchen and living room on the ground floor with a toilet and bath connected to it while two bedrooms are arranged upstairs on the first storey and with a front porch. Residences in Perija interest to design a one-storey house having two bedrooms. In this house, toilet and bath should be located between these bedrooms, living room should be open plan with the kitchen and a front porch should be located in front of the house. According to the selected appropriate types for the two cases, the rest of the new house design process has been fulfilled and appropriate rules have been

selected. After definition of the shape, size and location of the living room, other required spaces and desired components of the house such as the kitchen, bedrooms, toilet, bath, staircase, front porch, doors and windows are designed and added to the living room according to the selected types.

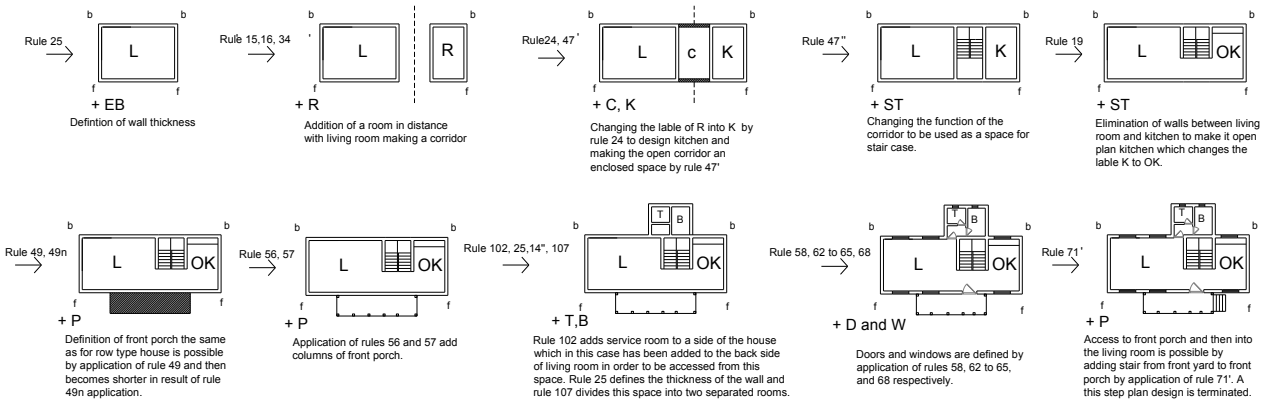


Figure 10.94: The process of applications of rules in order to design the new house in Diva in 2D.

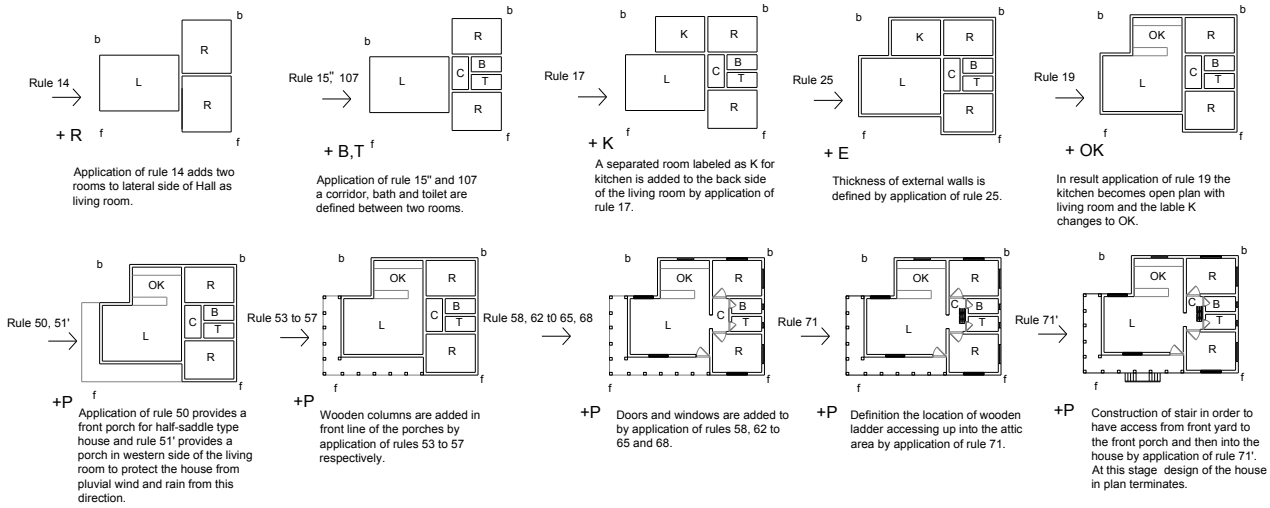


Figure 10.95: The process of applications of rules in order to design the new house in Perija in 2D.

The outcome is the design of the house in two dimensions. They are presented in figure 10.99 and include the process and rules for designing in two dimensions for a new house in Diva and figure 10.100 for a new house in Perija.

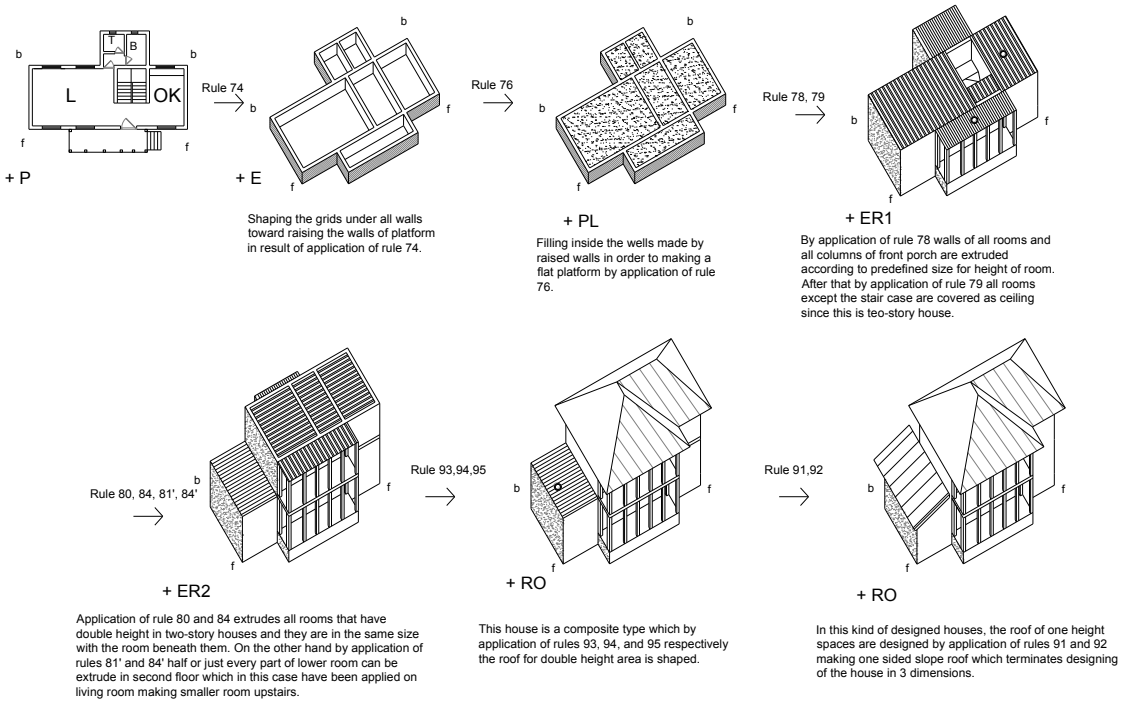


Figure 10.16: The process of application of rules in order to design the house of Diva in 3D, which is two-storeys high.

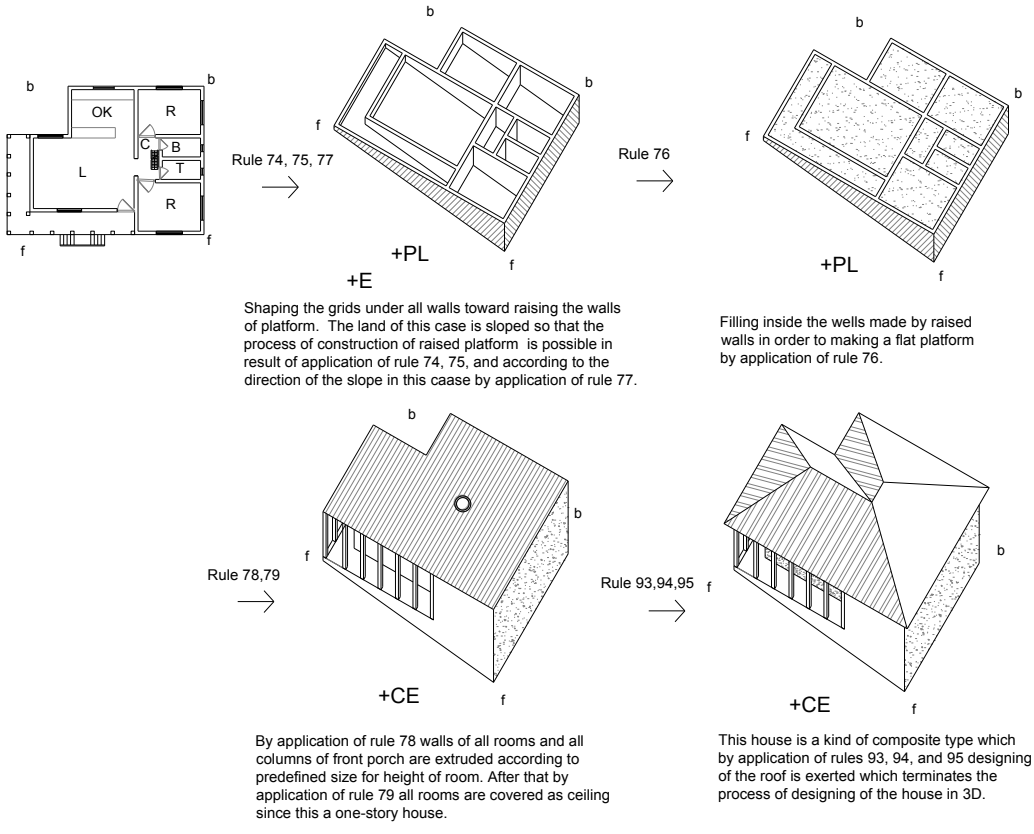


Figure 10.17: The process of application of rules in order to design the house of Diva in 3D, which is one storey high.

The end of designing the house in two dimensions means the start of the process of 3D design; this is exhibited within figures 10.111 and 10.112. The process of designing the house ends at the fulfilment of designing the house in 3D. It should be noted that, climatically, a one-storey house is suitable for the house within Perija (the forest area) and two-storeys are much better for the house in Diva (the forest border area). Both houses have been proposed and designed according to this climatic criterion too.

It should be mentioned that in order to completely design the new house, further rules are required. Those rules are related to designing architectural details and decorative or ornamental components of a house such as the detail and design of doors, windows, parapets, and capital of columns, which in this study have not been considered and performed. The above-mentioned details added to the outcomes of this research were inspired by existing local samples within the region and are just for completion of the design of a new house. New houses designed for Diva have been shown in figures 10.113 and 10.114, and the new house for Perija has been presented through figures 10.115, 10.116.

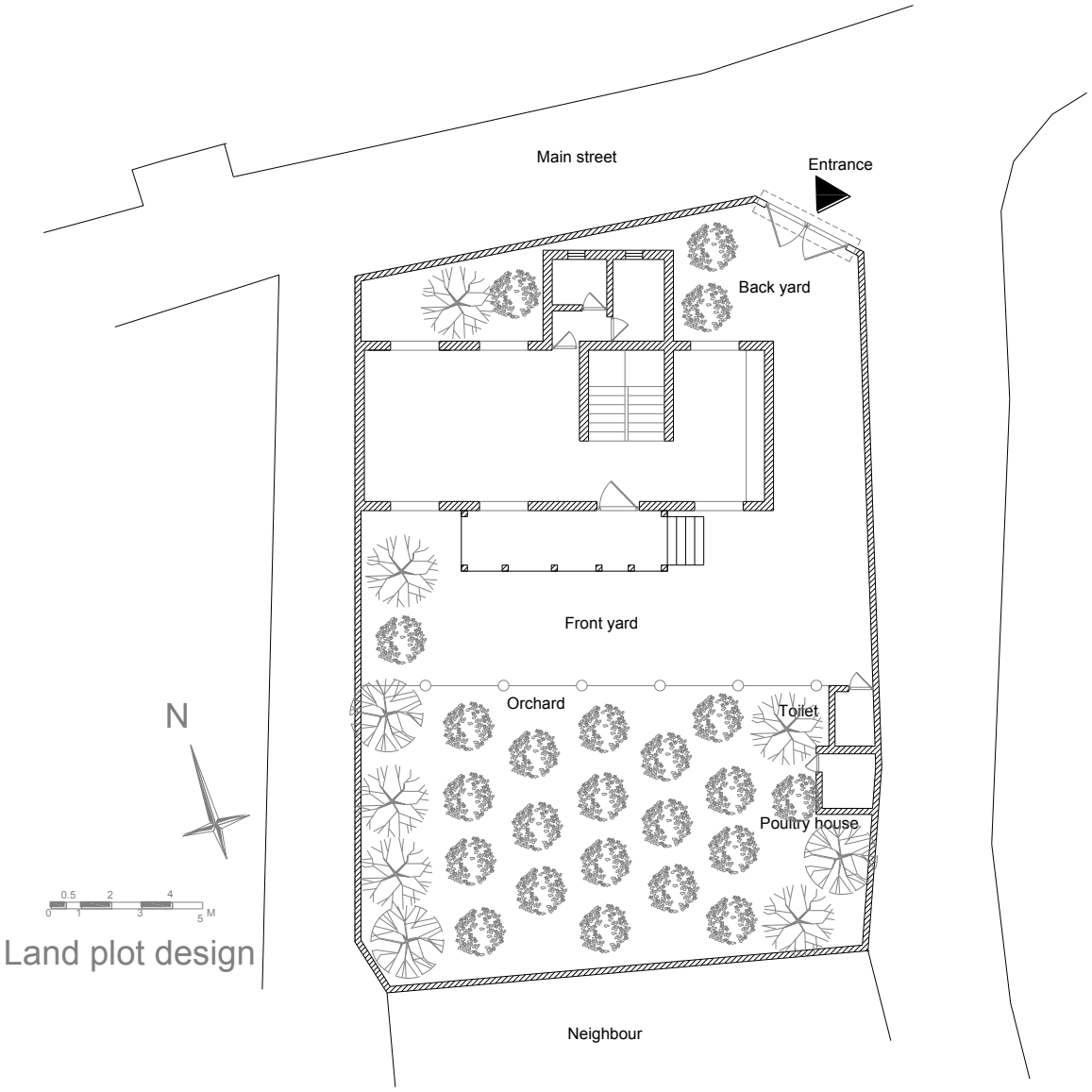


Figure 10.18: land plot design of the new house in Diva defining the location of the house, outbuildings, entrance into the land, and location of open spaces.

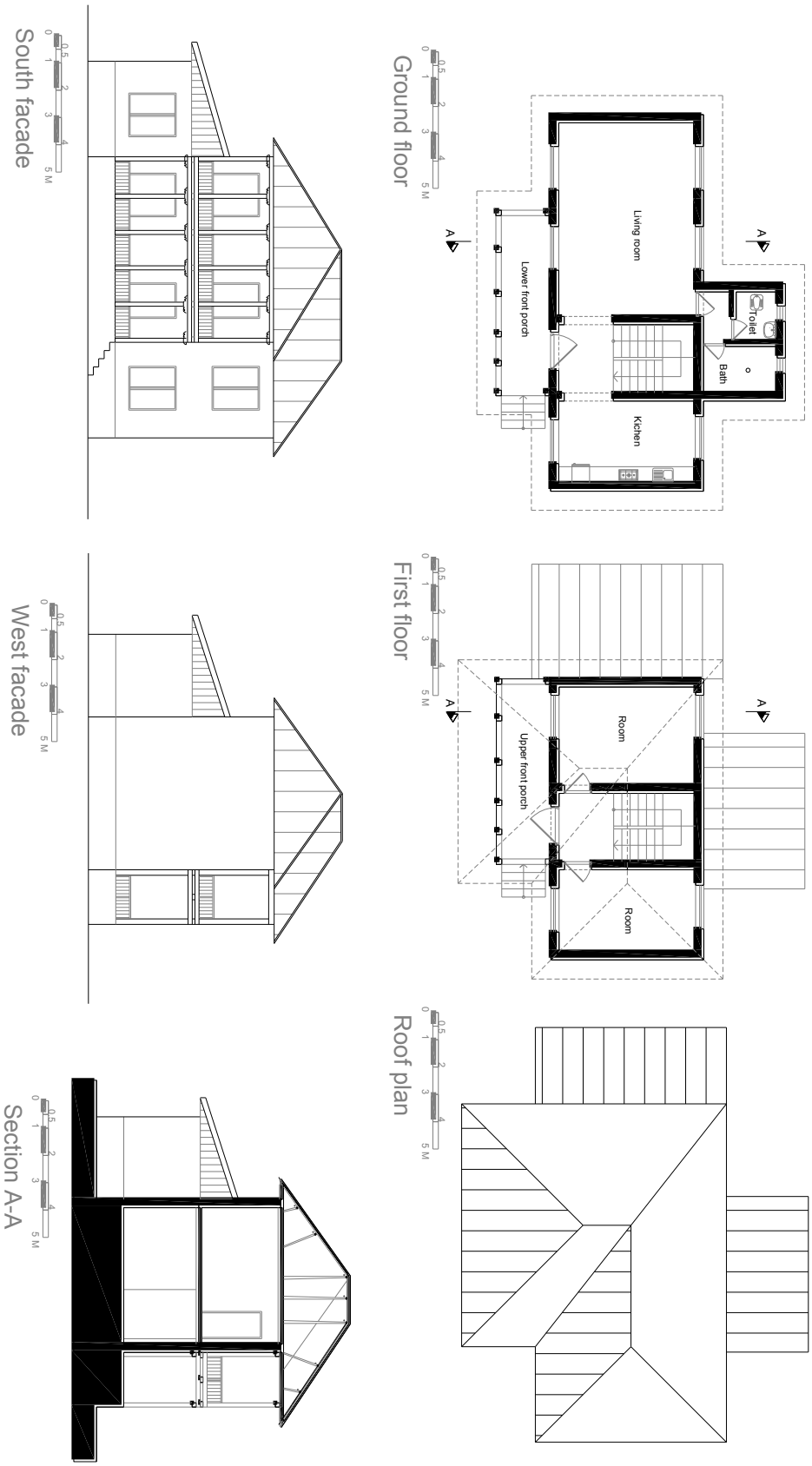


Figure 10.19: Plans, elevations and section of designed new house in Diva.

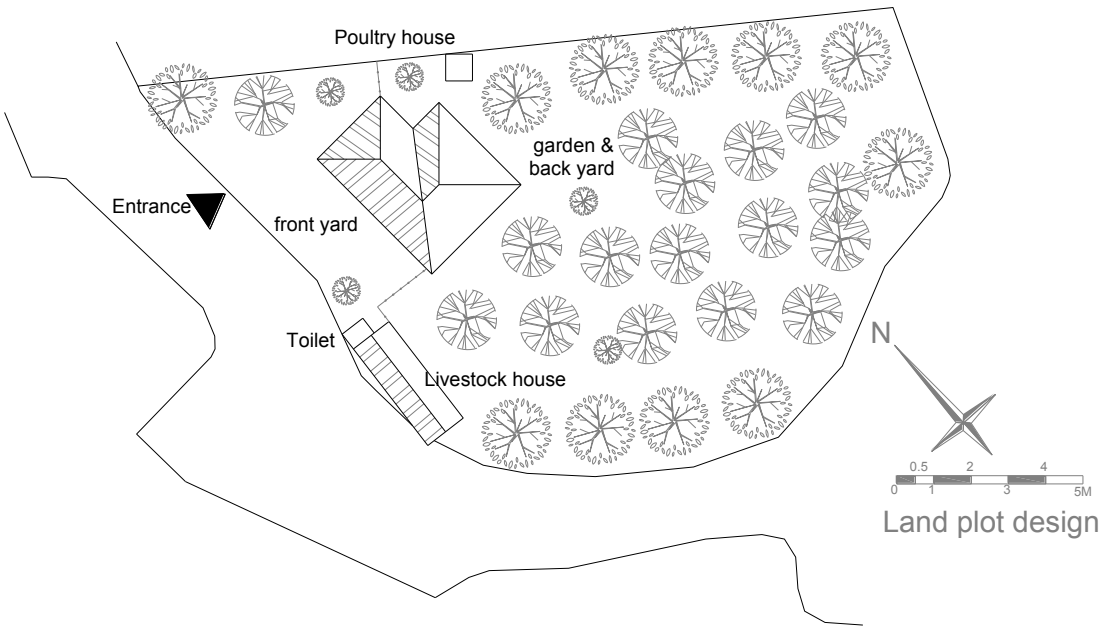


Figure 10.110: Land plot design on a sloped land of the new house in Perija defining the location of the house, outbuildings, entrance into the land, and location of open spaces.

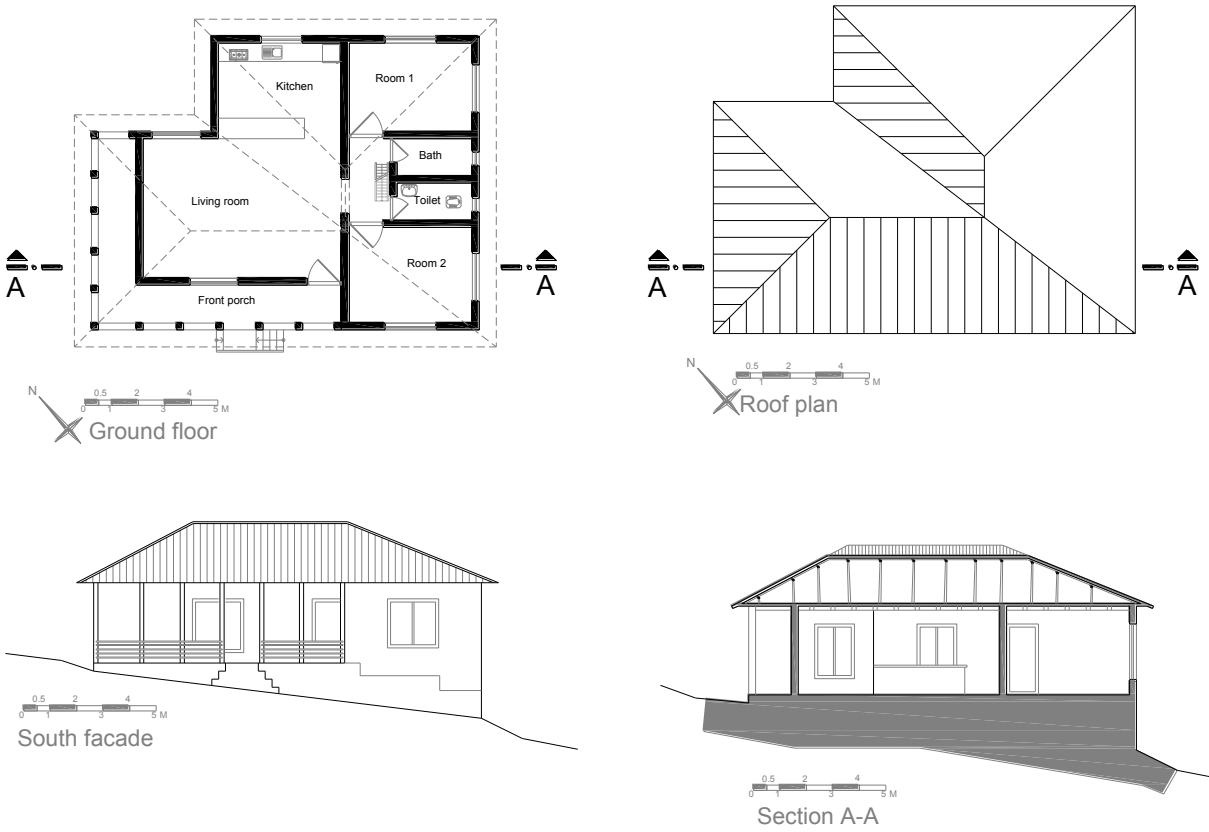


Figure 10.111: Plans, elevation and section of designed new house in Perija.

10.5 Discussion

These new designed houses have been inspired by climatic and sustainable rules that was employed within vernacular houses. Accordingly, both of these two new designed houses climatically take advantage of orientating towards the south adsorbing appropriate sunshine (zone), having external hip sloped roof projected from four sides in order to protect the volume of the houses from rain, and a flat inside ceiling making an attic area in between. Conduction of cross-ventilation is feasible by having two windows including one in the south and one in the north within main settings such as living room being used most of the time, and setting up a front porch. In addition, both houses are elongated east-west, which climatically allows obtaining more sunshine and enjoying from winds in order to provide thermal comfort. The proposed house for Diva, because of these two reasons has been designed two storeys, which was common form of vernacular house in this village.

Culturally, spatial organisation and house space configuration is set up according to the characteristics of settings and principals of their relationships in regards to the achievement of the identified compositional rules mainly derived from vernacular houses, which support systems of activities that villagers do within their systems of settings or have a desire to do.

Accordingly, the living room is the heart of the house connecting all rooms where most occupants' activities such as sitting, eating and drinking together, entertaining guests and watching TV take place. This room has the same proportion as vernacular living rooms but is larger. Because of new demands, and new furniture, sitting styles changed from sitting on the floor to sitting on the sofa, and locals need for large spaces to entertain guests.

The kitchen is a new important setting for local population, which can be open plan with a living room or independent but connected to this room by a door, both of these styles are preferred over the kitchen being located outside of the house. The size and proportion of the kitchen is proposed to be suitable for new defined function accommodating new kitchen appliances such as a fridge, oven,

washing machine, sink, cabinet for food and dish storage, and supporting different activities such as cooking, eating, drinking and sitting together. As the kitchen does not need to get sunshine from the south, it can be located at the back of the house getting sunshine from the east, and by being open plan with living room, it can take advantage of cross-ventilation as well.

The front porch is another most important setting within vernacular houses, which shapes the configuration of new houses and climatically has important role in achieving thermal comfort. It is located in the front of the proposed houses and performs as the entrance connecting the inside of the house to the outside, and the front yard. The size of this space in longwise has been shorter in proposed house for Diva to reduce the expenditure of house construction while the size of the deep is wider than vernacular style in order to make this space more functional for new lifestyle.

Additional rooms can be set up within the house configuration serving as a private room belonging to members of the family; their size and proportion are the same as vernacular samples but are solely accessed from the living room. Besides that, the bath and the toilet depending on the owner's wishes can be set up inside or outside of the house. In these houses are accessed indirectly from the living room, which is much convenient and acceptable for users

Stiny and Mitchell (1978) offer a characterisation of architectural style based on three purposes, (1) that it should clarify the underlying commonality of the structure and appearance, (2) that it should supply the conventions and criteria necessary to determine an instance of the style, and (3) that it should provide the compositional machinery needed to design new buildings that are instances of style.

The grammar in this research emerged from an unravelling of the vernacular process of design and construction and from the understanding of cultural and climatic influences thereupon, which according to the three criteria in the Stiny-Mitchell definition (1978), identified grammar and resulted proposed design of new houses are possible to be evaluated. Considering the plans of

different types of vernacular houses, it is apparent that they can be generated by the shape rules. As these houses are a representative collection of plan forms, the first criterion is satisfied in that the grammar captures the underlying structure of the house. It is clear that the plan forms are no more than representations of real plans so if exact replicas of actual plans were wanted, additional shape rules for each type would have to be supplied.

The grammar demonstrates the feasibility of going from basic compositional rules to real design. In this respect, it can be claimed that the grammar fulfils the second criterion, in which it is possible to state whether that plan is a manifestation of a vernacular house within the region of this study. Additionally, the third condition is evidently satisfied, that it can always produce a new basic form, which has all the ingredients of, and satisfies all the constraints on, a vernacular dwelling. Thus, it is possible to say that the shape rules collectively represent the style of vernacular houses in Mazandaran.

In addition to those criteria, these collective rules have been evaluated based on climatic and cultural constraints, which have been proposed and successfully undertaken within this research for the first time in shape grammar literature. As a result, some of these identified rules have been accepted with no changes while some have been rejected, some have been modified and upgraded according to new demands and lifestyles, and some new rules have been added to vernacular rules derived from new and middle style houses increasing the efficiency of the shape grammar for new housing. In this respect, it is expected that the new designed plans of houses respond to cultural characteristics and current systems of locals' activities at home, supporting new lifestyles and demands while it is sustainable and responsive to the specific climatic conditions of the region.

10.6 Conclusion of the thesis and model development

This study has set out to find a new model for designing new houses based on cultural traditions and sustainability of the villages located besides the rice fields of Mazandaran in the north of Iran. Accordingly, it has been hypothesised that a combination of two theoretical methodologies, the cultural analysis

methodology proposed by Rapoport entitled 'Culture as model system' (Rapoport, 2006b) and the expansion of this definition with the theory and methodology provided by 'Shape Grammars' (Stiny, 1972) creates a new desired model. This new model comprised a set of compositional rules, that when applied, can generate sustainable vernacular dwellings for the region of the study according to the locals experiences that exemplify culture, tradition and new lifestyles which has never been done before.

In this regard and for testing the proposed model, case study research has been undertaken with selection of four case study villages within two areas –the forest border and the forest areas- of two counties –Sari and Babol counties- in a province of the north of Iran, Mazandaran. This was followed by the study of 44 selected houses belong to different styles introduced as vernacular, middle and new styles. An appropriate methodology has been employed, which is a combination of different kinds of methodologies including measurement and mapping of houses, observation, visualising, questionnaire, focus group and one-on-one interviews, and content study have been conducted in order to find out what kind of 'systems of activities' occupants accomplish within which 'systems of settings' (Rapoport, 2006a, 2006b).

Collected data has been analysed qualitatively and quantitatively (mixed method), of which the most important results of this investigation were identification of different settings and different activities that villagers do within those settings belong to different types and styles of dwellings along with identification of villagers new form demands. Alongside this, maps of measured houses have been drawn using CAD software and a topology study has been conducted on them. Collected data from questionnaires has been analysed and summarised using Excel and SPSS software, the achievements supported evaluation of compositional rules and house configurations. Based on a climatic study, physical and behavioural responses to the climatic conditions along with recognition of sustainable solutions used when shaping the form of houses and lifestyle especially within vernacular houses have been investigated and introduced. Additionally, different identified types of vernacular houses have been

analysed within the framework that shape grammar provided (Stiny, 1972); the result was definition of set of rules employed for houses' design and construction. Documentation of any changes within houses through vernacular to new style and new housing rules were other parts of this analysis. Identified rules have been evaluated according to the achievements of cultural study derived from interviews and questionnaires, and findings of the climatic study. This evaluation led to identification and setting up compositional rules, that when applied, can generate sustainable and culturally appropriate new houses for the villagers of the region of this study. Two samples of application of those rules have been introduced representing two types of new houses for two villages. These samples (1) clarify the underlying commonalities of the structure and appearance, (2) supply the conventions and criteria necessary to determine an instance of the style, and (3) provide the compositional machinery needed to design new buildings that are instances of style (Stiny and Mitchell, 1978). Additionally, these new houses are acceptable to villagers, sustainable and climatically responsive as the grammatical rules employed for their creation, are derived from conduction of evaluation based on villagers' opinions, demands, their activities, and climatic conditions of the region.

This research makes two important contributions to the current literature. Firstly, the research study provides the first comprehensive investigation on villages of Mazandaran in the north of Iran, expanding our understanding of its particular cultural and environmental characteristics, along with obtaining the knowledge about common dwellings within this region, their different types, and characteristics. This kind of research has not still been undertaken, and has been carried out for the first time within this research. Secondly and as the main contribution, this research develops a theory, throughout combination of two other theories including 'shape grammar' (Stiny, 1972) and 'culture as model system' (Rapoport, 2006a, and 2006b). This combination has led to the introduction of a new model through improvement of the model that Rapoport (2006a, 2006b) has provided. According to this new model, represented in figure 10.117, studying the built environment and systems of settings should be led to identification of systems of rules. Designing new alternatives is a selective process

by selection of appropriate rules. These rules have been identified through an evaluation process considering to the findings of climatic and cultural investigations. Accordingly, form, geometry, and climate are as important as culture when improving the efficiency of the model for designing a new house within a vernacular environment aiming to be acceptable by users, conforming to cultural tradition, and being sustainable and climatically responsive. It also needs to be noted that employment of these compositional rules and the process of their selection is a creative process, which leads to a generation of infinite sets of new houses attracting different talents and meeting different needs and demands.

Some limitations to this study need to be acknowledged. First, the region of this study has reasonably been limited to two areas from four areas of Mazandaran, the result might not be able to be generalised for the other two areas including mountain and the flat plain areas. Secondly, because of some technical and cultural restrictions, this study was not able to employ some of useful methodologies for behavioural study such as behavioural mapping methodologies and capturing video footage during focus group interviews, which are supportive methods for conduction of behavioural studies. In addition, methodologies such as posting or emailing the questionnaire or carrying out phone interviews were not possible, which made conduction of field trip study necessary and longer, this took a considerable amount of time during this research study. Thirdly, this research did not focus on architectural and decorative details of houses such as wooden and brick decorative works, however, this does not reduce the efficiency of the proposed model in designing new appropriate houses.

As a recommendation for further research work, it would be interesting to undertake further studies in following areas: 1) conduction of a research study testing new designed houses proposed through the result of this research, 2)identification of rules that embody the form of villages towards proposition of a new model for designing new rural settlements or extension of existing villages, 3) identification of rules for generation of architectural, construction, and decorative detail which improves and completes rule bank employed when designing new houses for the region of this study, and 4) social sustainability that local villagers

within this region of study created and adopted in relation to culture and built environment.

Despite of the limitations, the field trip has been successfully conducted and the research has effectively resulted in the creation of a new model, which provides a comprehensive methodology toward designing new houses within villages of Mazandaran, which supports both practitioners and policy-makers. Depending on each designer's sense of creativity, new designed houses are different in appearance, spatial configuration, and space organisation when responding to different tastes. Because the model is founded on general characteristics of factors influencing the design process such as climatic, social, cultural, and architectural factors, this new model seems to have the capability to be employed for the conduction of research on vernacular build environments worldwide aiming to design new vernacular houses that are responsive to cultural, climatic and social conditions.

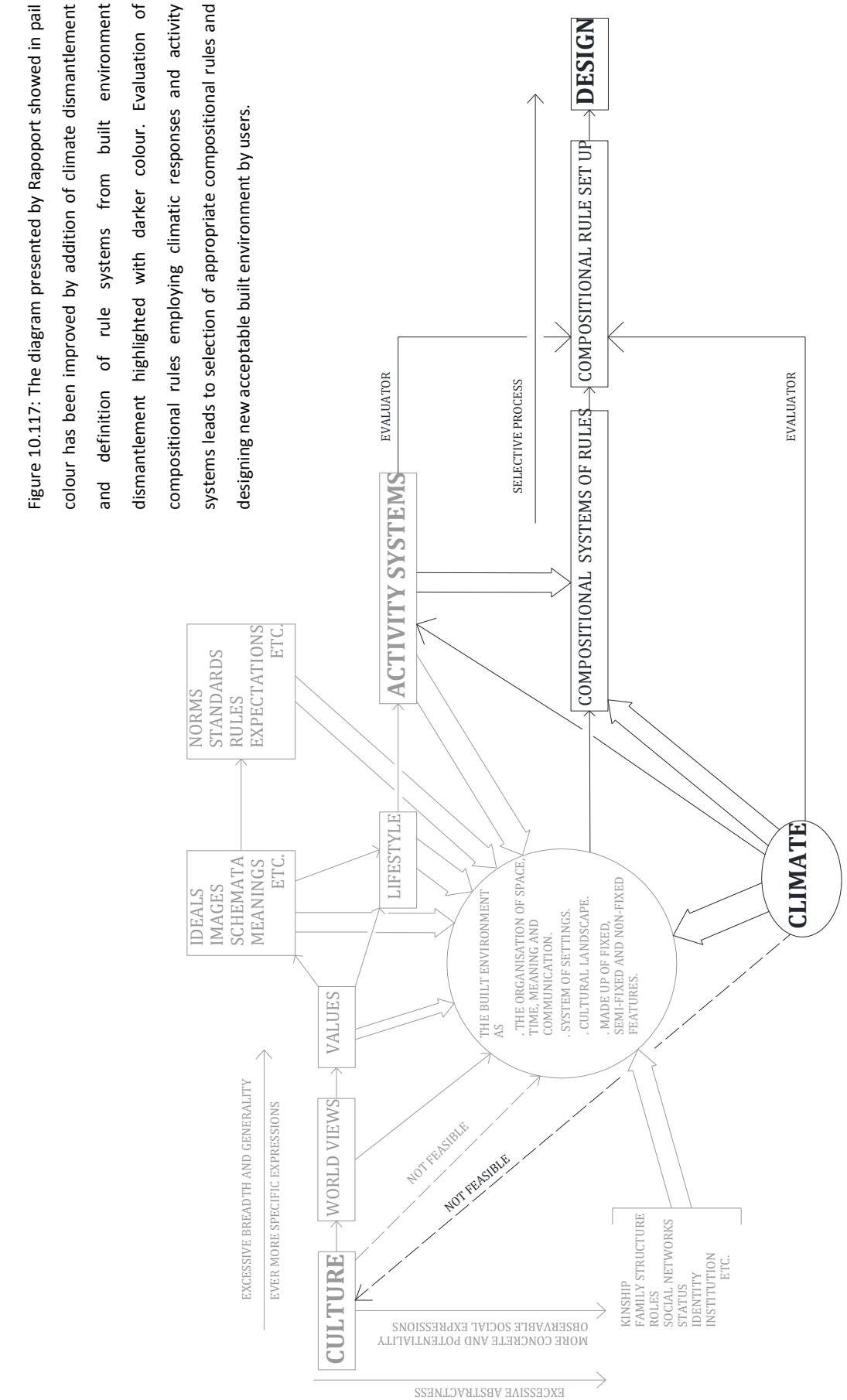


Figure 10.117: The diagram presented by Rapoport showed in pail colour has been improved by addition of climate dismantlement and definition of rule systems from built environment dismantlement highlighted with darker colour. Evaluation of compositional rules employing climatic responses and activity systems leads to selection of appropriate compositional rules and designing new acceptable built environment by users.

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Appendices

Appendix 1

The list of most of studied books and papers during this research is represented. Just some of them have been used through the thesis repot, which have been mentioned in bibliography. Additionally, the list of referred websites and papers derived from conferences have not been mentioned in this matrixes.

Litrature review Books						
Author(s)	Year & Location	Publisher	Name of book	Content	Importance	Critical analysis
Rapoport, A.	2005, Chicago	Science Publishing Company	**Culture, Architecture and Design**	Relation ship between culture, doin architecture based on it and how we can use culture for doin architecture in every region	It suggests a new method for design based on cultural approach and study	Its only about stable and current culturs. It does not have useful implication about transitionaing cultures like ours specially from traditional to modern. Also, it does not consider the tradition and last culture as an influentioal factor for new housing as well as beauty.
Alexander, C.	1977, new york	oxford university press	**A pattern languge**	Trying to find and suggest a method to be useable for every people to design it's house or so, resulted in suggestion of patterns and their relationships.	The way it's study, approach and extration of patterns from every context is very helpful	it does not consider well to beauty and art in architecture. Also the proccess of extraction and using of them is not as easy as the author claims. I think they are ambigues for rural people.
Alexander, C.	1964, Massuchus set	Harvard university press	**Notes on synthesis of forms**	About traditional way of design and having overall view considering all of problems in design proccess like and suggesting a mathematical method for design	Extraction of problems and every influentioal factors on design from the field or context is very interestin specially it's example in last pages which is about desipning of a new villge	It does not consider well to beauty and art in architecture. Also the proccess of is so confusing and hard. Also it depends on each person and con not be generelized
Fathi, H.	1979		**Construction with people: new Gourna experience**	Its about deploiment of people from one place t another and construction of new villge with all property for them using traditional way of construction and materials	The proccess is very well specially havin close interaction with people and experts, study of traditional style of architecture and updating some new elements	the suggeting method is too old and villges are like the old ones. It does not have any modern clues which is favorable for people. Specially using of adobe whithout any change seems very old for people who lived this new village at the end.
Chambers, A. Translator; M. Azkia	1983, Tehran	University of Tehran	**Rural development:Putting the last first**	Its about importance, accuracy, simplicity of rural and poor peoples decisions for their affairs which should be considered well by experts and authorities in any of rural development.	Getting importance to rural people taste, preferences, talents and decisions.	He does not try to find or suggest any way to extract these decisions.
Rewall, R.	Tulika, India		**Raj Rewall- Humane habitat at low cost**	About his theory and work including pictures and maps.	He tries to pass traditional architecture of poor area to new modern buildings using new modern materials. Consideration to aesthetical aspect of architecture.	The way he use is good but the materials are not sustainable like concrete, it is extreemly relied on himself, his believes and preferencesand can not be generalised or usable with people themselves and also he is very under influence of Khan.
G. Broadbent and R.Bunt and T.Liorens	1980, Chichester, UK	John Wiley	**Meaning and behavour in the built environment**	about semiotic and resaerch about that	being familiar with semiotic and finding if it could be useful for my research	
Edited by: Paul Emmons, John Hendrix and Jane Lomholt	2012, London, UK	Routledge	**The cultural role od architecutre contemporary and historical perspectives.**	about the definition of the culture, its comparision to technology and modernisation and its influence on architecture from anceint to now.	familiarisation better to culture and its relation to architecture	the componants of culture and using it for design of new building has not been considered
Kevin Lynch,	1981, Massachus etts, USA	The MIT press	**A theory of good city form**	presenting definition of five dimension and two mega criteria of a good city	this book and the dimensions defined support criteria for analysis of village's context and neighbourhood.	
Kevin Lynch,	1960, Massachus etts, USA	The MIT press	**The image of the city**	five types of elements of physical forms of of the city image have been defined based on and psychological study	the contents of this book supports the study for understanding and analysis of physical aspects of the villages	
Jane Jacobs	1964, UK	Pelican Books	**The death and life of great american city (the failure of town planning)**	analysis of city life, diversity,safe and security in city contexts and principles to create them, and about defining three kind of neighbourhood in city area	It supports my resarch especially for definition and understanding of neighbourhood in village area and analysis of physical and functional aspect of them.	the topics and principles are for city life not for all of human settlements such as villages.
Richard Sennett	1973, UK	Pelican books	**The use of disoredr (Personal identity and city life)**	a bout the importance of diversty and anarchy in city planning and design	It supports understanding the importance of diversity	
Raj Rewal in conversation with Ramin Jahanbegloo	2010, New Delhi, India	Osford University Press	**Talking Architecture**	It is mainly about Rewals opinions and concepts in designing buildings in India and learning from th past and traditional architecture	it supports this question that how we can learn from the past to desing new buldings combined with new technologies and which aspects of traditional architecture are learnable.	it is only based on his own personal belief and talent and he did not present any methodology for this process to be learned or repeated from others.

Amos Rapoport	1980, New Castle, UK	Urban international press	**Thirty three papers in environment-behavour research**	about the relationship between culture and architecture. During these articles he tryed to explain about culture, how and to what extent we can learn from the past, the componats of the culture and especially how one can apply cultural study in designing new building or environment process.	this book supports cultural study and analysis of the region of my study.	The process of application of cultural study in design is vague and is not supportive enough and does not consider the physical aspect of the environment
Group Editors	2001, USA	SI edition	**ASHRAE handbook fundamentals**	about standards of thermal comfort	it supports the climate study of the resarch	
S. Kaplan, R. Kaplan	1982, New york	Praeger publishers	**Cognition and environment**	about enviromental cognition	One part of this book devoted to cognition map and definition of edges, districts based on Kevin Lynch's scheme which is useful for understanding of these issues	
Harry C. Triandis	1972, USA	John wiley&sons	**The analysis of subjective culture**	discussion about the importance of cultural study, different aspects of culture especially about subjective and objective culture, and presents definition of components od culture.	It is supportive in division of culture into two different related field as subjective and objective as well as presentation of definition for some components of culture which can not be found in other sources related to culture including Rapoport's scripts	It does not discuss aboutrelationship between culture and architecture or built environment. So it doeshave no methodology about application of cultural study in architecture.
Geffrey Broadbent	1990, USA	Van Nostrand Reinhold (International) co. Ltd	**Emerging concepts in urban space design**	Discussion about the evoloution of urban design from past to now and main conceps related to them in european and moslems parts and mainly tried to find out the regularity or irregularity of urnban design in the past untill now. Besides them some prominent opinions and theries related to urban design mentioned by prominent socolars have been analysed.	presentation of collection of variety of opinions and theories about urban design and analysis of them is very helpful for analysis of rural environments	
Edward T. Hall	1979, New york,USA	Doubleday	**Beyond culture**	Mainly speaks about high context culture which is prevail in eatern countries and low context culture which is the aspect of inustrial countries.	Recognision to one aspect of culture in rural society of the research	It does not have any methodology for analysis or studying the culture according to this view
Paul Oliver	1987, Oxford, UK	Phaidon press	**Dwellings (the house across the world)**	about the various houses around the world and varous key factors in shaping of vernacular houses, their principles all around the world	It presents various kind of vernacular houses and tries to describe and analyise them which is supportive for my research.	It does not present any methodology for studying or analysing of vernacular houses and specially about the application of the lessons extracted from vernacular houses for design of new houses.
Hassan Fathy	1986, Chcago, USA	University of chicago press	**Natural energy and vernacular architecture**	this book is about natural ventilation techniques employed in traditional architecture mainly used in Eygipt with adobe raw brick material. Besides that it has been discussed that in which way these lesson should be learned from traditional architecture and these lessons how can be used for new architecture.	The outlook toward traditional architecture is useful and learnable from this book for the research.	
Lindsay Asquith, Marcel Vellinga	2006, London, UK	Taylor & Francis	**Vernacular Architecture in the twenty- first century -theory, education and practice**	discussion about tradition and vernacular architecture, different idea related to them, different method of studying them, the importance of studying vernacular architecture for new design and architecture and for students of architecture.	It is directlt related to the research improving revising and stduying of the vernacular architecture and undrestanding latest opinions and methodology related to the subject.	
Brian Edwards & David Turrent	2000, London, UK	E&FN Spon	**Sustainable housing, principles and pracice**	Collection of some papers about new modern defined principles of sustainability in urban design and architecture related to environment, economy and society.	It is helpful in analysis of rural traditional settlement of the project according to principles of sustainability	

Pirnia, A.	1995, Tehran, Iran	University of science and technology	**Introduction to iranian architecture**	main dimensions of iranian traditional architecture have been mentioned and discussed with argument of process of evoloution of Iranian traditional architecture.	It can be helpful for finding out the main dimensions of rural architecture of north of Iran, the area of the research.	
Zargar, A.	1998, Tehran, Iran	Shahid beheshti university	**A prelude to Iranian rural architecture**	different principles of rural architecture and different components of it for all around Iran has been argued along with using mapes, details drawing and photogrophy which make it like a monogrophy.	Its method can be helpful in description of rural architecture of the research.	it is mainly descriptive and does not try to provide and propose any way for application of the lessons of the rural settlement for new design in ruaral area.
Fathy, H.	1986 chicago, USA	University od chicago press	**ntural energy and vernacular architecture**	different lessons obtainable from vernacular architecture in order to provide thermal comfort.	this book is helpful in recognision of practical method employed in vernacular architecture creating thermal comfort.	
Gehl, j and Svarre, B.	Wshington, usa	Islan press	**Hoe to study public life**	this ook is about different method for data collection about human behaviour within public spaces of cities	this is a very good book for adoption of appopriate methodology for conduction of data collection for the research	
Whyate, W.H.	washington D.C. usa	The conservation foundation	**The social life of small urban spaces**	this book like previous one is about how to study human behaviour and activities within public area of a city	this is a very good book for adoption of appopriate methodology for conduction of data collection for the research	
Ahmad Hamid	2010, Cairo, Eygipt	The american university in Cairo press	**Hassan Fathy and continuity in islamic arts and architecture**	this book is about Fathy's opinions and practices in vernacular field of Egyiptiona architecture and its adaptibilty to new modern lifestyle, demands and situations.	It provides some practical work toward adaption of lessons gained from traditonal and vernacular architecre into new modern time and presents some outlook and viewpoint around this issue which can suppport the resaerch.	It proposes no methodology for gaining useful lessons ecept for climatic lessonsfrom the vernacular architecture which can be adaptable to new lifestyle or architecture and no methodology about the process of this adaption. It is mainly based on Fathy's own undescribed method and opinions.
Besim Selim Hakim	1986, Lonod, UK	KPI limited	**Arabic-Islamic cities (Building and planning priciples)**	this book submits and defines some dimentsions of vernacular arabic islamic settlements and tries to describe and analyse theire components such as streets, squers, Mahalla.	It will be supportive for the research in definition of rural settlement's dimensions.	
Cliff Moughtin	1999 (Sedond ED), Oxford, UK	Architectural press	**Urban design (street and squre)**	the principles of good street and squres have been discussed and some traditional european prominent examples have been analysed accordingly.	this book is benifitial in analysis of urban spaces which can support the research in analysis of rural public spaces.	
Cliff Moughtin	1996, Oxford, UK	Butterworth Heinemann	**Urban design: green dimensions**	The main subject of this book is sustainability. Its importance and principles and method in designing urban areas which along woth this it presents and analyse some exist examples related to the subject	It is helpful for the research to analyse and look at the rural vernacular settelemts of north of Iran according to sustainability and its influences on new urban settlements	
Roderick J. Lawrence (editor)	200, UK	Urban international press	**Sustaining human settlement (A challenge for the new millennium)**	it argues about the importance of susstanability and sustainable society, environment and settlement and discuss the principles of performing this aim and solution ways for sustaining societies.	It is helpful for the research to analyse and look at the rural vernacular settelemts of north of Iran according to sustainability and its influences on new urban settlements and also proposing some ways designing sustainable new settlements	
Jan Gehl	2010, UK	Island press	**Cities for people**	it argues how it is possible to make the cities for people not for cars. As for solution, it proposes designing cities according to human scale, size and eye level, and designing and improving special ways for pedestrians and bikes to be suitable for these activitis which will help the city to be vitality, health, safe and sustainable.	this book is very benifitial in analysing the rural settlements according to people and residentds' daily rutine work and activities and according to human needs to have a cohesion, safe, vital and sustainable community.	
Paul Oliver	1986, UK	Oxford institute for sustainable development and Oxford Brookes university	**Encyclopedia of vernacular architecture of the world**	different approaches toward looking at vernacular architecture and dimensions of vernacular architecture have been argued, defined and analysed and describes different components of vernacular architecture all around the world	the materials of this book is very helpful for understanding of different aspects of vernacular architecture and different approaches for studying it	
Ardakani, M	1994, Tehran, Iran	Research of housing ministry of Iran	**Using rice skin in concrete production**	the progress of production a new material for enhencement of concrete from burning rice skin has been defined	This can be one of new way of using local material for production of new construction material in Rural areas of north of Iran with rice farming.	
Bromberger, C.	1990, Tehran, Iran	cultural research and study institution	**Housing and rural socoiety of Guilan**	this book is a monogrophy on housing of Guilan provience in North of Iran neighbour to Mazandaran, its components and the way of residing and using them		
Hassan Fathy	1986, USA	university of chicago press	**architecture for the poor: and experiment in rural Eygipt**	He discusses his own experience of dewsigning and construction process of a rural settelement, new Gourna, in Eygipt.	It has not been described that by using which methodology, he extracted the coompatible traditional patterns with new lifestyle and demands and by support of which methodology it has been designed.	
Omrani, G.	1997, Tehran, Iran	University of Tehran	**Production of biogas out of rural and civic waste**	some way of production of metan gas for using in home from daily waste and especially from cow's dung have been defined, discussed and analysed.	this proposition can be used for rural area of the research and its functinality can be analysed	

Appendices

PAPERS/ARTICLES Litrature review

Researcher(s)	Year & Location	Keyword(s) Or the Journal	Study Content	Study tools (method)	Result	Importance	Critical analysis	Name of Article
S. suleiman, B. Himmo	2012, Jordan	Wind- catcher, Malqaf, solar air heating system, direct comfort ventilation	Investigating the performance of Malqafs for cooling indoors and trying to define new function for it	Litrature review and review of other experiments with analysis of maps and pictures of samples related to its opereation for cooling	New model of melqaf with two mutual function for cooling and heating proposed	Updating the function of an old element using new strategy and new materials and using solar renewable energy addition to using wind power	using concrete for its constrution which is non-renewable, no testing hase been done on suggesting model	**Direct comfort ventilation**
Hasamuddin Sotodeh, wan mohd zakeri	2012, Malaysia	Residents preferences, design quality, fitness, historical content	About best way of infill in historical environments	Litrature review, survey on 204 residents based on Semes theory, the qulitaty of fitness resulted from qualitative analisis using questionair and tabulation	Two way of infill between four ones ave been prefered by residences; Literal replication and Invention within style	It's emphesis on aesthetic quality, it is about Shiraz where is a city in Iran	Its not clear that can it be generalized to other cities with different resdince, different view and culture specially from ours	**Evaluation of design in urban historical context: from the perspective of residences**
Babatunde Jaiyeoba, filiz aklanoglu	2012, Nigeria	Low income, social production, social context, housing policy	inestigating a proper way to produce proper house for low incomes based on social view	Litrature review and doing a case study in Negeria	Low income regions should be investigat in different context themselves rather than having comprehensive approach or generelize result of one place for another	The region of my study is a kind of low income society, so it seems that the result of this study could not be generalized	the area of region of its study is not clear where is a villge or for a province	**Socio- economic issues in socially produced low income housing: theory and case study**
Supawadoe Chapram, Ross King, ornsiri Panin	2012, Thailand	transformation, local living, community ecosystem, vernacular house, Sogkhla lake basin	Invastigating a bout what the changes in house were, how were they strength and in which areas they were occurred.	Study tradition and changes by qualitative method and holistic approach in three villges, Data collection by documantary sources and direct and participate observation and interview with architectural draw of maps	changes were in 3 different part and emerging new architecture which is vernacular	It is known new changed architecture as vervacukar architecture, it's investigation on changes is fine and suitable for mine	the origin of these changes aren't clear and were the changes proper according to aesthetical and environmental view?	**Transformation of local living; Buddhist thai communities and vernacular houses**
Tamer Abdel, Indjy m.Shwket	2011, India	vernacular architecture, slums upgrading, sustainable development, housing problem, thirld world countries	investigting which parts of slum settlment need to be upgrade according to the view of residence.	Litrature review of vernacular architecture and its definition, sampling, observation, questionnaire, quantitative analisis, qualitative analisis	finding which area of slum settlments need important upgrad according to residence opinion, Are them communal or privat?	the method and outlook of this research is usable for mine.	Its not clear that can it be generalized to other slum areas in different countries, however its been generalised in this research.	**New strategy of upgrading slum areas in developing countries using vernacular trends to achieve a sustainable housing development**
fatemeh mohammad nia Garaei, mojtaba rafiean, nehzat jalalkammali	2012, Iran	Privacy, Crowding, culture, Iranian vomen	different perception of privacy between women in different cultur in Iran	Interview and questionnaire by random 100 selection, testing by Chi-squere test and Independent sample test and analisis of variance(ANOVA)	Yazdi women need more privacy in public area, level of required privacy is related to crowding, the perception of privacy for both are different.	The method of testing and analysis of this research and its result.	its only about in public city area and it doesn't have any impliction about in houses or dwelling areas. Could all of 100 sample fill the questiionnare?	**Investigation cross- cultural differences in the privacy regulation and perception of crowding: Northen and Yazdi women in Iran**
Jose Maria Fuertes	2009, Spain	Rural heritage, Vernacular architecture, Tradditional farm, Reuse, Spain	Investigating which factors should be considered in reuse of old tradditional farm houses in Spain	data collection, analysis of vernacular architecture	Having overal view is essential in reuse of rural buildings in Spain	Suggestion of overal view and also suggesting that people have biased toward these buldings, too.	Overall view has not been defined and also the weight or importance degree of it's component has not been clarified.	—
Zander Sonj	2004, _	—	Investigating the possibility and method of producing energy from sugar cane	Emperical data	Carbon materias obtained from suga cane and deciduas wood for heating	Its similir to our region with sugar cane, wood resedue and importantly rice resedue which production of some material for empowering the concrete from it has been suggeste but new energy production did not.	the economical benefit of it has not been cleared. Also it did not have any imply that rural people can produce it, themselves or it should be industrial?	—
phaholthep Charanya, Nopadon saharha	2012, Faculty of art, Bangkok, Thailand	Transforming value, vernacular crafts, modern utensile, Sukho thai tableware, visual refrence	Trying to appliction vernacular values into modern new handycrafts	litrature review, typology of chinaware by Delphi Method, Interview with experts during all research stages, modelling, using visual reference	Designing new modern utensile	Its an experince about design new thing based on tradditional values, the proccess of this project, specially interviewing with experts is interesting	Interview with people as customer and finding their point of view and taste has not been done	—
Da Costa	2004, South Easter Amazon	_	Analaysis the possibilty of producing biofuel in Amazon	Geo grphical area and plain chosen, a quantified analysis in term of income, job, land requiered	Some recognition proposed	The environment is very similir to ours and the result is inspiring for my research	Like number 10	—
Thafiq M. Abu-Ghazzeh	1997, Saudi Arabia	—	About culture and architecture	Litrature review about cultural practices in Saudi Arabia, Documentation of new vernacular architectur in Saudi	Regionalism in architecture is very important and vernacular architecture should be a part of architecture student study	suggesting regionalism for architecture students study	The way its application, the result and the quntity of this study have not been clarified and also tested. Its only a kind of hypothesis.	—
Shahrbanoo Djalilian, Mansoreh Tahbaz	2004, Iran	climatic, classification, Iran, vernacular, comfort, shade, ventilation, evaporation, wind, rural, region, questionnare, database, design strategy	To investigate how tradditional rural buildings design apply to minimize hydrocarbon consumtion in new buildinds.	Classification of climatic condition in two types of climate in Iran based on building bioclimatic chart and Penwarden chart, eploration of vernacular architectural strategy	Studies of different microclimate in different areas and field study and consider vernacular design strategy will guid architecture to design hydrocarbon energy saved building. Also, it has presented some design principles in flat plains of north of Iran	The method of this study on climatic condition and it's relation with environment condition and people behavior. It's suggestion for new buildings in our region	they did not consider the rural residents preferences and tastes and also other factors like economy, beauty, material use and so on.	**Minimizing of energy consumption based on vernacular design strategies.**
Shuzo Murakami, Toshiharu Ikaga	2008, Japan	—	Investigating that wether vernacular in different areas have acceptable performance according to CASBEE a kind of Japanese	Quntitative assessment of indoor thermal environment	All of these vernacular architecture have good performance like Ardakan venacular architecture in Iran which one of samples.	Vernacular architecture has good environmental performance and could be used for new modern ones.	—	**Evaluatig Environmental Performance of vernacular Architecture through CASBEE**
Afsha A., Salleh E., Lucas J.A.	2010, Malaysia	Iranian vernacular architecture, persian Gulf region, Kish island, Old saffein, New saffein	Investigation of principles of old building in this region and it's changes in new buildings trying to suggest some solutions	Documental and observational studies, qualitative analysis using tabulation.	Principles of old and new houses have been found.	the camparison between old and new houses	It did not suggest any emirical solution or method for new housing. It is only a comparison	**Application of vernacular architecture ideas in new saffein village of kish island**
			Second Edition					
R Banai	1995,USA	From Environment and planning B, Vol 23, P.P. 177-190	To assess the performance of neotraditional settlement according to Lynch's A theory of good city form and camparision with modern and post-modern ones	Evaluationg the Argument of neotraditional plans and general design features according to theoretical of Lynch Rather than assessing evidences	It indicates certain strenghs of the neotraditional settlements form, as well as issues which await reconciliation	My research theme is a kind of neotradtional which the outcome of this study is very helpful.	–	**A theoretical assessment of the 'neotraditional' settlement form by dimentions od performance**
M van leusen	1995,The Netherland	From Environment and planning B, Vol 23, P.P. 143-164	A tentative demonstratation including new typology of dwelling arrangements supporting design	Exempling Panerai (1980, p.75) work and work on some building for ne typolody definition	Its possible to represent duildings with sufficient degree of abstraction, Its possible to define various charactristics relevant to comparative evaluation of types,	I think it's a good strategy to find and represent the typologies of houses in the region of my study which would help in design for new ones	It only involves the spatial form and does not consider the ornamental or another factors	**A typology of dwelling arrangements**
G Stiny	1980, England	From Environment and planning B, Vol 7, P.P. 343-351	The definition pertaining to the shape grammar formalism have been develpoed	Whirlwind tour through the shape grammar formalism, and the definition and idea definitions and idea on which it is based	The formal machinary fir the algorithmic definition of Languages of two- and three-deimensioal spatial designs is thus established	It could help me to clarify the underlying commonality of structure and appearance, It would help me to identify any other building is an instance of the style, It could provide	It only support designing in the framework of any style and doesn't consider new element adding to it or considering changes in any style.	**Introduction to shape and shape grammars**
T Herbert, I Sanders, G Mills,	1993, Soth Africa	From Environment and planning B, Vol 21, P.P. 453-476	To find a shape grammar of the spatial design of linear Ndebele homestead	Reviweing 6 type of polygamous house and trying to find their shape grammar according to rules of shape grammar	Suggestion of shape grammar which this analytical technique provides a useful means for relating spatial layout to social ideas in a class of architectural	It could be replicated for the region of my study	—	**African shape grammar: A language of linear Ndebele homesteads**
S-C chiou, R Krishnamurti	1995, USA	From Environment and planning B, Vol 23, P.P. 191-216	Trying to illustrate shape grammar	working on 4 type of traditional houses and analysis of them according to the rules	Deraivation of four Taiwanese traditional vernacular house, based on a shape grammar and finding the rules	It is like above article related to South africa	—	**Example Taiwanese traditional houses**
Ji- Hyun Lee, Hyoung-June Park, Sungwood Lim, Sun-Joong Kim	2011, Republic of Korea	Culture, content analysis, bosangwhamun, shape grammar, hiearchical, deconstruction	Investigating a cultural artefact to find its variation, rules and genrating new ones using shape grammar rules	Litrature review, Illastrating the artefact for finding its typologyies, Using camputer program to register, analysis and generation of new ones also based on shape grammar and testing it in different workshopes	Finding the rules and generation of new ones even by workshope participants.	It is like above article related to South africa. Also it would help in analysis of ornamental elements of rural houses in my research.	—	**A formal approach to the study of the evolution and commonality of patterns**
Nilhan vural, serbulent vural, Nihan Engin, M. resat Sumerkan	2006, Turkey	Vernacular architecture, structural insulated panel, modular design	Trying to design new house specially ne wooden insulated prefabricated panel to consract them	Typology of traditional building, recognition problems of new concret buildings and research on SIPS.	proposing new diferent type of houses based on traditionals and using modular SIPS wooden prefabricated panels for their construction	Using SIPS wooden prefabricate panel has enough capability to be used in the region of my study where it's main traditional material is wood, too.	Instalation of machanical, electrical and other utilities have not been cleared. The foam between two layers of wood in panels are not sustainable. The industrial production proccess of the panel has not been thought as well as local's acceptance.	**Eastern Black Sea Region- Asample of modular design in the vernacular architecture**

Jose p Duarte, Jose Beirao	2011 UK	Environment and Planning B: Planning and Design, volume 38, pages 879-902	application of shape grammar in town planning and design and using shape grammar for teaching	First, analisis of existing urnab plans toward sketching the methodology. Second asking a group of students in fifth yar of the study to use the methodolgy and shape grammar to develop a rule based system for designing a new town, and then asking other students to develop a detailed plan for a smaller area of the larger expansion plan.	Results show that shape grammar can produce plans with nondefinitive formal solutions but with explisit and implicit flexibility. It allows the generation of alternative design solution while respecting a consistent spatial language and a common development vision. they can increase the efficiency of the plan and maybe extent its lifespan as they enhance the capacity to adjust to contextual changes.	it is a new application of shape grammar as using it in town planning and design. Using some pattern language attributed to Alexander for defining new rules for programming town planing and design	The functionality and acceptance of Alexander's patterns has not been proved. Aslo, human needs, activity and behavours has not been considered, well.	**Towards a methodology for flexible urban design: designing with urban patterns and shape grammars**
T W Knight	1999, UK	Environment and Planning B: Planning and Design, volume 26, pages 15-31	definition and describtion of six types of shape grammars has been presented.	Identification of different types of grammars and the answerability or solvability of questions about these grammars were the concerns.	different types of shape grammars and their relationshops have been introduced	Familiarising with different types of shape grammars, their applications, usefulness, restrictions and relationships.	—	**shape grammars: six types**
U Flemming	1987, UK	Environment and Planning B: Planning and Design, volume 14, pages 323-350	Separate grammars are given used for the generation of plans and for the articulation of plans in three dimensions for Qeen Anne style which dominated domestic architecture in the United States of America.	Using maps of on type of this style and shape grammar to analise its spatial configuration and generate new alternative/s.	a set of rules has been presented and new alternative has been generated.	Definition of differnt rules for it spatial configuration in 2D and also for its volume and ornamantal comonats in 3D.	the relationship between rules and criteria of construction of this style such as climatic or cultural ones are not cleared.	**More than the sum of parts: the grammar of Queen Anne houses**
H Koning, J Eizenberg	1981, UK	Environment and Planning B: Planning and Design, volume 8, pages 295-323	Separate grammars are given used for the generation of plans and for the articulation of plans in two and three dimensions for Wright's prairie houses.	Using maps of some houses of this style and shape grammar to analise their spatial configuration and generate new alternative/s.	set of rules have been extracted for this houses and then by their application 3 different new alternatives have been created.	Using shape grammar in analysis of a existent style,using set of rules in 2D and 3D to generate new alternatives.	the relationship between rules and criteria of construction of this style such as climatic or cultural ones are not cleared and also the acceptansability of generated alternatives is not mentioned by users.	**The language of the prairie: Frank Lioyd wright's prairie houses**
G Stiny, W J Mitchel	1978, UK	Environment and Planning B: Planning and Design, volume 5, pages 5-18	A parametric shape grammar that generates the ground of palladio's villa is developed as a definition of the palladian style. The grammar is applied to generate the plan for the villa Malcontenta	Using the maps of the house and parametric shape grammar	extraction of a set of rules for this house and geneation of new alternatives in result of its application	using parametric shape grammar to generate rules	the principles of these rule according to climate, technology, houseowner's need, Palladio's philisophy or so have not been mentioned.	**The Palladian grammar**
Amos Rapoport	1983, UK	Habitat International, Vol 7, No. 5/6. pp. 249-268	Deals with a particular way of approaching the design of environment for developing countries using cultural study.	Try to find out the 'core culture' which is more imprtant and has not changed or had a bit changes and design according to its principles and giving up changed or very changed ones as prepheral	application of this method for Isphahan, a city in Iran and designing ne type of house form for it	presentation of an analysis on culture and its relationships with architecture, what are the changes and how we can find them and why they changed. And it provides an new approach using cultural study in desing process.	methodology for data collection has not been mentioned as well as the design process is not well organaised.	**Development, Culture change and supportive Design**
Surapong chraratananon, Vu Duc Hein	2010, Thailand	wall mass, thermall mass, Heavy wall, wall performance, cooling load	Investigating the economical influence of wall thickness on energy consumtion for cooling indoors in residential and commercial building and comparison between vernacular and tradition ones.	From experiment and simulation using TRYSYS to simulate cooling and energy using for room models with thin and thich external layers	Massive walls are useful for spaces where are used during the day time and for spaces where are used during nighttime or evening, thin walls are better like vernacular ones in Thailand.	The region of this study is like my research's region of study which the result of study could be generalized to it.	The economical aspects have not been defined. I think the only consideration was quantity of energy consumtion. The cost effect of construction of these walls have not been inverted in comparision proccess	**Thermal performance and cost effectiveness of massive walls under Thai climate**
A.S.Pili, M.A. Naseer, T. Zacharia Vaeghese	2010, India	Kerala, Traditional buildings, Modern bildings, Thermal comfort, Questionnaire comfort	Comparison of indoor comfort according to residents view in traditional and modern ones	using questionnaire in different seasons spread to 200-300 residents who have been chosen randomly	modern buildings are not suitable according ot resident's veiw	Indoors comfort also should be considered culturally and according to resident's view.	It can not been generalaized. Also the causes and the problems have not been described	**Thermal cofort study of kerala traditional building based on questionnaire survey among occupants of traditional and modern**
Chalermwat tantasavasdi, Jelena Srebric, qingyon Chen	2001, Thailand	natural ventilation, computational fluid dynamics, Air velocity, Thermal comfort, Houses, Thailand	About designing new house using new natural ventilation	Using theoritical analysis	It only prove the possibility of natural ventilation in new houses	natural ventilation is very important in my region specially during summer	It does not have any functional suggetion to handle this problem	**Natural ventilation design for houses**
Uche Ikejiofor	1998, Nigeria	—	Trying to design new houses for low-income urbun areas with high density using the rules of traditional rural houses.	Trying to be familiar with traditional rural houses and their potentialities and the weeknesses of houses are built in urban area .	suggestion a type of new house for urnban area using traditional houses potentioality	This is a way worth thinking about in my research but using the potentiality of urban traditional houses to be used in new rural ones	The materials, details and technology of construction as a whole have not been considered as well as new life style and life standards of rural residents.	**If past traditions were buildings blocks, A perspective on low income housing development in Nigerian cities**
Ben Richard, Hughes, John calautit kaiser, Saud Abdul Ghani	2011, UK	Wind towers, natural ventilation, thermal comfort, eraporative cooling, windvent	Investigating designing new type of wind towers usable in modern architecture based on traditional ones	Analysis of system and operation of traditional ones usinf maps of them	Design and creating new devices as wind tower for commercial buildings using new material most from metal and testing them	The suggested mechanism in the result and review for cooling and making self-wind flow in houses is useful in my research	The suggested matterial should be review about.	**The development of commercial wind towers for natural ventilation: A review**
Heidi Dumreicher	2007, Austria	—	5 years study on rural china aiming estabishment the future image	Perticipating observation working with rural people, Direct observation and doing down-top strategy for development instead of top-down	Suggestion some important notes to be considered related to rural development and related to economic, socio-culture and ecology	Its completely related to mine	—	**Chinese village and their sustanable future: the european union-china-research project "SUCCESS"**
Hongy Lu, Limin Li, hua Zhang	2007, China	sustainable village-urbanisation, public bath houses, Dynamic statistic system, self-organized system	about constitution and the proccess of it in a village between two different part where were old and new	having close interaction with rural residents from both part	development of a new bath house and suggestion that development based on people opinion is much successful	the proccess of definition and design of a building and having close interaction with people during the proccess is veru useful	—	**Xia futou, bathhouse _ A sustainable urbanization experiment in a chinese villge**
Doris C.C. Kowaltowski	1998, Brazil	Self-built housing,aesthetics, Brazil	Discussion about Aesthetic consideration on apearance of low-income family houses	Using sampling, maping, phtogrophy and interview with users	Some specefic house features are preferred. In some different area of housing, professional intervention is essential due to current slow proccess and it's low quality.	Suggesting that some stage of housing proccess for low incomes like house plan, construction stage, detailing, neighbourhood design based on aesthetic must be interfier by professions	The degree and the way of intervention and design method has not been discussed	**Asthetic and self-built houses: an analysis of a Brazilian setting**
Jack L. Nasar, Junmo Kay	1998 USA	Asthetics, House preference, House meaning, Social class	About different tases of different groups related to different house style in Ohio	selecttion 15 different style of houses and defintion of differemt groups according to Gans(1974) to find the result by interview	the responses were very similiar acros the groups. The taste is related to education and occupation. Preference is not a matter of taste	Its important in my research specially during data collection related to finding residents preferences and tastes related to housing	It has not been discussed, if we change the criteria of group definition, the result would change? And does it vary between different cultures?	**House style preference and meaninig across taste culture**
Kongjian Yu	1994, In USA about China	Chinese landscape, cultural variance, landscape preference	Different preferences between 28 different groups	28 groups defined by socio-culture and social features. Some some places selected in China. Using SBE, procedure (Daniel, Boster 1976). Statistical analysis.	the different preference is related to education in rural and urban area. Most importantly, finding that preference of westernized landscape could be correlate well with those are well educated in urban chinese area not in rural	It proves above article's result that eduaction is an important factor in shaping the taste and any environment preference.	—	**Cultural variation in landscape preference: comparison among Chinese sub-groups and western design experts**
			Third Edition					

Jose p Duarte, Jose Beirao	2011 UK	Environment and Planning B: Planning and Design, volume 38, pages 879-902	application of shape grammar in town planning and design and using shape grammar for teaching	First, analisis of existing urnab plans toward sketching the methodology. Second asking a group of students in fifth yar of the study to use the methodolgy and shape grammar to develop a rule based system for designing a new town, and then asking other students to develop a detailed plan for a smaller area of the larger expansion plan.	Results show that shape grammar can produce plans with nondefinitive formal solutions but with explisit and implicit flexibility. It allows the generation of alternative design solution while respecting a consistent spatial language and a common development vision. they can increase the efficiency of the plan and maybe extent its lifespan as they enhance the capacity to adjust to contextual changes.	it is a new application of shape grammar as using it in town planning and design. Using some pattern language attributed to Alexander for defining new rules for programming town planing and design	The functionality and acceptance of Alexander's patterns has not been proved. Aslo, human needs, activity and behavours has not been considered, well.	**Towards a methodology for flexible urban design: designing with urban patterns and shape grammars**
T W Knight	1999, UK	Environment and Planning B: Planning and Design, volume 26, pages 15-31	definition and describtion of six types of shape grammars has been presented.	Identification of different types of grammars and the answerability or solvability of questions about these grammars were the concerns.	different types of shape grammars and their relationshops have been introduced	Familiarising with different types of shape grammars, their applications, usefulness, restrictions and relationships.	—	**shape grammars: six types**
U Flemming	1987, UK	Environment and Planning B: Planning and Design, volume 14, pages 323-350	Separate grammars are given used for the generation of plans and for the articulation of plans in three dimensions for Qeen Anne style which dominated domestic architecture in the United States of America.	Using maps of on type of this style and shape grammar to analise its spatial configuration and generate new alternative/s.	a set of rules has been presented and new alternative has been generated.	Definition of differnt rules for it spatial configuration in 2D and also for its volume and ornamantal comonats in 3D.	the relationship between rules and criteria of construction of this style such as climatic or cultural ones are not cleared.	**More than the sum of parts: the grammar of Queen Anne houses**
H Koning, J Eizenberg	1981, UK	Environment and Planning B: Planning and Design, volume 8, pages 295-323	Separate grammars are given used for the generation of plans and for the articulation of plans in two and three dimensions for Wright's prairie houses.	Using maps of some houses of this style and shape grammar to analise their spatial configuration and generate new alternative/s.	set of rules have been extracted for this houses and then by their application 3 different new alternatives have been created.	Using shape grammar in analysis of a existent style,using set of rules in 2D and 3D to generate new alternatives.	the relationship between rules and criteria of construction of this style such as climatic or cultural ones are not cleared and also the acceptansability of generated alternatives is not mentioned by users.	**The language of the prairie: Frank Lloyd wright's prairie houses**
G Stiny, W J Mitchel	1978, UK	Environment and Planning B: Planning and Design, volume 5, pages 5-18	A parametric shape grammar that generates the ground of palladio's villa is developed as a definition of the palladian style. The grammar is applied to generate the plan for the villa Malcontenta	Using the maps of the house and parametric shape grammar	extraction of a set of rules for this house and geneation of new alternatives in result of its application	using parametric shape grammar to generate rules	the principles of these rule according to climate, technology, houseowner's need, Palladio's philisophy or so have not been mentioned.	**The Palladian grammar**
Amos Rapoport	1983, UK	Habitat International, Vol 7, No. 5/6. pp. 249-268	Deals with a particular way of approaching the design of environment for developing countries using cultural study.	Try to find out the 'core culture' which is more imprtant and has not changed or had a bit changes and design according to its principles and giving up changed or very changed ones as prepheral	application of this method for Isphahan, a city in Iran and designing ne type of house form for it	presentation of an analysis on culture and its relationships with architecture, what are the changes and how we can find them and why they changed. And it provides an new approach using cultural study in desing process.	methodology for data collection has not been mentioned as well as the design process is not well organaised.	**Development, Culture change and supportive Design**

Appendix 2: A copy of four types of questionnaires.

Questionnaire 01: on general information about family & house

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Sample type; Sample number; Village name;

A. Biographical Data Date of filling;

1) Name of Respondent;

2) Address of respondent;

3) Your marital status *(tick as appropriate);*

Single ☐ Married ☐ Divorced ☐ Widowed ☐

Other ☐ (specify).....

4) From which age group are you?

-15 ☐
15-24 ☐
25-34 ☐
35-54 ☐
55-74 ☐
+75 ☐

5) Sex *(tick as appropriate);* Male ☐ Female ☐

6) Please tick as appropriate;

I am the owner of this house ☐
I am the tenant ☐
I am dependant of house owner ☐

7) Your status within household *(in relation to household head- tick as appropriate);*

Husband ☐
Wife ☐
Son ☐
Daughter ☐
Granddaughter ☐
Grandson ☐
Dependant ☐
Other ☐ (specify).....

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8) Please tick as appropriate;

I am originally from this village and a permanent resident	
I am not originally from this village but I am permanent resident	
I am not originally from this village and I am temporary resident	
I am originally from this village but a temporary resident	

9) Number of inhabitants; *(enter number in each age group)*

Age Group / *Gender*	-14	15-24	25-34	35-54	55-74	+75	Total
Male							
Female							
Total							

10) How many families live in this house?

1	
2	
3	
4	
+4	

11) Main occupation(s)[1] of head of the family.....
.....

12) Please tick as appropriate;

I work in this village	
I work in another village	
I work in city	

13) Marginal occupation(s).....
.....
.....

[1] : Main occupation is the main source of income of the family.

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14) Annual approximate Income *(In Toman, Iranian currency. Tick as appropriate)*

Under 500,000 ☐
500,000-999,999 ☐
1000, 000-1,499,999 ☐
+1,500,000 ☐

15) Annual approximate expenses *(In Toman, Iranian currency. Tick as appropriate)*

Under 500,000 ☐
500,000-999,999 ☐
1000, 000-1,499,999 ☐
+1,500,000 ☐

B. Degree of literacy *(If you are not literate please do not answer questions 17 and 18)*

16) Level of education *(tick as appropriate)*

In level of 'literacy movement' ☐
Primary school ☐
Guidance school ☐
High school ☐
University (Technician ☐ Bachelor ☐
Master ☐ PhD ☐

Other ☐ (specify).....

17) At what stage of the education are you? *(Tick as appropriate)*

Current Scholar ☐
Finished ☐
Taking a Break ☐
Other ☐ (specify).....

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C. House information

18) Approximate date of building Erection;

Before revolution	
After revolution-1988	
After 1988	

19) Method of Construction *(tick as appropriate);*

Method / ***Question***	Community **Self-Help**	Master **Mason**	Master **Carpenter**	Designer/ **Architect**	Designer/ **civil engineer**	Master of **concrete framer**	Other (specify)
a) This house **designed** by;							
b)This house **constructed** by;							

20) Approximate Cost of Building *(In Toman, tick as appropriate)*

Under 9, 99 Million	
10 – 50 Million	
50-100 Million	
+100 Million	

21) Has the house building changed in any way such as adding new room, merging some rooms together or removing any component?

Ye ☐ No ☐ If yes please specify below;

……
……
……
……
……
……

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22) Which fuel(s) is used for different purposes? *(Tick any appropriate);*

Fuels / *Questions*	Wood	Oil	Gasoline	Piped Gas	Gas Tank	Electricity	Other (specify)
a) Fuel for heating the house is;							
b) Fuel for cooking is;							

23) From which resources water for different purposes is provided *(tick any appropriate)*

Resources / *Questions*	Piped water	Public well	Public spring	Public reservoir	River	Other (specify)
a)Water for drinking and cooking is provided from;						
b)Water for taking shower is provided from;						
c)Water for washing dishes and clothes is provided from;						

24) What kinds of vehicle(s) do you have for transportation? *(Tick any appropriate)*

None ☐
Individual car ☐
Motorcycle ☐
Bicycle ☐
Other ☐ (specify) ……

25) What mode(s) of transportation do you usually choose within the village? *(Tick any appropriate)*

Individual car ☐
Motorcycle ☐
Bicycle ☐
Share taxi ☐
Walking ☐
Other ☐ (specify)……

University of Portsmouth

26) What kind of vehicle(s) do you have for farming or other productive activity(s)? *(Please list them)*

……
……
……
……

27) If you use the vehicle(s) mentioned in question 27 for other activity(s), please list them;

……
……
……
……

Thank you very much for your time and answers

Questionnaire 02: Questions on construction material

University of Portsmouth

Sample type; Sample number; Village name;

Date of filling;

Construction material(s) of different components of the house, tick as appropriate; (accompanied with a sketch free hand drawing on separate sheets)

Material / Member of building	Stone	Wood	Mud	Thatch	Brick	Concrete Block	Concrete	Metal (specify)	Other (specify)	description
Foundation										
Load bearing wall(s)										
Wall of the area raised from the ground										
Floor										
Exterior walls										
Interior walls										
Roof										
Pitched roof cover										
Doors										
Windows										
Parapets										
Fencing around the dwelling land										

Questionnaire 03: about new form demand for house

University of Portsmouth

Sample type; Sample number; Village name;

Date of filling;

1) Your status within household *(in relation to household head- tick as appropriate)*

Husband ☐
Wife ☐
Son ☐
Daughter ☐
Granddaughter ☐
Grandson ☐
Dependant ☐
Other ☐ (specify) ……..

2) Your marital status *(tick as appropriate)*

Married ☐
Single ☐
Divorced ☐
Widow ☐
Other ☐ (specify)……..

3) From which age group are you;

15-24 ☐
25-34 ☐
35-54 ☐
55-74 ☐
+75 ☐

If you are literate please answer questions 4 and 5, otherwise go to question 6:

4) Your level of education *(tick as appropriate)*

Literacy movement ☐
Primary school ☐
Guidance school ☐
High school ☐
University (Technician ☐ Bachelor ☐
Master ☐ PhD ☐

Other ☐ (specify)……..

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5) At what stage of the education are you? *(tick as appropriate)*

Current Scholar	☐
Finished	☐
Taking a Break	☐
Other	☐ (specify)……

6) The questions arranged in the table below are related to the form of exterior and interior of a house. Please tick any place shows your level of agreement or disagreement according to your opinion.

Questions	Strongly agree	agree	neither	disagree	Strongly disagree	Don't know
a)Each member of family is better to have individual room						
b) Living area and gust entertaining area should be in separated room						
c) Kitchen should be open with living area						
d)House should have pitched roof						
e)House should have front semi open porch						
f)Toilet should be inside the house configuration						
g)House is better to be with flat end roof						
h)House is better to have *'Serepish'*						
k)House should be on the ground						
l)House should accommodate more than one family						
m)House should be multi-story						
n)Bath should be inside the house configuration						
p)House should be on the pilot						
q)House should be accompanied with *'Peshtesere'*						

7) Any other opinion or suggestion about the form of the house;

……

……

Thank you very much for your time and answers

Questionnaire 04

Relation to the owner:	Gender:	Type of the house:	Number of the sample:

Setting / Activity																
Eating																
Drinking tea																
Chatting																
Listen to radio																
Smoking																
Watching TV																
Sitting together																
Entertaining Guest																
Playing with children																
Drying vegetables																
Producing cheese and yogurt																
Cultivating vegetable																
Repairing tools																
Writing																
Reading and studying																
Resting during the day																
Sleeping																
Cooking																
Washing dishes																
Washing cloths																
Washing the body (Bathing)																
Drying cloths																
Changing clothes																
Grazing poultries																
Praying																
Washing for praying																
Sacrificing animal																
Barbecue																
Making tea																
Washing hands and feet after work																

Appendix 3: Ethical approval confirmation documents

University of Portsmouth

Majid YousefniaPasha <up604385@myport.ac.uk>

Conditional ethical approval

3 messages

Wendy Powell <wendy.powell@port.ac.uk> 20 February 2015 at 20:54
To: Majid YousefniaPasha <majid.yousefniapasha@myport.ac.uk>
Cc: Catherine Teeling <catherine.teeling@port.ac.uk>

Dear Majid,

A formal notification letter will be issued to you shortly, the text of which is reproduced below:

Dear Majid,

I apologise for the delay in processing your application - we have had a number of committee members ill or away.

I am pleased to inform you that the CCI Faculty Ethics Committee, based on the information you have provided in your initial application and your additional responses to our questions, has given your application for the study entitled 'A generative model for new houses based on the cultural traditions and sustainability of villages in rice fields of north of Iran' (application date 16/01/2015), a **conditional** favourable opinion.

Specific concerns which have been raised for you to bear in mind are:

- A risk assessment should be undertaken for lone working and working in remote areas
- Consideration should be given to sensitivities regarding photography and voice recording, and fully informed consent should be sought (this can be done verbally, but should be recorded where possible), with all potential participants given clear opportunities to withhold or withdraw consent.
- A standard explanation of the study in easily understood terms should be given to participants before engaging them in the data collection process
- Steps should be taken to avoid any perceived or implied coercion to participate (for example, given an impression of authority or influence)
- Given the isolated nature of the communities, are they any plans to disseminate findings back to the stakeholders or participants?

In this instance, the nature of your study means that we are unable to give advice regarding your specific questions or interview techniques, and it is important that you familiarise yourself with the University guidelines on ethical conduct in research before collecting data.

This opinion has been given for this study only, and any changes in the conditions of the study may require you to re-apply for ethical review.

Although the Committee has given a favourable opinion, the final responsibility for the ethical conduct of this work lies, as always, with the researcher(s).

Please note that the Committee reserves the right to re-review this application should any concerns be raised about it in the future.

Your ethical review number is FO:02/15 - 0087

If you have any questions about this, please let me know.

Dr Wendy Powell, PhD, BSc Hons, BA. D.C, FHEA, MBCS

Senior Lecturer in Applications of Virtual Reality

Chair of CCi Faculty Ethics Committee

University of Portsmouth

FORM UPR16

Research Ethics Review Checklist

University of Portsmouth

Please include this completed form as an appendix to your thesis (see the Postgraduate Research Student Handbook for more information

Postgraduate Research Student (PGRS) Information				**Student ID:**	604385
PGRS Name:	Majid Yousefniapasha				
Department:	CCI	**First Supervisor:**	Catherine Teeling		
Start Date: (or progression date for Prof Doc students)	**01.02.2013**				
Study Mode and Route:	Part-time ☐	MPhil ☐	MD ☐		
	Full-time ☒	PhD ☒	Professional Doctorate ☐		

Title of Thesis:	A generative model for new houses based on cultural traditions and sustainability- A study on villages of rice fields in north of Iran
Thesis Word Count: (excluding ancillary data)	77200

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:
(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: http://www.ukrio.org/what-we-do/code-of-practice-for-research/)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES ☒ NO ☐
b) Have all contributions to knowledge been acknowledged?	YES ☒ NO ☐
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES ☒ NO ☐
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES ☒ NO ☐
e) Does your research comply with all legal, ethical, and contractual requirements?	YES ☒ NO ☐

Candidate Statement:

I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):	FO:02/15 - 0087

If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:

UPR16 – August 2015

Signed *(PGRS)*:		**Date:** 30.01.2016

Appendix 4: The table represents sizes of sample houses' components.

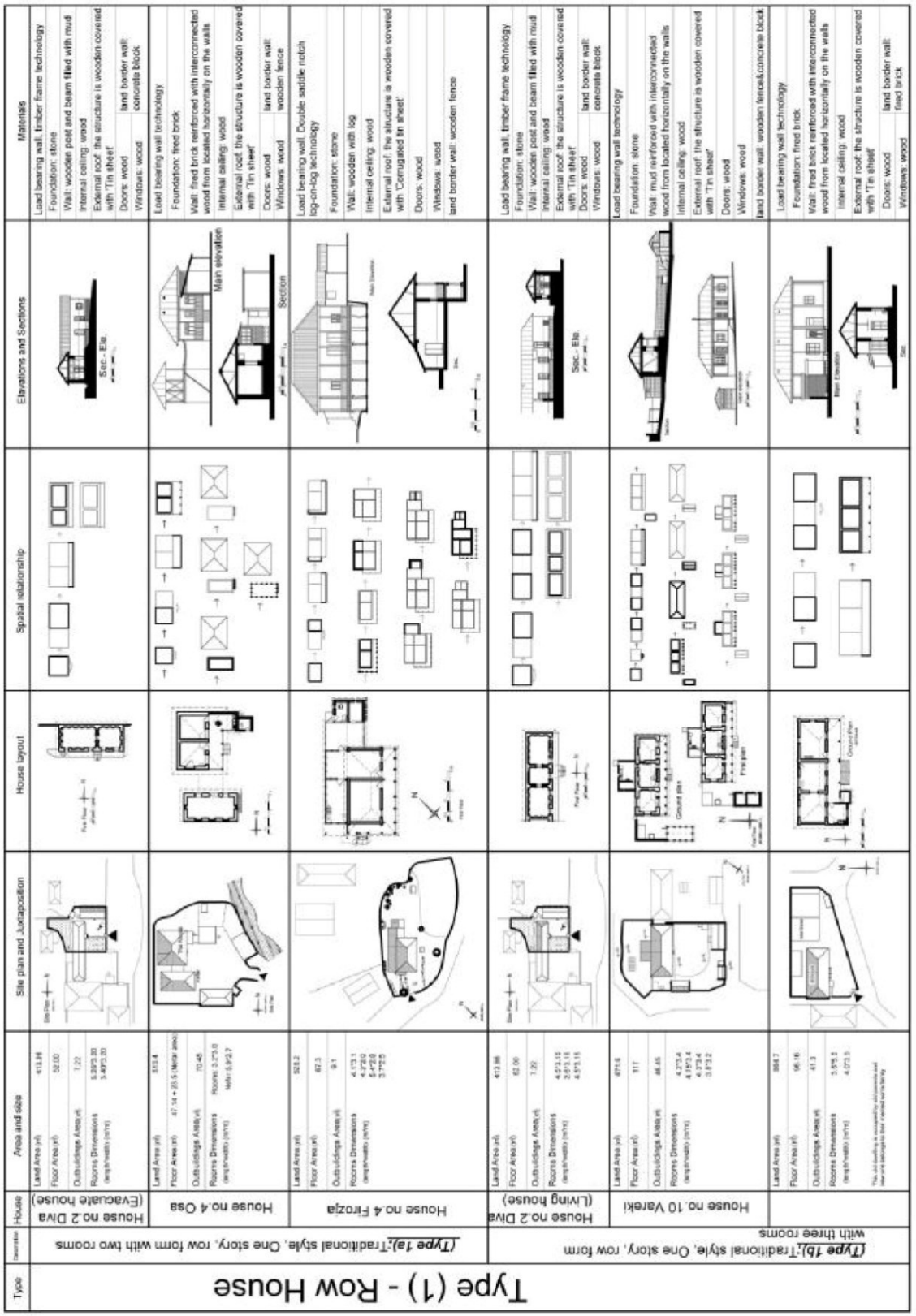
	Land Aera (㎡)	Total floor Aera (㎡)	Service Aera (㎡)	Rooms Dimensions (length*width) (m*m)	Windows (height*width) (m*m)	Doors (height*width) (m*m)	Fenestration ratio in facades(%)			
							south	north	east	west
house 01 Vareki	394	66.78	18.4	3.0*2.5 2.8*2.6 7.3*3.3	1.4*1.2 1.4*1.45	2.0*.8 2.2*1.0	31	5	3	6
house 02 Vareki	387.4	67.2	3.7	3.25*3.8 4.8*3.25 4.65*2.7	1.45*1.3 .95*1.0	1.8*1.0	18	0	0	9.8
house 03 Vareki	666	80.3	70.15	4.15*2.95 4.25*2.95 5.0*3.0	1.2*1.0 .9*1.0	1.9*1.0	0	7	16	0
house 04 Vareki	1040	Old house:92.4 + Nefar:14.6	5	5.5*3.1 5.0*3.5 4.75*3.5	1.2*1.1 .8*.9	1.9*1.0 1.8*1.0	15	2	17	0
		New house: 79.2		3.8*3.0 4.5*3.0 4.3*4.2 4.4*3.1	1.2*1.3	2.0*.8 2.2*1.2	5	10	9	0
house 05 Vareki	698.9	108.42 (92.96+15.46)	17	4.25*3.1 4.2*3.1 4.7*4.2 4.8*2.9	1.0*1.1 1.35*1.1	2.4*1.2 2.0*1.0 2.2*1.0	18	1.9	4	9
house 06 Vareki	630.1	117.1	31.8	5.35*4.2 4.2*5.0 4.4*5.4	1.5*1.5 1.3*1.5	2.2*1.0 2.2*.85	11	4	0	0
house 07 Vareki	244.4	86.9 + Nefar:22.5	3	4.4*3.3 5.0*3.3 4.3*3.3 4.1*3.9(Nefar)	1.4*1.3 1.4*.9 1.1*.9	1.8*.8 1.7*.6 1.7*.9	15	0	0	12
house 08 Vareki	465.5	98	3.1	4.5*3.8 4.0*3.8 5.5*2.5	.9*.9 .9*1.0 1.0*1.4	1.9*.9 2.0*.9	14	0	0	18
house 09 Vareki	511	84.4	25.7	3.0*4.25 4.0*3.0 5.0*2.6	1.3*1.2 .9*1.0 .7*.8	2.2*.9 2.35*.9	16	0	7	0
house 10 Vareki	671.5	117	46.45	4.2*3.4 4.75*3.4 4.3*3.4 3.8*3.2	1.7*1.7 1.7*1.5 1.35*1.2 1.35*1.3	2.4*1.0 2.0*.9	23	9	0	11
house 11 Vareki	548	67	0	Ground floor: 5.8*3.15 3.15*2.6 First floor: 3.1*2.5 3.7*3.0 7.0*3.6	1.2*1.2 1.2*1.4 1.2*1.0	2.4*1.3 2.4*.9	24	9	11	0
house no.1 Osa	215.4	Ground floor: 81.65	31.92	Ground floor: 4.9*3.1 3.3*1.8 4.0*3.0	1.8*1.4 1.8*1.75 1.4*1.0	2.5*2.35 2.5*1.6 2.5*1.0	8.6	4	31	16
		First floor:81.65		First floor: 6.5*3.0 4.9*3.1 4.3*3.3	1.8*1.8 1.2*1.4	2.2*1.0 2.2*2.4 2.2*3.0				
house no.2 Osa	302.7	Ground floor:81.9	39.7	Ground floor: 3.6*3.0 3.4*3.0 4.0*2.4	.7*.7	2.0*1.0	47	12	0	7
		First floor:102.5		First floor: 3.7*3.4 5.7*3.6 5.2*4.0 3.5*3.4	1.6*1.0	2.7*2.6				
house no.3 Osa	470	Ground floor: 74.14	133	Ground floor: 4.6*3.4 4.3*3.0 4.6*4.0	1.4*2.0 .8*1.8	2.1*1.2	25	10	19	36
		First floor: 49		First floor: 4.7*3.4 4.3*3.0 4.6*4.0	2.0*2.4 1.4*2.0	2.4*1.2				
house no.4 Osa	513.4	47.14 + Nefar:23.5	70.48	3.2*3.0 Nefar: 5.9*2.7	1.15*1.6 1.4*1.3	1.9*.8	7	0	20	0
house no.5 Osa	564.7	Old house:96.16	41.3	3.5*5.2 4.0*3.5	1.75*1.45 .8*1.0 1.3*1.0	2.15*1.1 2.15*.95	12	8	4.4	0
		New house:117.7		5.4*3.0 5.4*4.7 5.0*3.5 4.2*4.1	1.0*1.2	2.4*1.8 2.4*1.0	5	0	0	34
house no.6 Osa	1150.5	pilot: 134.9 first floor:151.2	96.6	4.6*3.9 4.1*3.9 7.6*6.1 4.5*3.5	1.0*1.4	2.1*.8 2.1*1.0	38	6	0	0
house no.7 Osa	228.6	Ground floor: 56.9 first floor:56.9	39.6	3.8*3.6 4.6*3.5	1.9*2.1 1.9*1.8	2.4*1.0	50	0	0	9

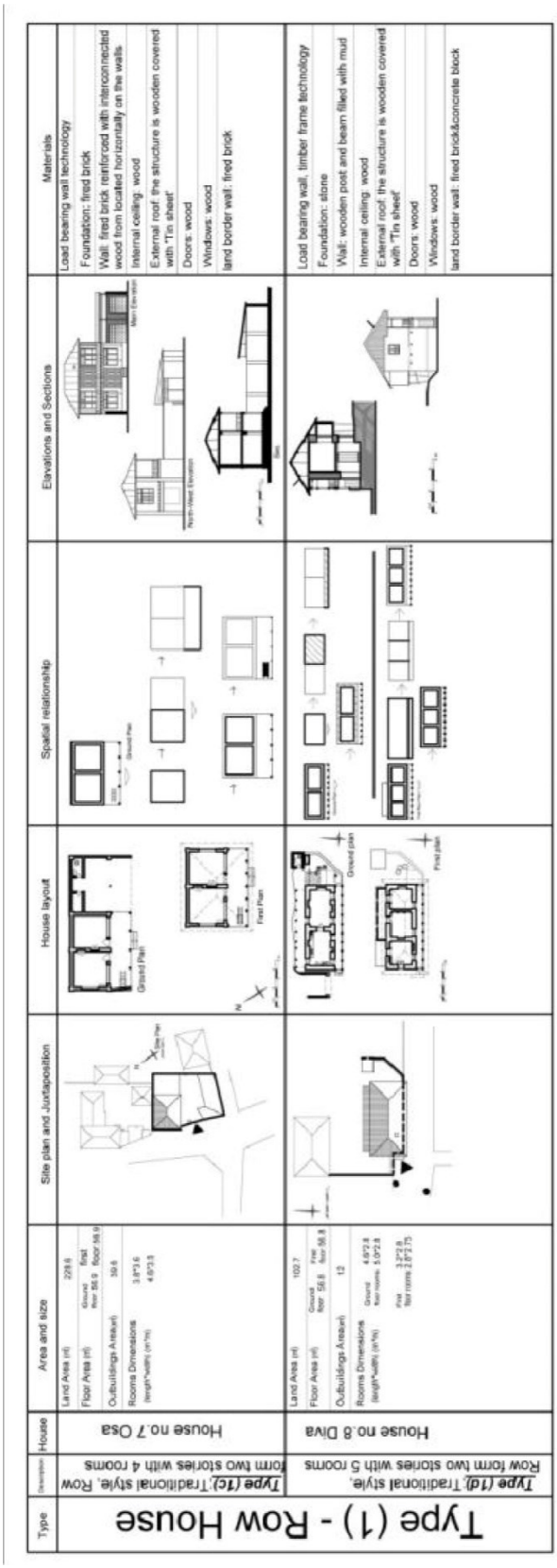
Appendices

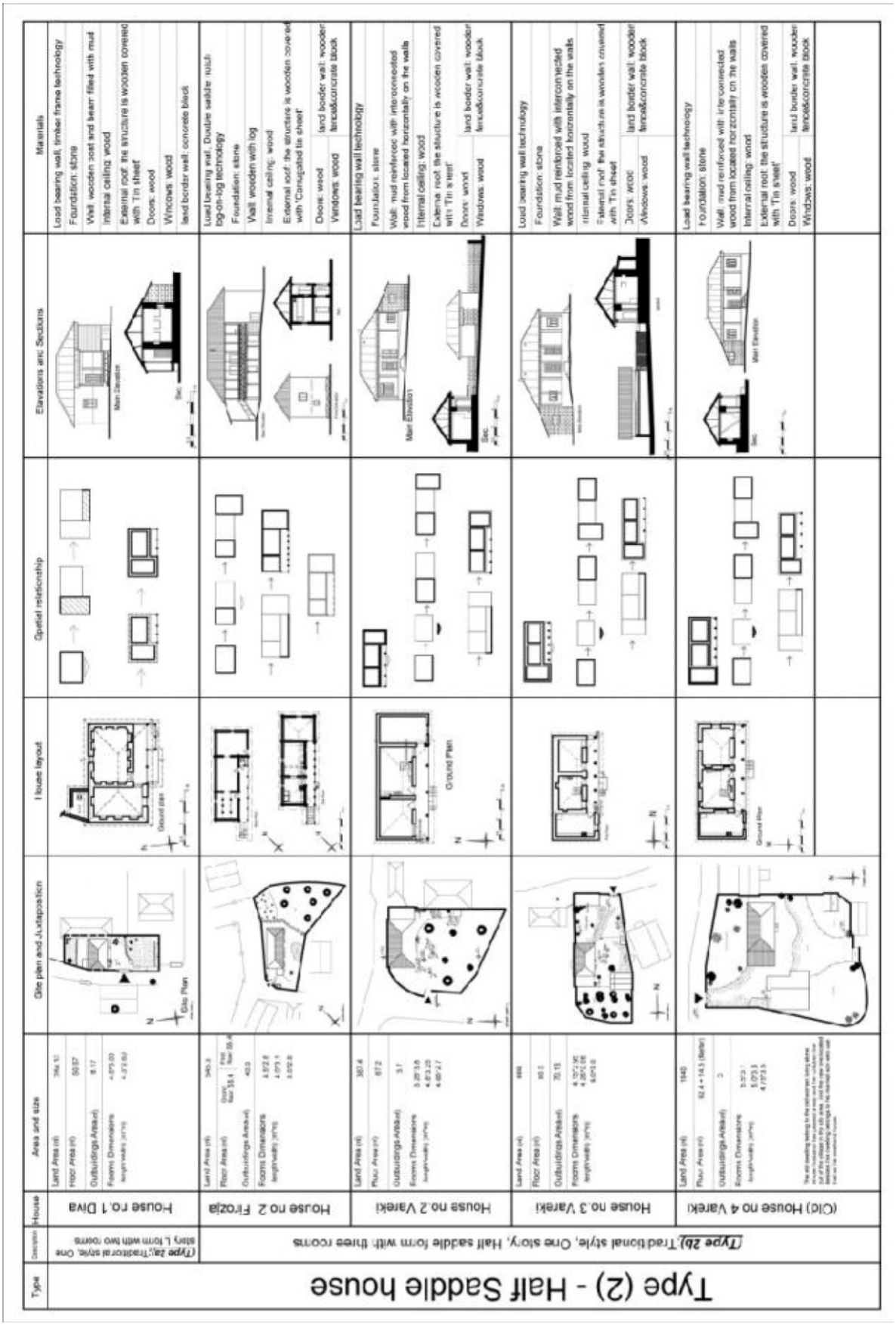
	Land Aera (㎡)	Total floor Aera (㎡)	Service Aera (㎡)	Rooms Dimensions (length*width) (m*m)	Windows (height*width) (m*m)	Doors (height*width) (m*m)	Fenestration ratio in facades(%)			
							south	north	east	west
house no.1 Firozja (Old house)	1457	91.6	68.8	4.25*3.1 4.5*2.8 3.8*2.8 2.8*2.8 4.25*2.8	.88*.88 .88*.7	1.6*.9	8.6	3.4	3.7	2
house no.1 Firozja (New house)	1457	Ground floor:111.2 First floor:111.5	68.8	Ground floor: 3.8*3.0 3.9*3.0 4.0*3.5 5.1*4.1 3.9*3.1 First floor: 4.7*3.0 3.3*3.0 4.6*3.0 6.0*4.0 2.7*3.0	1.2*1.4 1.0*1.2 1.2*1.4 1.0*1.2	2.1*1.0 2.5*1.0 2.1*1.0 2.2*1.3	18	9	1.2	5
house no.2 Firozja	545.3	Grond floor: 55.4 First floor: 55.4	43.3	4.5*2.8 4.0*3.1 3.5*2.8	.9*.75 .6*.5 .6*.7	1.5*1.0	1.4	18.6	8	4
house no.3 Firozja	530.7	Ground floor:100.5 First floor:140.7	163.2	9.1*3.0 5.5*3.5 7.4*4.2 3.2*2.5	1.7*1.6 1.5*1.4 1.0*1.2	2.5*1.0	1.3	12	0	15
house no.4 Firozja	528.2	67.3	9.1	4.1*3.1 4.3*2.0 5.4*2.8 3.7*2.5	.8*.7	1.5*.8	8	0	0	2.3
house no.5 Firozja	436.12	125	75.7	5.4*3.0 3.8*3.1 5.0*3.0 4.0*3.0	1.55*1.5 1.4*1.0	2.1*1.0	16	3.6	0	20
house no.6 Firozja	944.5	104.7	22.76	4.7*2.9 3.0*2.9 4.5*2.9 2.9*2.5 4.5*3.0 2.6*2.4	1.1*.8 .7*.5 .55*.5	1.65*1.0 1.5*.9	13	2	7	7
house no.7 Firozja	545.3	Ground floor:76.9 First floor: 148	126.1	4.1*2.9 3.3*2.9 4.4*6.5	1.3*.95 1.4*1.4 .5*.65	2.1*1.0 2.4*1.0	38	1.2	1	5
house no.8 Firozja	2404	Ground floor:76.36 First floor: 95	145	2.65*4.0 3.7*3.0 3.64*2.4 3.0*2.5	.8*.7 .6*.5	1.5*.9	10	4.3	5	1
house no.9 Firozja	7589	Ground floor: 91 First floor:104.3	192.8	4.0*3.5 3.9*2.55 4.6*3.0 3.0*2.4	.56*.55	1.6*.9	2.8	3.7	1	4.3
house no.1 Diva	284.37	50.57	8.17	4.6*3.00 4.3*2.60	1.2*.80 0.5*.80	1.5*.80	7.8	1.7	0	0
house no.2 Diva	413.98	evacuated house: 50.57 current living house: 56.42	7.22	evacuated: 5.25*3.20 3.40*3.20 current living: 4.5*3.15 2.6*3.15 4.5*3.15	1.0*.90 1.6*.90 .78*.70	1.6*.90 1.55*.75	12 0	0 0	0 16	0 0
house no.3 Diva	636.5	92	21	5.68*3 5.2*2.8 5.0*3.1	1.7*1.26 1.6*1.4 .8*2.00	1.5*.80	14	6	0	9
house no.4 Diva	405.53	Ground floor: 99.16 First floor: 99.16	28.8	Ground floor 4.1*3.3 4.0*3.0 4.8*3.0 5.0*2.4 First floor 7.6*4.1 6.2*3.6	1.6*1.5 1.0*1.2 1.6*1.0 1.6*1.3	2.4*1.0 2.4*1.4 2.0*.9	21	6	18	8
house no.5 Diva	570.9	100	72	3.2*3.0 3.1*2.2 3.0*4.0	1.8*1.75 0.8*1.6	2.4*1.0	39	33	0	0
house no.6 Diva	745.5	Ground floor: 48 First floor: 52.5	51.6	Ground floor: 3.8*3.0 5.0*3.0 First floor: 3.8*3.0 5.0*3.0	1.2*1.2 1.15*.85 1.0*.85 1.2*1.0	1.5*.9 1.6*.9 1.8*.9	12	4	8	11
house no.7 Diva	499.3	115.3	18.3	6.6*3.3 6.3*3.0 4.6*3.0	1.9*2.0 1.3*1.0 1.0*.8	1.8*.9 1.7*1.0 2.0*1.0	5	57	16	1.6
house no.8 Diva	102.7	Ground floor: 56.8 First floor:56.8	12	Ground floor: 4.6*2.8 5.0*2.8 First floor: 3.2*2.8 2.8*2.75	1.3*1.0 1.0*.8 1.0*.8 1.0*.8	1.75*.9 1.75*.9 1.75*.8	16	11	0	3
house no.9 Diva	1000	96.6	0	3.8*3.0 3.0*3.0 6.3*4.0 4.0*3.0	1.0*1.2 1.0*.8	2.0*1.0	6	16	2.4	2

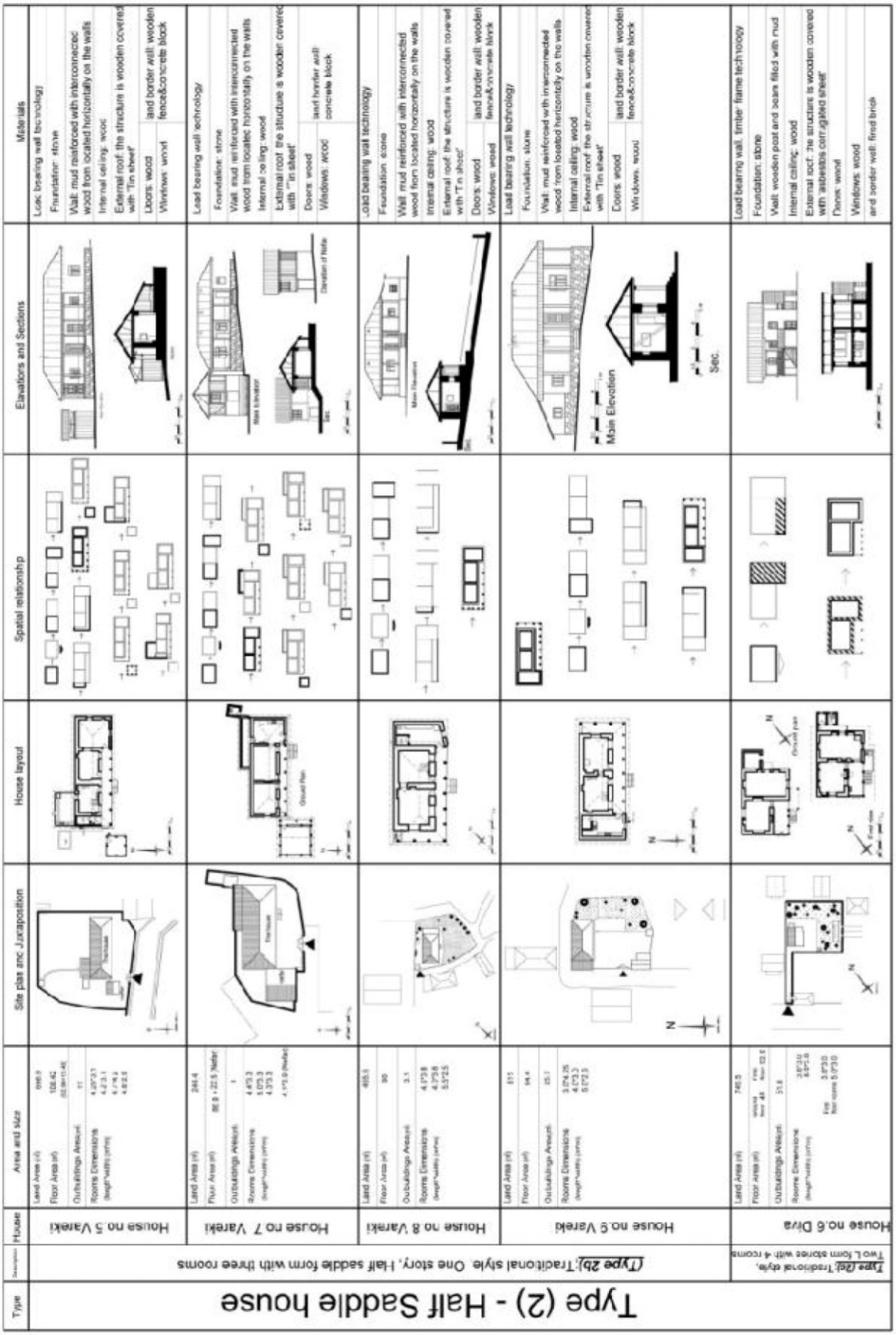
	Land Aera (m^2)	Total floor Aera (m^2)	Service Aera (m^2)	Rooms Dimensions (length*width) (m*m)	Windows (height*width) (m*m)	Doors (height*width) (m*m)	Fenestration ratio in facades(%)			
							south	north	east	west
house no.10 Diva	497.2	Ground floor: 79.5 First floor: 81.37	61.8	Ground floor: 4.8*2.8, 3.0*2.8, 4.9*2.8 First floor: 4.8*2.8, 4.7*2.8, 4.15*3.2	.9*.6 1.8*1.3	1.7*.95 1.7*.95	13	8	10	0
house no.11 Diva	526.3	Ground floor: 85.4 First floor: 117.4	76.2 76.2	4.0*2.8, 4.2*3.2 3.8*2.8, 3.2*2.5 6.4*3.7, 5.6*3.0	1.7*1.5 1.9*1.5	2.0*.9	25	13	8.8	14
house no.12 Diva		Pilot floor: 135.6 First floor: 104.5	60.6	9.0*3.5, 3.2*3.0 3.0.*2.9, 2.9*2.5	1.4*1.45 1.4*1.0	2.2*1.2 2.0*1.0	23	10	0	4
house no.13 Diva	204.9	Ground floor: 75.7 First floor: 75.7	53.2	Ground floor: 6.3*3.4, 4.3*3.4 First floor: 3.4*3.3, 3.7*3.4, 4.8*3.0	1.7*1.3 1.7*1.2	1.8*1.0 2.1*1.0	14	10	0	20
house no.15 Diva	1370.5	Ground floor: 198.2 First floor: 198.2	11.5	Ground floor: 6.2*3.4, 4.0*3.4, 5.0*2.7, 3.4*2.6 First floor: 6.2*3.4, 4.0*3.4, 3.4*2.6	1.6*1.4 1.6*1.2 1.9*1.3	2.1*1.0 1.6*1.0 2.1*1.0	13	6.8	0	5
house no.16 Diva	222.7	83	13.9	3.1*3.0, 6.7*5.6, 2.6*2.4	.95*1.1 1.0*1.4 1.2*1.0	2.0*1.0	12	10	0	9
house no.17 Diva	6690	91.9	11.3	4.0*3.0, 8.5*4.5	1.2*1.2 1.2*1.2 .8*1.0	1.8*1.0	17	4.7	2	5

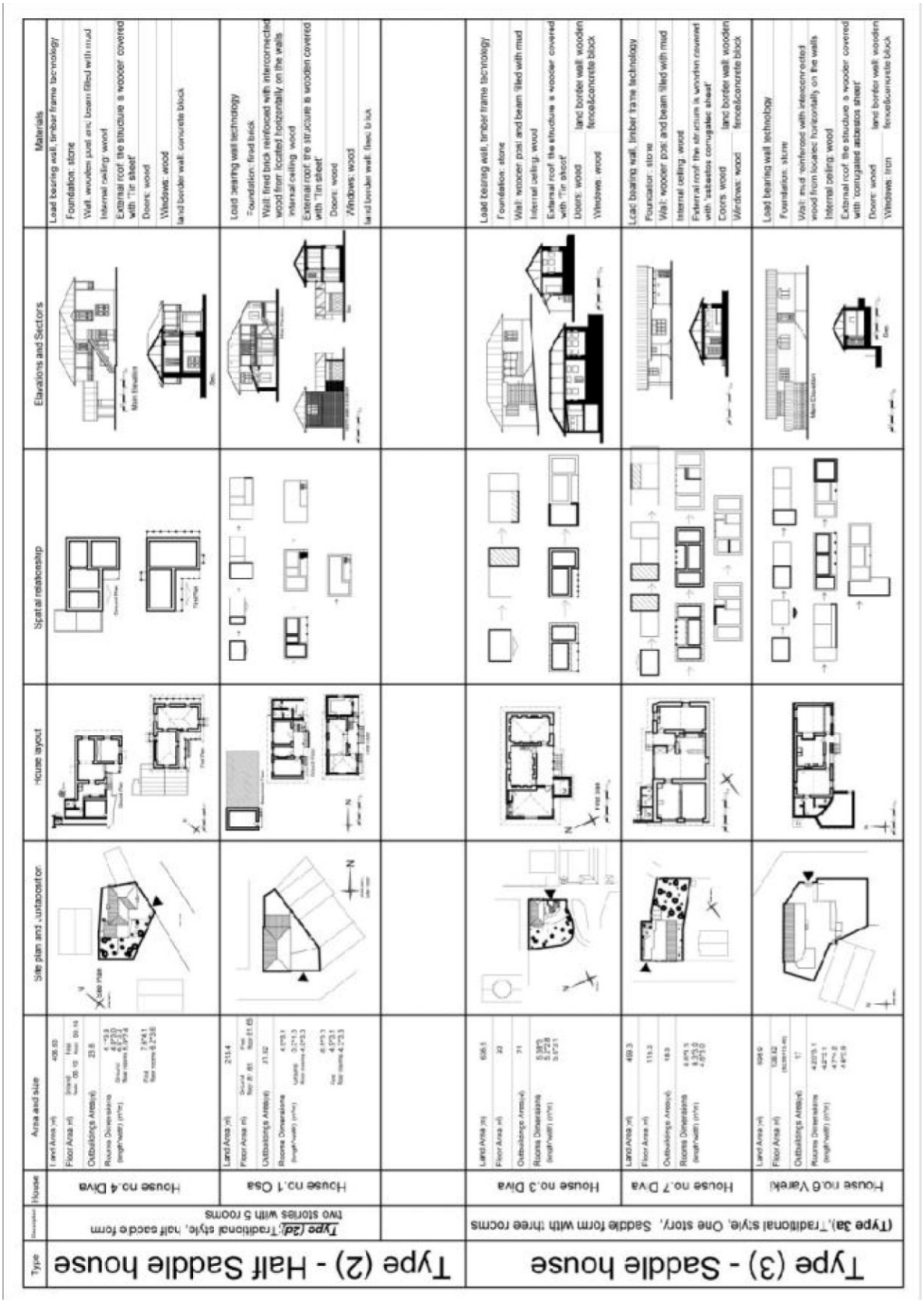
Appendix 5: The table shows typology of all sample houses.



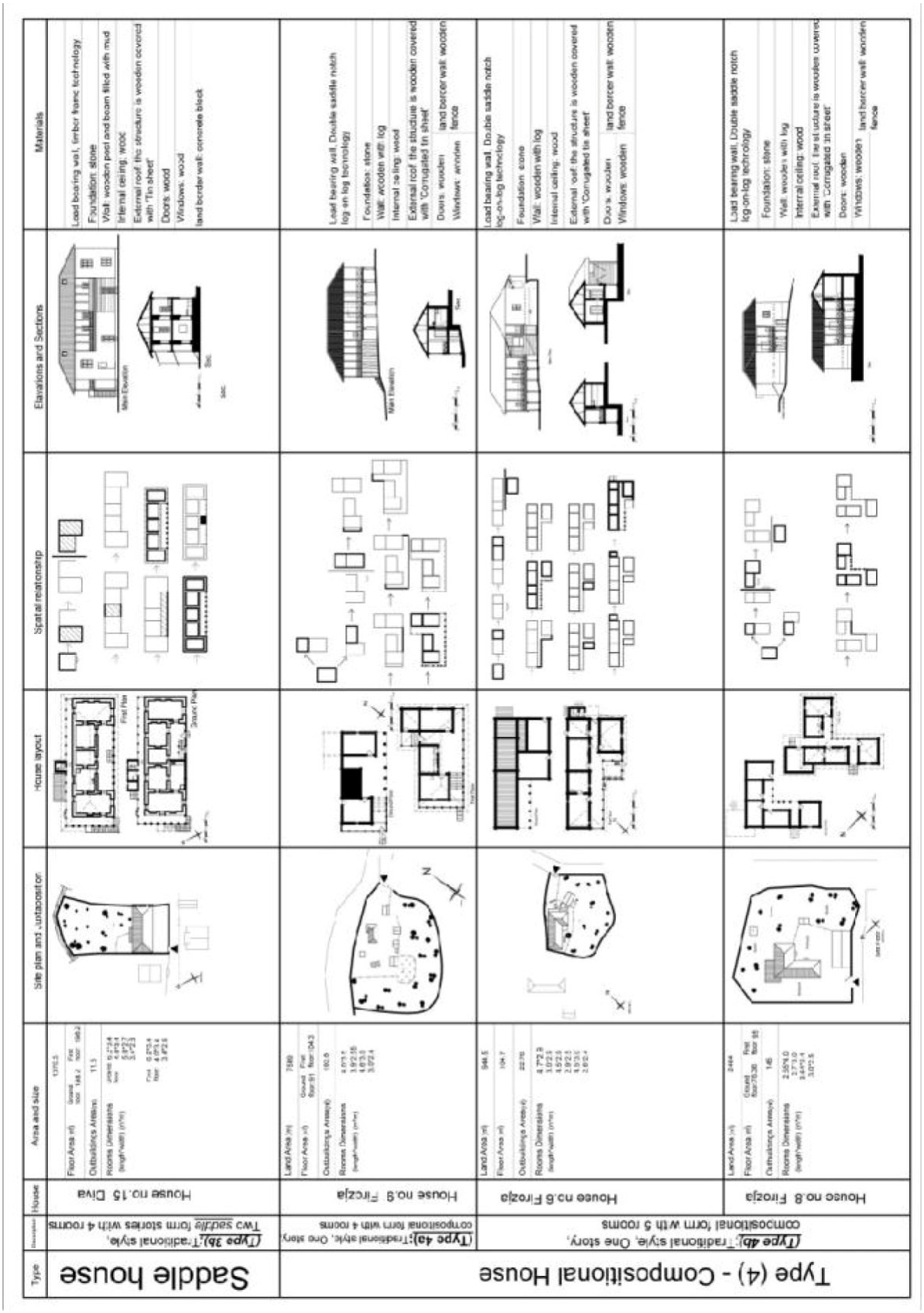

Type (1) - Row House
Type
Description
House
Area and size
Site plan and Juxtaposition
House layout
Spatial relationship
Elevations and Sections
Materials
Type (1c). Traditional style. Row form two stories with 4 rooms
House no.7 Osa
Land Area (sf) 228.6
Floor Area (sf) Ground floor 56.9 First floor 56.9
Outbuildings Area(sf) 39.6
Rooms Dimensions (length*width) (sf/%) 3.8*3.6 4.6*3.8
Load bearing wall technology
Foundation: fired brick
Wall: fired brick reinforced with interconnected wood from located horizontally on the walls
Internal ceiling: wood
External roof: the structure is wooden covered with "Tin sheet"
Doors: wood
Windows: wood
land border wall: fired brick
Type (1d). Traditional style. Row form two stories with 5 rooms
House no.8 Diva
Land Area (sf) 102.7
Floor Area (sf) Ground floor 56.8 First floor 56.8
Outbuildings Area(sf) 12
Rooms Dimensions (length*width) (sf/%) Ground floor rooms 4.6*2.8 5.0*2.8 First floor rooms 3.2*2.8 2.8*2.75
Load bearing wall: timber frame technology
Foundation: stone
Wall: wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with "Tin sheet"
Doors: wood
Windows: wood
land border wall: fired brick&concrete block

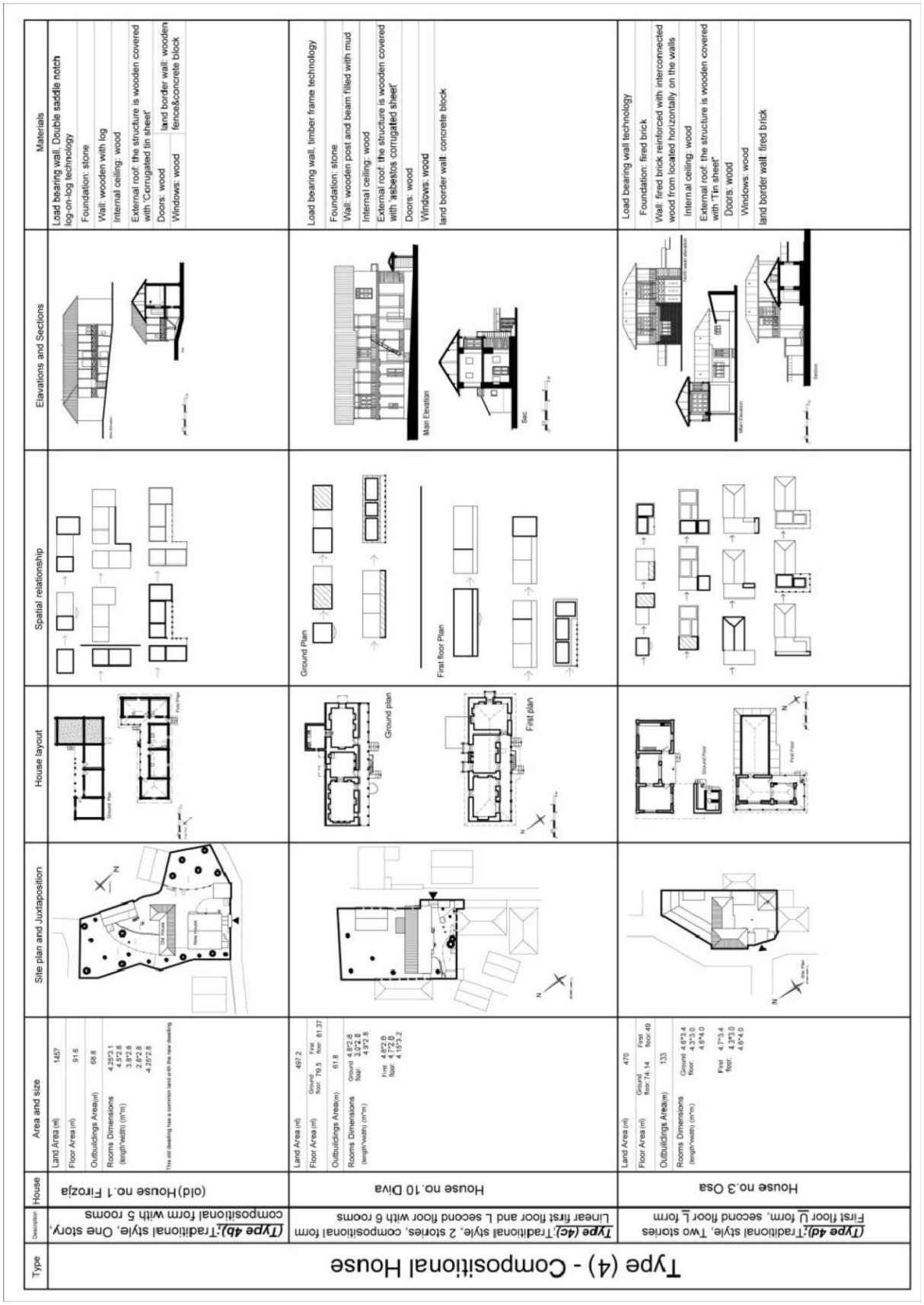

Type (2) - Half Saddle house
Type
Description
House
Area and size
Site plan and Juxtaposition
House layout
Spatial relationship
Elevations and Sections
Materials
Type 2a: Traditional style, One storey L form with two rooms
House no.1 Diva
Site Plan
Ground plan
Load bearing wall, timber frame technology
Foundation: stone
Wall wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with Tin sheet
Doors: wood
Windows: wood
land border wall: concrete block
Type 2b: Traditional style, One storey, Half saddle form with three rooms
House no.2 Firoza
Site Plan
Load bearing wall: Double wall/tie: rubble
Eg-on-log technology
Foundation: stone
Wall wooden with log
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated tin sheet'
Doors: wood
land border wall: wooden
Windows: wood
land border wall: concrete block
House no.2 Vareki
Site Plan
Ground Plan
Load bearing wall technology
Foundation: stone
Wall: mud reinforced with interconnected wood from located horizontally on the walls
Internal ceiling: wood
External roof: the structure is wooden covered with Tin sheet
Doors: wood
land border wall: wooden
Windows: wood
land border wall: concrete block
House no.3 Vareki
Load bearing wall technology
Foundation: stone
Wall mud reinforced with interconnected wood from located horizontally on the walls
Internal ceiling: wood
External roof: the structure is wooden covered with Tin sheet
Doors: wood
land border wall: wooden
Windows: wood
land border wall: concrete block
(Old) House no 4 Vareki
Load bearing wall technology
Foundation: stone
Wall: mud reinforced with interconnected wood from located horizontally on the walls
Internal ceiling: wood
External roof: the structure is wooden covered with 'Tin sheet'
Doors: wood
land border wall: wooden
Windows: wood
land border wall: concrete block


Type (2) - Half Saddle house
Type
House
Site plan and Juxtaposition
House layout
Spatial relationship
Elevations and Sections
Materials
Type 2b: Traditional style. One story, Half saddle form with three rooms
Type 2b: Traditional style, Two L form storey with 4 rooms
House no.5 Vareki
House no.7 Vareki
House no.8 Vareki
House no.9 Vareki
House no.6 Diva
Main Elevation
Sec.

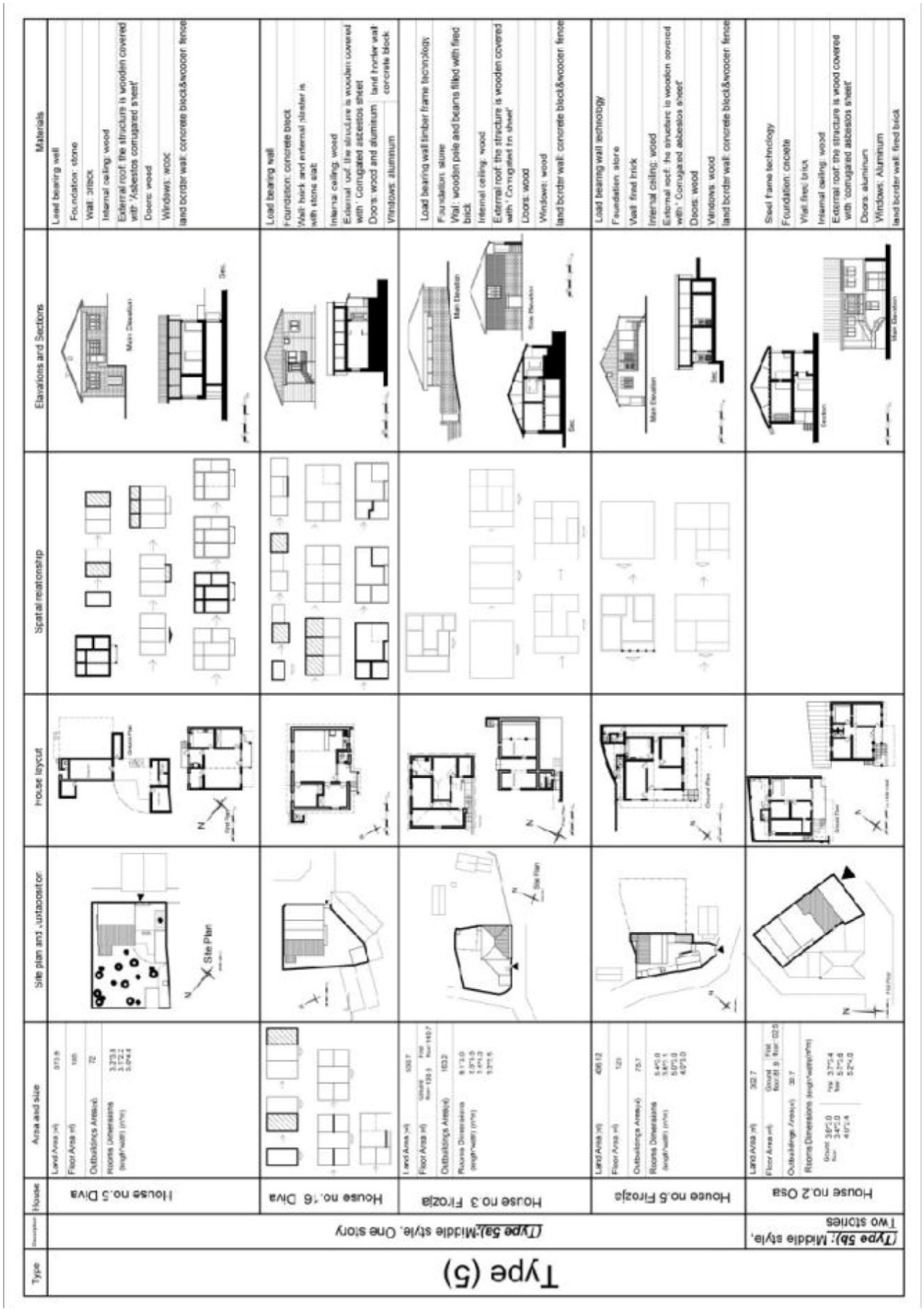


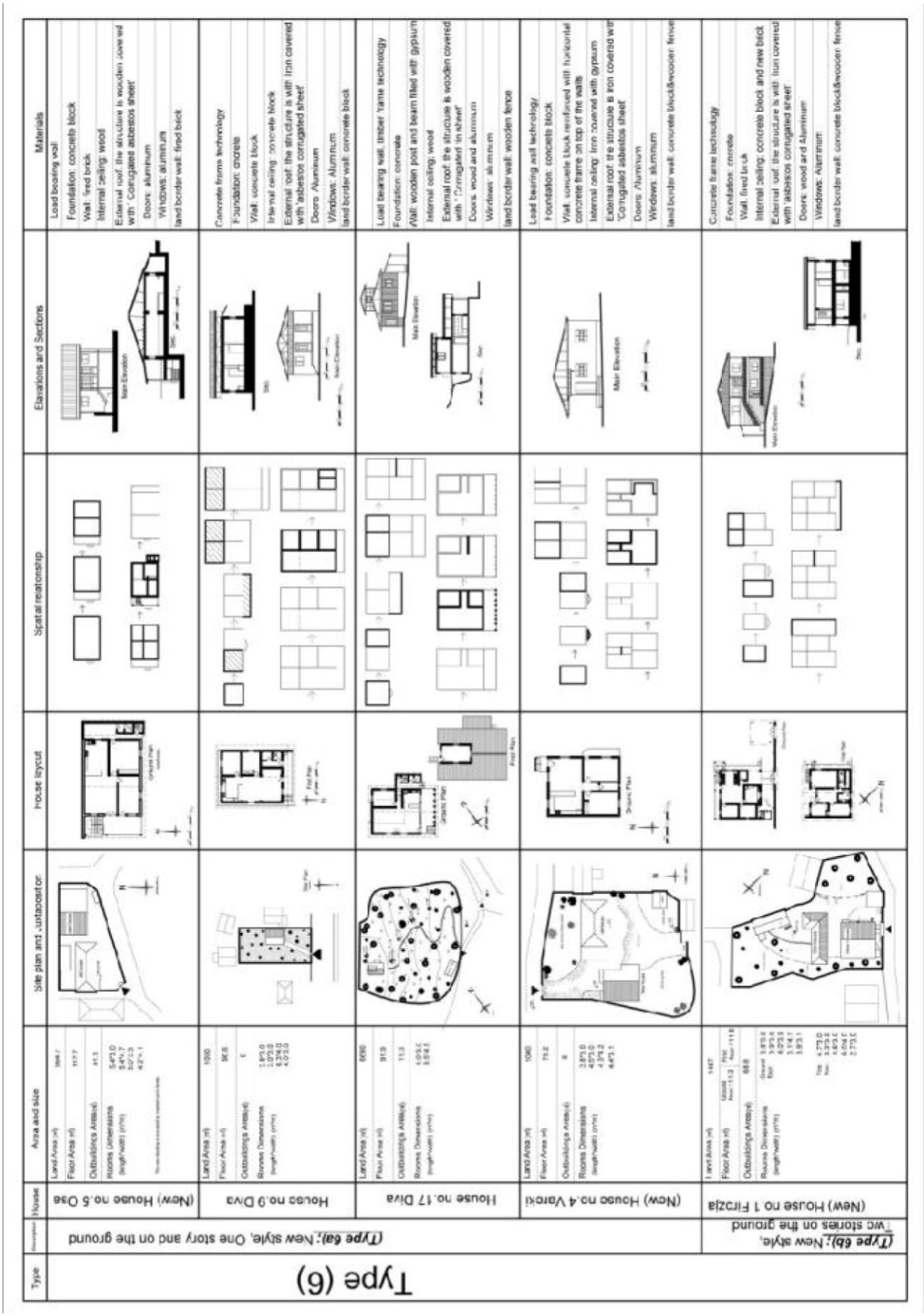
Type	House	Area and size	Site plan and Juxtaposition	House layout	Spatial relationship	Elevations and Sections	Materials
Type (2) - Half Saddle house							
	House no.4 Diva						Load bearing wall, timber frame technology Foundation: stone Wall: wooden post and beam filled with mud Internal ceiling: wood External roof: the structure is wooden covered with 'Tin sheet' Doors: wood Windows: wood land border wall: concrete block
	House no.1 Osa						Load bearing wall technology Foundation: fired brick Wall: fired brick reinforced with interconnected wood from located horizontally on the walls Internal ceiling: wood External roof: the structure is wooden covered with 'Tin sheet' Doors: wood Windows: wood land border wall: fired brick
Type (3) - Saddle house							
(Type 3a),'Traditional style, One story', Saddle form with three rooms	House no.3 Diva						Load bearing wall, timber frame technology Foundation: stone Wall: wooden post and beam filled with mud Internal ceiling: wood External roof: the structure is wooden covered with 'Tin sheet' Doors: wood land border wall: fence&concrete block Windows: wood
	House no.7 Diva						Load bearing wall, timber frame technology Foundation: stone Wall: wooden post and beam filled with mud Internal ceiling: wood External roof: the structure is wooden covered with 'asbestos corrugated sheet' Doors: wood land border wall: fence&concrete block Windows: wood
	House no.6 Vareki						Load bearing wall technology Foundation: stone Wall: mud reinforce with interconnected wood from located horizontally on the walls Internal ceiling: wood External roof: the structure is wooden covered with 'corrugated asbestos sheet' Doors: wood land border wall: fence&concrete block Windows: iron

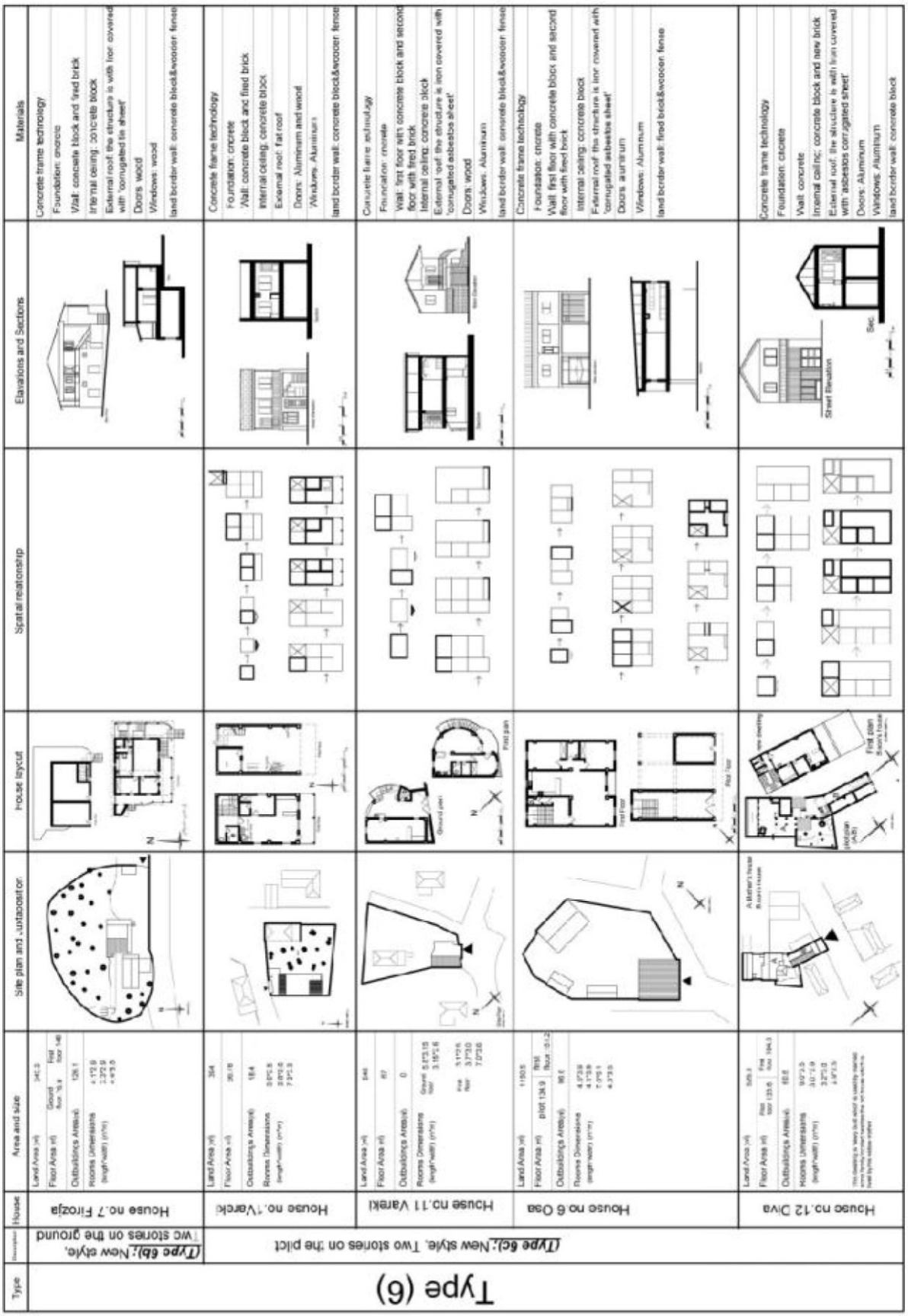

Type
Saddle house
Type (4) - Compositional House
Type 3b: Traditional style, Two saddle form storeys with 4 rooms
Type 4a: Traditional style, One storey, compositional form with 4 rooms
Type 4b: Traditional style, One storey, compositional form with 5 rooms
House
House no.15 Diva
House no.9 Firoza
House no.8 Firoza
Area and size
Site plan and Juxtaposition
House layout
Spatial relationship
Elevations and Sections
Materials
Load bearing wall, timber frame technology
Foundation: stone
Wall: wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with 'Tin sheet'
Doors: wood
Windows: wood
land border wall: concrete block
Load bearing wall, Double saddle notch log on log technology
Foundation: stone
Wall: wooden with log
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated tin sheet'
Doors: wooden
land border wall: wooden fence
Windows: wooden
Load bearing wall, Double saddle notch log-on-log technology
Foundation: stone
Wall: wooden with log
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated tin sheet'
Doors: wooden
land border wall: wooden fence
Windows: wooden
Load bearing wall, Double saddle notch log-on-log technology
Foundation: stone
Wall: wooden with log
Internal ceiling: wood
External roof: The structure is wooden covered with 'Corrugated tin sheet'
Doors: wooden
land border wall: wooden fence
Windows: wooden


Type (4) - Compositional House
Type
Description
House
Area and size
Site plan and Juxtaposition
House layout
Spatial relationship
Elevations and Sections
Materials
(Type 4b):Traditional style, One story, compositional form with 5 rooms
(old)House no.1 Firozja
Land Area (㎡) 1457
Floor Area (㎡) 91.6
Outbuildings Area(㎡) 68.8
Rooms Dimensions (length*width) (m*m) 4.25*3.1 4.5*2.8 3.9*2.8 2.8*2.8 4.25*2.8
*The old dwelling has a common land with the new dwelling
Load bearing wall. Double saddle notch log-on-log technology
Foundation: stone
Wall: wooden with log
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated tin sheet'
Doors: wood
land border wall: wooden fence&concrete block
Windows: wood
(Type (4c):Traditional style, 2 stories, compositional form Linear first floor and L second floor with 6 rooms
House no.10 Diva
Land Area (㎡) 497.2
Floor Area (㎡) Ground floor: 79.5 First floor: 81.37
Outbuildings Area(㎡) 61.8
Rooms Dimensions (length*width) (m*m) Ground floor: 4.8*2.8 3.8*2.8 4.9*2.8
First floor: 4.8*2.8 4.8*2.8 4.15*3.2
Ground Plan
First floor Plan
Main Elevation
Sec.
Load bearing wall, timber frame technology
Foundation: stone
Wall: wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with asbestos corrugated sheet
Doors: wood
Windows: wood
land border wall: concrete block
(Type 4d):Traditional style, Two stories First floor U form, second floor L form
House no.3 Osa
Land Area (㎡) 470
Floor Area (㎡) Ground floor: 74.14 First floor:49
Outbuildings Area(㎡) 133
Rooms Dimensions (length*width) (m*m) Ground floor: 4.6*3.4 4.3*3.0 4.6*4.0
First floor: 4.7*3.4 4.3*3.0 4.6*4.0
Load bearing wall technology
Foundation: fired brick
Wall: fired brick reinforced with interconnected wood from located horizontally on the walls
Internal ceiling: wood
External roof: the structure is wooden covered with 'Tin sheet'
Doors: wood
Windows: wood
land border wall: fired brick


Type (4) - Compositional House
Type
Description
House
Area and size
Site plan and ,ustaoistor
House layout
Spatial relationship
Elevations and Sections
Materials
(Type 4a):Traditional style, Two stories First floor L form, second floor Linear
House no.13 Diva
Land Area (m)
Floor Area (m)
Outbuildings Area(s)
Rooms Dimensions (length/width) (m/m)
Site Plan
Ground Floor
First Floor
Main Elevation
Sec
Load bearing wall: timber frame technology
Foundation: stone
Wall: wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with "Tin corrugated and non-corrugated sheet"
Doors: wood
Windows: wood
land border wall: concrete block
(Type 4b):Traditional style, Two stories composed of multi L forms
House no.19 Diva
North-east Elevation
Load bearing wall: timber frame technology
Foundation: stone
Wall: wooden post and beam filled with mud
Internal ceiling: wood
External roof: the structure is wooden covered with "wooden shingle"
Doors: wood
Windows: wood
land border wall: fired brick


Type (5)
Type
House
Description
Site plan and ,ustaoositor
house layout
Spatial realtonstip
Elavations and Sections
Materials
House no.5 Diva
House no.'6 Diva
House no.3 Firozja
House no.5 Firozja
House no.2 Osa
(Type 5a):Middle style. One story
(Type 5b): Middle style, Two stories
Site Plan
Main Elevation
Sec
Load bearing wall
Foundation: stone
Wall: stack
Internal ceiling: wood
Doors: wood
Windows: wood
land border wall: concrete block&wooden fence
Load bearing wall
Foundation: concrete block
Wall: brick and external plaster is with stone slab
Internal ceiling: wood
Doors: wood and aluminum
Windows: aluminum
concrete block
Load bearing wall timber frame technology
Foundation: stone
Wall: wooden pole and beams filled with fired brick
Internal ceiling: wood
Doors: wood
Windows: wood
Load bearing wall technology
Foundation: stone
Wall: fired brick
Internal ceiling: wood
Doors: wood
Windows: wood
Steel frame technology
Foundation: concrete
Wall: fired brick
Internal ceiling: wood
Doors: aluminum
Windows: Aluminum
land border wall: fired brick


Type (6)
Type
Description
House
Area and size
Site plan and surroundings
House layout
Spatial relationship
Elevations and Sections
Materials
(Type 6a): New style, One story and on the ground
(Type 6b): New style, WC stores on the ground
(New) House no.5 O3a
House no.9 D1v3
House no.17 D1v3
(New) House no.4 Varaki
(New) House no.1 Firdzija
Load bearing wall
Foundation: concrete block
Wall: fired brick
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated asbestos sheet'
Doors: aluminium
Windows: aluminium
land border wall: fired brick
Concrete frame technology
Foundation: chrete
Wall: concrete block
Internal ceiling: concrete block
External roof: the structure is with iron covered with 'asbestos corrugated sheet'
Doors: Aluminum
Windows: Aluminum
land border wall: concrete block
Load bearing wall: timber frame technology
Foundation: concrete
Wall: wooden post and beam filled with gypsum
Internal ceiling: wood
External roof: the structure is wooden covered with 'Corrugated tin sheet'
Doors: wood and aluminum
Windows: aluminum
land border wall: wooden fence
Load bearing wall technology
Foundation: concrete block
Wall: concrete block reinforced with horizontal concrete frame on top of the walls
Internal ceiling: iron covered with gypsum
External roof: the structure is iron covered with 'Corrugated asbestos sheet'
Doors: Aluminum
Windows: aluminum
land border wall: concrete block&wooden fence
Concrete frame technology
Foundation: chrete
Wall: fired brick
Internal ceiling: concrete block and new brick
External roof: the structure is with iron covered with asbestos corrugated sheet
Doors: wood and Aluminum
Windows: Aluminum
land border wall: concrete block&wooden fence


Type (6)
Type
Description
House
Area and size
Site plan and outdoor or
House layout
Spatial relationship
Elevations and Sections
Materials
(Type 6b): New style, Two stories on the ground
(Type 6c): New style, Two stories on the plot
House no.7 Firozja
House no.'1Varcki
House no.11 Varski
House no 6 Osa
House no.12 Oiva
Concrete frame technology
Foundation: concrete
Wall: concrete block and fired brick
Internal ceiling: concrete block
External roof: the structure is with iron covered with 'corrugated tin sheet'
Doors: wood
Windows: wood
land border wall: concrete block&wooden fense
Concrete frame technology
Foundation: cnorete
Wall: concrete block and fired brick
Internal ceiling: concrete block
External roof: flat roof
Doors: Aluminum and wood
Windows: Aluminum
land border wall: concrete block&wooden fense
Concrete frame technology
Foundation: cnorete
Wall: first floor with concrete block and second floor with fired brick
Internal ceiling: concrete slick
External roof: the structure is iron covered with 'corrugated asbestos sheet'
Doors: wood
Windows: Aluminum
land border wall: concrete block&wooden fense
Concrete frame technology
Foundation: cnorete
Wall: first floor with concrete block and second floor with fired brick
Internal ceiling: concrete block
External roof: the structure is iron covered with 'corrugated asbestos sheet'
Doors: aluminum
Windows: Aluminum
land border wall: fired brick&wooden fense
Concrete frame technology
Foundation: cnorete
Wall: concrete
Internal ceiling: concrete block and new brick
External roof: the structure is with iron covered with 'asbestos corrugated sheet'
Doors: Aluminum
Windows: Aluminum
land border wall: concrete block