

Assessing the Role of Courtyards in the Spatial Organization of the Traditional Houses of Kashan

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the Degree of

Doctor of Philosophy
in
Architecture

Eastern Mediterranean University
June 2015
Gazimağusa, North Cyprus

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ABSTRACT

Traditional houses of Iran possess significant qualities in terms of being responsive to the local context; not only from environmental aspects, but also by highly consideration of cultural values, and certainly, along with responding to the functional requirements of the inhabitants. Kashan as a city with 7000 years historical precedents encompasses a great number of traditional houses that worth to be studied in detail. The study of spatial organization of such houses is a fundamental issue in order to comprehend the topological relationships of the spaces, specifically based on the socio-cultural features. The study classifies and examines thirty traditional houses of Kashan by implementing several methods; mainly as schematic analysis of the houses and space syntax method, to clarify their spatial organizations. It should be mentioned that, courtyard that is known as the key component in the spatial organization of these houses is the basis of their classifications.

Under this scope, the study is carried out in five chapters; the first chapter defines the problem and the necessity of such a study as well as the main objectives, and the process of handling the study.

The second chapter provides information on the traditional residential architecture of Iran and its formation under the impacts of socio-cultural aspects as well as physical and environmental issues. Moreover, the general design principles and the main spaces in the traditional Iranian houses are explained.

Following that the third chapter deals with the identification and evolution of Kashan city as the context of the study. Accordingly, some explanations are given regard to

the location and climatic characteristics of the city along with its establishment and evolution throughout the history.

In the fourth chapter, the traditional houses of Kashan are discussed in terms of their general architectural characteristics, and specifically on the existence of courtyard in them. Subsequently, the selected houses are classified, and analyzed through the schematic analysis, which clarifies some characteristics on their space organizations. Moreover, the spatial analysis of the houses is done by utilization of the space syntax method, which provides the syntactic data of the houses, and some findings and discussions are presented related to the inequality genotypes, rings, control values and generally verifying the role of courtyard in these houses.

In conclusion, that is the fifth chapter; the results of the study are highlighted as well as the significance of comprehending the traditional architecture of the city in order to create identifiable contemporary architectural designs. In view of that, the traditional houses of Kashan and their specific characteristics should be sustained in order to achieve architectural continuity and maintain the identity of the city.

Keywords: Spatial Organization, Courtyard, Traditional Houses, Kashan, Iran.

ÖZ

Geleneksel İran evleri, çevreye gösterdiği duyarlılığın yanısıra, kültürel değerlere ve kullanıcılarının ihtiyaçlarına yönelik geliştirmiş olduğu çözümler nedeniyle yerel dokuya uygun önemli bir mimariye sahiptir. 7000 yıllık geçmişe sahip olan Kashan şehri çok sayıda geleneksel İran evine ev sahipliği etmektedir. Bu tür evlerin mekansal organizasyonunun anlaşılması için doğru ve kapsamlı bir şekilde mekanların topolojik ilişkisi özellikle sosyo-kültürel değerler dikkate alınarak incelenmelidir. Bu çalışmada, geleneksel otuz Kashan evi, şematik analiz, mekansal sentaks gibi çeşitli yöntemler kullanılarak incelenmiş ve sınıflandırılmıştır. Bu tip evler mekansal organizasyonunda önemli bir unsur olarak Kabul edilen avlu, sınıflandırmanın temelini oluşturmaktadır.

Bu bağlamda, çalışma beş bölümden oluşmaktadır. Birinci bölümde problem araştırma, çalışmanın gerekliliği, hedefleri ve süreçleri tanımlanmıştır. Çalışmanın ikinci bölümünde İran geleneksel konut mimarisi ve sosyo-kültürel, fiziksel, çevresel değerlerin bu tip mimari üzerindeki etkileri hakkında bilgi verilmiştir. Ayrıca, geleneksel İran evinin genel tasarım prensipleri ve başlıca temel mekanlar açıklanmıştır.

Üçüncü bölümde, Kashan şehrinin oluşumu ve gelişimi çalışma kapsamında anlatılmıştır. Aynı kapsamda, tarihsel süreç boyunca şehrin konumu ve iklimsel özellikleri, kentin kuruluşu ve gelişimi açıklanmıştır.

Dördüncü bölümde, geleneksel Kashan evlerinin, özellikle avlunun varlığı ve konumu temel alınarak genel mimari karakterleri tartışılmıştır. Sonrasında, seçilen

evler, mekansal organizasyonu açıklamaya yardımcı olan şematik analizler sonucunda sınıflandırılmış ve değerlendirilmiştir. Ayrıca, mekan analizleri, mekansal sentaks (space syntax) metodu izlenerek yapılmıştır. Böylelikle, konutların sentatik bilgileri, sonuçlar ve karşılaştırılmalı tartışmalarda, avlunun konut biçimlenmesindeki rolü belirlenmiştir.

Sonuç bölümü olan beşinci kısımda, bu çalışma kapsamında elde edilen sonuçlar ve Kashan şehri geleneksel konut mimarisinin önemi ve çağdaş mimari tasarımlar elde etmek için içerdiği ipuçları vurgulanmıştır. Bu bilgiler ışığında, geleneksel Kashan evleri ve belirlenen özgün mimari karakteristikleri, mimari sürekliliği sağlamak ve kentin kimliğini korumak için sürdürülebilir olmalıdır.

Anahtar kelimeler: Mekansal Organizasyon, Avlu, Geleneksel Evler, Kashan, Iran.

DEDICATION

... dedicated to my family

ACKNOWLEDGEMENT

I would initially like to express my sincere gratitude to my supervisor Prof. Dr. Ozgur Dincyurek and my co-supervisor, Prof. Dr. Ibrahim Numan, for their vast knowledge and invaluable feedbacks. This thesis would not have been completed without their supports and trust in me.

I would also like to say special thanks to Assoc. Prof. Dr. Mukaddes Fasli and Prof. Dr. Hifsiye Pulhan for their helpful advices, supports and contributions to the study. I am also thankful to Prof. Dr. Nuran Kara Pilehvarian, Prof. Dr. M. Bülent Uluengin and Prof. Dr. Kokan Grchev for their presence in my jury and sharing their valuable ideas with me.

I should also thank Ali Akbar Helli, the general manager of Kashan Art Organization for sharing his valuable information and experiences on the traditional houses of Kashan. I am also thankful to all my friends for being with me, supporting me and encouraging me through all stages of my study. I should say my special thanks to Arash Vahedi for his valuable assistance. I should also say my deep thanks to Kamyar Arab who has been always my great support and never left me alone.

At last but not least, the deepest thanks go to my family; my parents, my brother and sisters, for the support they provide me throughout my life. Without their understanding and help this thesis would remain only a dream.

Thank you all...

TABLE OF CONTENTS

ABSTRACT	iii
ÖZ	v
DEDICATION.....	vii
ACKNOWLEDGEMENT	viii
LIST OF TABLES.....	xii
LIST OF FIGURES	xiv
1 INTRODUCTION	1
1.1 Background Study	2
1.2 Aims and Objectives.....	5
1.3 Research Methodology	6
1.4 Limitations of the Study	10
2 IMPACTS ON THE FORMATION OF TRADITIONAL RESIDENTIAL ARCHITECTUREOF IRAN.....	12
2.1 Socio-Cultural Aspects on the Formation of Traditional Iranian Houses	13
2.1.1 Demographic features and Life style	13
2.1.2 Privacy.....	14
2.1.3 Introverted approach	15
2.1.4 Respecting Neighborhood	16
2.2 Physical and Environmental Aspects on the Formation of Traditional Iranian Houses	16
2.2.1 The Northern Coastal Region with Mild–Humid Climate	17
2.2.2 The Mountainous Region with Cold Climate.....	18
2.2.3 The Southern Coastal Region with Hot–Humid Climate	19

2.2.4 The Plateau Region with Hot–Arid Climate.....	19
2.3 General Design Principles in the Traditional Iranian Houses.....	20
2.4 Main Spaces in the Traditional Iranian Houses	23
3 THE IDENTIFICATION AND EVOLUTION OF KASHAN CITY	30
3.1 Location and Climatic Characteristics of the Kashan City.....	30
3.2 Etymology of Kashan	31
3.3 Establishment and Evolution of the Kashan City throughout History	32
3.3.1 Early years of Islam till Al-e-Bouyeh period (3 rd Hijri-Qamari Century) .	34
3.3.2 Seljukid Period (4 th Hijri-Qamari century /1040 - 1157 AD).....	35
3.3.3 Ilkhanid till Safavid period.....	37
3.3.4 Safavid and Qajar periods	38
3.3.5 Pahlavi’s period	40
3.4 Morphology of the City Context	41
4 TRADITIONAL HOUSES OF KASHAN.....	44
4.1 General Architectural Characteristics of the Traditional Houses in the Kashan City	45
4.2 Courtyard in the Traditional Houses of Kashan City.....	55
4.2.1 Historical Perspective of Courtyard.....	55
4.2.2 Courtyard and Privacy.....	57
4.2.3 Position of Courtyard	58
4.2.4 Space Arrangement around Courtyard.....	60
4.2.5 Accessibility to Courtyards	62
4.3 Classification of the Traditional Houses of Kashan based on Courtyard.....	63
4.3.1 One Courtyard Houses	64
4.3.1.1 Two Sided Built (opposite or alongside)	64

4.3.1.2 Three Sided Built.....	68
4.3.1.3 Four Sided Built	73
4.3.2 Two or Three Courtyard Houses.....	76
4.3.2.1 One Outer and One Inner Courtyard	76
4.3.2.2 One Outer and Two Inner Courtyards	82
4.3.3 Multi Courtyard Houses (Family Complexes)	84
4.4 Spatial Analysis of the Traditional Houses of Kashan.....	91
4.4.1 Inequality Genotypes.....	104
4.4.2 Rings.....	112
4.4.3 Control Values	115
5 CONCLUSION.....	118
REFERENCES.....	123
APPENDICES	132
Appendix A: Tables for Classification of the Selected Houses.....	133
Appendix B: Syntactic Data of the Selected Houses	164

LIST OF TABLES

Table 1.1. Tables' Layout for Classification of the Traditional Houses of Kashan	7
Table 4.1a. Schematic Analysis of the 2 Sided Built, One Courtyard Houses	66
Table 4.1b. Schematic Analysis of the 2 Sided Built, One Courtyard Houses	67
Table 4.2a. Schematic Analysis of the 3 Sided Built, One Courtyard Houses	69
Table 4.2b. Schematic Analysis of the 3 Sided Built, One Courtyard Houses	70
Table 4.2c. Schematic Analysis of the 3 Sided Built, One Courtyard Houses	71
Table 4.2d. Schematic Analysis of the 3 Sided Built, One Courtyard Houses	72
Table 4.3a. Schematic Analysis of the 4 Sided Built, One Courtyard Houses	74
Table 4.3b. Schematic Analysis of the 4 Sided Built, One Courtyard Houses	75
Table 4.4a. Schematic Analysis of the Two Courtyard Houses	78
Table 4.4b. Schematic Analysis of the Two Courtyard Houses	79
Table 4.4c. Schematic Analysis of the Two Courtyard Houses	80
Table 4.4d. Schematic Analysis of the Two Courtyard Houses	81
Table 4.5a. Schematic Analysis of the Three Courtyard Houses	83
Table 4.5b. Schematic Analysis of the Three Courtyard Houses	84
Table 4.6a. Schematic Analysis of the Multi Courtyard Houses	86
Table 4.6b. Schematic Analysis of the Multi Courtyard Houses	87
Table 4.7a. Justified Graphs of the 3 Sided Built, One Courtyard Houses	94
Table 4.7b. Justified Graphs of the 3 Sided Built, One Courtyard Houses	95
Table 4.8. Justified Graphs of the 2 Sided Built, One Courtyard Houses	96
Table 4.9. Justified Graphs of the 4 Sided Built, One Courtyard Houses	97
Table 4.10a. Justified Graphs of the Two Courtyard Houses	98
Table 4.10b. Justified Graphs of the Two Courtyard Houses	99

Table 4.11. Justified Graphs of the Three Courtyard Houses	100
Table 4.12. Justified Graphs of the Multi Courtyard Houses.....	101
Table 4.13. Integration Order of Functions in the Traditional Houses of Kashan ...	104
Table 4.14. Rings in the Traditional Houses of Kashan	113
Table 4.15. Control Values in the Traditional Houses of Kashan.....	115

LIST OF FIGURES

Figure 2.1. Climatic classification of Iran.....	17
Figure 2.2. A typical traditional house in Mild–Humid Climate	18
Figure 2.3. Typical traditional houses in Cold Climate.....	18
Figure 2.4. Typical traditional houses in Hot-Humid Climate.....	19
Figure 2.5. A typical traditional house in Hot-Arid Climate	20
Figure 2.6. Entrance, Hashti and Dalan (left to right) in a traditional Iranian house .	24
Figure 2.7. Eyvan (left) and Ravagh (right).....	25
Figure 2.8. Courtyard of a traditional Iranian house	25
Figure 2.9. A Seh-dari (left) and a Panj-dari (right) in a Traditional Iranian House..	27
Figure 2.10. Different spaces in a traditional Kashani house.....	29
Figure 2.11. The hierarchy chart of spaces in the traditional Iranian houses.....	29
Figure 3.1a. Location of Isfahan province in Iran map.....	30
Figure 3.1b. Location of Kashan city in Isfahan Province.....	30
Figure 3.2. Primary scheme of Kashan city	33
Figure 3.3. Kashan in Al-e-Bouyeh period	34
Figure 3.4. Remained parts of Seljukid walls	35
Figure 3.5. Kashan General View Looking toward Ancient Citadel.....	36
Figure 3.6. Kashan in Seljukid period	37
Figure 3.7. Kashan in Safavid period.....	38
Figure 3.8. Kashan in Qajar period.....	40
Figure 3.9. Kashan in Pahlavi period.....	41
Figure 3.10. The map of old Kashan	42
Figure 4.1. Courtyard, Broujerdi House	46

Figure 4.2. Sharomi, Taj House.....	47
Figure 4.3. High external walls, narrow and shaded streets of Kashan.....	48
Figure 4.4. Materials used in a traditional Kashani house	49
Figure 4.5. A vault roof, Broujerdi House	49
Figure 4.6. Longitudinal Section of Broujerdi house, showing level difference between the ground level and street.....	50
Figure 4.7. Summer and winter parts of Broujerdi house.....	51
Figure 4.8. Wind Catcher function in a typical section of a traditional Iranian hous.....	52
Figure 4.9. View from inside the Sardab	52
Figure 4.10. A thick and heavy wall of a house in Kashan.....	53
Figure 4.11. Windows, view to the courtyard in the traditional Kashani houses.....	53
Figure 4.12. View from outside and inside of the basement in a traditional Kashani house	54
Fig 4.13. Howz-Khaneh, Abbasian House.....	54
Figure 4.14. Chogha Zanbil, in its prime scheme spaces had been located around a courtyard	55
Figure 4.15. Asur Palace with one courtyard and four Iwans.....	56
Figure 4.16. Inner and outer courtyards, Barforoush House.....	58
Figure 4.17. Flattened Courtyard, Dastmalchi House	59
Figure 4.18. Sunken Courtyard, Tahami House.....	59
Figure 4.19. Arrangement of Talar and winter room around the courtyard, in one courtyard houses	60
Figure 4.20. Axial organization of courtyards in the houses with two or more than two courtyards	61
Figure 4.21. Space arrangement around the courtyard	61

Figure 4.22. Accessibility to the courtyards.....	62
Figure 4.23. (a),(b) Two possible relations of spaces a & b to the outside(space c)..	92
(c),(d) The corresponding justified graphs for (a) and (b) respectively.....	92
Figure 4.24. Symmetry-Asymmetry in spatial relationships.....	103

Chapter 1

INTRODUCTION

Traditional architecture is crucial to be understood in order to progress toward an identifiable contemporary architecture. Traditional architecture is a great source of historical, cultural and architectural identities of a society, which is fundamental to be considered as a foundation for today's architectural designs not only to maintain their identities but also to achieve continuity in the evolutionary process of architecture as well.

Throughout history, houses and their spatial organizations have been evolved under the influences of various factors, mainly as: environmental conditions, socio-cultural issues, and economic situation of the inhabitants. Certainly, traditional houses are not an exceptional case from that, even, such houses reflect the impact of the mentioned factors to a great extent.

Iran is a country with a rich historical, cultural and architectural background. It covers a vast area and comprises various climatic conditions that create diverse architectural designs in order to respond to the specific characteristics of a region; in particular, this variety can be observed in its traditional buildings.

The city of Kashan is an old city located in the hot and arid climate, which the existence of it dates back to 7000 years ago, possesses a considerable number of

traditional houses with a remarkable contextually and culturally responsive architecture which this study deals with them.

1.1 Background Study

The main focus of the researches on the studies related to the traditional Iranian houses had been mostly based on the climatic issues, while the socio-cultural aspects are rarely examined in such houses. Ghobadian (2003) "Climatic analysis of the traditional Iranian buildings", Kasmaie (1984) "Climate and Architecture", Tavassoli (1974) "Architecture in the Hot Arid zones" and Shaterian (2008) "Climate and Architecture of Iran" can be mentioned among this type of studies.

In spite of the fact that, the traditional houses of Kashan have a great historical, cultural and architectural potential to be studied more in detail, there is a gap of knowledge specifically in terms of systematic analysis of these houses by considering the socio-cultural impacts. In this respect, the related studies on the traditional houses of Iran, particularly in the hot and arid climate and the city of Kashan are mentioned below.

Leylian, et.al. (2010), in "Design principles in the hot and arid climate of Iran, the case of Kashan", have evaluated modern and traditional houses of Kashan in terms of design criteria such as, selection of the area, distance between buildings, orientation, building envelope and building form. Moreover, a simplified thermal evaluation and comparison of a traditional house (Boroujerdi house) with a contemporary house (Amiriyan house) have been given in this study.

Memarian (2006) in "Introduction to House Typology in Iran, Courtyard Houses", and similarly, the other book related to houses without courtyard, as a sort of

typological study, classifies the traditional residential architecture of Iran in two types: Introverted (courtyard houses) and extroverted (houses without courtyard). In this respect, the general characteristics of the houses in each type are discussed in different cities.

Farrokhyar (2008) in “Iran’s Architecture: Traditional Buildings, Practices, Performances, Particulars, Repair Works” mainly discusses about the construction process of traditional buildings, different types of them based on their material type, various types of arches and domes, and also the maintenance of such buildings are explained.

Furthermore, some of the studies are related to the issue of sustainability in the traditional Iranian houses such as: Maleki (2011) “Traditional Sustainable solutions in Iranian desert architecture to solve the energy problem”, Soflaee and Shokouhian (2005) “Natural cooling systems in sustainable traditional architecture of Iran for the built environment”, Nikpour, et.al. (2012) “Creating Sustainability in Central Courtyard Houses in Desert Regions of Iran”, and Taleghani, et.al. (2010) “Energy Efficient Architectural Design Strategies in Hot-Dry Area of Iran: Kashan”.

On the other hand, there are some limited studies considering socio-cultural issues in the traditional houses of Iran as: Shabani, et.al. (2011) “Relation of cultural and social attributes in dwelling, responding to privacy in Iranian traditional house”, which explains the cultural affects on the Iranian traditional architecture which results in division of the house to public and private domains for achieving privacy. Moreover, Shabani, et.al. (2010) in “Achieving Privacy in the Iranian Contemporary Compact Apartment through Flexible Design” compares the Iranian traditional houses with

modern houses arrangements to set a new method of design which is based on the cultural requirements of the users and it is attempted to create privacy in contemporary architecture. Consequently, flexibility as a recognizable technique in Iranian traditional architecture which provides the possibility of combining the spaces together and separating them from each other to have more privacy is discussed to be applied in today's compact apartments.

Besides, Karimi and Hosseini (2012) in "The Influence of Iranian Islamic Architecture on Traditional Houses of Kashan" have studied two traditional houses in Kashan: Bafandehand Shahyalani houses, in terms of the general design principles in these houses in relationship with the spiritual needs of the residents as well as responding to the environmental conditions and climate of the city.

Payam Eskandari's "Analysis of Traditional Iranian Houses of Kashan, Iran in terms of Space Organization and Access Design" is an unpublished Master thesis, which analyzes eighteen houses in terms of central, grid, symmetry and clustered organization, adjacent spaces or linking by a common space, different kinds of entrances (recessed, flat or additional), sequence of entrance space (entrance-vestibule or entrance-corridor-vestibule), open and closed spaces, summer and winter parts, and symmetry form of facades.

Investigation on the discussions and findings of the previous studies, affirms that there is a lack of studies on the traditional houses of Iran and subsequently the city of Kashan in terms of analyzing these houses and their spatial configuration in a systematic way by consideration of the socio-cultural impacts. In this respect, this dissertation is developed to fulfill the necessities in this field.

1.2 Aims and Objectives

In this study, it is aimed to investigate on the spatial configuration of the traditional houses of Kashan by considering and verifying the role of courtyard. Accordingly, these houses are classified in terms of number of their courtyards; as it is believed that courtyard is the central core in the space organization of the houses (not only physically but also from socio-cultural point of view) and all the other spaces are organized around the courtyard. Moreover, based on this classification, the spatial characteristics of each group of the houses are identified.

On the other hand, privacy as one of the main concepts in the spatial configuration of the traditional houses of Iran and certainly Kashan, is a fundamental issue to be studied in such houses in order to clarify the socio-cultural impacts on their space organization and to detect the privacy level of spaces in these houses.

Following that, the integration order of functions as one of the properties in the spatial configuration of the houses is examined, which determines the level of integration/segregation of a function in the house layout that is directly affect the degree of privacy of that function. In this respect, there are two other properties that are studied in the spatial configuration of these houses: ring and control value. The investigation on rings determines the spaces, which are linked to each other into circuits, and control value is related to the number of the connections that each space has with the other spaces in a way that increase in the number of connections results in higher control value.

At last, it is aimed to provide new dimensions for the contemporary architecture of the city through the identification of the traditional architecture and its significant principles.

1.3 Research Methodology

Traditional architecture with its various dimensions has the potential to be studied from different perspectives. In this study, the traditional houses of Kashan are analyzed in terms of their spatial configuration, role of courtyard in their formation, and the socio-cultural approaches on their space organizations. In order to fulfill the aims and objectives of this study, the following methods are applied:

The literature survey method is used, which is mainly based on the traditional residential architecture of Iran and the effective factors on the formation of it, general design principles and the main components in the space organization of the traditional Iranian houses. Following that, the city of Kashan, its identification and evolution is studied particularly.

Field study is also carried out in this dissertation by visiting the thirty traditional houses of Kashan and thoroughly investigating on them via observations, interviews, sketches, and digital photographs, in order to collect the necessary data. Moreover, it should be mentioned that the architectural drawings of these houses have been provided by the cultural heritage organization of Kashan city.

In order to classify the selected houses in accordance to their courtyards, a table is developed in this study, which is completed for each house. It possesses two main sections: one part indicates the general characteristics of the house such as: location, relationship between entrance and street, general functional hierarchy, summer and

winter parts of the house, together with some necessary explanations and photographs, while, the other part clarifies more specific characteristics of the house based on its courtyard as: number and direction of courtyard, its position and encloses, accessibility and space sequences from entrance to the courtyard, inner and outer courtyards and the accessibility among courtyards (Table 1.1) (see Appendix A).

Table 1.1. Tables' Layout for Classification of the Traditional Houses of Kashan

The Traditional Houses of Kashan				
General Classifications of the House	Location plan	Relationship between Ent. & street	Photographs	Explanation of the House
	Hierarchy in terms of function	Seasonal Classification ■ Summer Part ■ Winter Part	Photographs	
Classification of the house based on Courtyard	Number & Direction of Courtyard	Position of Courtyard (Flattened or Sunken)	Encloses of Courtyard (2, 3 or 4 Sided)	
	Space Sequences From Ent. To the Courtyard	Accessibility to the Courtyard (Direct or Indirect Access)	Inner & Outer courtyard In terms of Privacy	

Subsequently, the selected houses are mainly categorized as: one courtyard houses with sub-categories of two, three and four sided built, two or three courtyard houses as one outer and one inner courtyard, or, one outer and two inner courtyards, and multi-courtyard houses which are the family complexes.

Based on this classification, initial investigation on the general layouts and space organizations of these houses is carried out by means of schematic analysis of the

houses in terms of grouping and zoning the spaces within each house into the main categories as: the spaces that serve mostly to the visitors, spaces which are mainly used by the family members, courtyard, service parts, and basement.

Accordingly, ground and basement floor plans of these houses along with their sections are analyzed, which assists the identification of their space organization both in vertical and horizontal layouts. Consequently, findings determine that the houses have some common characteristics in general, while each group of the houses has its own specific features as well.

Space syntax is another method that is used in this study. Space syntax is an analytical, quantitative and descriptive method for analyzing the spatial configurations (Hillier and Hanson, 1984). It is a useful method in analyzing and investigating on the spatial configuration of a building in a precise and systematic way. Space syntax identifies the topological relationships in a spatial system, which is related to how people create and use the spaces, as well as the relationship between socio-cultural concepts and spatial configuration.

Configuration is related to the way that spaces are connected to each other in an overall pattern. In this method, the spatial properties of each space are measured in relation to the other spaces within a configurational system and the topological relationships in a layout, these properties are determined in a quantitative way.

The level of integration and the depth value of a space are considerable spatial properties while defining the topological relationship of a space with the other spaces in a system. A space can be directly related to its adjacent one, or they can be

separated, which in that case, their connection is depended on the intermediate spaces. The space with the least depth is the most integrated one, while the space with the highest depth value is the most segregated one. Ring and control value are the other spatial properties, which are clarified through this method.

The analysis in this method is based on 'justified graph' (Hillier & Hanson 1984). These graphs are arranged by putting the entry space as base of the graph or root space. After that the spaces that are directly accessible from the root space are positioned horizontally above it as depth 1, then, the spaces that are accessible after depth 1 are arranged horizontally above the first level on depth 2, and the same logic is applied for the other spaces and it continues like that till all the spaces in the system are positioned in the graph. Afterward, all the connecting lines are drawn to show the relationship between the spaces. Such graph is a sort of visual representation of depth of a space, besides, the number of connections that each space has within the layout is determined, which is related to the control value of a space, rings are also specified through the graphs.

Subsequently, after providing the graphs for all the selected houses by means of computer software called as 'AGRAPH', calculations for achieving the quantitative values of the spatial properties of each space is done.

Accordingly, based on these values or syntactic data of each house, the integration order of functions or the inequality genotypes of each house is determined, which identifies some features particularly on the level of privacy as one of the significant socio-cultural factors on the spatial configuration of these houses. Besides, the control value of each space is clarified that assists to find out the spaces with the

maximum and minimum control values in every house, which also provides some other results on the spatial configuration of the traditional houses of Kashan.

1.4 Limitations of the Study

This study is limited with the spatial configuration of the traditional houses of Kashan by considering the role of courtyard and the socio-cultural impacts on this configuration. In this respect, certain limitations are defined for this study and put forward as follows:

Architectural design theories cover various subjects; however, this study does not aim to examine all aspects of design theories in the traditional houses of Kashan, since, it is further than the scope of a thesis. For that reason, this study focuses on particular issues related to the spatial organization principles.

In general, the traditional houses of Iran are formed under the impacts of two main factors: socio-cultural aspects, and physical and environmental features. However, this study mainly concentrates on the spatial organization of these houses regarding to the socio-cultural impacts.

Iran in terms of climatic situation is divided to four main regions; the northern coastal region with mild–humid climate, the mountainous region with cold climate, the southern coastal region with hot–humid climate, and the plateau region with hot–arid climate which covers a vast area in the central part of Iran. The city of Kashan, which is the focus of this study, is located in the hot-arid climate.

This study is limited to the city of Kashan; because of its historical precedent, and its remarkable traditional architecture, which is responding to the socio-cultural needs of

the users as well as the physical and environmental conditions of the city, to a great extent.

Traditional buildings are valuable sources in terms of experience and knowledge for achieving precious ideas and developing contextually and culturally responsive design principles. Housing, as one of the primary needs of human being is an essential subject in traditional architecture. Due to this fact, traditional houses is another limitation of this study in terms of building type; since, the socio-cultural values are greatly reflected on the spatial organization of such houses.

Kashan is located in an earthquake-prone region; therefore, many of the traditional buildings in Kashan have been ruined due to the several earthquakes happened in the city. The last very heavy earthquake happened during the last years of Zandieh period and most of the buildings in the city were destructed and only a few of them remained. Therefore, the majority of the buildings which exist currently in Kashan city are belonging to the Qajar's period (1786-1925 A.D.). Accordingly, the selected traditional houses of Kashan that are studied here are from early Qajar till early Pahlavi period.

There are nearly 80 traditional houses in Kashan, which have been registered by Cultural Heritage Organization of the city; however, some of the houses have been gradually ruined and there are not enough documents related to such houses. Therefore, considering all the restrictions, in this study, thirty traditional houses of Kashan city have been selected to be analyzed under the scope of this study.

Chapter 2

IMPACTS ON THE FORMATION OF TRADITIONAL RESIDENTIAL ARCHITECTURE OF IRAN

Iran is a country with a remarkable historical precedents, and covers a vast area with various climatic conditions. In order to create human comfort in every climate, which has its own special characteristics, traditional builders have presented series of logical solutions to respond each climate and context. This variety causes a great diversity in the traditional architecture of Iran and subsequently in its residential architecture, since it is oriented according to the local features. Housing as one of the basic human needs has a great importance in the traditional architecture of Iran and is a notable subject in current debates. For that reason, it needs to be studied more in details, especially investigating on the traditional ones is more required to maintain the architectural characteristics of a region.

Architectural built forms have evolved in response to the climate, lifestyle and availability of building materials through the history. Although, housing typologies are a result of multiple determinants, climate and culture are the two most important ones (Rapoport 1969). Accordingly, the main determinants which greatly affect on the formation of traditional Iranian houses by considering the users' needs, as culture and climate are discussed as follows.

2.1 Socio-Cultural Aspects on the Formation of Traditional Iranian Houses

As Wilson (1986: 17) states “the meaning of architecture lies in use, and that buildings only come into being to serve the needs of a culture. He asserts that the limits of architecture are the limits of the culture that it serves. It is the embodiment of values that have been worked out by a culture in all its levels of awareness”. According to Rapoport (1969: 2) “vernacular architecture is the direct and unselfconscious translation into physical form of a culture, its needs and values, as well as the desires, dreams and passions of a people”.

The cultural effect on formation of a house is one of the consequences of socio-cultural factors. As Rapoport (1969: 47) states “building a house is a cultural phenomenon in itself”.

Culture in a country like Iran, is known as a fundamental aspect in the essence of its architecture. “Iran, more than anything else, like a spiritual-cultural reality, demonstrated throughout the life of people who constantly maintained the sequence of their cultural creativity and national identity” (Nasr, 2003: 457).

Accordingly, the effect of culture on the Iranian architecture and specifically on its traditional architecture is a doubtless fact. In the following part, some of the socio-cultural issues which have influenced on the traditional Iranian houses are discussed.

2.1.1 Demographic features and Life style

The dominant household model in Iranian traditional society was the patriarchal extended family. Its members would include an initial couple, its children, and

families of these children (Ladier-Fouladi, 2002). It is composed of up to three generations, living together in the same house. It is obvious that in this case, the house, like a living organism, should grow and adapt to the new situation in order to accommodate the changing needs of a rapidly growing family.

Most of the houses accommodate varied functions, not limited to residential activities. In some cases, the house was also the workplace. This would happen, when the head of the family had an office or workshop in an independent area of the house. In this case, the interior territory of the house (andaruni) would be separated from the exterior area (biruni), which the andaruni occupied by women and children, and the biruni by men and visitors (Einifar, 2003).

Women had an important role in household economic activities. Apart from cooking, washing clothes and dishes, and taking care of children, they produced handicrafts such as rugs and textiles (Soltanzadeh, 2005). House spaces were adapted for these varied activities. Therefore, an Iranian house was a multifunctional unit designed for residential, economic, and service functions.

2.1.2 Privacy

The notion of privacy is greatly in association with the culture; it can be explained as a control of the connection between outside and inside of the house (Gazzeh, 2009). Privacy is one of the significant factors that influence housing formation. In order to achieve privacy in the houses, different strategies have been used; as Tahir (2010) discusses division of spaces in terms of public, semi-public/semi-private, and private, is one of the approaches to reach privacy; public area is the space which is used for gatherings mostly with guests and it should have the possibility to be expanded (visitors did not have a direct access to the particular parts of the house, and usually

the guest room was close to the main entrance which guests could easily entered to this room without passing through the more private parts of the house), semi-public/semi-private area is the space which is only for the use of family members and close friends or relatives, and as Haeri (2010) explains private area is the specific indoor area for individual use and it has all the privacy boundaries.

Without doubt, privacy is strongly rooted in Iranian society and culture, therefore, it has greatly affected on the spatial configuration of the Iranian houses. A sequence of spaces provides a clear hierarchy of privacy in the Iranian houses (Shirazi, 2011).

In the traditional Iranian houses to create privacy, one strategy is, being surrounded by high walls in order to make it inaccessible from the street. Another approach is mostly a linking space known as 'Hashti' were taken place between outside and inside of the house, turned corridors have also been used in order to break direct view to the internal parts of the house and create more privacy. Moreover, level rising was another strategy in order to avoid view from courtyard as a semi-private space to the rooms as private ones (Shabani, 2011). Besides, creating inner (andaruni) and outer (biruni) courtyards has also an important role to make more privacy in the houses.

2.1.3 Introverted approach

This feature is referred to both cultural and climatic issues; there is no direct visual contact between inside and outside of the house. Different spaces in these houses have been arranged around courtyards in a way that their openings are towards the courtyard. It brings safety, security and privacy to the house in terms of harsh climatic conditions and also the cultural aspects. These houses look simple from outside but they have a glorious inside which was a big surprise for the observer,

since it had a magnificent design. It is impossible for the observer to see and guess what is inside the house.

2.1.4 Respecting Neighborhood

In the traditional Iranian houses by considering economical aspect, it can be easily perceived that the owners had different financial situation; however, the ones, who had a better economical condition could add more floors but they did not, and most of the houses are in the same level; in order to let their neighbors to get the equal light with them, and also not to be overlooking to their houses (Pirnia, 2009).

2.2 Physical and Environmental Aspects on the Formation of

Traditional Iranian Houses

Traditional architecture is a sort of sustainable architecture; it is the most successful solution of its time period in order to respond the environmental conditions of a region, users' needs and comfort, using energy and resources in a rational way, using local materials and formation of local architectural forms which are in harmony with natural environment, it is durable, and is the result of many years of experiences by transferring from one generation to another one.

One of the main features in the traditional architecture of Iran is its response to the natural, geographical and cultural needs; in the other words, it is the adaptation to the climatic condition of a region (Tavassoli, 2002).

According to Ghobadian's (2005: 34) classification, Iran is mainly divided into four climatic regions: The Northern Coastal Region with Mild-Humid Climate, The Mountainous Region with Cold Climate, The Southern Coastal Region with Hot-Humid Climate, and The Central Plateau Region with Hot-Arid Climate. Each region

has some specific architectural characteristics to be suitable for that climate which are discussed as follows.

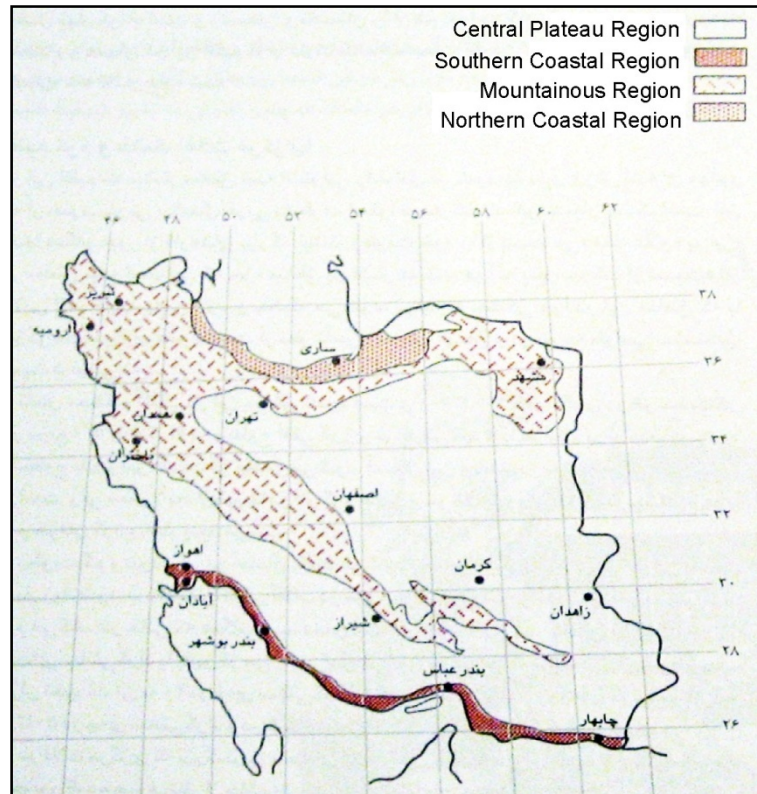


Figure 2.1. Climatic classification of Iran (Ghobadian, 2003)

2.2.1 The Northern Coastal Region with Mild-Humid Climate

This region which is located below the Caspian Sea and above the Alborz Mountain has high humidity ratio with extreme precipitation in nearly the whole year. The main material, which is used in this region is wood, since it is a local material and light. In order to be protected from the humidity of the soil, houses are usually built on wooden or stone legs in a higher level than the ground and there is no basement in these houses. Moreover, for protecting rooms from the rain allied with the wind, the wide porch 'Eyvanak' are built around the rooms of the houses. Buildings in this region are extroverted, and for using maximum natural ventilation and air flow, these

buildings are organized in decentralize and irregular way. Roofs are built with the high slope because of high rain in this region. (Shaterian, 2008)



Figure 2.2. A typical traditional house in Mild–Humid Climate (Ghobadian, 2003)

2.2.2 The Mountainous Region with Cold Climate

In this region buildings are dense, compact and introverted. Minimum external surfaces and minimum ventilation are used. The height of the rooms is not much, and the walls are too thick. Materials that are used in these buildings have high capacity of thermal insulation to prevent losing internal heat. Flat roof are used to keep the snow and acting as a thermal insulator (Ghobadian, 2009)



Figure 2.3. Typical traditional houses in Cold Climate (Shiri, ISNA, 2008)

2.2.3 The Southern Coastal Region with Hot–Humid Climate

Materials with low thermal capacity are used for the buildings in this region. Buildings are oriented in a way to get the maximum use of shadow and draught. These buildings contain courtyard, rooms with high ceilings and tall windows, wide and tall porches. Since, the air temperature and humidity is high in this region, large wind catchers are used in these buildings in order to get the breeze from sea and direct it to the inside of the building. (Shaterian, 2008)

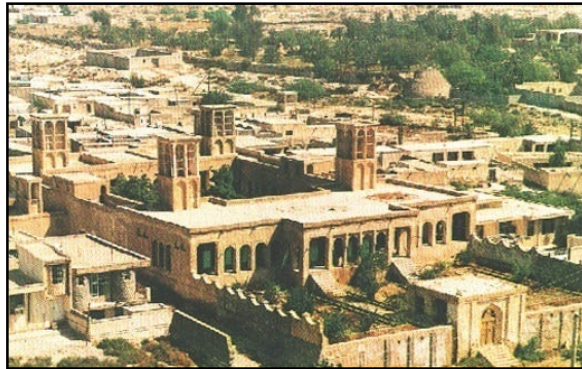


Figure 2.4. Typical traditional houses in Hot-Humid Climate (Kasmaei, 2003)

2.2.4 The Plateau Region with Hot–Arid Climate

Buildings in this region are introverted and compact as possible, to have minimum exterior surface, and decreasing the amount of temperature exchange, this compactness also creates more shadow. There are narrow and turned streets, which are mostly covered by arches. Some parts of these buildings are built underground since soil acts as a thermal insulator. Materials, which are used in this region are clay, mud, mud brick and brick since they have a high capacity of thermal insulation. Lack of rain and wood in this region is caused construction of dome roofs with mud and clay. For decreasing the temperature caused by sunlight on the walls, usually light colors are used for the exterior surfaces and number and area of the windows

are decreased, mostly windows are located on the upper part of the walls. Walls are thick and nearly high. Wind towers are used in these buildings to ventilate the air and cool inside. Internal courtyards with pool and garden are also used to create humidity and cool environment(Ghobadian, 2009).



Figure 2.5. A typical traditional house in Hot-Arid Climate
(Maeiyat and Movahed, 2009:4)

2.3 General Design Principles in the Traditional Iranian Houses

According to Pirnia (2005: 26-33), there are some general principles in the traditional Iranian houses that can be classified as below:

- **Harmony with people desires (*Mardomvary*)**

This is related to the functional terms, concerning people demands in the design of the house. In the other words, to design for responding people's needs and for that reason, human scale is an important issue to be considered.

- **Self-Efficiency/Autarchy (*Khod-Basandegi*)**

Using local materials and resources is one of the major aspects in the traditional Iranian houses which brings Self-Efficiency in the construction of these buildings.

- **Proportion**

It is another important character in the traditional Iranian houses; all the spaces in the houses have been arranged based on proportions by a modular system (there is one

major unit or module which is a reference for the other proportions and measurements of the building) which is known as “Peymoon” in Iranian architecture. Relationships between different spaces, their required dimensions and forms are structured accordingly.

- **Avoiding Un-necessities (*Parhiz az Bihoudegy*)**

In the traditional Iranian architecture, construction cost was reasonable, waste of materials were avoided, unnecessary dead loads were removed to achieve a lighter construction.

- **Structural Rigidity (*Niaresh*)**

Durability of the buildings was an important issue in the traditional Iranian architecture; for that reason, builders used their knowledge and applied the technology of the day, in order to generate durable buildings that could be sufficiently strong against the disasters such as earthquake.

Moreover, Pirnia (2009) mentions about some other characteristics of traditional Iranian houses as follows:

- **Symmetry**

This characteristic can be seen in the most of the traditional Iranian houses, which is not only for the aesthetic quality of the houses but also it increases the strength of building against side forces such as earthquake.

- **Analogy**

One of the main features in the traditional Iranian houses is that different spaces of the houses are designed in attention to the geographical location of the houses to get the maximum benefit from the natural factors such as sunlight, air circulation...

- **Geometry**

According to Haji-Qassem (2003) the arrangement of the traditional Iranian houses follows certain geometrical rules. This geometry not only defines the general body but also gives shape to its every single detail. It creates a hierarchy between different parts of the house, which determine their locations and relationships in accordance with their character and importance. While harmoniously connected to each other in the design, each part of the house has its own complete independence and are always separated from the others by intermediary areas.

- **Flexibility**

The spatial organization in the traditional Iranian houses was totally flexible toward the life style and requirements of its users. There is no obstructed space in these houses. Each space, besides its independent function, has the potential to combine with other spaces; usually, the spaces are combined by opening the doors between them (Shabani, Tahir, Arjmandi, Che-Ani, Abdullah, Usman, 2010).

- **Sequence and Diversity**

It is not possible to observe a traditional Iranian house at one glance; organization of the spaces in such houses can not be seen in one image. However, in order to perceive it, it is necessary to enter the house, walk inside of it and consecutively, reach to different and variable spaces in it.

- **Orientation**

Orientation of the traditional Iranian houses were towards the specific direction, which was in attention to the sun and wind direction to obtain maximum benefits from them; in a way that each part of the house was appropriate for a special season of the year. In the majority of the traditional houses in the hot-arid climate of Iran,

the main axis is directed to northeast-southwest as it was the best location to gain more shaded areas in summer and more sunlight in winter days (Pirnia, 2009).

2.4 Main Spaces in the Traditional Iranian Houses

As Pirnia (2004) explains, generally, there are two main parts in the traditional Iranian houses: inner (*Andarooni*) and outer (*Birooni*). Within this division there are different spaces that can be described as below:

- **Entrance**

Entrance door is one of the important components in the entrance part of a house, which the main function of it, is adjusting the connection between indoor and outdoor spaces. Shape of the entrance doors in the traditional houses depending to the economic situation of the owner was variable in terms of their decoration, dimension and height. Usually, the entrance doors were built in rectangular shape and the material was wood. Generally, twin type of doors is used for the entrances in the traditional Iranian houses and on each leaf of the door there is a knocker, one for men with bass voice and one for women with sub voice. There are two main parts in the traditional entrance doors: top of the door (*Sardar*) which is a covered area and protects people who are entering or exiting from the entrance; and platforms (*Sakkoo*) which are at the both sides of the main entrance for sitting, resting, waiting or chatting with neighbors (Soltanzadeh, 1991).

- **Vestibule (*Hashti*)**

The first space right after the entrance which is used to distribute entrants to the different parts of the house and is the only space that is in touch with the outside; mostly with octagonal shape. Although, it is a primary space in the traditional Iranian houses, it was big enough for first visits and short conversations.

- **Corridor (*Dalan*)**

In the traditional Iranian houses usually narrow and turned corridors were used to direct the entrants from the vestibule to the courtyard; it helps privacy of the house and never gives an immediate understanding to the activities, which are happening in the house.



Figure 2.6. Entrance, Hashti and Dalan (left to right) in a traditional Iranian house

- **Veranda (*Eyvanand Ravagh*)**

Semi-open areas, which are used to create shady and cool living spaces during the day. They had also an important role in articulating open and closed spaces. The “Ravagh” semi-open colonnade arranged in the courtyard always provides shady areas. The “Eyvan”, a space, walled on three sides, with one end entirely open, in front of the rooms, permits a common life inside. Usually they are oriented to the south. Particularly south and east oriented eyvans are very cool and shady places for summer afternoons. Typically, eyvans open onto a central courtyard, and have been used in both public and residential architecture.

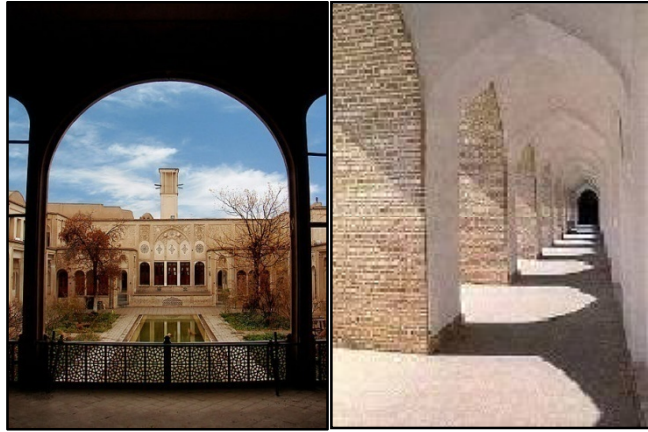


Figure 2.7. Eyvan (left) and Ravagh (right) (Leylian et al., 2010)

- **Courtyard including pool and garden**

Generally, courtyards are in rectangular shapes, located in the center of the house and acts as the heart of it. They are mostly used for gatherings in various events. Usually, there was a pool or garden in it, in order to respond to the local climate; especially, in the regions with hot and arid climate, existence of pools and trees would provide humidity and shady areas that moderate the air temperature and create pleasant atmosphere.



Figure 2.8. Courtyard of a traditional Iranian house

- **Rooms**

In Iranian houses, rooms are usually known by their morphology, location, the time of usage and rarely according to their function (Rafieisereshki et al., 2003); they are generally arranged around the courtyard in such a way that the summer rooms always face the north: away from the hot summer afternoon sun, while winter rooms are located on the opposite side (Kheirabadi, 2000).

Moreover, there is an important point about the accessibility to the rooms, which is through a corridor adjusted to them, it is not possible to enter them directly from outdoor areas.

Besides, the dimensions of the rooms is in accordance to the human scale and it is exactly according to the needs of the users, everything has its own place, which ‘avoiding un-necessities (*Parhiz az Bihoudegy*)’ can be clearly seen in their design.

- **Hall (*Talar*):** is a welcoming space to the guests with beautiful decorations. It is a large room which is mostly used in summer time, since it can be opened to the fresh air. For the winter time, there is a room in the north side of the house called as “Tehrani” which is a large sunlit room. In some of the houses, in front of Talar, there is an Eyvan.
- **Living room (*Seh-Dari*):** this space was used for gathering of the family members and their close friends or relatives; since, it contained three doors, its name is Seh-Dari and its importance was less than Hall but more than simple rooms.

- **Salon (*Panj-Dari*):** it is a large room with five doors, that is often near to the main talar of the house, and mostly connected to a large balcony which together with its five doors provide primary views to the courtyard of the house. Panj-Dari room was used for the guests and usually there was a recess inside of it, positioning a bit higher than the ground level, which is called as “Shah-neshin” and it was used for the special guests. Moreover, the panj-dari room as a sort of living room was usually used for main daily hub of the inhabitants as well.



Figure 2.9. A Seh-dari (left) and a Panj-dari (right) in a Traditional Iranian House

- **Guest room:** this space is located close to the entrance to be more separated from the family area and sustain privacy of the house.
- **Pastoo (back part of a room):** is a small space that is located in the back side of a room (mainly seh-dari or panj-dari rooms), that is connected to the room by a door. Generally, there is a closet inside, to put some objects or foods in it.

- **Keryas:** is a pre-entry space to the rooms; it is a closed space, and it provides accessibility to the rooms from the courtyard. Since, this space is used as a passageway, the tranquility of the room could be kept.

- **Service areas:** these spaces were traditionally separated from living quarters. This separation causes all service areas, such as kitchens, lavatories, storerooms, and stables, to remain hidden from sight and not interfere with inhabitants' comfort (Haji- Qassemi, 2003). Since, such spaces were usually located at the back side of the other spaces, ceiling of the kitchen was generally high and in dome shape, which in the center of it, there was a large skylight to get the light in and also for exiting the smoke and warm air of inside to out.

Rooftops and basements were also used in different seasons to accommodate relevant functions in the house. Usually, in the desert regions, rooftops were used for sleeping during the summer time. Besides, basements were also one of the important spaces during the hot days of the summer that could provide cool and pleasant air for the inhabitants.

The figure below demonstrates different spaces which are commonly exist in the traditional Iranian houses.

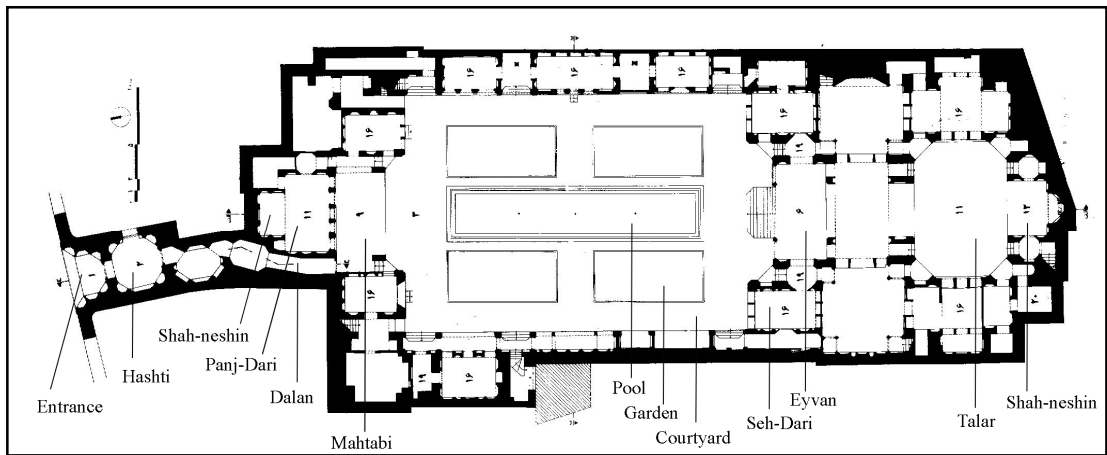


Figure 2.10. Different spaces in a traditional Kashani house

Moreover, the chart below illustrates the general hierarchy of the spaces in the traditional Iranian houses.

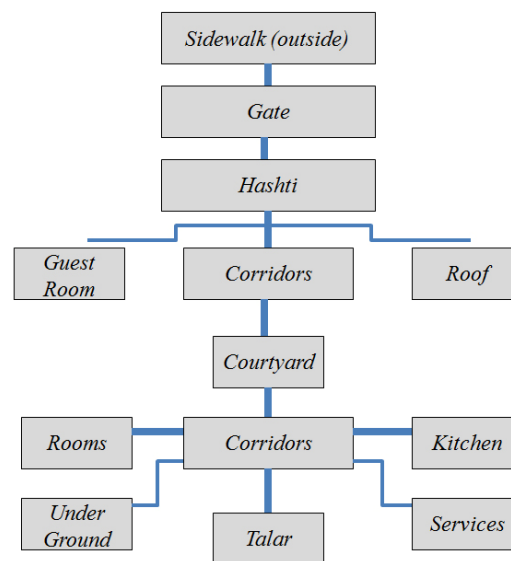


Figure 2.11. The hierarchy chart of spaces in the traditional Iranian houses (Shabani et al., 2010:290)

In addition, since, the city of Kashan is the context of this study, the following chapter deals with the identification, establishment and evolution of the city throughout history.

Chapter 3

THE IDENTIFICATION AND EVOLUTION OF KASHAN CITY

3.1 Location and Climatic Characteristics of the Kashan City

Kashan is one of the important cities in north-west side of Isfahan province and it is located in 220 km in south of Tehran and 195 km from Isfahan city (Manioglu and Yılmaz, 2008).



Figure 3.1a. Location of Isfahan province in Iran map

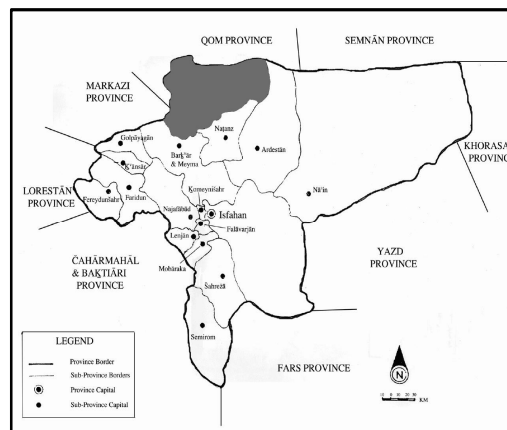


Figure 3.1b. Location of Kashan city in Isfahan Province (Kashan Municipality)

Kashan is the city along the desert edge in the central plateau of Iran. The climate of the central plateau is relatively similar to desert climate which represents the hot and arid one and covers a vast area of Iran. This climatic zone has high temperature in the summer and cold winters, almost, there is no rain and humidity in this region and there is a high temperature difference between day and night. The desired wind is from north-west and the formation of buildings and wind catchers is mostly based on this direction. There is also the possibility of sand storms from the desert during the whole year. However, the existence of Karkas Mountains in the south-west direction of the city creates a contrast between the dry immensity of the desert land and the greenery which makes the city more attractive (Baradaran Mohajeri and Irani Behbahani, 2009).

3.2 Etymology of Kashan

According to some etymologists, Kashan is the name of summer houses, which are built by wood and reed. There are different theories on Kashan name, which none of them are certain. However, the most well-known ones can be summarized as follows (Kashan Cultural Heritage Organization).

The name of Kashan city in the islamic references has been recorded as “Ghashan or Ghasan”; while, the most recent archeology researches in the Sialk hills showed that “Kasan or Kashan” has been taken from the name of a tribe as “Kasou or Kashou” which were known as “Kasian or Kashian” and gradually it became famous as “Kasan or Kashan”.

Moreover, Kashane in Persian means green house, and since, Kashan is an oasis in the middle of the desert, some believe that this is the reason that Kashan has been chosen as name of this city.

Besides, Kashane in Turkish literature is also denoted as “camli oda” or “sirca saray” (Nişanyan, 2009), which means green house that is related to the house which is plastered by water or mud and it is one of the characteristics of Kashan houses.

3.3 Establishment and Evolution of the Kashan City throughout

History

Kashan is one of the ancient cities of Iran with a valuable historical context. Archeology researches shows that the precedence of Kashan city refers to 7000 years ago. One of the oldest civilizations in the central plateau of Iran is Sialk hill, which is located 4km away in south west of Kashan city (The Sialk ziggurat still stands today in the suburbs of Kashan after 7000 years). Moosavi (2007) states that Sialk civilization had lots of innovations in terms of industry of their time; they had cultural and economical contacts with Mesopotamian civilization and other parts of Iran. Existence of Fin spring nearby it attracts people for living in this region which had an important role in the formation and development of the city.

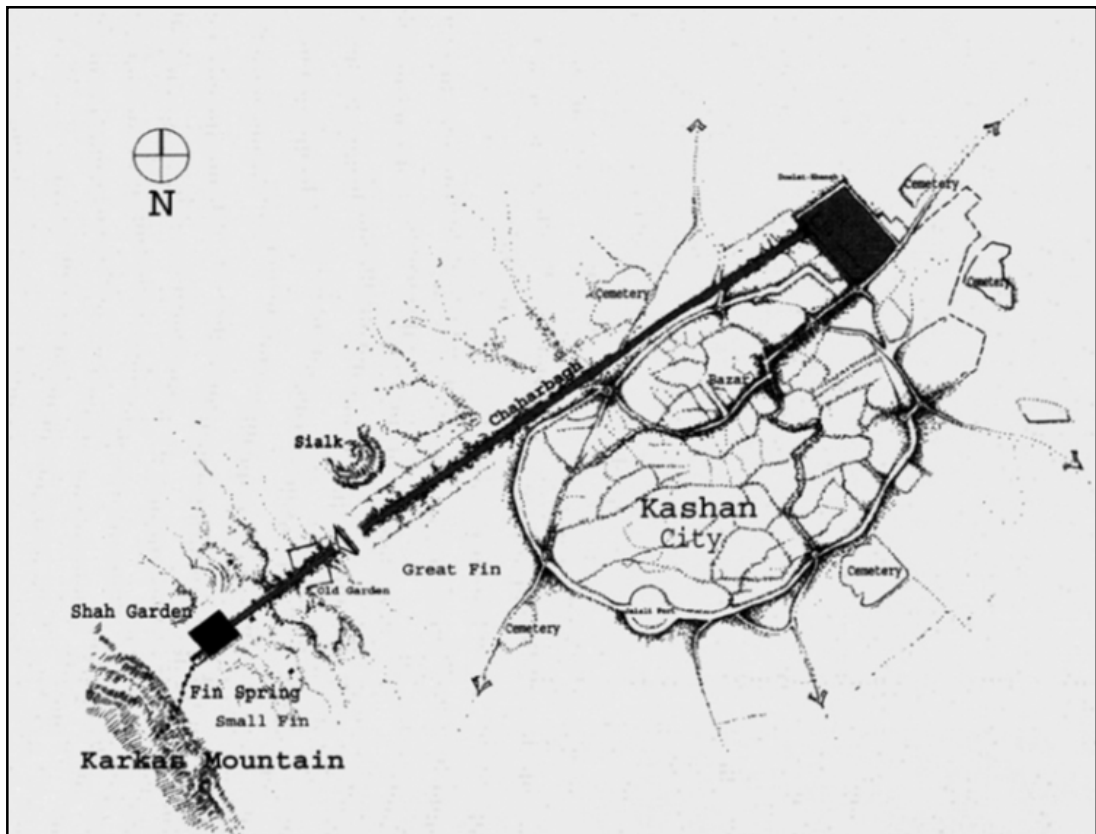


Figure 3.2. Primary scheme of Kashan city (Source: Javaherian, 2004)

From the early years of Islam, Kashan had always been faced with the positive growth; especially, in Seljukid and Safavid eras the city progressed and developed enormously. However, Kashan city faced with heavy damages during the Arabs (1st Hijri-Qamari Century, before Al-e-Bouyeh) and Mongols' (7th Hijri-Qamari Century, before Safavid) attack, but it again flourished and became as one of the considerable centers in terms of art, culture and construction of magnificent buildings during Seljukid and Safavid period. Several earthquakes had also ruined many of the buildings in Kashan city; the last very heavy earthquake happened during the last years of Zandieh period and most of the parts in the city were destructed and only a few buildings remained. Therefore, most of the buildings which exist currently in today's city of Kashan are from Qajar's period. In the

following part, the development and formation of the city in each period is discussed more in detail.

Primary cores of the city contained of a number of mausoleums (Imamzadeh) spread in different parts of the city, a Qanat (canals carrying water from mountains to the city) located near to the Fin Gate, a citadel and a Jami-Mosque. Moreover, development of the city is classified under five periods, explained as below (Naghsh-e-Jahan-Pars Consulting Engineers, 2006).

3.3.1 Early years of Islam till Al-e-Bouyeh period (3rd Hijri-Qamari Century)

Kashan city is located in the desert region, and there are mountains in the south and west edge of the city, thus, the slope of the city is decreased toward the north-east direction. For that reason, the direction of natural water flows and Qanats mainly affect the structure of the city by formation of the main routes along and also gathering of the residents nearby them. Bazaar and Jami-Mosque as two main elements of the city were also located in the main routes and connected by one of them together, which created the main circulation path and center of the city. These routes were ended to the gates of the city. In that time, configuration of the city was linear with a compact context.

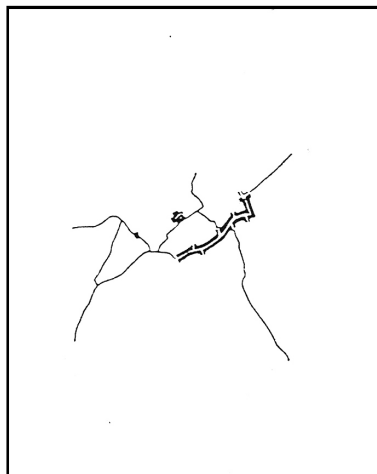


Figure 3.3. Kashan in Al-e-Bouyeh period

3.3.2 Seljukid Period (4th Hijri-Qamari century /1040 - 1157 AD)

Seljukid built the first citadel known as “Jalali citadel” in the southern part of the city and an elliptical enclosure wall for defense purposes all around the city. The existence of the remained parts of these citadels proves that Kashan has been an important city in terms of military aspects in that region.



Figure 3.4. Remained parts of Seljukid walls

In the fifth century, Jami-Mosque was built with “Madrase” (religious schools) in it which gave Islamic character to the city.

In Seljukid period, Isfahan became the capital city of Iran; therefore, Kashan as the city which was located in the connection route of Isfahan city, faced with a remarkable economical growth. Consequently, its Bazaar developed in the same trade route of the city from south-west towards north-east direction. Parallel with that, new constructions initiated in the city and more public buildings were added.

Economical growth of the city and its important location in the main routes, were the reasons to increase the military power of the city for being protected from the possible attacks. Consequently, a citadel known as Jalali citadel was built in the south-west of the city and nearly a half century after that a huge wall was built all around the city, which was not only containing the built parts of the city, but also the distance between the main core of the city and Jalali citadel (which were all gardens

and farming lands) was surrounded by that too. The Sejukid wall stabilized the historical form of the city and through the centuries, the city developed and evolved inside of it with respect to the main elements of the city to maintain its identity.



Figure 3.5. Kashan General View Looking toward Ancient Citadel
(Source: Ghasemi, 1996)

In that period, the structure of the city was a main route with linear organization which the most important elements of the city were adjusted to it or by some sub-routes (that were ended up to the main parts of the city such as Jami-Mosque) were connected to it. The context of the city was nearly same as previous period while the number of the buildings such as mosques, schools... had been increased. It should be mentioned that nearly all the buildings in this city were introversion with a courtyard in.

Religious and trading functions were in direct relationship with each other, while the governmental ones were more isolated from them.

Due to the development of the city, numbers of the routes were increased, and the numbers of the city gates were also increased from three to six. All the routes within the city wall were connected through Bazaar.

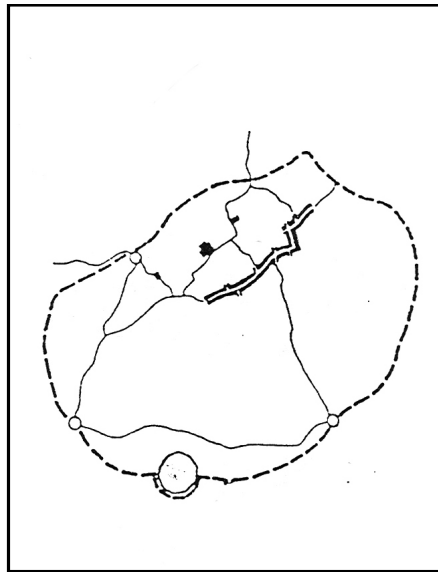


Figure 3.6. Kashan in Seljukid period

3.3.3 Ilkhanid till Safavid period

During Ilkhanids' period, Kashan was considered as an industrial city; as it was located in the trading routes, it was necessary to be well protected, therefore, construction of new buildings found more importance. Two main complexes known as "Sang Square" and "Dar-ol-Sayyadeh" were built in that time, which were consisted of mosque, Madrased, guest houses... and they caused growth of the city from bazaar toward them. It should be mentioned that Bazaar (mainly in form of a covered street) has always been the backbone of the city through those periods and had an important role in terms of economical, social and cultural aspects. Each one of

the complexes mentioned above were also close to one of the city gates, therefore, the main part of the city could be connected to the outside of it fast and easily. The expansion boundaries of the city were limited within the Seljukid wall in that period.

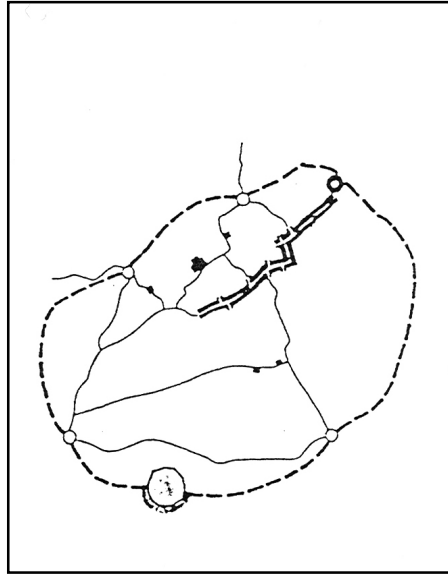


Figure 3.7. Kashan in Safavid period

3.3.4 Safavid and Qajar periods

During Safavid period, Kashan developed much more; since the desire of Safavid kings was the expansion of the city and its bazaars. Therefore, the industrial and economical activities of the city were grown remarkably. One of the Safavid Kings “Shah-Abbas” built a complex in the north-east of the city which was included different buildings in it such as the king palace, the guest-house known as Dolat-khaneh for accommodating visitors, bath, and some other buildings with gardens around them, besides, there was a Qanat, which was bringing the water to this complex. Moreover, in the outer parts of the city, there were some other complexes consisted of gardens and kings’ palaces, which were connected through Chahar-Bagh street (a street with trees in two sides of it) to the other gardens and palaces in Fin. In addition, Shah-Abbas also expanded the bazaar and added more shops and also

caravanserais to it. In that period, some other buildings such as mosque and Madrase were built nearby bazaar too.

After Safavid period, through Afghans' attacks and several heavy earthquakes, which happened to the city, main parts of the city were ruined, therefore, during Zandieh and Afsharieh periods, mostly reconstruction of previous buildings was done and there was no considerable development in the main core of the city.

During Qajar's period (1786-1925 A.D.), the expansion pattern of the city changed; in the other words, no more complexes was built in the city, but mostly, bazaar and caravanserais were expanded-bazaar was extended toward north-east and caravanserais were added to it- and solitary buildings such as Madrase and Mosque were built nearby the bazaar.

During Safavid period, the growth of the city was still limited within the Seljukid boundaries. In the Qajars time, these boundaries did not change much, only some parts were added to the north and north-east of the city, but still the growth of the city was a linear pattern, mainly through bazaar from south-west direction toward north-east of the city. Except the gardens and small palaces "Kooshk" within them, which were built in those periods and they were more open, the majority of the buildings were still compacted and introverted.

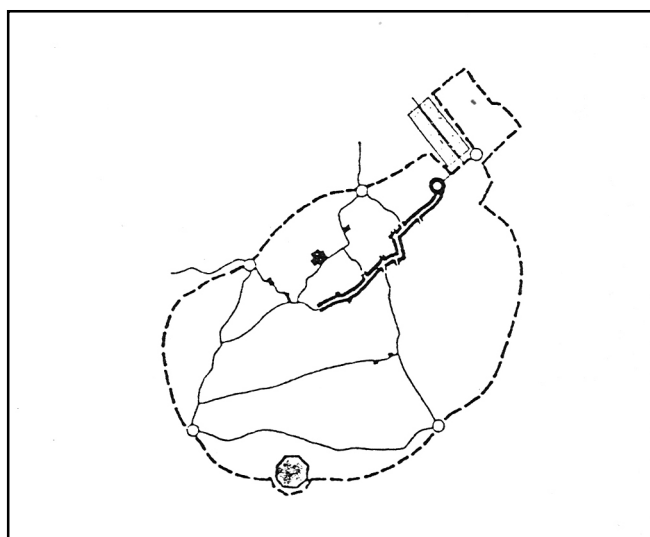


Figure 3.8. Kashan in Qajar period

3.3.5 Pahlavi's period

After Qajar's period, the expansion of the city was mostly in the west side from north to south of it. The reason for that is the existence of the desert in the east and north-east side of the city, mountains in the south-west of it and the distribution of water.

In the first Pahlavi's period, Kashan like the other cities of Iran found some changes in its city context. Some new streets were added into the organic context of the city, even a part of bazaar was changed to a street. However, Kashan as an old city in close proximity to the desert, has still kept its identity. Non-local and fragmented buildings were built in the city such as administrative buildings, educational, medical and sport facilities... and for that reason, the new structure of the city was appeared and did not have any certain pattern.

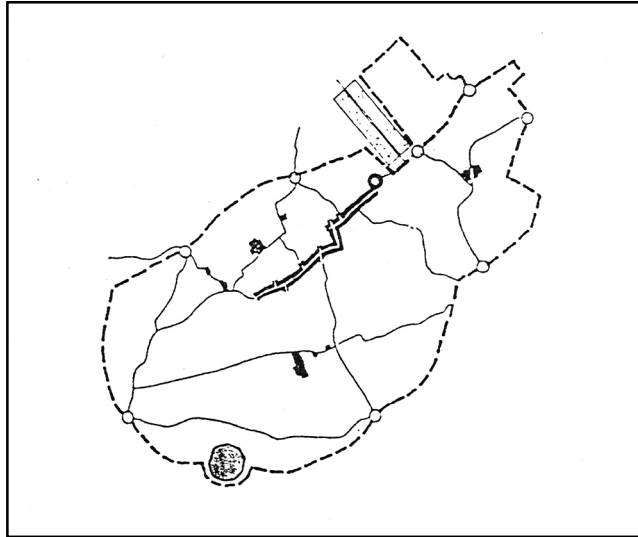


Figure 3.9. Kashan in Pahlavi period

3.4 Morphology of the City Context

There is an organic and irregular pattern within the historical context of the city, which is also formed according to the climate and culture of the people, who were lived in.

For an instance, introverted approach is not just limited to the housing, it is also exist in the city context. Existance of different spaces in the city context such as small plazas or platforms to provide socializing opportunity forthe local people.

Buildings were too compacted to each other and narrow streets in between. Direction of the buildings was variable and generally it was derived from the direction of the streets. Proximity and coordination of the main elements of the city such as mosques, Bazaars, cisterns,...with the main streets has always been asignificantfeature in the organization of Kashan's city context, which makes it readable and gives identity to it.

In the following chapter, the traditional houses of Kashan are discussed in terms of their architectural characteristics, and their spatial organizations are analyzed accordingly.

Chapter 4

TRADITIONAL HOUSES OF KASHAN

There are considerable number of traditional houses in the historical context of Kashan city; which proves the value and significance of this context. There are almost 80 traditional houses, which have been registered by Cultural Heritage Organization of the city. Each of these houses is considered as a prototype in attention to the application of desert vernacular architecture principles and their strategies in order to respond particular climatic conditions of this region. Moreover, it should be mentioned that the passages between these houses are valuable too; all these characters together increase the significance of the city and make it as one of the most exclusive historical context of the country.

However, during the last years of Qajar and the beginning of the first Pahlavi's period, Kashan faced with the gradual disappearance of the local people from its historical context (due to their desire to live in big and modern cities such as Tehran which had economical developments), therefore, most of the traditional houses left empty or replaced with low-income people mainly as rural and immigrants. This issue caused gradual ruining and reduction of the traditional houses of the city; since, their inhabitants were not only poor in terms of economical situation but also from cultural point of view. Accordingly, study of the traditional houses of Kashan is crucial not only to understand their architectural and cultural values, but also to maintain these values through properly transmitting them to the future generations.

4.1 General Architectural Characteristics of the Traditional Houses in the Kashan City

In general, the houses in the hot and arid climate of Iran, which Kashan is located in, are introverted and the most preferred plan type is the courtyard houses. Courtyard is the heart of the house both from social and environmental aspects and its size depends on the total size of the land which house is built in. It is narrow enough to create shady areas in summer while is also wide enough to gain solar rays in winter time. Moreover, courtyard is one of the important components of the domestic buildings which provides privacy, security and nearly, all the other parts of the house are built around the courtyard and facing to it, so they can easily get the light and air flow through it.

Courtyards have distinct forms depending on the landscape of the house. In courtyards, use of plants and water as an effective factors in such climate not only makes an attractive setting but also help for evaporative cooling, and more shaded areas can be obtained. As Maleki (2011) mentions planting reduces the direct sun radiation to the courtyard, creates shading on ceiling, walls, windows and courtyard, increases humidity and decreases the temperature, dust and undesirable wind speed in building surroundings.

Existence of the high walls surrounding the courtyard can reduce the floor temperature, and subsequently, the open areas can be used during the day. Water channels poured out from the pool are important elements for cooling and increasing the humidity; these channels spread water to the courtyard floor and evaporative cooling from the surface of the courtyard floor is efficient (Tavassoli, 1974).



Figure 4.1. Courtyard, Broujerdi House

In the central part of Iran, sometimes, the level of courtyards are lower than the street level, therefore, entering to the house should be done from the upper level of the courtyard. For that reason, in order to access different parts of the house in the upper level, an open passageway is built around the courtyard in the upper level, which is called as 'Sharomi'. This type of the houses possessing sunken courtyards are known as 'Godal-Baghcheh'. While, walking on Sharomi, all the facades of the house can be seen. Actually, Sharomi is like a narrow Iwan on four sides of the house in the first floor that is accessible by all the spaces around it (Haeri, 2004).

Moreover, Godal-Baghcheh was one of the solutions in such houses, to assist avoiding direct sunlight during the summer time and reducing the temperature inside of the house.



Figure 4.2. Sharomi, Taj House (Rezvani, Panoramio, 2009)

Moreover, in this climate, compact forms are chosen to reduce the area affected by solar radiation and also to increase the shaded areas. Generally, rectangular forms, which their northern and southern sides of them, are larger than eastern and western ones are more suitable in this climate. In other words, the proper direction for the buildings' expansion is along east-west direction.

As Ghobadian (2009) explains not only the buildings but also the overall layout of the cities are organized with special qualities in order to respond to the environmental conditions of the region, which can be mentioned as below:

In the hot and arid climate of Iran, urban spaces are enclosed and buildings are adjoined; there are narrow and irregular streets, traditional houses are isolated from the street and surrounded by high walls. During the day, external walls of houses provide shady areas in narrow streets and especially in courtyards (Leylian, Amirkhani, Bemanian, Abedi, 2010).



Figure 4.3. High external walls, narrow and shaded streets of Kashan

In such climate, the building envelope was constructed by the materials (such as mud and adobe), with a high heat capacity as thick as possible. Therefore, the effect of the outside temperature is reduced and a cool internal area can be achieved during the day. For this reason, materials such as mud, mud brick, brick, thatch (mud and straw), calcareous rock, stone, wood and the combinations of them are always preferred in this climate, since they have thermal resistance and high heat capacity, they act as good insulators against cold and warm air and regulates the humidity of the living place (Kasmaie, 1984).

Moreover, absorption and desorption characteristics of the materials, which are mainly related to their colors, are another important factors to reduce the heat inside of the building; bright colors like white might reflect up to 90% of the sunlight heat, while the dark colors up to 15% or even less (Tavassoli, 1990). Besides, The transparency ratio of the building envelope is chosen as low as possible.



Figure 4.4. Materials used in a traditional Kashani house

Roofs were constructed with mud and adobe, usually, with a tatched surface, in a convex form. The domes and vaults' curve helps minimizing solar gain into the room below it; since, a part of the roof is always in shade and speed up heat loss from the room through ventilated cupolas. Moreover, domes are usually built in 2 layers, therefore, air insulation between two layers prevents transferring heat to the inside. Also Domes are more strong against side forces such as wind & earthquake (Farrokhyar, 2008).

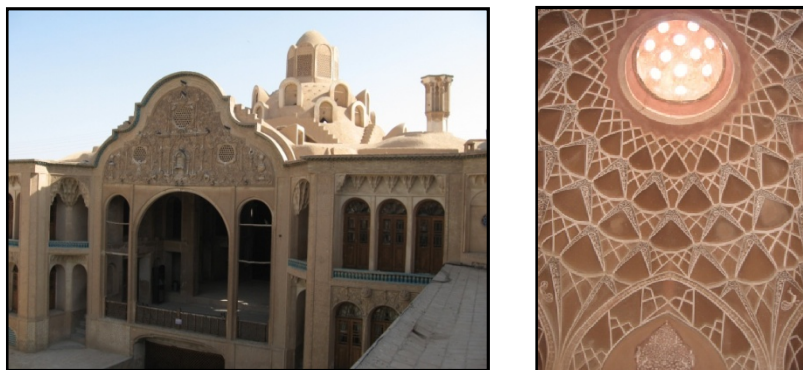


Figure 4.5. A vault roof, Broujerdi House

Two storey buildings with basement are preferrable in this climate; and usually, ground floor is lower than the street level. The main facade of the building is mostly

looks to the south which creates the best thermal condition inside of it (to get warm in winter and cool in summer).

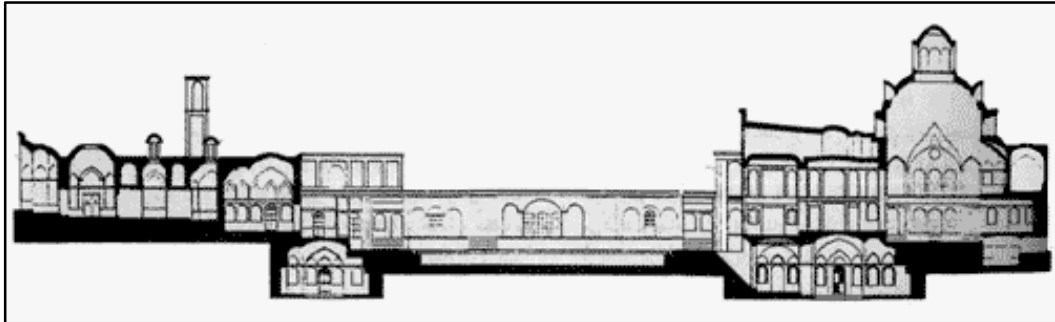


Figure 4.6. Longitudinal Section of Broujerdi house, showing level difference between the ground level and street(Cutural Heritage Organization of Kashan City)

Houses in Kashan city are known as four season houses; location of the activities in the house was changed with the seasons; generally, in winter, the family would gather in the south-facing side of the house known as ‘Zemestan-Neshin’ with more and larger windows to take the maximum benefit of the winter light, while in summer, most of the activities would take place in the north-facing side known as ‘Tabestan-Neshin’ where the windows were less and smaller.

Moreover, the roof level of the summer part is higher than the winter one which also helps to the thermal comfort of the inside area; usually, winter part includes different rooms such as Seh-Dari, Panj-Dari, Tehrani, and summer part contains Talar with a veranda and a high roof. Generally, basement is built below the summer part of the house and in hot seasons, its temperature is less than the other parts (Zomorsheidi, 1995: 57). Besides that, since during most of the year the weather is hot and arid, the spaces, which belong to the summer time cover a larger area comparing to the winter one.



Figure 4.7. Summer and winter parts of Broujerdi house

Traditional Iranian architecture can be considered as a sustainable one; as Soflaee (2005) also states in the traditional Iranian architecture is easy for dealing with the environmental problems in long period of time; climatic factors as well as local construction materials and natural cooling systems in the hot and arid regions are the areas, which sustainability is obvious.

There are some elements in the traditional Iranian architecture of hot and arid region in order to reduce the effects of harsh environmental conditions, which can be explained as below: (Soflaee, 2005)

- **Wind Catcher (*Badgir*):** is one of the main and eye-catching elements in the sky line of most of the historical cities in Iran with hot-arid or hot-humid climate; it is a vertical shaft which is used in order to catch prevailing wind and channels it down to the building in order to ventilate the air and make inside cooler. There are in different forms and shapes which differs according to the wind direction. Moreover, the dimension of the wind catcher depends to the size of the space that is going to be ventilated by it.

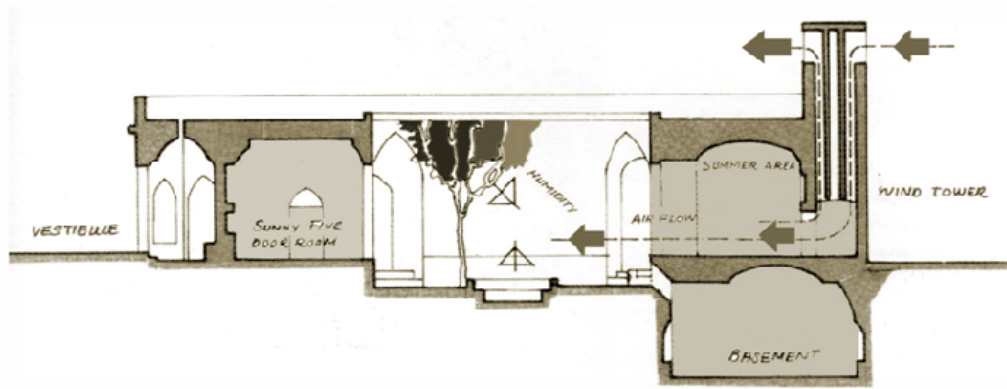


Figure 4.8. Wind Catcher function in a typical section of a traditional Iranian house (Maeiyat and Movahed, 2009:4)

- Cistern (*Sardab*):** in such a hot-arid climate, the best possible solution to escape from the sun is to go underground; therefore, traditional houses of Kashan are typically built with some spaces below the ground level for vertical migration. Generally, on both sides of the courtyard steep steps lead down to a Sardab, which is incredibly cool by being on the permanent shade (the temperature difference is such, as if you entered into an air-conditioned room).



Figure 4.9. View from inside the Sardab

Walls: heavy and thick walls, with nearly one meter thickness, cause difficulties in transferring the heat between outside and inside of the house and provide comfort for the users by making warm environment in winter and cool environment in summer.



Figure 4.10. A thick and heavy wall of a house in Kashan

- **Windows:** there are not much windows on the external façades of the houses, but there are enough number of them facing to the courtyard; these windows also help internal ventilation. Usually, windows were consist of colorful (bright colors like green, yellow, red and blue) and small glass pieces within wooden frames.

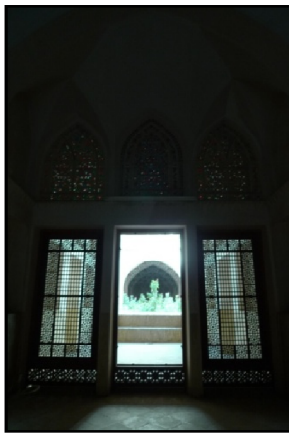


Figure 4.11. Windows, view to the courtyard in the traditional Kashani houses

- **Basement (*Shabestan*):** all the traditional Iranian houses in the hot and arid region have a basement or Shabestan; its ceiling is about one meter above the level of courtyard for ventilation and getting light and and the rest of it is fully placed underground.



Figure 4.12. View from outside and inside of the basement in a traditional Kashani house

- Pool-House (*Howz-Khaneh*):** This space is a sort of summer living room to be used by the family members; since, it is well-protected from the sun and is cool. There is a fountain in the middle, which the water of the Qanat would come to it. The ceiling is usually 5 or 6 meters high with a dome at the top. It acts as a passive cooling system to create more thermal comfort in the houses. It is well-decorated and furnished in order to be more comfortable and cosy area.



Figure 4.13. Howz-Khaneh, Abbasian House

4.2 Courtyard in the Traditional Houses of Kashan City

4.2.1 Historical Perspective of Courtyard

Presence of buildings with a courtyard in the Iranian architecture dates back to eight thousand years ago. In different buildings and specifically in the houses reaching to the complete form of courtyard took nearly six thousand years. A number of buildings with courtyards, which have been survived from the pre-Islamic and the Islamic period could be mentioned as: the original building of the Chogha Zanbil from 1250 BC (Ghodar 1978); the 'Suhkte' building in Tepe Hesar', Damghan, from 1000–800 BC (Malek-I Shahmirzadi 1988); the 'Susa' palace of Dario of the Achaemenid dynasty from 550 BC; the 'Asur Palace' from the Parthian period; the 'Firuz Abad' Fire Place (third century AD); the Palace at Sarvistan (fifth century AD); the Jami Fahraj Mosque (eighth century AD); the Jami Mosque at Shiraz (ninth century AD); the Nuo Mosque at Shiraz (thirteenth century AD) and the Khan Madresseh at Shiraz (seventeenth century AD). These examples verify the historical precedents of the courtyard in houses of Middle Eastern societies (Memarian, 2006).

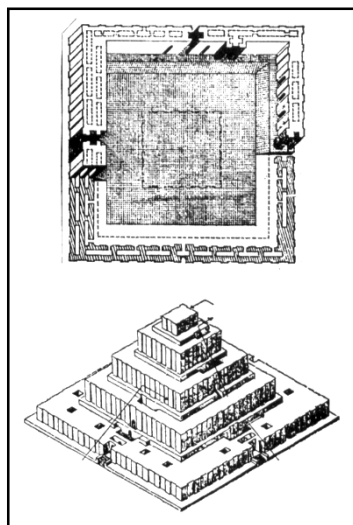


Figure 4.14. Chogha Zanbil, in its prime scheme spaces had been located around a courtyard (Memarian after Girshman, 2006:20)

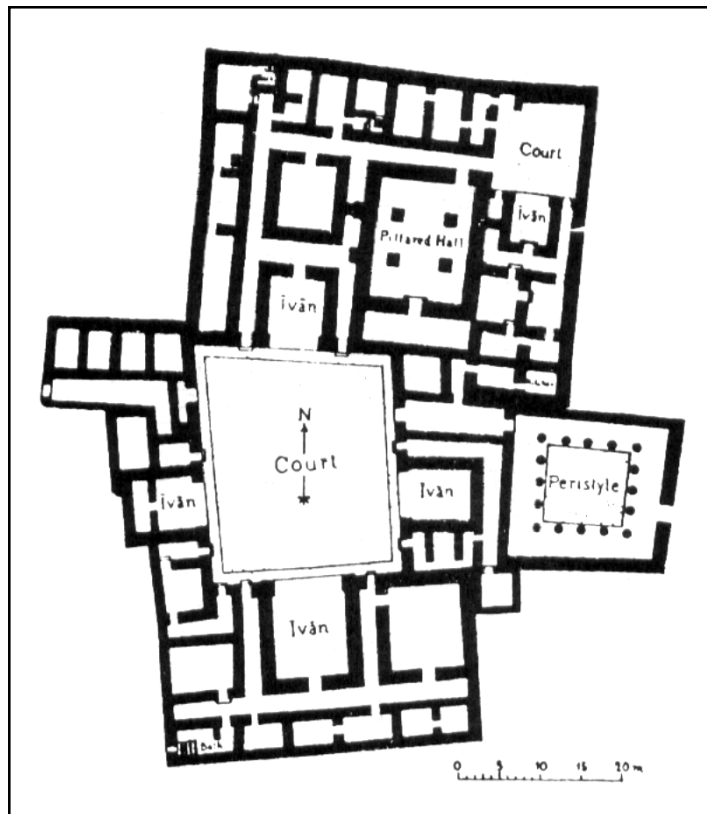


Figure 4.15. Asur Palace with one courtyard and four Iwans (Memarian after Pope, 2006:22)

Courtyards were used for various reasons. Its role differs from one region to another. In Iranian houses, courtyards have been mostly used for one or more than one of the purposes below:

- As a sign for showing the ownership boundaries
- To create unity between diverse elements and spaces in the house
- As a circulation backbone, for connecting different parts of the house
- To create a pleasure milieu by counting water and greenery
- To direct the prevailing wind to the house and assist ventilation
- As an essential element in order to arranging different spaces
- As a safe and private place for comfort of the family (Memarian, 2006)

In the hot and arid climate of Iran, Builders tried to create comfortable environment for the inhabitants of these houses in hot summers and cold winters. The entrance part was the only connection between outside and inside of the house; because of the hot and arid climate, there was no vegetation outside and for that reason, there was no need to have visual or physical contact to the outside and builders take the attention and vision of the inhabitants to the inside of the house with beautiful pool and gardens.

Courtyard has always had a great role (in both climatic and cultural aspects) in the formation of the introverted houses which is the most typical form for the houses of the hot and arid climate of Iran and subsequently Kashan as one of the cities in this climate. Different parts of the house such as seasonal rooms, private and public areas are organised around the courtyard to be related one to another.

4.2.2 Courtyard and Privacy

Traditional houses of Kashan have been formed in a variety of designs with one or more courtyards; the houses mostly contained inner (Andarooni) and outer (Birooni) parts. Courtyards can also be divided into two types (depending to the largeness and design of the house): inner (for Andarooni part) and outer (for Birooni part) ones for the houses with two or more than two courtyards. In this respect, courtyards can assist creating privacy by defining public and private parts of the house.

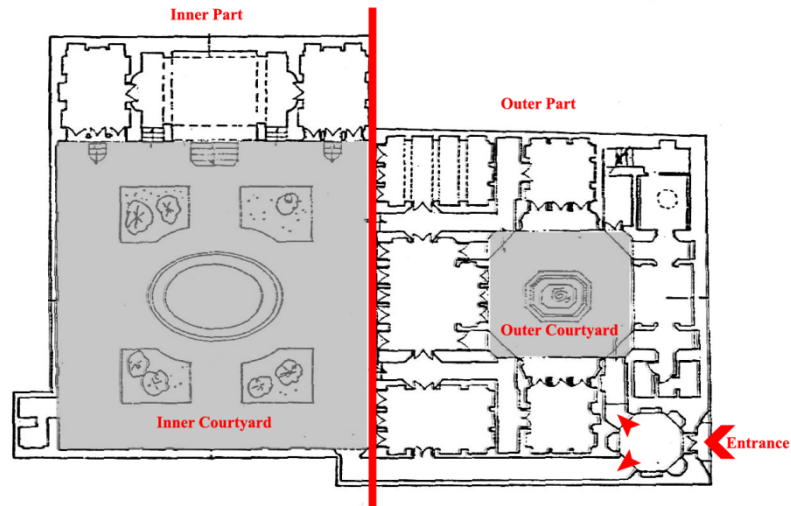


Figure 4.16. Inner and outer courtyards, Barforoush House
(After Cultural Heritage Organization of Kashan City)

Inner and outer parts of the house have connection with each other in different ways; this connection can be in the level of ground floor through different corridors and also it can be by means of some underground passages.

4.2.3 Position of Courtyard

Courtyards are mainly in an elongated rectangular shapes; they were mainly built in two types: flattened and sunken courtyards.

- **Flattened courtyards:** these courtyards are the ones which are built in the same level with the ground floor of the house. Different parts of the house were usually built in a higher level from the courtyard in order to take light and have ventilation and entrances to the basement in this part.

Usually in the longitudinal axis of the courtyards, there was a pool and parallel with it there were two or four gardens; pools and gardens were designed in various and beautiful shapes.

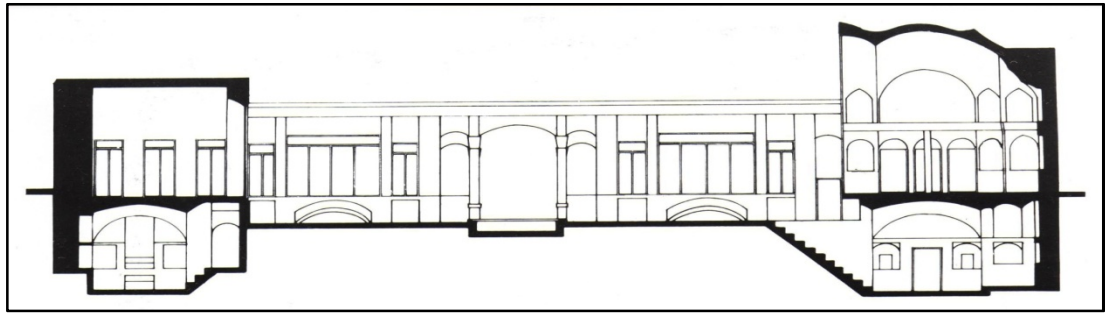


Figure 4.17. Flattened Courtyard, Dastmalchi House
(Cultural Heritage Organization of Kashan City)

- **Sunken courtyards (*Godal-Baghcheh*):** this type of courtyards are built one floor down into the ground, they are in the same level with the basement of the house. In the houses with *Godal-Baghcheh*, taking light for some parts of the basement is done through this part. By means of *Godal-Baghcheh* accessibility to the underground water was easier and also it provides the required soil for the adobes used in the construction of the house. Besides, *Godal-Baghcheh* by being sunken and with the existence of trees created cool environment. In the houses without *Godal-baghcheh* usually the whole or some parts of the spaces under the ground floor has been occupied by the basement.

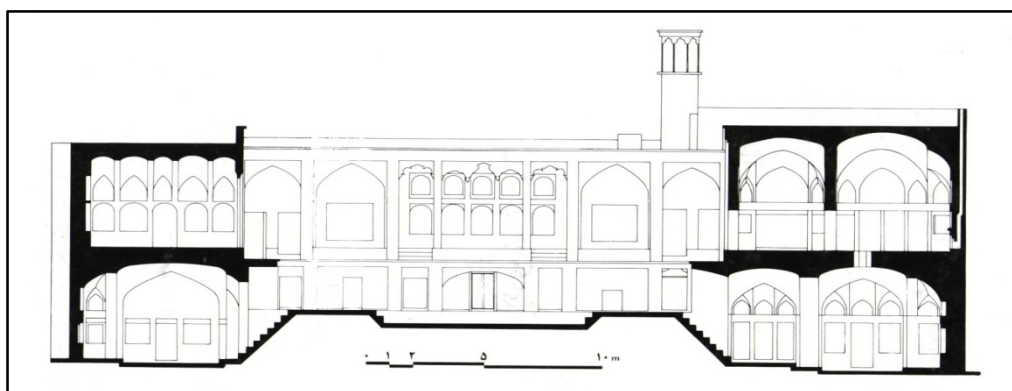


Figure 4.18. Sunken Courtyard, Tahami House
(Cultural Heritage Organization of Kashan City)

4.2.4 Space Arrangement around Courtyard

One of the main features in the traditional houses of Kashan is the seasonal movement that occurred between rooms on different sides of the courtyard; for this reason, the arrangement of summer and winter parts are one of the important aspects in the space arrangement around the courtyard. For the houses with one courtyard, there might be only a Talar in summer part (mostly located in the southern side) and a room in winter part (mostly located in the northern side), or it can be a Talar with spaces adjusted to it and combination of the same number of spaces in the winter part of the house to keep the same rhythm in both parts.

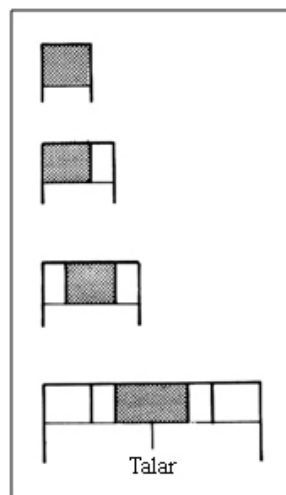


Figure 4.19. Arrangement of Talar and winter room around the courtyard, in one courtyard houses (Memarian, 2006:296)

For the houses with two or more than two courtyards, there is a main axis in accordance to the location of two main spaces: Talar and Winter Room (summer and winter parts). The direction of the main axis and the arrangement of spaces can be classified as below:

- The main axis of all courtyards are parallel with each other, and the courtyards are in the same line either from length or width.
- The main axis of two or more courtyards are parallel but the courtyards are not in the same line neither from length nor width.
- The main axis are perpendicular
- Combination of these three types

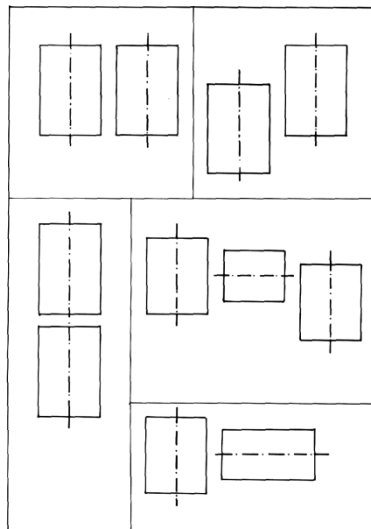


Figure 4.20. Axial organization of courtyards in the houses with two or more than two courtyards (Memarian, 2006:311)

Moreover, spaces are arranged around the courtyard in one of the following types; they can be located on one side of the courtyard, or they may be situated on two sides of it (opposite/perpendicular sides), courtyard might also be enclosed by spaces on its three or four sides.

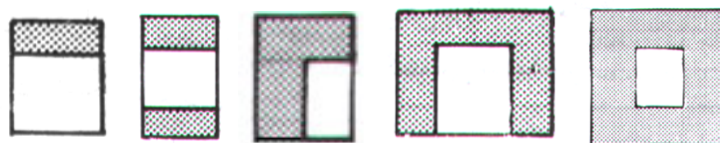


Figure 4.21. Space arrangement around the courtyard

4.2.5 Accessibility to Courtyards

According to the location of courtyards, their accessibility could be in different ways:

- Most of the time, courtyards are accessible through the Hashti and Dalan; Hashti could contain two entrances and Dalans: one to the inner (Andarooni) and one to the outer (Birooni) parts. Where the entrance or corridor opened directly to the courtyard, a guest room might be provided nearby it.
- If the house was located between different streets, accessibility to the courtyards (Andarooni and Birooni) could be done through different entrances.
- Another solution is a combination of two other solutions mentioned above, which means use of Hashti and Dalans or entrances from surrounded streets.

For the houses with two or more than two courtyards, accessibility among the courtyards is usually through the spaces between them; courtyards might be accessible through separate entrances, also there could be one entrance and then through different corridors it might have access to the courtyards, besides, it is also possible to have one entrance to one of the courtyards and then through the spaces between the courtyards, accessibility to the other courtyards is achievable.

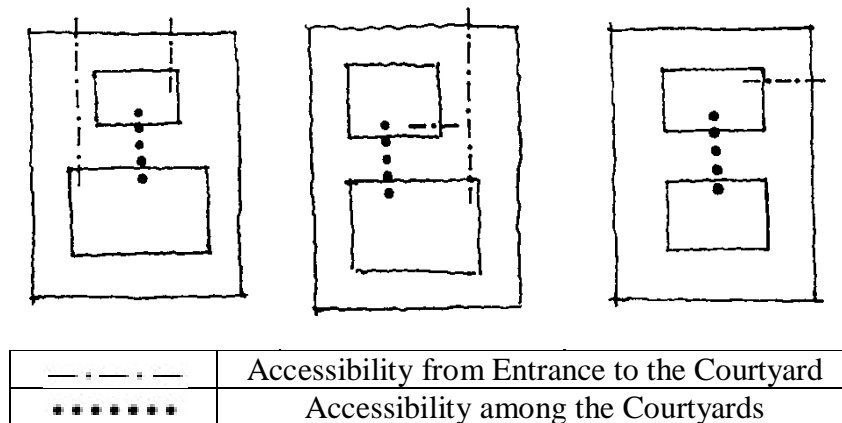








Figure 4.22. Accessibility to the courtyards

4.3 Classification of the Traditional Houses of Kashan based on Courtyard

Traditional houses of Kashan were belonged to different level of people in terms of their social and economic situation in the society. Due to this fact, there are variety in such houses in terms of their sizes and number of the courtyards, which in general are divided to three main groups: one courtyard houses, two and three courtyard houses (including inner and outer parts), and multi-courtyard houses (family complexes).

It sounds that one courtyard houses were belonged to the low-income people of the society, while two/three courtyard houses generally with more variety of spaces, were belonged to the middle classes and rather rich families. Moreover, multi-courtyard houses, which were built as family complexes with several courtyards and great decorations, were belonged to the tradesmen, local rulers, capitalists who were wealthy people in the society.

By considering the classification of these houses, firstly, they are interrogated through the schematic analysis of their plans and sections, to simplify their general layouts, and clarify their space organizations both in horizontal and vertical directions as well as specification of the particular characteristics of the houses in each group. Accordingly, there is a necessity of grouping the spaces and determine the zoning in these houses, which are mainly categorized as:

	A : Spaces that serve mostly to the visitors
	B : Spaces which are mainly used by the family members
	C : Courtyard
	D : Service parts
	E : Semi-open spaces
	S : Basement

4.3.1 One Courtyard Houses

4.3.1.1 Two Sided Built (opposite or alongside)

This group of the houses which possesses different spaces on two sides of the courtyard is divided into two groups; spaces on two opposite sides and spaces on two adjacent sides. The other two sides of these houses do not contain any space and they are just simple walls with some arch-shape recesses.

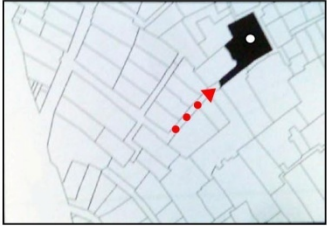
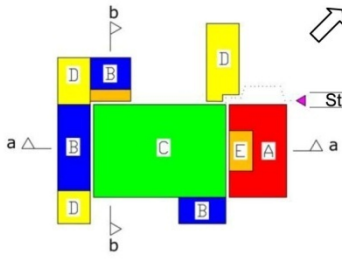
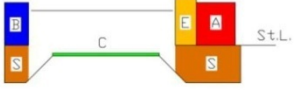
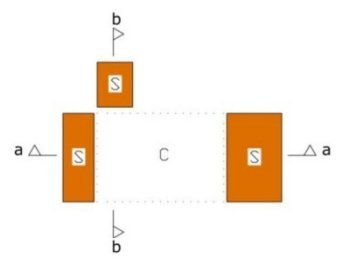
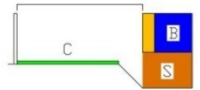
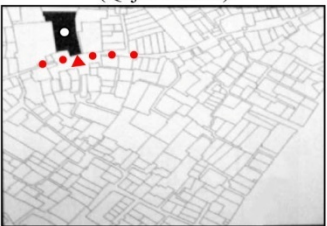
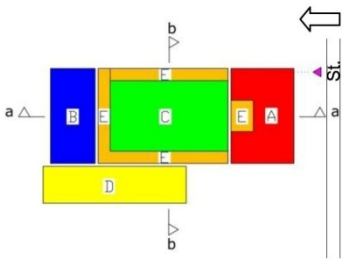
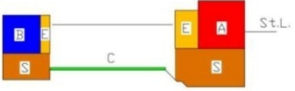
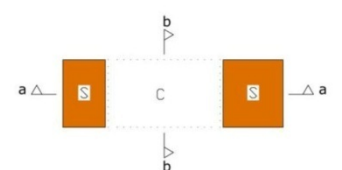
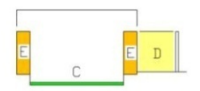
In these houses, on the two sides of it, important parts or main domains of the house are positioned; usually one side, which is more close to the entrance part belongs to the public domain and the other side with more family rooms belongs to the private domain of the house.

In the houses with spaces on two opposite sides, usually the spaces are arranged in accordance to the seasonal change; in a way that the side which faces to the sun is the winter part and the side which is rear to the sun is the summer part of the house.

There are a limited number of houses with two adjacent spaces. The arrangement of the spaces is mainly depended on the land's shape and direction. The simplest example of these houses is Karkhanehchi house, which possess three three-door rooms on one side and on the other side, a five-door room in the middle flanked by two three-door rooms. The symmetrical Keryas between the spaces on each side can also be seen in this type of houses.

Usually, the basements are also located underneath of these two main parts of the house.

Table 4.1a. Schematic Analysis of the 2 Sided Built, One Courtyard Houses

2 Sided Built One Courtyard Houses- Flattened Courtyard	Plan	Section
<p>Kheirieh House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>
<p>Saleh House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>




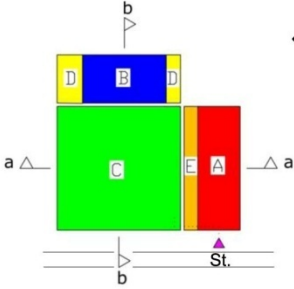
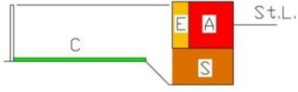
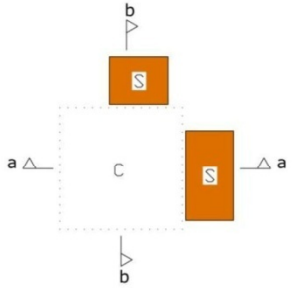


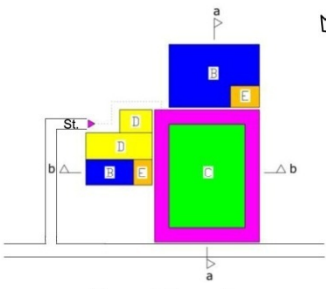
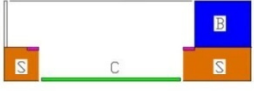
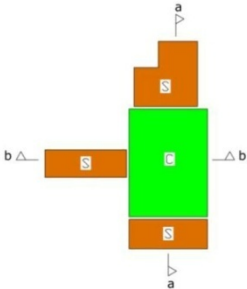
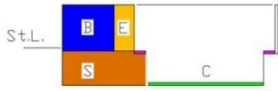
	Street
	Entrance

Table 4.1b. Schematic Analysis of the 2 Sided Built, One Courtyard Houses

<p>Karkhanehchi House (Late Qajar-Early Pahlavi Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
<p>2 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)</p>	 <p>Basement plan</p>	 <p>Section b-b</p>
<p>Balalzadeh House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>

4.3.1.2 Three Sided Built


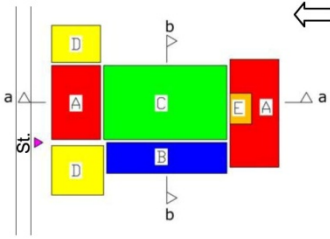


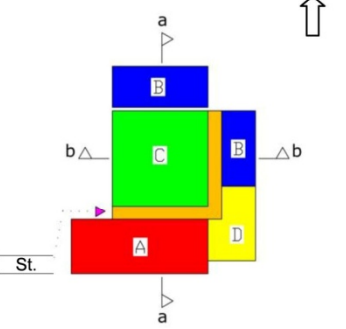

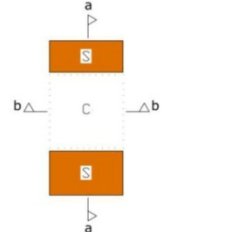

This group of the houses which different parts of the house were built around three sides of its courtyard are nearly a considerable number (one fourth) among the studied traditional houses of Kashan.

In these houses, at least on two sides of it, important parts or main domains of the house are positioned, and on one side (the third side) less important spaces which are mostly service parts of the house such as bathroom, kitchen,... are located. However, as it is seen in most of the studied houses, the main domains of the house are exist on three sides of its courtyard.

The forth side of the courtyard in this type of the houses does not contain any space and is just a wall with the similar façade to its opposite side.

This type of the houses mostly has a flattened and quite large courtyard, and just a few of them have a sunken courtyard (Godal-baghcheh).

Table 4.2a. Schematic Analysis of the 3 Sided Built, One Courtyard Houses

3 Sided Built One Courtyard Houses- Flattened Courtyard	Plan	Section
<p data-bbox="391 517 584 573">Sharifian House (Early Qajar Period)</p> 	 <p data-bbox="772 584 943 613">Ground floor plan</p>	 <p data-bbox="1171 584 1283 613">Section a-a</p>
<p data-bbox="373 1196 603 1274">Modarresian House (Qajar Period) (middle level of society)</p> 	 <p data-bbox="772 1357 943 1386">Ground floor plan</p>	 <p data-bbox="1171 1357 1283 1386">Section a-a</p>
	 <p data-bbox="788 1666 927 1695">Basement plan</p>	 <p data-bbox="1171 1666 1283 1695">Section b-b</p>

● ● ● ●	Street
▲	Entrance

Table 4.2b. Schematic Analysis of the 3 Sided Built, One Courtyard Houses


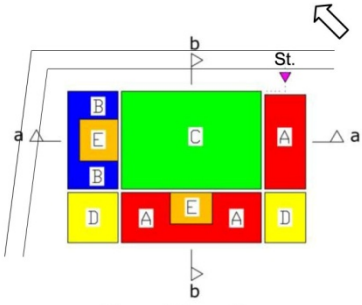
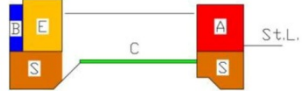
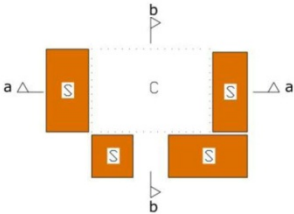
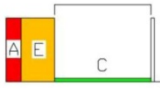
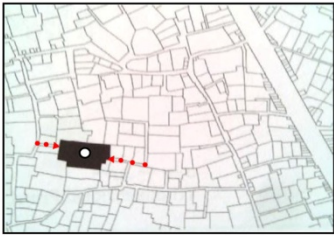
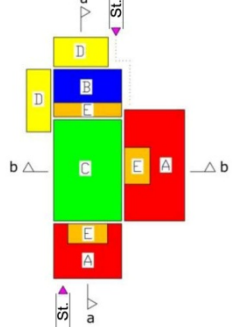
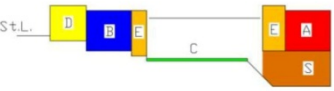
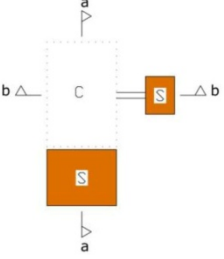
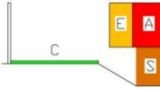
3 Sided Built One Courtyard Houses- Flattened Courtyard	Plan	Section
<p>Dastmalchi House (Late Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>
<p>Manouchehri House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>

Table 4.2c. Schematic Analysis of the 3 Sided Built, One Courtyard Houses

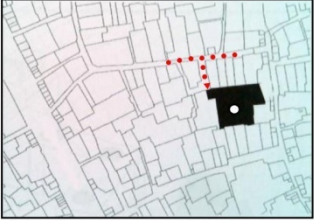
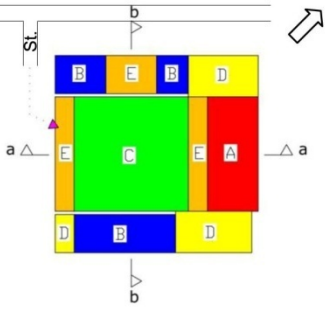

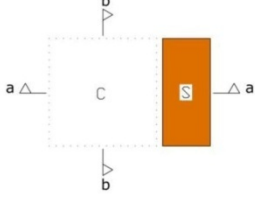


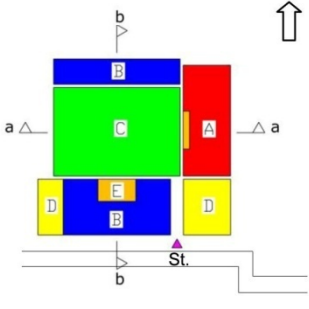
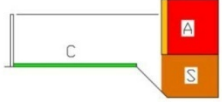
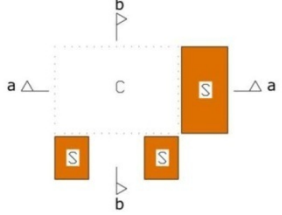
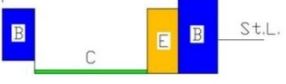
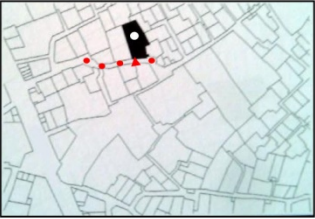
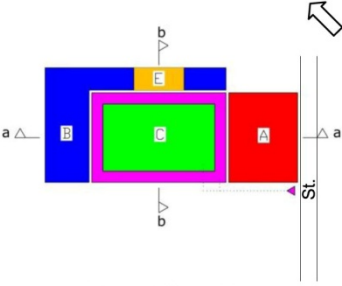
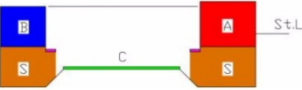

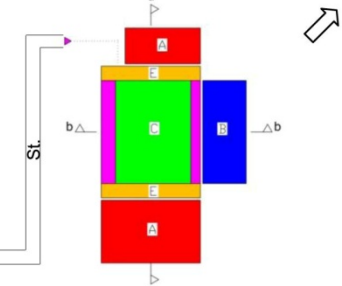

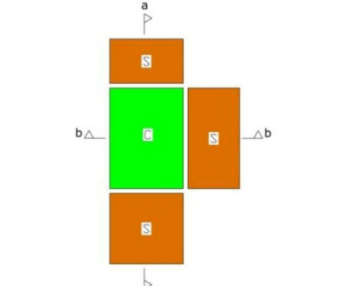
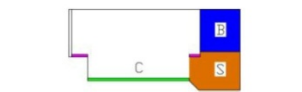
<p style="text-align: center;">Darolghoran House (Early Pahlavi Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>
<p style="text-align: center;">Attarha House (Qajar Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>

Table 4.2d. Schematic Analysis of the 3 Sided Built, One Courtyard Houses

3 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	Plan	Section
<p>Tahami House (Early Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
<p>Jahanbani House (360 m2) (Late Qajar-Early Pahlavi Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>

4.3.1.3 Four Sided Built


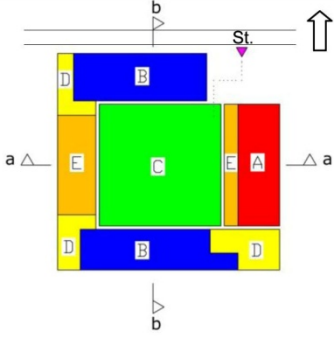

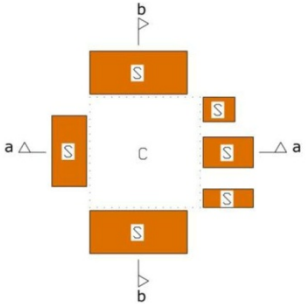


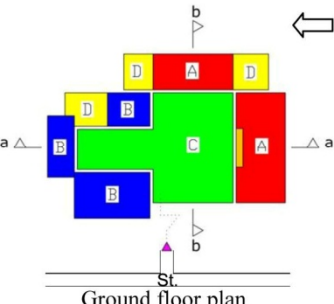

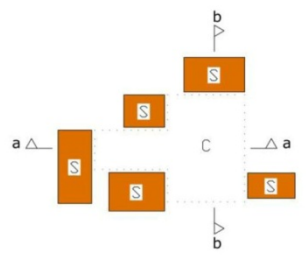

This type of the houses with one courtyard possesses different spaces on four sides of the courtyard. One of the reasons to have plenty of spaces on four sides of the courtyard sounds to be the large number of the inhabitants. In another words, this type of the houses were mostly belonged to the mid-level and crowded families of the society.

In these houses, at least two sides of the courtyard contain the main domains of the house (public/private) and the other sides consist of less important rooms or service parts.

Generally in this group of the houses, diversity and the number of the spaces with the beautiful symmetrical views are much more than the other groups.




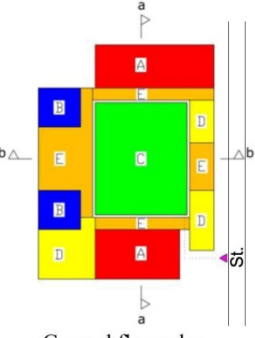
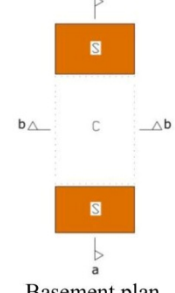

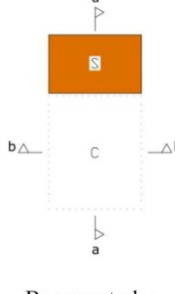

All the spaces on four sides are mainly positioned a few steps higher than the courtyard level. Since, mostly they have flattened courtyard and the spaces on the ground floor are located on the ceiling of underground basements (Sardab).

Table 4.3a. Schematic Analysis of the 4 Sided Built, One Courtyard Houses

4 Sided Built One Courtyard Houses-Flattened Courtyard	Plan	Section
<p>Nobakhti House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>
<p>Sajjadi House (Late Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>

● ● ● ●	Street
▲	Entrance

Table 4.3b. Schematic Analysis of the 4 Sided Built, One Courtyard Houses

<p style="text-align: center;">Saheb House (Late Qajar Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
<p style="text-align: center;">Ghoreishi House (Late Qajar-Early Pahlavi Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>

4.3.2 Two or Three Courtyard Houses

4.3.2.1 One Outer and One Inner Courtyard

A great number (approximately one third) of the traditional houses in Kashan belongs to this group. This type of the houses possesses two courtyards: one big and one small, which mainly the small one serves to the outer and the big one is located in the inner part of the house. In fact, the main part of the house, which generally covers the bigger area is the inner part of it.

In the studied houses, the relationship between the inner and outer courtyards and the accessibility from outside to inside of the house is various. In some houses, there are separate access from outside to the outer and inner courtyards like the Hashemian house. In some other houses, there is a common entrance (Hashti) and then by separated corridors (Dalan), inner and outer courtyards are accessible such as: the Bakoochi house. Moreover, there are some houses, which first there is an access to the outer courtyard and then is possible to reach the inner courtyard through the spaces among them mainly as a corridor (Dalan/Keryas) or an Iwan like the Taj House.

The inner and outer parts of the houses are also linked to each other either through ground floor passages or underground corridors such as the Bakoochi house.

The main domains of the house are mainly located around the inner courtyard. Generally, the common side between the inner and outer courtyards belongs to the public domain including the main Talar of the house and the other sides of the inner courtyard usually consist of the private domain (family rooms) and service parts.

However, the outer courtyard is surrounded by the rooms which are mainly used by the male members of the family especially for their business activities.

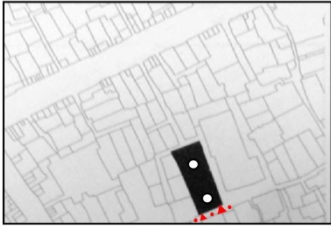
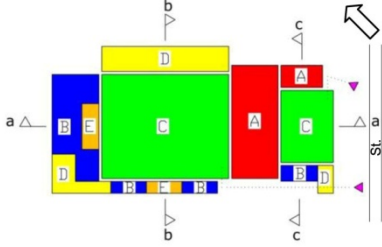

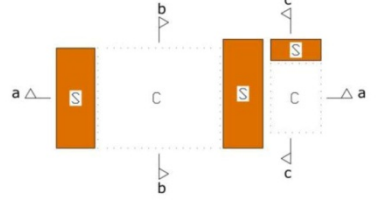
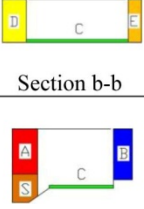

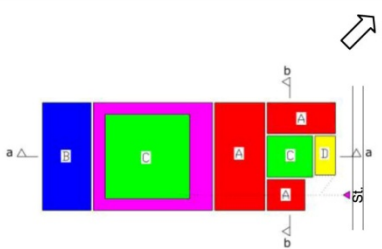
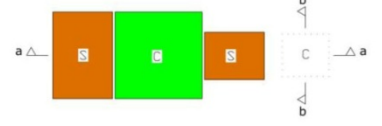

The arrangement of the courtyards is also different; in some houses, the courtyards are located on the parallel axis like the Taj house and in some other houses, the courtyards are positioned on the same axis like the Bakoochi and the Bafandeh houses.

One of the considerable characteristics of these houses is the existence of sunken courtyard (Godal-Baghcheh) which is very common among them (mainly they have one sunken which is generally the bigger and inner courtyard and one flattened which is usually the smaller and outer courtyard like the Taj, Sadooghi and Bafandeh houses).

The Pool-house (Howz-khaneh), which is mainly located on the level of the courtyard in the houses with the flattened courtyard and in the houses with the sunken courtyard is on the same level with the Godal-Baghcheh is one of the unique architectural features of these houses such as the Bafandeh and Sadooghi houses. This space which is a kind of covered space with a pool in the middle of it provides a cool environment for gatherings of the family members during the summer time. Mostly, this pool is connected through a water channel to the main pool of the house in the middle of the courtyard.

Around all the courtyards, a typical façade which faces to the courtyard contains a five-door room in the middle of the façade flanked by two Seh-dari rooms and Keryas between them, as a very familiar arrangement in these houses.

Table 4.4a. Schematic Analysis of the Two Courtyard Houses (One Outer and One Inner Courtyard)

Two Courtyard Houses- One Outer and One Inner Courtyard	Plan	Section
<p data-bbox="384 546 580 600">Hashemian House (Early Qajar Period)</p> 	 <p data-bbox="783 667 954 696">Ground floor plan</p>	 <p data-bbox="1193 667 1305 696">Section a-a</p>
	 <p data-bbox="783 972 954 1001">Basement plan</p>	 <p data-bbox="1193 824 1305 853">Section b-b</p> <p data-bbox="1193 981 1305 1010">Section c-c</p>
	<p data-bbox="400 1189 564 1243">Bafandeh House (Qajar Period)</p> 	 <p data-bbox="783 1317 954 1346">Ground floor plan</p>
 <p data-bbox="783 1621 954 1650">Basement plan</p>		 <p data-bbox="1193 1615 1305 1644">Section b-b</p>

● ● ● ●	Street
▲	Entrance

Table 4.4b. Schematic Analysis of the Two Courtyard Houses (One Outer and One Inner Courtyard)


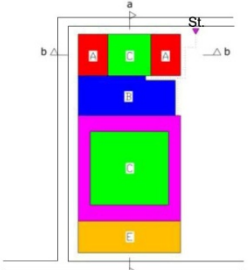
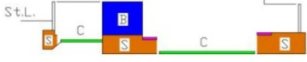
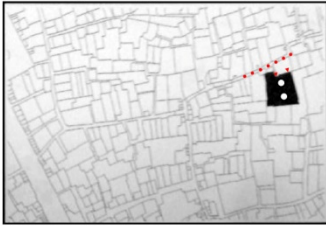
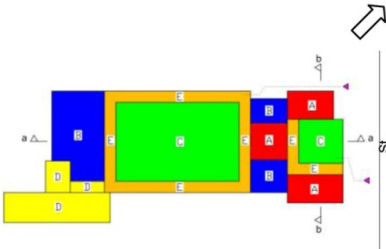

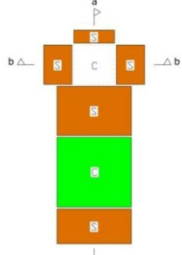

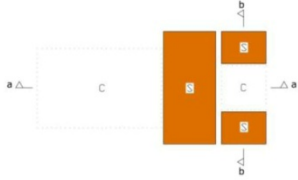

<p style="text-align: center;">Bakoochi House (Qajar Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
<p style="text-align: center;">Esfahanian House (Late Qajar Period)</p> 	 <p style="text-align: center;">Ground floor plan</p>	 <p style="text-align: center;">Section a-a</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>
	 <p style="text-align: center;">Basement plan</p>	 <p style="text-align: center;">Section b-b</p>

Table 4.4c. Schematic Analysis of the Two Courtyard Houses (One Outer and One Inner Courtyard)


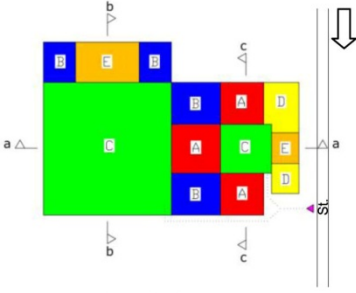

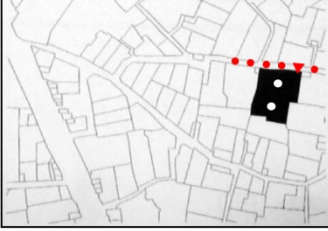
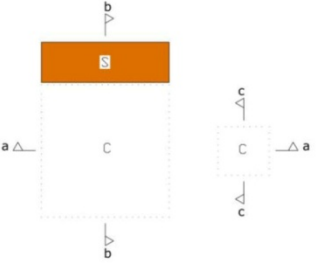
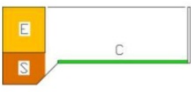
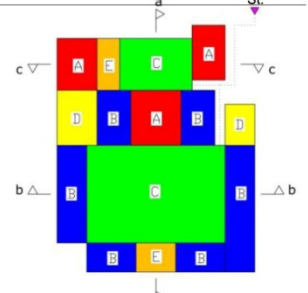

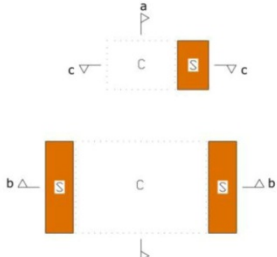


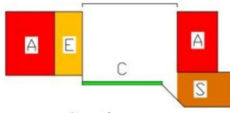

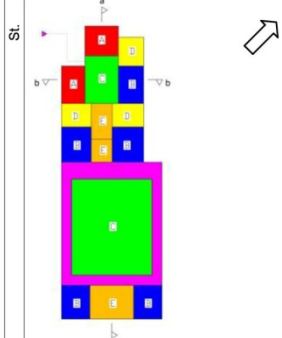
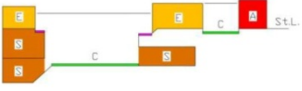
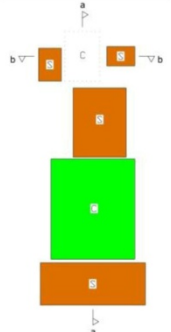
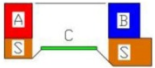
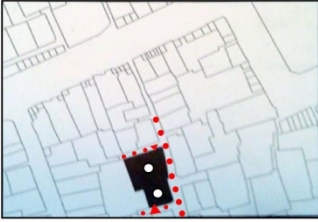
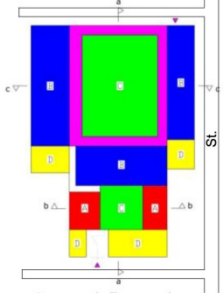
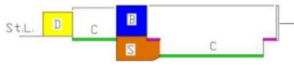
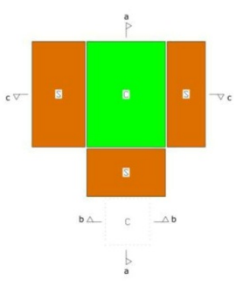


<p>Barforoush House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
<p>Mohtashami House (Late Qajar- Early Pahlavi Period)</p> 	 <p>Basement plan</p>	 <p>Section b-b</p>
	 <p>Ground floor plan</p>	 <p>Section c-c</p>
	 <p>Basement plan</p>	 <p>Section a-a</p>
		 <p>Section b-b</p>
		 <p>Section c-c</p>

Table 4.4d. Schematic Analysis of the Two Courtyard Houses (One Outer and One Inner Courtyard)

<p>Taj House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>
<p>Sadooghi House (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>  <p>Section c-c</p>

4.3.2.2 One Outer and Two Inner Courtyards

This type of the houses with magnificent architecture and elaborated decorations possesses one outer and two inner courtyards, which the arrangement of the spaces and the axial organization of their courtyards is differed. Sometimes, the courtyards are located on the parallel axis like the Boroujerdi house; and sometimes the main/outer courtyard is perpendicular to the other two inner courtyards that are positioned on the same axis like the Tabatabaie house.


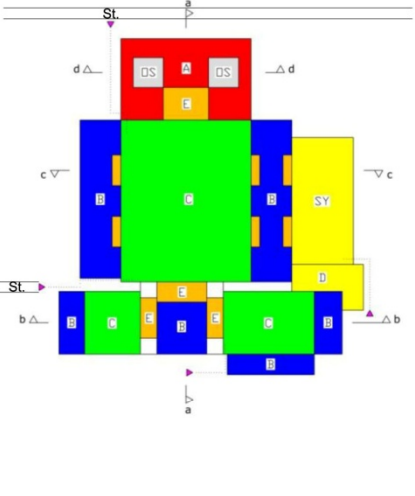
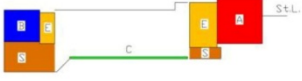
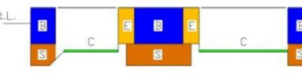
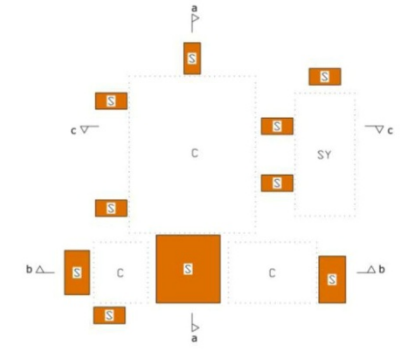

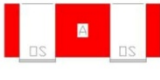
In these houses, the main hall (Talar) of the house and its surrounding spaces are located around the outer courtyard and contain decorations. The great spaces and the special decorations as well as the number of the spaces prove that these houses belonged to the rich and high ranked people of the society.

One of the other important characteristics of these houses is that the main and big courtyard is enclosed by various spaces on its four sides. In this type of the houses, there might be some other yards (in addition to the main courtyards), which are surrounded by the less important spaces and mainly they were used as service yards. Symmetrical quality on the facades around the courtyards is another common feature in these houses.

Another remarkable characteristic in these houses is the common rooms (usually five door room) between the inner and outer courtyards, which are used by both courtyards. Therefore, such a room can achieve good view, light and air at least by two sides of it.

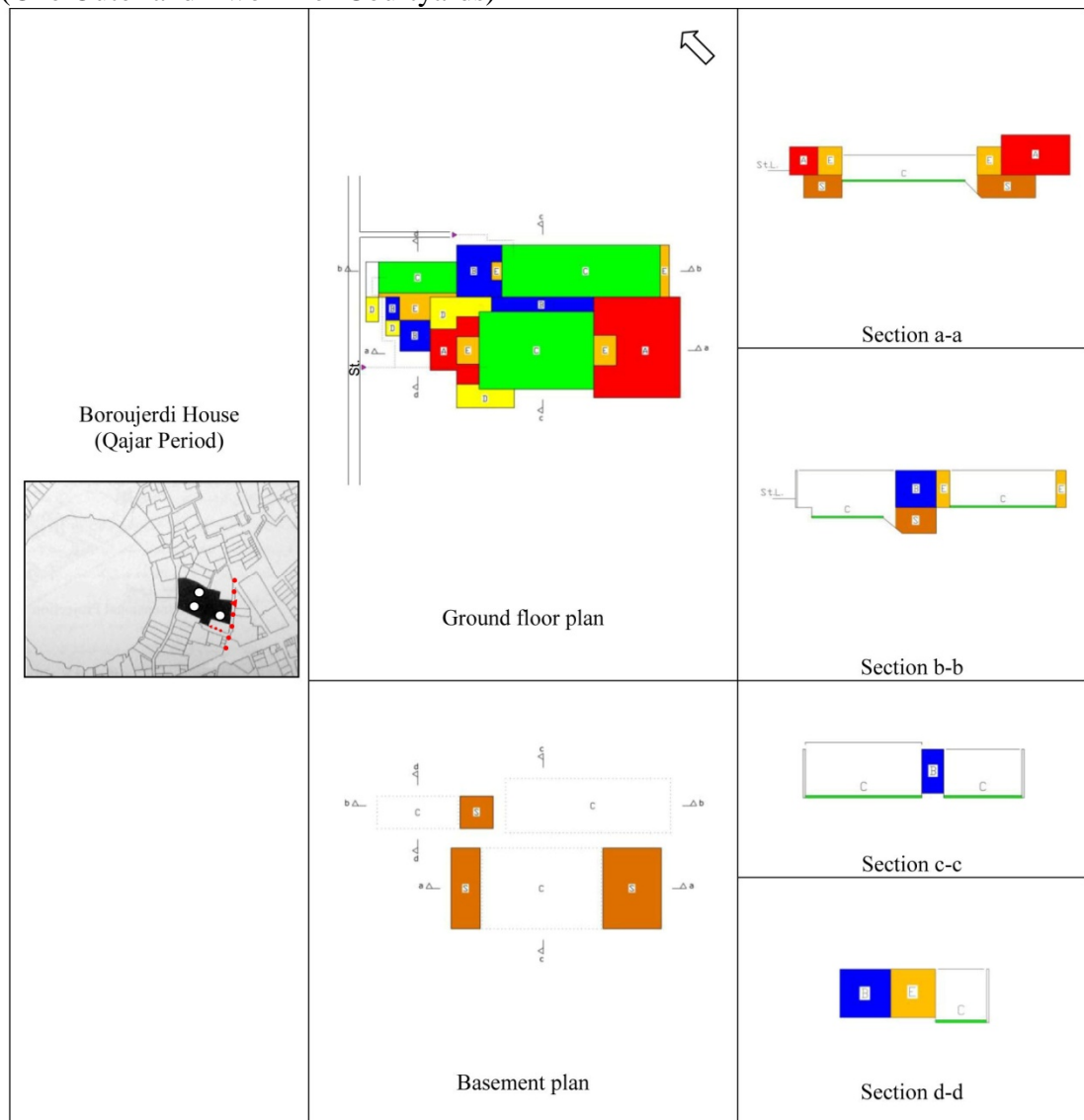
All the courtyards of the studied houses in this group are flattened and the underground basements or cellars (Sardab) are accessible through the courtyard by a flight of stairs.

Table 4.5a. Schematic Analysis of the Three Courtyard Houses (One Outer and Two Inner Courtyards)

Three Courtyard Houses- One Outer and Two Inner Courtyard	Plan	Section
<p data-bbox="375 1070 544 1122">Tabatabaei House (Qajar Period)</p> 	 <p data-bbox="746 1283 919 1312">Ground floor plan</p>	 <p data-bbox="1177 969 1289 999">Section a-a</p>  <p data-bbox="1177 1328 1289 1357">Section b-b</p>
	 <p data-bbox="762 1787 903 1816">Basement plan</p>	 <p data-bbox="1177 1552 1289 1581">Section c-c</p>  <p data-bbox="1177 1776 1289 1805">Section d-d</p>

● ● ● ●	Street
▲	Entrance

Table 4.5b. Schematic Analysis of the Three Courtyard Houses (One Outer and Two Inner Courtyards)



4.3.3 Multi Courtyard Houses (Family Complexes)

As mentioned before, due to the financial potentiality of the owner and their belief on keeping the house safe from strangers, and having all the family including the extended members in the house, these houses have several courtyards depending on the number of the family members. These houses, which are very few in numbers usually belong to the local rulers, business men, landowners... such as the Abbasian complex.

The Abbasian complex which belonged to one of the famous businessmen of the city includes five courtyards: Abbasian, Taghavi, Masoudifar, Abbasi Moghaddam and Haghani. However, the Haghani courtyard is destroyed and there are no enough documents of it to be studied.


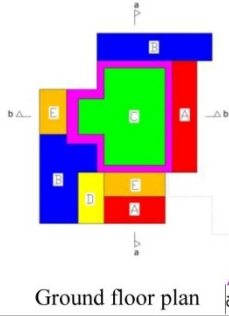


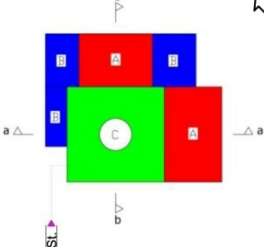
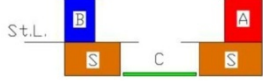
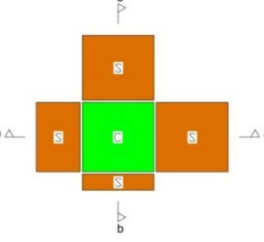
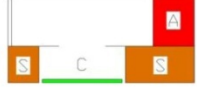
The axial organization of the courtyards can be different; they can be on the same axis, on two or three parallel axis, or on two main perpendicular axis. Generally, in such complexes, a combination of these axial organizations of the courtyards can be seen.

Since, these houses are vast in area; there are several entrances to different parts of the complex from the surrounding alleys. Moreover, accessibility to the courtyards varies according to their positions. The main entrance to the complex is by passing through a long corridor (Dalan), then the primary Hashti of the complex is reachable, which the secondary Hashti and Dalans that are all connected to it would direct us to the different courtyards of the complex.

There are both flattened and sunken courtyards in this complex. However, the Taghavi courtyard has a special characteristic, since there is an opening in the middle of its courtyard to provide the light for the basement spaces on the lower level, which makes it more similar to the sunken courtyards.


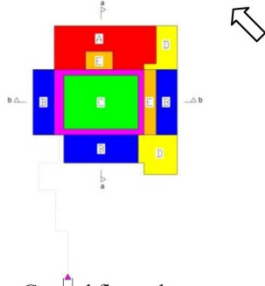

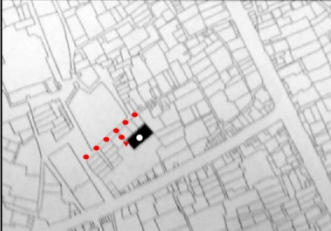
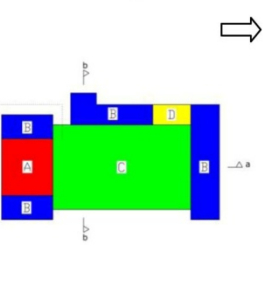

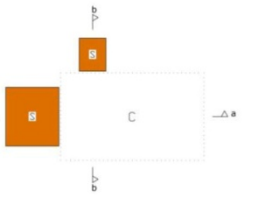

It seems that the Taghavi courtyard used to be more for public activities as an outer courtyard, and the Masoudifar courtyard as the inner courtyard of the complex.

Table 4.6a. Schematic Analysis of the Multi Courtyard Houses (Family Complexes)

Multi Courtyard Houses- (Family Complexes) Abbasian House	Plan	Section
<p data-bbox="395 555 587 607">Abbasian Courtyard (Qajar Period)</p> 	 <p data-bbox="778 685 943 712">Ground floor plan</p>	 <p data-bbox="1174 685 1278 712">Section a-a</p>
<p data-bbox="403 1205 579 1256">Taghavi Courtyard (Qajar Period)</p> 	 <p data-bbox="778 1312 943 1339">Ground floor plan</p>	 <p data-bbox="1174 1312 1278 1339">Section a-a</p>
	 <p data-bbox="794 1637 927 1664">Basement plan</p>	 <p data-bbox="1174 1626 1278 1653">Section b-b</p>

● ● ● ●	Street
▲	Entrance

Table 4.6b. Schematic Analysis of the Multi Courtyard Houses (Family Complexes)

<p>Masoudifar Courtyard (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
<p>Abbasi Moghaddam Courtyard (Qajar Period)</p> 	 <p>Ground floor plan</p>	 <p>Section a-a</p>
	 <p>Basement plan</p>	 <p>Section b-b</p>

Moreover, schematic analysis of the all selected houses clarifies some common issues related to the space organization of them, which are explained as follows.

All the traditional houses of Kashan have at least one courtyard. In one courtyard houses depending on the economical situation of the owner, on two, three or four sides of the courtyard, different spaces of the house in one or two floor high are positioned. Moreover, the direction and form of the land are the other important factors on the formation of the spaces around the courtyard. In other words, spatial configuration on four sides of the courtyard is differentiated in accordance to the financial level of the owner, size and direction of the land.

All the courtyards according to their position in the house are divided into two types: flattened courtyards (no Sharomi) and sunken courtyards/Godal-Baghcheh (with Sharomi).

Sunken courtyards possess two floor spaces around it, and Sharomi as an important circulation element around the courtyard on the first floor level are the general configuration of the houses with the sunken courtyard. The ground floor (courtyard/Godal-Baghcheh level) comprises service parts, basements, cellars (Sardab), and pool-house (Howz-khaneh).

In the houses with the flattened courtyard, the spaces are positioned a few steps up from the courtyard level, on the ceiling of the underground basements and cellars (Sardab).

Mostly the longitudinal axis (main axis) of the houses is ended up with the main domains of the house (public or private). Sometimes it is ended up with Talars (public domain) at its two ends, or it can be a public domain at one end and a private one (family rooms) at the opposite end. But the remarkable point is that there is always a Talar at least at one end of the main axis.

The direction of the main axis is mostly on north-south direction which is usually turned to the east or west (NE-SW/NW-SE) in order to get the maximum light and desired wind.

At least under one of the ends of the main axis, there is a basement (Sardab) which is mainly accessible by a flight of stairs through the courtyard.

Mostly, there is an Iwan in front of the Talar (public domain) as the main Iwan of the house; however there are some other Iwans in the private domain and around the courtyard of the house which all emphasizes the view to the courtyard and inwardness of these houses.

In the houses with the flattened courtyard, mostly the service rooms are positioned on the ground floor; they might be at the corners of the courtyard flanked by the main domains, or they can be on one side of the courtyard (generally parallel to the main axis). However, in the houses with the sunken courtyard, generally the service rooms are located at the Godal-Baghcheh level, and are accessible through it.

In order to access different parts of the house, after the entrance part (mostly a Hashti and Dalan) the courtyard is reachable (sometimes, in case of existence of an Iwan, first Iwan and then the courtyard), afterward from the courtyard, the other parts of the house especially the private parts are accessible through some other Iwans and corridors. However, the public domain and sometimes the service part of the house could be reached right after the entrance part.

In most of the houses the street level is higher than the courtyard level; therefore, from the entrance hall by a number of steps or slope Dalan, it is possible to reach the courtyard. In the houses with the sunken courtyard, from the entrance part, Sharomi (which is an area on the upper level around the courtyard and connects different parts of the house at this level) is accessible and then through the Sharomi, the courtyard/Godal-Baghchehisreachable. However, sometimes a long slope Dalan could make courtyard/Godal-Baghcheh directly accessible from the entrance part.

In most of the houses, there is a five door room (Panj-Dari) in the middle of the façade (facing the courtyard) and two rooms eitherwith three-door (Seh-Dari) or two-door (Do-Dari) on both sides of it with two Keryas (a sort of pre-entering space to the rooms) between these sided rooms and the five door room, which relates them together. Sometimes, the height of the five-door room is about two floors high, which causes the sided rooms to be built in two floors.

4.4 Spatial Analysis of the Traditional Houses of Kashan

Spatial analysis is a technique to study the topological properties of spaces. “Privacy is a dynamic topological property of space” (Ali Mustafa, et al. 2010), and the degree of privacy in spaces can increase or decrease based on the needs of its occupants (Georgiou, 2006).

There are some limitations that society puts on its members, particularly the privacy for the females of the family, and the differentiations in the way that a space is used among the two genders (Zako, 2005). People are in need of privacy meanwhile the social interaction (Altman, 1975). Privacy mainly provides limitation in social interaction with some strategies to control this interaction, and increase identity (Abu-Gazze, 1996).

Privacy as one of the fundamental notions in the traditional houses of Kashan, is essential to be discussed in order to identify the spatial characteristics of the houses based on such socio-cultural concepts. This study applies space syntax method both as a theoretical and analytical framework to analyze and detect the privacy level of the spaces and to clarify their spatial configurations as well as the degree of social interaction in the traditional houses of Kashan.

Space syntax method introduced by Hillier and Hanson (1984), deals with the concept of permeability of spaces while considering their function. The main theory of space syntax analysis is that the topological structure of space is a fundamental tool to clarify the spatial patterns of buildings. The analysis process consists of interrelated and integrated topological data as well as adopting descriptive and numerical analysis. The syntactic data of the spaces in terms of depth properties

explores the sequence of movement and permeability from the entrance (Bellal, 2007).

Space syntax analysis determines the space-function inequalities in configuration of houses (Guney and Wineman, 2008). The sequence of integration values offers a reliable pattern called as ‘inequality genotype’ which reflects the basic socio-cultural logic related to the functions’ order in the spatial configuration of a house (Bafna, 2003).

The graphs called “justified graphs” of these relationships provide a clear scheme to reveal the morphological characteristics of houses’ plan layouts. It is a useful method to represent spatial configuration. Figure below exemplifies the relation between two spaces and their corresponding justified graphs.

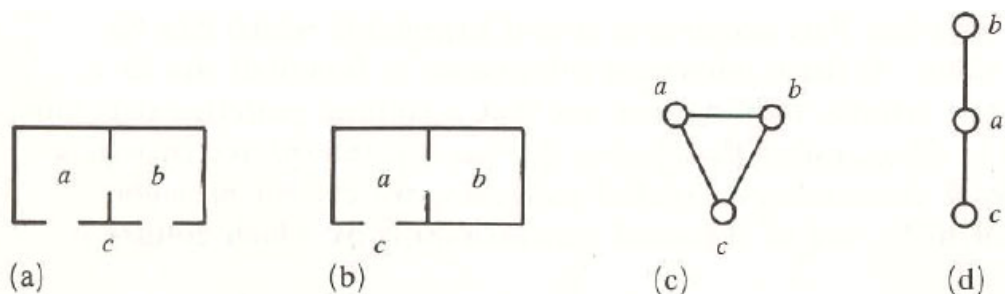


Figure 4.23. (a),(b) Two possible relations of spaces a & b to the outside(space c).
 (c),(d) The corresponding justified graphs for (a) and (b) respectively.
 (Hillier et al. 1987: 363)

This study is based on the analysis of the thirty traditional Kashani houses, by investigating on the relationship between spaces and the internal spatial structures of the houses, in addition to the association of the residents and the visitors. In the provided graphs for the traditional houses of Kashan, mainly the entrance of a house is selected as a root space and the other spaces are placed above it on the

levels, which differ according to the number of spaces that should be passed through to reach each space from the root. Consequently, all spaces of the house are given depth values according to the horizontal lines, which the spaces are located on them. Therefore, the spaces that are positioned on one horizontal line share the same depth. According to the explanations above, the justified graphs of the selected houses are provided as follows, and the abbreviations and colors, which are used in the graphs are defined as:























 Ent.: Main Entrance	 CS: Covered Space
 E: Secondary Entrance	 OS: Open Space
 H: Hashti	 1D: one door room
 D: Dalan	 2D: two door room
 CY: Courtyard	 3D: three door room
 GB: Godal-Baghcheh	 5D: five door room
 Sh: Sharomi	 7D: seven door room
 K: Keryas	 T: Talar
 I: Iwan	 P: Pastoo
 S: Service room	 HK: Howz-Khaneh
 SY: Service Yard	 B: Basement

Table 4.7a. Justified Graphs of the 3 Sided Built, One Courtyard Houses

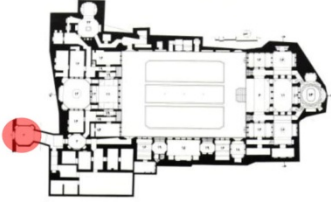
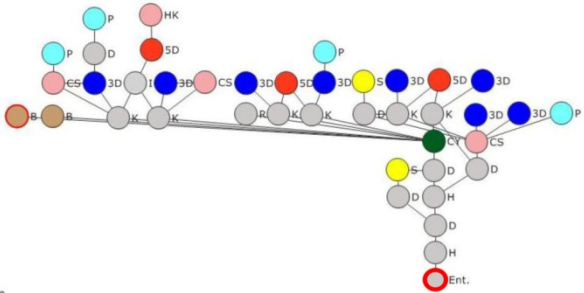
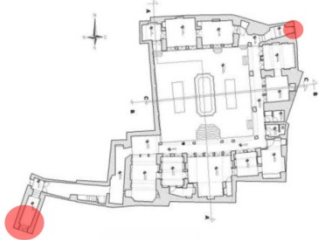
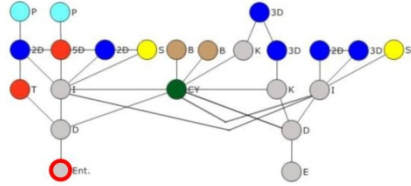
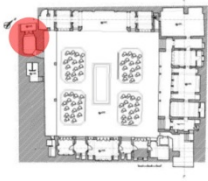
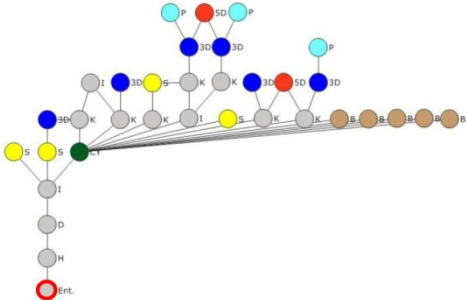
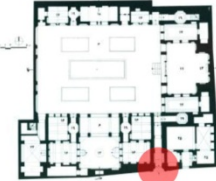
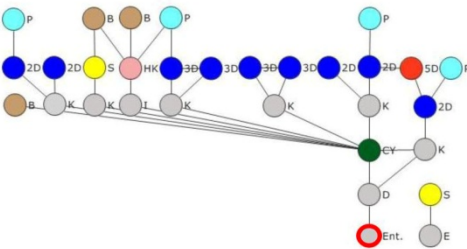
3 Sided Built One Courtyard Houses-Flattened Courtyard	J-Graph
<p style="text-align: center;">Sharifian House</p> 	<p style="text-align: center;">Sharifian</p> 
<p style="text-align: center;">Modarresian House</p> 	
<p style="text-align: center;">Darolghoran House</p> 	
<p style="text-align: center;">Attarha House</p> 	

Table 4.7b. Justified Graphs of the 3 Sided Built, One Courtyard Houses

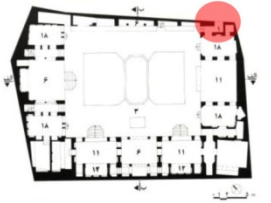
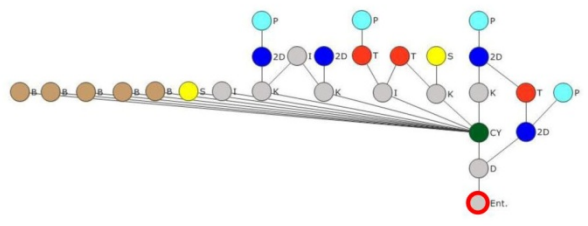
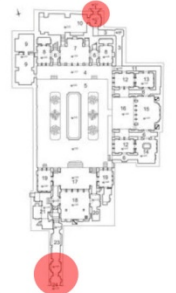
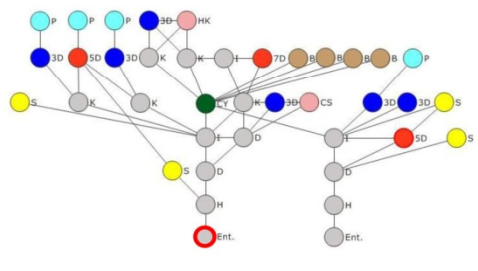
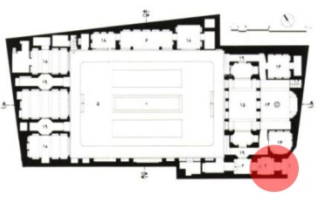
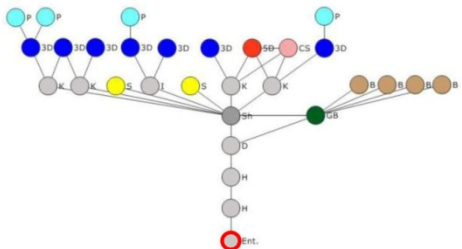
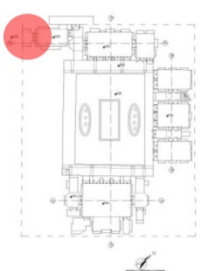
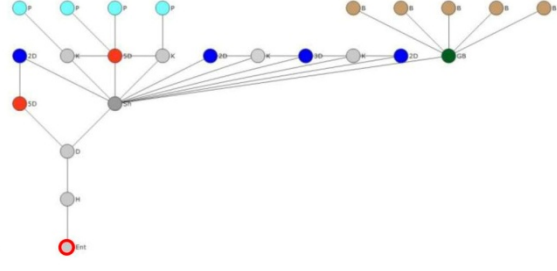
3 Sided Built One Courtyard Houses-Flattened Courtyard	J-Graph
<p data-bbox="422 297 592 320">Dastmalchi House</p> 	
<p data-bbox="411 589 603 611">Manouchehri House</p> 	
3 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	J-Graph
<p data-bbox="438 1023 576 1046">Tahami House</p> 	
<p data-bbox="427 1319 587 1341">Jahanbani House</p> 	<p data-bbox="758 1624 805 1646">Jahanbani</p> 

Table 4.8. Justified Graphs of the 2 Sided Built, One Courtyard Houses

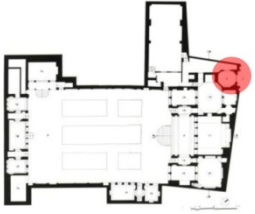
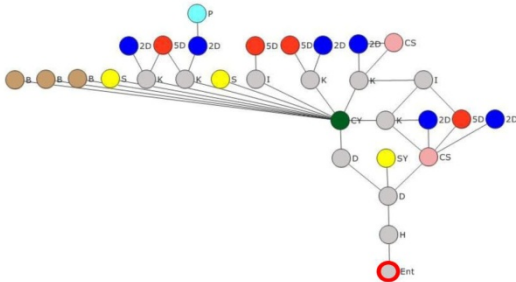
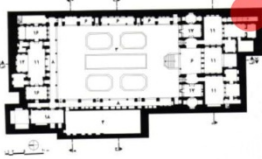
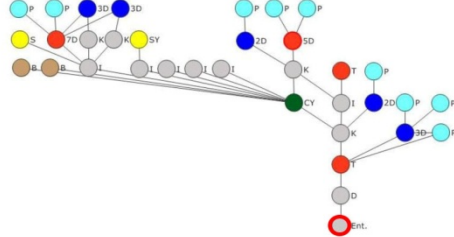
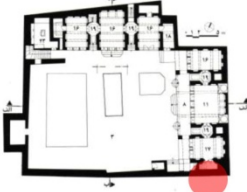
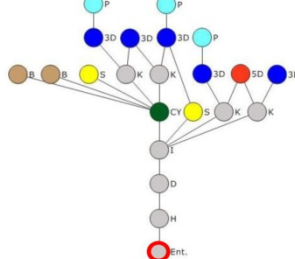
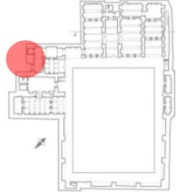
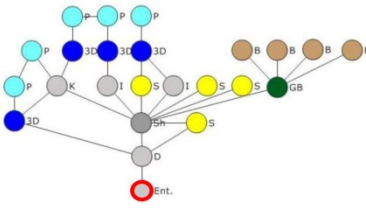
2 Sided Built One Courtyard Houses-Flattened Courtyard	J-Graph
<p data-bbox="422 295 566 318">Kheirieh House</p> 	
<p data-bbox="438 631 550 654">Saleh House</p> 	
<p data-bbox="399 938 590 960">Karkhanehchi House</p> 	
2 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	J-Graph
<p data-bbox="406 1341 582 1364">Balalzadeh House</p> 	

Table 4.9. Justified Graphs of the 4 Sided Built, One Courtyard Houses

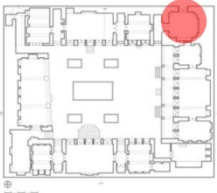
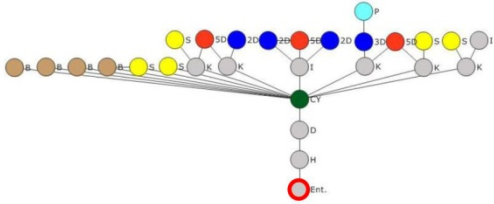
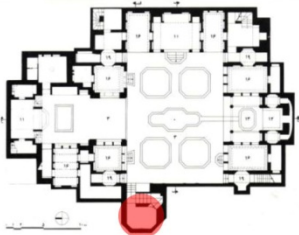
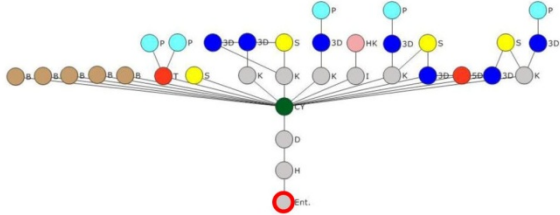
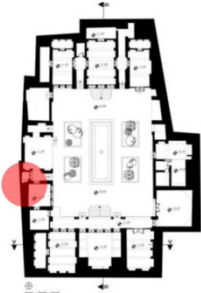
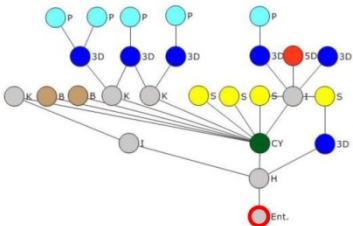

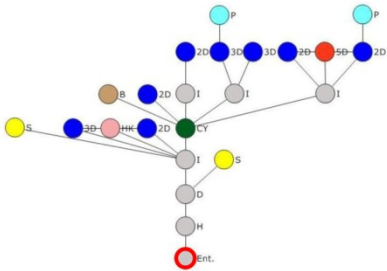
4 Sided Built One Courtyard Houses-Flattened Courtyard	J-Graph
<p data-bbox="421 293 569 315">Nobakhti House</p> 	
<p data-bbox="432 575 558 598">Sajjadi House</p> 	
<p data-bbox="437 893 553 916">Saheb House</p> 	
<p data-bbox="421 1270 569 1292">Ghoreishi House</p> 	

Table 4.10a. Justified Graphs of the Two Courtyard Houses

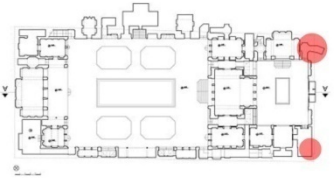
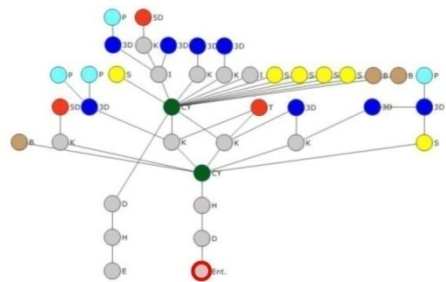
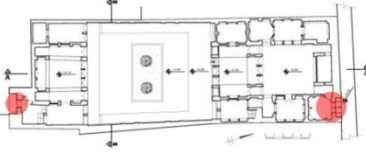
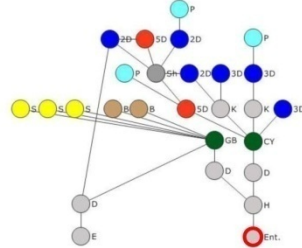
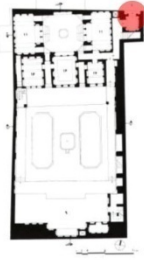
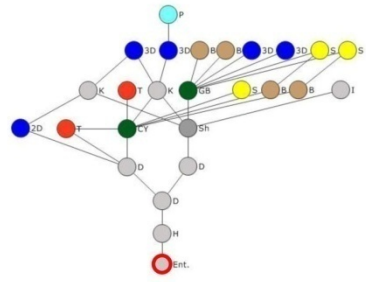
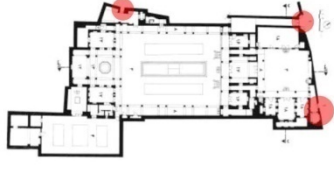
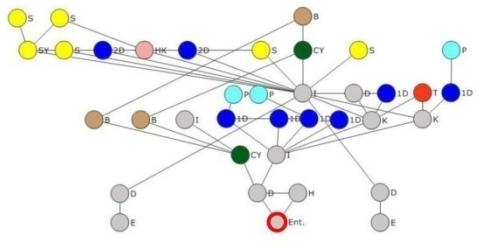
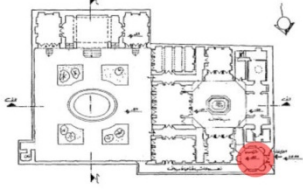
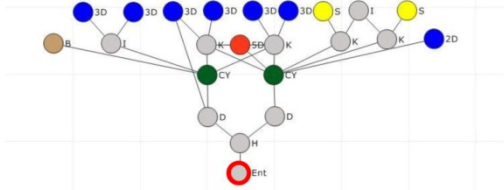

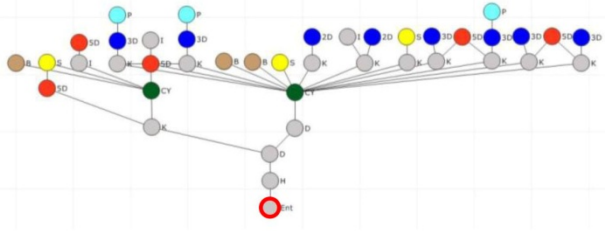
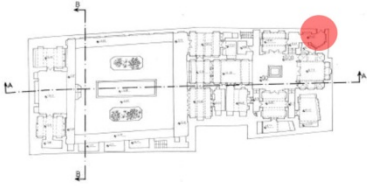
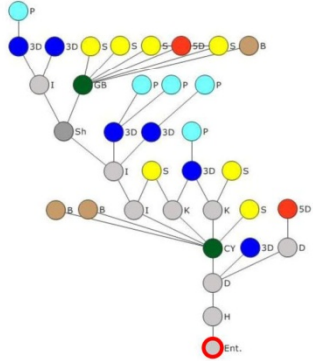

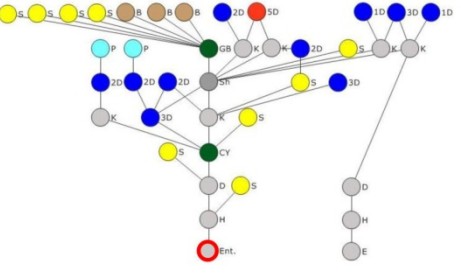
Two Courtyard Houses- One Outer and One Inner Courtyard	J-Graph
<p style="text-align: center;">Hashemian House</p> 	
<p style="text-align: center;">Bafandeh House</p> 	
<p style="text-align: center;">Bakoochi House</p> 	
<p style="text-align: center;">Esfahanian House</p> 	

Table 4.10b. Justified Graphs of the Two Courtyard Houses

<p>Barforoush House</p> 	
<p>Mohtashami House</p> 	
<p>Taj House</p> 	
<p>Sadooghi House</p> 	

After formation of the graphs, some numeric values are calculated and exported, through the AGRAPH computer software, to determine the properties of spatial configuration of the house. These values are meandepth (MD) of spaces within the spatial organization (house layout), the integration value of space (I) or relative asymmetry (RA) (I is $1/RA$), which $RA=2(MD-1)/(k-2)$, where MD is the mean depth and k is the number of spaces in the system (Hillier and Hanson, 1984).

Based on these values the privacy level of interior spaces within the house is detected. The integration and permeability values prove that how “busy” or how “quiet” a space will be (Hanson, 1998). The distribution of integration in the organization of spaces are varied according to the ways that spaces connected together, which makes some spaces more accessible (public spaces) than others (private spaces) in a house. The integration sequences organize interactions among residents of a house and also between residents and visitors. The numerical values define the morphological properties of a space in a house layout as: symmetric-asymmetric, distributed/non-distributed; which show the permeability of a space and its depth in the spatial configuration. These properties give tangible results regarding privacy; symmetry/asymmetry which is about the integration/segregation or less/more private that determines the relative depth of a space in relation to the other spaces in the system (Hillier, 1993).

Depth value of a space is one of the significant properties in the spatial configuration of a house which indicates how many spaces should be passed from the root to reach that space (Guney and Wineman, 2008). It is calculated as “... assigning a depth value to each space according to how many spaces it is away from the original space, summing those values and dividing by the number of spaces in the system less one

(the original space)", that is $MD(n)=TD(n)/(K-1)$, where Total Depth of a node $TD(n)$ is the total of the shortest distances from node (n) to the other nodes in the system (Hillier and Hanson, 1984: 108).

Depth value also clarifies the integration level of a space in the house layout, which the low values represent higher integration and the high values show high segregation (Manum, 1999). In the graph, the depth of a space is determined according to its distance from the root space (which generally is the entrance); when a space is directly connected to the root space, the minimum depth is achieved that is called symmetric space, while the maximum depth can be seen when the spaces are positioned in a linear order away from the root space which is known as asymmetric space (Hillier et al., 1987; Hillier and Hanson, 1988; Hillier, 2007) (Figure 4.22). RA value varies from 0 to 1; a low value shows more integration of a space in the system while a high value demonstrates more segregation (Shoul, 1993; Sungur and Çağdaş, 2003).

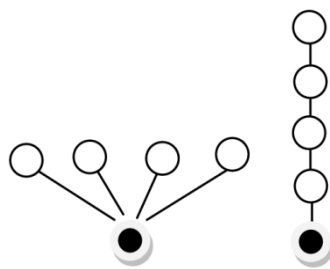


Figure 4.24. Symmetry-Asymmetry in spatial relationships (Hillier et al. 1987)

By implementing this method it is possible to obtain some significant results related to the spatial configuration of the selected houses. Establishment of the j-graphs in every house provides the fundamental syntactic properties of the house in numerical

values, which are calculated by the AGRAPH software based on the mathematical formulae explained (more in details) in the relevant references (Hillier and Hanson, 1984; Hillier et al, 1987; Hanson, 1998) (see Appendix B).

4.4.1 Inequality Genotypes

As it is discussed before, inequality genotype is related to the sequence of integration values of functions in a house layout, which reflects the basic socio-cultural approaches in relation with the functions' order in the spatial configuration of a house.

The table below shows the inequality genotypes for the studied houses that demonstrate the order of functions in terms of their integration values within the house layout.

Table 4.13. Integration Order of Functions in the Traditional Houses of Kashan
Integration order of functions

House Name	Functions order
3 Sided Built One Courtyard Houses-Flattened Courtyard	
Sharifian	Cy > K > B > 5D > CS > 3D = I > S > 3D = CS > K > 3D = CS = 5D > 3D > 3D = P = 5D > 3D = P > P > S > HK > P
Modarresian	Cy > I > K > 2D = 5D > K > 2D > B > S > T > 3D = 2D > S > 3D > P
Darolghoran	Cy > I > K > S = B > K > S > 3D > S > 5D > I > 3D > P > 5D > P
Attarha	Cy > K = I > K > B > HK > 2D > 3D > S > 3D > 2D > 3D > P > 5D > B > P
Dastmalchi	Cy > K = I > K > I = S = B > 2D > T = I = 2D > S = 2D > T > P
Manouchehri	Cy > I > K > B > S > I = 7D > 5D > 3D > S > 3D > 3D = CS > 3D = HK > 3D > S > P
3 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	
Tahami	Sh > GB > K > K = I > K > S > 5D = CS > 3D = B > 3D > P
Jahanbani	Sh > GB > 5D > K > 3D = 2D = K > 2D > B > 5D > P
2 Sided Built One Courtyard Houses-Flattened Courtyard	
Kheirieh	Cy > K > I > S = B > CS > I > 2D > 5D > 2D = CS > 5D > 2D > 5D > 2D = SY > P

Saleh	$Cy > K > I > K > I > T > I=B > 2D=7D > 5D=K > 2D =S > 3D > P > T > SY > 3D > P$
Karkhanehchi	$Cy > I > K = S > K > 3D > S = B > 3D > 5D > 3D > P$
2 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	
Balalzadeh	$Sh > K > GB > I > S = I > S > 3D > B > P$
4 Sided Built One Courtyard Houses-Flattened Courtyard	
Nobakhti	$Cy > I = K > K > S = B > 5D > 3D = 5D > 2D > S = I = 2D > P$
Sajjadi	$Cy > K > K = 5D = T > 3D > I > S = B > 3D = S > P > HK > P$
Saheb	$Cy > I > K > S > K > S = B > 3D > S > 3D > 5D = 3D > I > P$
Ghoreishi	$Cy > I > 2D = B > HK > 2D = 3D > S > 5D = 2D > 2D > 3D > 2D > S > P$
Two Courtyard Houses- One Outer and One Inner Courtyard	
Hashemian	$Cy_{(inner)} > K > Cy_{(outer)} > I > K > I = S = B > T = 3D > 3D > K > S > K > B > 3D = K > 3D > P > 3D > 5D > 5D = P > P$
Bafandeh	$Sh > Cy > 5D = 2D > GB > 2D > 5D > K > K = 2D > 3D > P > E > B = S > 3D > P$
Bakoochi	$Sh > Cy = K > GB > B > K > S > T = 2D > 3D = I > 3D > T = S > B = 3D > P$
Esfahanian	$I > K > I > Cy_{(inner)} > SY > S = HK > 2D > S > T > B > 1D > Cy_{(outer)} = 1D > 1D > B > S > P > I > P$
Barforoush	$Cy_{(outer)} > K > Cy_{(inner)} > 5D > K > 3D > 2D > I > 3D > B > I > S > 3D$
Mohtashami	$Cy_{(inner)} > 5D > K > Cy_{(outer)} > S = B > I > 3D > K > 5D > 3D = 5D > 3D = 2D = I > S = I > S = 2D > B > P > 5D > P > 5D$
Taj	$I > Cy > Sh > S > 3D > GB > K > I > S = B > 3D > 3D = P > 5D > P = S > S = B > S > 3D > 5D = P > P$
Sadooghi	$Sh > K > 3D > GB > Cy > K > S > 2D > 3D > 2D > K > 3D = B = S > S > 1D > 5D > 2D = 1D > P > S > 2D > S > P$
Three Courtyard Houses- One Outer and Two Inner Courtyard	
Tabatabaei	$Cy_{(outer)} > K > I > K > I > K > B > Cy_{(inner)} > I > 5D > K > I > Cy_{(inner)} > K > I > OS = 5D > K = 5D = 3D > OS = K > I = 3D > I > K > 3D = K > B > 5D > 3D > SY = 3D > K > 3D > B > 3D > P > 3D = 5D > 3D > S = B > 5D$
Boroujerdi	$Cy_{(outer)} > K > Cy_{(inner)} > K > I > S = B > 2D > 5D > I = 3D > I > 3D > 2D > CS > 5D > 3D > K > 5D > S > 3D = S > CS > Cy_{(inner)} > 3D > K > P > I > CS > S > T > B > 3D = S > HK > 5D > 3D$
Multi Courtyard Houses- (Family Complexes) Abbasian House	
Abbasian	$Sh > K > CS > K > GB > K > S > OS > K > I > K > S > 3D > 2D > I > HK = S > B = S > S = 2D = 5D = 3D > 5D$
Taghavi	$Cy > K > 3D = 5D = B = S > 5D > S > 3D$
Masoudifar	$Sh > K = GB = I > K > OS > K > I = 5D > S = B > 3D > 3D = S > S > 5D > S > P$
Abbasi Moghaddam	$Cy > I > K > B > 1D = K > 1D > 5D > 2D > 3D > P = S > P$

The study of the justified graphs and the integration order of the functions in the spatial organization of the selected houses, determine some general issues about them, as follows.

The level of privacy and integration in different types of rooms including two, three, five and seven door rooms, Talar, covered spaces and Howz-khaneh (pool house) is varied according to their position in the house layout. Despite the common belief that two and three door rooms are always used by the family members and five and seven door rooms for the public activities, it is clarified that the position of them in the spatial organization of the house together with their depth value as well as their connections to the other spaces could make them more integrated or segregated.

Similarly, Howz-khaneh (pool house), which is mainly known as a family gathering space, and in most of the houses can be seen a way from the root space with a high depth value, but still it depends to its position in the house layout; as an example, in Manouchehri house, it is placed at the last level of the justified graph that makes it more segregated and private, while in the Ghoreishi house, it is situated at the same level with the courtyard (the level four among seven levels in the graph) that means its depth value is less and is more integrated space in the house.

It is affirmed that Pastoo (back part of a room) is the most segregated and private space in the spatial configuration of these houses; it is mainly located with maximum distance from the root space and it has usually the highest depth value.

Basement and service spaces are mainly accessible directly through the courtyard or from the entrance part (including Hashti and Dalan), which decrease their depth

value, however, in case of an indirect access from the courtyard or entrance part that means passing through a transitional space such as Iwan or Keryas, their depth value and privacy level would be increased, both cases can be seen in most of the houses such as the Dastmalchi and Darolghoran houses. Moreover, it should not be forgotten that, the number of connections that they have with the other spaces, directly affects on their integration value as well.

The justified graphs of the studied houses, indicate that concentration of the dots in these graphs are mainly at the first and second level above the courtyard level (or Sharomi in case of sunken courtyards). Consequently, it is verified that most of the spaces are accessible from the courtyard and it acts as the main connection point, which should be passed in order to reach to the other spaces in the house.

Moreover, as it can be generally observed in all types of the houses, after the courtyard, Iwans and Keryas are the most integrated spaces; because, rooms mainly are not directly connected to the courtyard, and this type of spaces act as a sort of transitional space to give the accessibility to the rooms from the courtyard.

On the other hand, each type of the houses contains some specific issues to be discussed separately, as below.

The investigation on the justified graphs and the integration order of the functions in the one courtyard houses clarify that:

In the houses with the flattened courtyard, courtyard is the most integrated space; since, it is accessible right after the entrance section (including Hashti and Dalan) and the majority of the spaces are accessible through the courtyard.

However, in the houses with the sunken courtyard (Godal-Baghcheh), Sharomi is the most integrated space as it connects the majority of spaces on the first floor level of the house. While the Godal-Baghcheh is in the second position in terms of the integration value and mainly gives accessibility to the basement and service spaces located around it on the ground level, which is sunken.

It is specified that the integration value of courtyard in the houses remarkably change with its vertical position in the spatial organization of the house. As it is discussed above, the flattened courtyards have the highest integration value in the house layout while the sunken courtyards do not.

The total number of the levels in the justified graphs of the houses determines that how deep are the spaces situated in the house layout, and in which level the concentration of the dots or spaces is more, would clarify the level of privacy in the general layout of the house and the level of social contact in that house. For example, in the Sharifian house, total number of the levels in its justified graph is nine and its courtyard is positioned at the fifth level and following that the majority of spaces are located at the sixth and seventh level of the graph, which shows that this house is generally more private and has less social contact that is most probably related to the profession of its owner. On the other hand, the justified graph of the Dastmalchi house possesses totally five levels, and its courtyard is positioned at the second level and subsequently, the majority of the spaces are located at the third level of the

graph, which indicates that the spaces in this house have less depth and relatively its privacy is less and sounds to have more social contact that is a sort of respond to the professional and social situation of the owner.

Sometimes, there are two entrances to the house, one is the main and public entrance, and the other one is more private and mainly used by the family members; in this case, the courtyard that is accessible from both entrances is located in the middle of the graph, and usually the spaces are positioned on two sides of it, somehow divided in a way that the spaces, which are more public are placed in different levels above the main entrance, and the spaces that are more private are similarly located over the secondary entrance of the house, like the Modarresian house. However, in some houses, the secondary entrance of the house just gives an access to the service part of the house and is ended there, therefore, the general organization of their graphs are similar to the houses with one entrance, like the Attarha house.

Moreover, the study on the justified graphs and the integration order of the functions in the two courtyard houses (comprising one outer and one inner courtyard) determines that:

According to the owner's needs and desires, the importance given to the inner or outer part and subsequently, the spatial configuration of the house differ, which directly affects the integration value of the courtyards.

Mostly, the inner part of the house is more important to the owner and it possesses more spaces to serve the different needs of the family members. In that case, the inner courtyard is the most integrated space, while, the outer courtyard has lower integration value such as Hashemian house.

However, if the outer part of the house is more significant to the owner (usually, in the houses that the owner has more relationship to the outside and uses this part of the house more for business purpose), it contains more spaces than the inner part of the house. Therefore, the outer courtyard in such houses has higher integration value than the inner courtyard such as Barforoush house.

Moreover, in some houses, one of the courtyards is flattened (mainly the outer one) and the other one is sunken (mostly the inner one). Similarly, in these houses, the idea of giving different importance to the inner and outer parts of the house, can be perceived as well. Besides, as it is mentioned before, in the sunken courtyards, Sharomi has the higher integration value than the sunken courtyard (Godal-Baghcheh). Therefore, in the houses which the outer courtyard has the higher integration value, Sharomi and then Godal-Baghcheh are positioned after that with lower integration value such as Taj house. While, in the houses that the inner part of the house is more significant to the owner and contains more spaces than the outer part, Sharomi has the highest integration value, then Godal-Baghcheh and following that the outer courtyard are located with the lower integration values such as Sadooghi house.

In some houses, Iwan, which is located between two parts of the house (outer and inner parts), acts as a linkage between them and gives access to both sides, therefore, it has the highest integration value in the spatial organization of the house such as Taj house. Besides, some Iwans are positioned around the courtyard and play an important role in terms of permeability to different parts of the house. Such Iwans also have the highest integration value in the house layout such as Esfahanian house.

In the houses that accessibility to the inner courtyard is through passing the outer courtyard and the spaces between them, the number of the levels and the general depth of the house increase that makes their justified graphs more vertically linear, like the Taj house.

However, in the houses that accessibility to the inner and outer courtyards are provided through the separated Dalansderiving from the main entrance, courtyards are usually positioned on the same level and the spaces are more horizontally distributed in their justified graphs, that makes the general depth of the house less, like the Mohtashami house.

Furthermore, the investigation on the justified graphs and the integration order of the functions in the three courtyard houses (including one outer and two inner courtyards) specifies that:

This type of the houses is the most complex ones by possessing numerous spaces. The main part of the house belongs to the outer part with a large courtyard and a great number of spaces around it, while, the inner parts together with their courtyards are smaller. Therefore, the outer courtyard has the highest integration value in such houses, then, Keryas and Iwans (which are sort of transition spaces between the courtyard and the spaces around it) in the second position, followed by that, one of the inner courtyards and subsequently, the other inner courtyard which is more private are situated.

Finally, the study of the multi courtyard houses that are family complexes, clarifies that:

Generally, the depth of spaces in such houses is much more than the other types of houses, as there is a common entrance (including Dalan and Hashti) to the complex and then an individual entrance part to each house.

Such complexes consist of a few houses in themselves; therefore, the spatial organization of each house is studied individually. For that reason, the studied houses within the Abbasian complex, once more affirms that the courtyard has the highest integration value in the houses with one flattened courtyard, while Sharomi and then Godal-Baghcheh have the highest integration value respectively, in the houses with one sunken courtyard, which is the similar approach with the other one courtyard houses.

Moreover, the justified graphs of the houses in the Abbasian complex, show that the Taghavi and the Abbasi Moghaddam courtyards comparatively to the Abbasian and the Masoudifar courtyards, have less depth and subsequently, more social contact. While, the Abbasian and the Masoudifar courtyards, which are both sunken, have more depth and possess more spaces in their layouts; the spaces in these houses are mainly accessible through the Sharomi, which subsequently has the highest integration value in the spatial organization of these houses.

4.4.2 Rings

Ring is another property in the spatial configuration of the houses. Rings are created when spaces are connected to each other into circuits that provide more than one route for a single space to be accessed (Dawson, 2002). The study of the rings within

the selected houses reveals some other general features in the spatial patterns of them. Table 4.14 shows the spaces which are linked by a ring in each house.

Table 4.14. Rings in the Traditional Houses of Kashan

Spaces which are linked by a ring in each house

House Name	Rings
3 Sided Built One Courtyard Houses-Flattened Courtyard	
Sharifian	(D,H,S) (H,D,Cy,K) (Cs,K,D) (Cy,K,5D) (K,3D,Cs) (Cy,K,I)
Modarresian	(D,T,2D,I) (D,I,Cy) (I,2D,5D) (I,2D,S) (D,K,Cy) (Cy,K,3D) (I,2D,3D)
Darolghoran	(I,Cy,K,3D,S) (Cy,K,I) (Cy,K,S,I) (Cy,K,5D) (I,K,3D,5D)
Attarha	(D,Cy,K) (Cy,K,2D,5D) (Cy,K,3D,P,Hk,I) (Cy,K,S,B,Hk,I)
Dastmalchi	(D,Cy,K,2D,T) (Cy,K,T,I) (Cy,K,I)
Manouchehri	(D,I,5D) (I,5D,S) (H,D,I,K,5D,S) (I,K,5D) (I,D,K) (D,K,3D) (D,3D,Cs) (K,I,7D) (Cy,I,K) (Cy,K,3D) (Cy,K,Hk) (Cy,K,3D,Hk)
3 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	
Tahami	(D,Sh,GB) (Sh,K,5D) (Sh,K,Cs) (Sh,K,5D,Cs) (Sh,K,3D)
Jahanbani	(D,Sh,2D,5D) (Sh,K,5D) (Sh,K,2D) (Sh,K,3D)
2 Sided Built One Courtyard Houses-Flattened Courtyard	
Kheirieh	(D,Cy,K,Cs) (Cs,K,2D) (Cs,K,I,5D) (Cy,K,I) (K,2D,Cs) (Cy,K,5D) (D,Cy,K,I,Cs) (D,Cy,K,I,5D,Cs)
Saleh	(T,3D,P) (K,Cy,I) (I,7D,3D,K)
Karkhanehchi	(I,Cy,K,3D,S) (I,K,5D) (Cy,K,3D)
2 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)	
Balalzadeh	(D,Sh,S) (D,Sh,K,3D) (3D,K,P) (Sh,K,3D,P,I) (Sh,I,3D,S)
4 Sided Built One Courtyard Houses-Flattened Courtyard	
Nobakhti	(Cy,K,5D) (I,5D,2D) (Cy,S,B)
Sajjadi	(Cy,K,S,3D) (Cy,3D,5D) (K,3D,S)
Saheb	(H,I,K,Cy) (H,Cy,I,S,3D) (Cy,I,S) (Cy,K,3D)
Ghoreishi	(I,2D,Hk) (I,3D,Hk) (I,2D,5D)
Two Courtyard Houses- One Outer and One Inner Courtyard	
Hashemian	(Cy _o ,K,3D,S) (Cy _o ,K,3D) (Cy _o ,K,T) (Cy _o ,K,Cy _i)

Bafandeh	(Cy _o ,K,2D,Sh,5D) (Sh,5D,2D)
Bakoochi	(D,T,Cy _o) (D,2D,K,Sh) (D,2D,K,3D,Sh) (Sh,K,3D) (D,Cy _o ,K,Sh) (D,T,Cy _o ,K,Sh)
Esfahanian	(I,K,T) (K,1D,D) (K,I,D) (I,S,2D) (I,2D,Hk) (I,Hk,S)
Barforoush	(H,D,Cy _i ,Cy _o ,K,5D) (Cy _o ,K,5D) (Cy _o ,K,I) (D,Cy _i ,K,3D)
Mohtashami	(Cy _i ,K,5D) (D,K,Cy _o ,5D,Cy _i) (D,K,Cy _o ,5D,K,Cy _i) (K,Cy _o ,S,5D)
Taj	(Cy _o ,K,3D) (Cy _o ,I,K,S) (GB,S,5D)
Sadooghi	(Cy _o ,3D,2D,K) (Cy _o ,3D,Sh,K) (Sh,K,3D) (K,Sh,2D,S) (Sh,K,5D)
Three Courtyard Houses- One Outer and Two Inner Courtyard	
Tabatabaei	(Cy _o ,D,3D,K,I) (I,K,3D,5D) (Cy _o ,I,K,3D,5D) (Cy _o ,I,5D) (Cy _o ,I,K,3D) (Cy _o ,K,Os) (Cy _o ,K,3D) (5D,I,S) (5D,K,I) (Cy _i ,3D,5D) (Cy _i ,K,I) (Cy _o ,K,I) (Cy _i ,K,3D)
Boroujerdi	(D,Cy _o ,K,5D,I) (Cy _o ,K,Cy _i) (Cy _o ,K,5D,3D) (Cy _o ,K,Cs,I) (K,Cs,I) (K,5D,2D,Cy _i) (D,2D,Cy _i)
Multi Courtyard Houses- (Family Complexes) Abbasian House	
Abbasian	(K,GB,Sh) (K,GB,I) (Sh,K,I) (Sh,K,3D) (Sh,Cs,3D,K) (H,D,3D,K) (D,3D,K)
Taghavi	(Cy _i ,K,5D)
Masoudifar	(Sh,K,3D) (Sh,K,I) (Sh,K,5D) (I,K,5D)
Abbasi Moghaddam	(Cy _i ,K,5D)

- Rings including Courtyard, Keryas, one of the rooms
- Rings including Courtyard, Keryas and Iwan

Investigation on the rings in the selected houses, determines that the most common ring in these houses includes courtyard, Keryas together with one of the rooms, which can be two, three, five or seven door room. In a few cases, it is observed that the covered space or Howz-khaneh (pool house) is positioned instead of the room in this set, an example of that can be seen in the Manouchehri house. Moreover, in the houses with the sunken courtyard, Sharomi takes the place of courtyard in such a ring, as it is observed in the Tahami, Jahanbani, Bakoochi, Sadooghi, Abbasian and Masoudifar houses. Besides, in some of the houses, Iwan can be placed instead of the courtyard in the ring, such as Darolghoran, Manouchehri, Karkhanehchi, Tabatabaei and Masoudifar houses.

Furthermore, another common ring that can be observed in these houses comprises of courtyard, Keryas and Iwan. This set of spaces changes to Sharomi, Keryas and Iwan when the house has a sunken courtyard, as it is seen in the Abbasian and Masoudifar houses.

Accordingly, it is specified that there are two basic patterns in the spatial configuration of the studied houses; one is the courtyard/Sharomi/Iwan, Keryas together with any type of room, and the second one is the courtyard/Sharomi, Keryas and Iwan. These patterns reflect the significant relationship between these spaces in the house layout. Also, it should be mentioned that, courtyard, Sharomi, Keryas and Iwan are the main components of the rings, which at least one or two of them could be always seen in the existing rings of these houses.

4.4.3 Control Values

Control value (CV) is also one of the properties in the spatial configuration of the houses, which is calculated for each space and it is defined as “the degree of choice that each space represent for its immediate neighbours as a space to move to” (Hillier et al., 1983: 237). It is mainly affected by the number of the connections that each space has with the other spaces (see Hillier, 1984: 109). Table 4.15 shows the spaces that own the maximum and minimum control values in each house.

**Table 4.15. Control Values in the Traditional Houses of Kashan
Spaces with the maximum and minimum CV in each house**

House Name	Maximum CV	Minimum CV
3 Sided Built One Courtyard Houses-Flattened Courtyard		
Sharifian	Courtyard	Basement
Modarresian	Courtyard	Basement

Darolghoran	Courtyard	Basement
Attarha	Courtyard	Basement
Dastmalchi	Courtyard	Basement
Manouchehri	Courtyard	Basement
3 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)		
Tahami	1)Godal-Baghcheh 2)Sharomi	Service parts
Jahanbani	1)Godal-Baghcheh 2)Sharomi	Basement
2 Sided Built One Courtyard Houses-Flattened Courtyard		
Kheirieh	Courtyard	Basement & Service parts
Saleh	Courtyard	Basement
Karkhanehchi	Courtyard	Basement& Service parts
2 Sided Built One Courtyard Houses-Sunken Courtyard (Godal-Baghcheh)		
Balalzadeh	1)Sharomi 2)Godal-Baghcheh	Service parts
4 Sided Built One Courtyard Houses-Flattened Courtyard		
Nobakhti	Courtyard	Basement
Sajjadi	Courtyard	Basement
Saheb	Courtyard	Basement
Ghoreishi	Courtyard	Basement & Service parts
Two Courtyard Houses- One Outer and One Inner Courtyard		
Hashemian	1)Inner Courtyard 2)Outer Courtyard	Basement & Service parts
Bafandeh	1)Godal-Baghcheh 2)Courtyard 3)Sharomi	Basement & Service parts
Bakoochi	1)Godal-Baghcheh 2)Courtyard 3)Sharomi	Basement
Esfahanian	1)Iwan 2)Outer Courtyard 3)Inner Courtyard	Service parts
Barforoush	1)Outer Courtyard 2)Inner Courtyard	Basement
Mohtashami	1)Inner Courtyard 2)Outer Courtyard	Basement & Service parts
Taj	1)Godal-Baghcheh 2)Courtyard 3)Sharomi	Basement & Service parts
Sadooghi	1)Godal-Baghcheh 2)Sharomi 3)Courtyard	Basement & Service parts
Three Courtyard Houses- One Outer and Two Inner Courtyard		
Tabatabaei	Outer Courtyard	Basement
Boroujerdi	Outer Courtyard	Basement & Service parts

Multi Courtyard Houses- (Family Complexes) Abbasian House		
Abbasian	1)Godal-Baghcheh 2)Sharomi	Service parts
Taghavi	Courtyard	Basement & Service parts
Masoudifar	1)Godal-Baghcheh 2)Sharomi	Basement & Service parts
Abbasi Moghaddam	Courtyard	Basement

Examination of the spaces within the selected houses in terms of their control values, clarifies that generally the courtyards of the houses have a remarkable control value compare to the other spaces, which once more prove the role of courtyard as a key component in the spatial organization of such houses. In case of the houses with sunken courtyards, the highest control values belong to the Godal-Baghcheh and Sharomi. In addition, in the two courtyard houses, both inner (flattened/sunken) and outer courtyards are seen with the maximum control values, while in the three courtyard houses, only the outer courtyard has the highest control value. Moreover, among the studied houses, only in the Esfahanian house, the highest control value belongs to the Iwan (since, it is located all around the courtyard) and following that the outer and inner courtyards are positioned with high control values. On the other hand, the basement and service parts contribute to the spatial organization of the houses mostly with the least control values.

Chapter 5

CONCLUSION

Nowadays, due to the rapid growth of population and increasing number of demands for construction especially in the residential sectors, various types of buildings have been appeared, which are mainly in lack of architectural qualities and contradict to the values rooted in their context.

Investigation on traditional architecture and understanding its principles specifically, through the examination of their spatial organization is an important reference and a considerable issue for designers in order to create an identifiable contemporary architecture.

The spatial organizations, which are evolved in traditional buildings, are the well recognized examples in accordance to the socio-cultural understanding of a region, especially traditional houses as the essential components of traditional architecture, directly reflect these values.

Unfortunately, in the city of Kashan, the connection between traditional and contemporary architecture has been totally lost; although, the traditional architecture of Kashan is known among the perfect instances of responding to the environmental conditions and respecting to the cultural values, the contemporary architecture of the city is absolutely peculiar to the local context, which results in absence of identity.

On the other hand, there is a threat in terms of losing such great sources because of their gradual destruction, which is happening due to the immigration of their owners and being empty for years. Moreover, many of these houses have been demolished and replaced by trading complexes and anonymous buildings.

It is obvious that there is a fundamental necessity of studying the traditional houses of Kashan; in this respect, these houses are taken into consideration in terms of analyzing their spatial organizations and transmitting their basic concepts to the future generations. Consequently, the connection between past and present architecture of the city and its continuity would be retrieved, and the city identity would be maintained.

Adaptation to the local context is the main feature of the traditional houses of Kashan. Such houses were mainly formed under the influences of environmental factors in one hand and socio-cultural issues in another hand.

The main socio-cultural determinants in the spatial organization of the traditional houses of Kashan are related to the family structure, gender role, relation of the residents and the visitors, privacy approaches, and life style of the inhabitants.

Moreover, courtyard is known as a key component in the spatial organization of the traditional houses of Kashan not only for climatic purposes, but also for responding cultural needs of the users. It is recognized as the primary core of the house and all the other spaces are arranged around the courtyard.

In identification of the traditional houses of Kashan, these houses are classified in terms of their courtyards (by considering number of courtyards, its enclosure and position, being inner or outer) and are analyzed through two different methods, schematic analysis of the houses as well as space syntax method, which have been already discussed in the methodology section of this study.

Schematic analysis of these houses assists to generalize the fundamental features of them, and gives the possibility of perceiving the common ideas behind such complex organizations. It is believed that, such study would provide some references for contemporary architecture of the city and could make it identifiable.

According to the findings of the study, it is certified that the common spatial genotypes of these houses are configurationally integrated around the courtyard as an integrating core that links the spaces together, and controls the circulation. However, there are some differences in these houses, which show a variety of approaches on household organization with diverse family lifestyles, gender relationships, and ways that guests could get into the house as well as the spatial relationship between visitors and inhabitants of the houses.

Besides, it is realized that the integration value of courtyard is highly depended to its vertical position in the spatial organization of the house. As it is discussed before, the flattened courtyards have the highest integration value in the house layout while in the houses with the sunken courtyards, Sharomi owns the highest one.

Moreover, these houses have a tendency to be divided into two separate domains: inner and outer; which inner part is exclusively used by the inhabitants while the

outer part is for receiving male guests. According to the owner's needs and desires, the importance given to the inner or outer part and subsequently, the spatial configuration of the house differ, which directly affects the integration value of the courtyards as well.

Furthermore, it is specified that there are two basic patterns in accordance to the ring property, in the spatial configuration of the studied houses, which reflect the significant relationship between these spaces in the house layout; one set is related to the 1) Courtyard/Sharomi/Iwan, 2) Keryas and 3) any type of room, and the second one is the 1) Courtyard/Sharomi, 2) Keryas and 3) Iwan.

The role of courtyard as a key component in the spatial organization of such houses, once more is proved by examination of the control values of spaces within the selected houses. It is clarified that generally the courtyards have a remarkable control value compare to the other spaces, while, the basement and service parts contribute to the spatial organization of the houses mostly with the least control values.

Present study is an attempt to clarify the concepts and approaches, which exist in such houses, not only from environmental aspects, but mainly from cultural point of views, which is the reason that makes this study different than the other researches in this field.

It is believed that understanding the essence of architecture lies in learning from the traditional architecture, and conveying its messages provides contribution to the contemporary environment. Such contribution should not be through copying the past but it is necessary to combine the main ideas of that with today's conditions and

needs. It results in consistent designs, which respond to the climatic conditions as well as offering convenient solutions to the functional and socio-cultural needs.

The traditional houses of Kashan own particular spatial organizations, which have been mainly evolved under environmental and cultural circumstances. The present study points out certain characteristics of these houses based on their spatial configurations; it provides an opportunity to obtain regional and cultural identity that results in achieving continuity in the present architecture of the city.

Consequently, in order to maintain the specific features of the traditional houses of Kashan in terms of being responsive to the environmental conditions, respectful to the cultural values and traditions, along with being adaptive to the functional requirements in today's milieu, the valuable ideas behind them should be perceived and taken into consideration.

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APPENDICES

Appendix A: Tables for Classification of the Selected Houses

Appendix B: Syntactic Data of the Selected Houses

TDn	: Total Depth (TD) for actual node
MDn	: Mean Depth (MD) for actual node
RA	: Relative Asymmetry
I	: Integration Value
NCn	: Number of connections from actual node
CV	: Control Value

Sharifian House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	240	6.00	0.25	3.90	0.50	1.00
1	H	201	5.02	0.20	4.84	1.33	2.00
2	D	164	4.10	0.15	6.29	1.33	3.00
3	H	132	3.30	0.11	8.47	1.00	3.00
4	D	121	3.02	0.10	9.62	0.94	3.00
5	CY	101	2.52	0.07	12.78	4.75	9.00
6	D	178	4.45	0.17	5.65	0.83	2.00
7	S	155	3.87	0.14	6.78	0.83	2.00
8	D	127	3.17	0.11	8.96	0.75	3.00
9	CS	151	3.77	0.14	7.02	3.91	6.00
10	3D	190	4.75	0.19	5.20	0.16	1.00
11	3D	190	4.75	0.19	5.20	0.16	1.00
12	P	190	4.75	0.19	5.20	0.16	1.00
13	K	114	2.85	0.09	10.54	1.94	4.00
14	K	160	4.00	0.15	6.50	2.00	4.00
15	3D	153	3.82	0.14	6.90	0.25	1.00
16	3D	199	4.97	0.20	4.90	0.25	1.00
17	5D	141	3.52	0.12	7.72	0.50	2.00
18	D	185	4.62	0.18	5.37	1.41	3.00
19	S	224	5.60	0.23	4.23	0.33	1.00
20	5D	169	4.22	0.16	6.04	0.66	2.00
21	K	134	3.35	0.12	8.29	1.11	3.00
22	K	136	3.40	0.12	8.12	1.61	3.00
23	3D	171	4.27	0.16	5.95	1.33	2.00
24	3D	175	4.37	0.17	5.77	0.33	1.00
25	P	210	5.25	0.21	4.58	0.50	1.00
26	R	140	3.50	0.12	7.80	0.11	1.00

27	I	153	3.82	0.14	6.90	1.00	3.00
28	K	130	3.25	0.11	8.66	1.44	4.00
29	K	124	3.10	0.10	9.28	1.11	4.00
30	3D	168	4.20	0.16	6.09	0.75	2.00
31	3D	157	3.92	0.15	6.66	1.08	3.00
32	5D	190	4.75	0.19	5.20	1.33	2.00
33	CS	168	4.20	0.16	6.09	0.75	2.00
34	CS	158	3.95	0.15	6.61	1.58	3.00
35	HK	229	5.72	0.24	4.12	0.50	1.00
36	D	194	4.85	0.19	5.06	1.33	2.00
37	P	233	5.82	0.24	4.04	0.50	1.00
38	P	197	4.92	0.20	4.96	0.33	1.00
39	B	140	3.50	0.12	7.80	0.11	1.00
40	B	140	3.50	0.12	7.80	0.11	1.00

Min	101.00	2.52	0.07	3.90	0.11
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Mean	166.63	4.16	0.16	6.63	1.00
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Max	240.00	6.00	0.25	12.78	4.75
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Modarresian House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	69	3.13	0.20	4.91	0.25	1.00
1	D	48	2.18	0.11	8.88	1.76	4.00
2	CY	38	1.72	0.06	14.43	3.64	8.00
3	T	63	2.86	0.17	5.63	0.50	2.00
4	I	40	1.81	0.07	12.83	1.87	7.00
5	2D	55	2.50	0.14	7.00	1.89	4.00
6	5D	55	2.50	0.14	7.00	1.72	4.00
7	2D	58	2.63	0.15	6.41	0.89	3.00
8	S	60	2.72	0.16	6.07	0.47	2.00
9	S	65	2.95	0.18	5.37	0.16	1.00
10	P	76	3.45	0.23	4.27	0.25	1.00
11	P	76	3.45	0.23	4.27	0.25	1.00
12	I	44	2.00	0.09	10.50	2.51	6.00
13	3D	64	2.90	0.18	5.50	0.66	2.00
14	2D	64	2.90	0.18	5.50	0.66	2.00
15	K	56	2.54	0.14	6.79	0.62	2.00
16	K	54	2.45	0.13	7.21	0.87	3.00
17	3D	74	3.36	0.22	4.44	1.00	2.00
18	3D	72	3.27	0.21	4.62	0.83	2.00
19	E	72	3.27	0.21	4.62	0.25	1.00
20	D	51	2.31	0.12	7.96	1.62	4.00
21	B	59	2.68	0.16	6.24	0.12	1.00
22	B	59	2.68	0.16	6.24	0.12	1.00
	Min	38.00	1.72	0.06	4.27	0.12	
	Mean	59.65	2.71	0.16	6.81	1.00	
	Max	76.00	3.45	0.23	14.43	3.64	

Darolghoran House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	176	5.33	0.27	3.69	0.50	1.00
1	H	144	4.36	0.21	4.75	1.50	2.00
2	D	114	3.45	0.15	6.51	0.75	2.00
3	I	86	2.60	0.10	9.96	2.07	4.00
4	CY	65	1.96	0.06	16.50	8.41	13.00
5	S	118	3.57	0.16	6.21	0.25	1.00
6	S	114	3.45	0.15	6.51	0.75	2.00
7	K	92	2.78	0.11	8.94	1.07	3.00
8	K	93	2.81	0.11	8.80	1.57	3.00
9	3D	117	3.54	0.15	6.28	0.83	2.00
10	3D	125	3.78	0.17	5.73	0.33	1.00
11	I	120	3.63	0.16	6.06	0.66	2.00
12	K	91	2.75	0.10	9.10	0.57	2.00
13	S	111	3.36	0.14	6.76	0.83	2.00
14	K	93	2.81	0.11	8.80	1.57	3.00
15	K	91	2.75	0.10	9.10	1.07	3.00
16	3D	125	3.78	0.17	5.73	0.33	1.00
17	3D	121	3.66	0.16	6.00	1.33	2.00
18	5D	119	3.60	0.16	6.13	0.66	2.00
19	P	153	4.63	0.22	4.40	0.50	1.00
20	S	97	2.93	0.12	8.25	0.07	1.00
21	I	82	2.48	0.09	10.77	0.91	3.00
22	K	105	3.18	0.13	7.33	1.16	3.00
23	K	108	3.27	0.14	7.04	0.66	2.00
24	3D	129	3.90	0.18	5.50	1.83	3.00
25	3D	132	4.00	0.18	5.33	2.00	3.00
26	5D	155	4.69	0.23	4.32	0.66	2.00
27	P	161	4.87	0.24	4.12	0.33	1.00

28	P	164	4.96	0.24	4.03	0.33	1.00
29	B	97	2.93	0.12	8.25	0.07	1.00
30	B	97	2.93	0.12	8.25	0.07	1.00
31	B	97	2.93	0.12	8.25	0.07	1.00
32	B	97	2.93	0.12	8.25	0.07	1.00
33	B	97	2.93	0.12	8.25	0.07	1.00
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	Min	65.00	1.96	0.06	3.69	0.07	
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	Mean	114.29	3.46	0.15	7.17	1.00	
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	Max	176.00	5.33	0.27	16.50	8.41	

Attarha House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	102	3.64	0.19	5.10	0.33	1.00
1	D	75	2.67	0.12	8.04	1.44	3.00
2	CY	54	1.92	0.06	14.53	4.00	9.00
3	K	73	2.60	0.11	8.40	0.77	3.00
4	2D	92	3.28	0.16	5.90	1.83	3.00
5	5D	111	3.96	0.21	4.55	0.66	2.00
6	2D	92	3.28	0.16	5.90	1.83	3.00
7	K	73	2.60	0.11	8.40	1.44	3.00
8	K	77	2.75	0.12	7.71	1.11	3.00
9	K	75	2.67	0.12	8.04	0.94	3.00
10	K	77	2.75	0.12	7.71	0.61	2.00
11	S	96	3.42	0.17	5.55	1.00	2.00
12	3D	97	3.46	0.18	5.47	0.66	2.00
13	3D	103	3.67	0.19	5.04	0.83	2.00

14	I	73	2.60	0.11	8.40	0.36	2.00
15	HK	89	3.17	0.16	6.19	2.50	4.00
16	3D	93	3.32	0.17	5.81	1.33	3.00
17	3D	103	3.67	0.19	5.04	0.83	2.00
18	P	110	3.92	0.21	4.60	0.58	2.00
19	2D	100	3.57	0.19	5.25	0.33	1.00
20	K	75	2.67	0.12	8.04	1.61	3.00
21	2D	100	3.57	0.19	5.25	1.33	2.00
22	2D	102	3.64	0.19	5.10	0.33	1.00
23	P	127	4.53	0.26	3.81	0.50	1.00
24	P	119	4.25	0.24	4.15	0.33	1.00
25	P	119	4.25	0.24	4.15	0.33	1.00
26	B	116	4.14	0.23	4.29	0.25	1.00
27	B	112	4.00	0.22	4.50	0.75	2.00
28	B	81	2.89	0.14	7.13	0.11	1.00

Min	54.00	1.92	0.06	3.81	0.11
Mean	93.65	3.34	0.17	6.28	1.00
Max	127.00	4.53	0.26	14.53	4.00

Dastmalchi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	90	3.33	0.17	5.57	0.33	1.00
1	D	64	2.37	0.10	9.48	1.41	3.00
2	CY	46	1.70	0.05	18.47	9.16	13.00
3	2D	82	3.03	0.15	6.38	1.83	3.00
4	T	102	3.77	0.21	4.68	0.66	2.00

5	2D	84	3.11	0.16	6.15	2.00	3.00
6	K	66	2.44	0.11	9.00	0.41	2.00
7	K	68	2.51	0.11	8.56	1.57	3.00
8	P	108	4.00	0.23	4.33	0.33	1.00
9	P	110	4.07	0.23	4.22	0.33	1.00
10	S	94	3.48	0.19	5.23	0.33	1.00
11	T	88	3.25	0.17	5.75	0.66	2.00
12	I	66	2.44	0.11	9.00	1.07	3.00
13	T	90	3.33	0.17	5.57	1.33	2.00
14	P	116	4.29	0.25	3.94	0.50	1.00
15	K	66	2.44	0.11	9.00	1.07	3.00
16	K	68	2.51	0.11	8.56	1.57	3.00
17	2D	90	3.33	0.17	5.57	1.33	2.00
18	2D	94	3.48	0.19	5.23	0.33	1.00
19	I	88	3.25	0.17	5.75	0.66	2.00
20	P	116	4.29	0.25	3.94	0.50	1.00
21	I	72	2.66	0.12	7.80	0.07	1.00
22	S	72	2.66	0.12	7.80	0.07	1.00
23	B	72	2.66	0.12	7.80	0.07	1.00
24	B	72	2.66	0.12	7.80	0.07	1.00
25	B	72	2.66	0.12	7.80	0.07	1.00
26	B	72	2.66	0.12	7.80	0.07	1.00
27	B	72	2.66	0.12	7.80	0.07	1.00

Min	46.00	1.70	0.05	3.94	0.07
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Mean	82.14	3.04	0.15	7.10	1.00
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Max	116.00	4.29	0.25	18.47	9.16
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Manouchehri House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	184	4.84	0.20	4.81	0.33	1.00
1	H	147	3.86	0.15	6.44	1.83	3.00
2	D	118	3.10	0.11	8.78	0.67	3.00
3	I	90	2.36	0.07	13.51	2.49	7.00
4	CY	89	2.34	0.07	13.78	4.84	8.00
5	S	168	4.42	0.18	5.40	0.58	2.00
6	D	116	3.05	0.11	9.01	1.30	5.00
7	K	115	3.02	0.10	9.12	1.67	6.00
8	3D	146	3.84	0.15	6.50	0.70	3.00
9	CS	146	3.84	0.15	6.50	0.70	3.00
10	I	129	3.39	0.12	7.72	0.70	3.00
11	7D	129	3.39	0.12	7.72	0.70	3.00
12	K	115	3.02	0.10	9.12	1.45	5.00
13	K	122	3.21	0.11	8.36	0.79	3.00
14	3D	149	3.92	0.15	6.33	0.86	3.00
15	HK	149	3.92	0.15	6.33	0.86	3.00
16	K	117	3.07	0.11	8.89	0.89	3.00
17	K	117	3.07	0.11	8.89	0.89	3.00
18	3D	152	4.00	0.16	6.16	1.33	2.00
19	3D	152	4.00	0.16	6.16	1.33	2.00
20	5D	140	3.68	0.14	6.89	2.16	4.00
21	P	189	4.97	0.21	4.65	0.50	1.00
22	P	189	4.97	0.21	4.65	0.50	1.00
23	S	127	3.34	0.12	7.89	0.14	1.00
24	I	108	2.84	0.09	10.04	2.70	6.00
25	3D	145	3.81	0.15	6.57	0.16	1.00
26	3D	143	3.76	0.14	6.69	1.16	2.00
27	5D	140	3.68	0.14	6.89	0.91	3.00

28	P	180	4.73	0.20	4.95	0.50	1.00
29	S	144	3.78	0.15	6.63	0.50	2.00
30	S	175	4.60	0.19	5.13	0.25	1.00
31	D	138	3.63	0.14	7.03	2.00	4.00
32	Ent.	210	5.52	0.24	4.08	0.50	1.00
33	H	173	4.55	0.19	5.20	1.25	2.00
34	P	177	4.65	0.19	5.05	0.25	1.00
35	B	126	3.31	0.12	7.98	0.12	1.00
36	B	126	3.31	0.12	7.98	0.12	1.00
37	B	126	3.31	0.12	7.98	0.12	1.00
38	B	126	3.31	0.12	7.98	0.12	1.00
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	Min	89.00	2.34	0.07	4.08	0.12	
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	Mean	141.84	3.73	0.14	7.28	1.00	
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	Max	210.00	5.52	0.24	13.78	4.84	

Tahami House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	151	5.20	0.30	3.32	0.50	1.00
1	H	123	4.24	0.23	4.31	1.50	2.00
2	H	97	3.34	0.16	5.97	0.83	2.00
3	D	73	2.51	0.10	9.22	0.77	3.00
4	Sh	56	1.93	0.06	15.03	4.00	9.00
5	S	84	2.89	0.13	7.38	0.11	1.00
6	K	78	2.68	0.12	8.28	1.77	4.00
7	K	76	2.62	0.11	8.63	1.27	4.00
8	5D	99	3.41	0.17	5.80	0.83	3.00

9	CS	99	3.41	0.17	5.80	0.83	3.00
10	3D	106	3.65	0.18	5.27	0.25	1.00
11	3D	102	3.51	0.17	5.56	1.25	2.00
12	I	78	2.68	0.12	8.28	1.61	3.00
13	3D	104	3.58	0.18	5.41	1.33	2.00
14	3D	106	3.65	0.18	5.27	0.33	1.00
15	P	132	4.55	0.25	3.94	0.50	1.00
16	S	84	2.89	0.13	7.38	0.11	1.00
17	K	76	2.62	0.11	8.63	0.94	3.00
18	K	80	2.75	0.12	7.96	1.61	3.00
19	3D	100	3.44	0.17	5.71	2.33	3.00
20	3D	108	3.72	0.19	5.13	0.33	1.00
21	3D	100	3.44	0.17	5.71	0.66	2.00
22	P	128	4.41	0.24	4.10	0.33	1.00
23	P	128	4.41	0.24	4.10	0.33	1.00
24	P	130	4.48	0.24	4.01	0.50	1.00
25	GB	72	2.48	0.10	9.44	4.44	6.00
26	B	100	3.44	0.17	5.71	0.16	1.00
27	B	100	3.44	0.17	5.71	0.16	1.00
28	B	100	3.44	0.17	5.71	0.16	1.00
29	B	100	3.44	0.17	5.71	0.16	1.00

Min	56.00	1.93	0.06	3.32	0.11
Mean	99.00	3.41	0.17	6.42	1.00
Max	151.00	5.20	0.30	15.03	4.44

Jahanbani House

		TDn	MDn	RA	I	CV	NCn
0	Ent	94	4.08	0.28	3.56	0.50	1.00
1	H	72	3.13	0.19	5.16	1.33	2.00
2	D	52	2.26	0.11	8.72	1.09	3.00
3	5D	72	3.13	0.19	5.16	0.83	2.00
4	Sh	36	1.56	0.05	19.46	3.86	11.00
5	2D	56	2.43	0.13	7.66	0.59	2.00
6	2D	57	2.47	0.13	7.44	0.42	2.00
7	K	56	2.43	0.13	7.66	0.92	3.00
8	3D	56	2.43	0.13	7.66	0.75	3.00
9	K	56	2.43	0.13	7.66	0.92	3.00
10	2D	57	2.47	0.13	7.44	0.42	2.00
11	K	53	2.30	0.11	8.43	1.29	3.00
12	5D	50	2.17	0.10	9.37	2.75	5.00
13	K	53	2.30	0.11	8.43	1.29	3.00
14	P	75	3.26	0.20	4.86	0.33	1.00
15	P	72	3.13	0.19	5.16	0.20	1.00
16	P	72	3.13	0.19	5.16	0.20	1.00
17	P	75	3.26	0.20	4.86	0.33	1.00
18	GB	48	2.08	0.09	10.12	5.09	6.00
19	B	70	3.04	0.18	5.38	0.16	1.00
20	B	70	3.04	0.18	5.38	0.16	1.00
21	B	70	3.04	0.18	5.38	0.16	1.00
22	B	70	3.04	0.18	5.38	0.16	1.00
23	B	70	3.04	0.18	5.38	0.16	1.00

Min	36.00	1.56	0.05	3.56	0.16
Mean	63.00	2.73	0.15	7.12	1.00
Max	94.00	4.08	0.28	19.46	5.09

Kheirieh House

		TDn	MDn	RA	I	CV	NCn
0	Ent	142	4.73	0.25	3.88	0.50	1.00
1	H	113	3.76	0.19	5.24	1.25	2.00
2	D	86	2.86	0.12	7.76	2.20	4.00
3	SY	115	3.83	0.19	5.11	0.25	1.00
4	D	73	2.43	0.09	10.11	0.33	2.00
5	CY	55	1.83	0.05	17.40	7.50	12.00
6	CS	85	2.83	0.12	7.90	2.50	5.00
7	2D	114	3.80	0.19	5.17	0.20	1.00
8	K	70	2.33	0.09	10.87	1.11	4.00
9	2D	92	3.06	0.14	7.01	0.45	2.00
10	K	76	2.53	0.10	9.45	1.41	4.00
11	2D	104	3.46	0.17	5.87	0.75	2.00
12	CS	104	3.46	0.17	5.87	0.75	2.00
13	I	91	3.03	0.14	7.13	1.00	3.00
14	5D	106	3.53	0.17	5.72	0.53	2.00
15	K	80	2.66	0.11	8.70	2.08	3.00
16	5D	109	3.63	0.18	5.50	0.33	1.00
17	2D	109	3.63	0.18	5.50	0.33	1.00
18	I	82	2.73	0.11	8.36	1.08	2.00
19	5D	111	3.70	0.18	5.37	0.50	1.00

20	S	84	2.80	0.12	8.05	0.08	1.00
21	K	78	2.60	0.11	9.06	1.08	3.00
22	K	80	2.66	0.11	8.70	1.58	3.00
23	2D	105	3.50	0.17	5.80	1.33	2.00
24	2D	109	3.63	0.18	5.50	0.33	1.00
25	5D	103	3.43	0.16	5.95	0.66	2.00
26	P	134	4.46	0.23	4.18	0.50	1.00
27	S	84	2.80	0.12	8.05	0.08	1.00
28	B	84	2.80	0.12	8.05	0.08	1.00
29	B	84	2.80	0.12	8.05	0.08	1.00
30	B	84	2.80	0.12	8.05	0.08	1.00

Min	55.00	1.83	0.05	3.88	0.08
Mean	95.03	3.16	0.14	7.33	1.00
Max	142.00	4.73	0.25	17.40	7.50

Saleh House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	173	5.08	0.24	4.03	0.50	1.00
1	D	140	4.11	0.18	5.29	1.25	2.00
2	T	109	3.20	0.13	7.48	1.50	4.00
3	K	88	2.58	0.09	10.38	1.19	4.00
4	CY	77	2.26	0.07	13.04	6.20	9.00
5	3D	137	4.02	0.18	5.44	2.75	4.00
6	P	170	5.00	0.24	4.12	0.25	1.00
7	P	170	5.00	0.24	4.12	0.25	1.00
8	P	139	4.08	0.18	5.34	0.50	2.00
9	I	107	3.14	0.13	7.68	1.50	3.00

10	T	140	4.11	0.18	5.29	0.33	1.00
11	K	96	2.82	0.11	9.04	1.27	4.00
12	2D	127	3.73	0.16	6.03	1.25	2.00
13	P	160	4.70	0.22	4.45	0.50	1.00
14	5D	125	3.67	0.16	6.16	2.25	3.00
15	P	158	4.64	0.22	4.52	0.33	1.00
16	P	158	4.64	0.22	4.52	0.33	1.00
17	2D	119	3.50	0.15	6.60	1.25	2.00
18	P	152	4.47	0.21	4.75	0.50	1.00
19	I	110	3.23	0.13	7.38	0.11	1.00
20	I	110	3.23	0.13	7.38	0.11	1.00
21	I	110	3.23	0.13	7.38	0.11	1.00
22	I	108	3.17	0.13	7.58	1.11	2.00
23	I	94	2.76	0.10	9.35	2.31	5.00
24	7D	119	3.50	0.15	6.60	3.20	5.00
25	3D	150	4.41	0.20	4.83	0.70	2.00
26	3D	150	4.41	0.20	4.83	0.70	2.00
27	K	125	3.67	0.16	6.16	0.70	2.00
28	K	125	3.67	0.16	6.16	0.70	2.00
29	S	127	3.73	0.16	6.03	0.20	1.00
30	SY	141	4.14	0.19	5.24	0.50	1.00
31	P	152	4.47	0.21	4.75	0.20	1.00
32	P	152	4.47	0.21	4.75	0.20	1.00
33	B	110	3.23	0.13	7.38	0.11	1.00
34	B	110	3.23	0.13	7.38	0.11	1.00
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	Min	77.00	2.26	0.07	4.03	0.11	
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	Mean	129.65	3.81	0.17	6.33	1.00	
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	Max	173.00	5.08	0.24	13.04	6.20	

Karkhanehchi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	98	4.66	0.36	2.72	0.50	1.00
1	H	78	3.71	0.27	3.68	1.50	2.00
2	D	60	2.85	0.18	5.38	0.70	2.00
3	I	44	2.19	0.10	8.40	1.83	5.00
4	CY	46	2.09	0.11	9.13	3.86	6.00
5	K	58	2.76	0.17	5.67	1.20	3.00
6	K	60	2.85	0.18	5.38	1.70	3.00
7	3D	76	3.61	0.26	3.81	1.33	2.00
8	3D	80	3.80	0.28	3.55	0.33	1.00
9	5D	74	3.52	0.25	3.96	0.66	2.00
10	P	96	4.57	0.35	2.80	0.50	1.00
11	K	59	2.80	0.18	5.52	1.00	3.00
12	K	60	2.85	0.18	5.38	1.16	3.00
13	3D	65	3.09	0.20	4.77	1.83	3.00
14	3D	78	3.71	0.27	3.68	1.33	2.00
15	3D	73	3.47	0.24	4.03	0.66	2.00
16	P	85	4.04	0.30	3.28	0.33	1.00
17	P	98	4.66	0.36	2.72	0.50	1.00
18	S	66	3.14	0.21	4.66	0.16	1.00
19	S	58	2.76	0.17	5.67	0.53	2.00
20	B	66	3.14	0.21	4.66	0.16	1.00
21	B	66	3.14	0.21	4.66	0.16	1.00
	Min	44.00	2.09	0.10	2.72	0.16	
	Mean	70.18	3.34	0.23	4.70	1.00	
	Max	98.00	4.66	0.36	9.13	3.86	

Balalzadeh House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	78	3.39	0.21	4.60	0.25	1.00
1	D	56	2.43	0.13	7.66	1.94	4.00
2	Sh	41	1.78	0.07	14.05	4.70	9.00
3	S	59	2.56	0.14	7.02	0.36	2.00
4	S	59	2.56	0.14	7.02	0.44	2.00
5	I	59	2.56	0.14	7.02	0.44	2.00
6	3D	77	3.34	0.21	4.68	2.00	3.00
7	P	99	4.30	0.30	3.32	0.33	1.00
8	S	63	2.73	0.15	6.32	0.11	1.00
9	S	63	2.73	0.15	6.32	0.11	1.00
10	3D	67	2.91	0.17	5.75	1.00	3.00
11	K	52	2.26	0.11	8.72	1.44	4.00
12	3D	69	3.00	0.18	5.50	0.75	2.00
13	I	58	2.52	0.13	7.22	0.61	2.00
14	3D	75	3.26	0.20	4.86	1.00	2.00
15	P	89	3.86	0.26	3.83	1.00	2.00
16	P	86	3.73	0.24	4.01	1.00	2.00
17	P	87	3.78	0.25	3.95	0.83	2.00
18	P	72	3.13	0.19	5.16	0.75	2.00
19	GB	55	2.39	0.12	7.90	4.11	5.00
20	B	77	3.34	0.21	4.68	0.20	1.00
21	B	77	3.34	0.21	4.68	0.20	1.00
22	B	77	3.34	0.21	4.68	0.20	1.00
23	B	77	3.34	0.21	4.68	0.20	1.00
	Min	41.00	1.78	0.07	3.32	0.11	
	Mean	69.66	3.02	0.18	5.98	1.00	
	Max	99.00	4.30	0.30	14.05	4.70	

Nobakhti House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	115	4.25	0.25	3.98	0.50	1.00
1	H	89	3.29	0.17	5.66	1.50	2.00
2	D	65	2.40	0.10	9.23	0.57	2.00
3	CY	43	1.59	0.04	21.93	7.41	13.00
4	I	63	2.33	0.10	9.75	1.41	4.00
5	2D	88	3.25	0.17	5.75	0.58	2.00
6	5D	87	3.22	0.17	5.85	1.25	3.00
7	2D	88	3.25	0.17	5.75	0.58	2.00
8	S	68	2.51	0.11	8.56	0.57	2.00
9	K	63	2.33	0.10	9.75	1.07	3.00
10	K	65	2.40	0.10	9.23	1.57	3.00
11	3D	87	3.22	0.17	5.85	1.33	2.00
12	S	91	3.37	0.18	5.48	0.33	1.00
13	5D	85	3.14	0.16	6.05	0.66	2.00
14	K	65	2.40	0.10	9.23	2.07	3.00
15	S	91	3.37	0.18	5.48	0.33	1.00
16	I	91	3.37	0.18	5.48	0.33	1.00
17	K	65	2.40	0.10	9.23	1.57	3.00
18	K	65	2.40	0.10	9.23	1.57	3.00
19	2D	91	3.37	0.18	5.48	0.33	1.00
20	S	91	3.37	0.18	5.48	0.33	1.00
21	5D	87	3.22	0.17	5.85	0.66	2.00
22	P	113	4.18	0.24	4.08	0.50	1.00
23	S	69	2.55	0.11	8.35	0.07	1.00
24	B	68	2.51	0.11	8.56	0.57	2.00
25	B	69	2.55	0.11	8.35	0.07	1.00
26	B	69	2.55	0.11	8.35	0.07	1.00
27	B	69	2.55	0.11	8.35	0.07	1.00

Min	43.00	1.59	0.04	3.98	0.07
Mean	78.57	2.91	0.14	7.65	1.00
Max	115.00	4.25	0.25	21.93	7.41

Sajjadi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	143	4.33	0.20	4.80	0.50	1.00
1	H	111	3.36	0.14	6.76	1.50	2.00
2	D	81	2.45	0.09	11.00	0.55	2.00
3	CY	53	1.60	0.03	26.40	10.33	17.00
4	K	80	2.42	0.08	11.23	1.05	3.00
5	S	109	3.30	0.14	6.94	0.66	2.00
6	3D	109	3.30	0.14	6.94	0.66	2.00
7	3D	108	3.27	0.14	7.04	1.50	3.00
8	K	81	2.45	0.09	11.00	0.39	2.00
9	K	81	2.45	0.09	11.00	0.55	2.00
10	3D	111	3.36	0.14	6.76	1.50	2.00
11	I	83	2.51	0.09	10.56	1.05	2.00
12	HK	115	3.48	0.15	6.43	0.50	1.00
13	K	79	2.39	0.08	11.47	1.05	3.00
14	3D	109	3.30	0.14	6.94	1.33	2.00
15	S	108	3.27	0.14	7.04	0.66	2.00
16	P	143	4.33	0.20	4.80	0.50	1.00
17	P	141	4.27	0.20	4.88	0.50	1.00
18	5D	81	2.45	0.09	11.00	0.72	3.00
19	3D	82	2.48	0.09	10.77	0.89	3.00

20	3D	82	2.48	0.09	10.77	0.89	3.00
21	S	108	3.27	0.14	7.04	0.66	2.00
22	K	79	2.39	0.08	11.47	1.05	3.00
23	3D	109	3.30	0.14	6.94	1.33	2.00
24	P	141	4.27	0.20	4.88	0.50	1.00
25	S	85	2.57	0.09	10.15	0.05	1.00
26	T	81	2.45	0.09	11.00	2.05	3.00
27	P	113	3.42	0.15	6.60	0.33	1.00
28	P	113	3.42	0.15	6.60	0.33	1.00
29	B	85	2.57	0.09	10.15	0.05	1.00
30	B	85	2.57	0.09	10.15	0.05	1.00
31	B	85	2.57	0.09	10.15	0.05	1.00
32	B	85	2.57	0.09	10.15	0.05	1.00
33	B	85	2.57	0.09	10.15	0.05	1.00

Min	53.00	1.60	0.03	4.80	0.05
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Mean	98.35	2.98	0.12	9.12	1.00
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Max	143.00	4.33	0.20	26.40	10.33
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Saheb House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	86	3.44	0.20	4.91	0.25	1.00
1	H	62	2.48	0.12	8.10	2.10	4.00
2	CY	45	1.80	0.06	15.00	6.08	10.00
3	I	84	3.36	0.19	5.08	0.75	2.00
4	3D	79	3.16	0.18	5.55	0.75	2.00
5	S	76	3.04	0.17	5.88	0.66	2.00

6	K	67	2.68	0.14	7.14	0.60	2.00
7	S	69	2.76	0.14	6.81	0.10	1.00
8	I	57	2.28	0.10	9.37	3.60	6.00
9	3D	79	3.16	0.18	5.55	1.16	2.00
10	P	103	4.12	0.26	3.84	0.50	1.00
11	5D	81	3.24	0.18	5.35	0.16	1.00
12	3D	81	3.24	0.18	5.35	0.16	1.00
13	S	63	2.52	0.12	7.89	0.26	2.00
14	S	69	2.76	0.14	6.81	0.10	1.00
15	K	59	2.36	0.11	8.82	0.76	3.00
16	K	61	2.44	0.12	8.33	0.93	3.00
17	3D	79	3.16	0.18	5.55	2.33	3.00
18	P	103	4.12	0.26	3.84	0.33	1.00
19	P	103	4.12	0.26	3.84	0.33	1.00
20	3D	83	3.32	0.19	5.17	1.33	2.00
21	P	107	4.28	0.27	3.65	0.50	1.00
22	3D	75	3.00	0.16	6.00	1.66	3.00
23	P	99	3.96	0.24	4.05	0.33	1.00
24	B	69	2.76	0.14	6.81	0.10	1.00
25	B	69	2.76	0.14	6.81	0.10	1.00

Min	45.00	1.80	0.06	3.65	0.10
Mean	77.23	3.08	0.17	6.37	1.00
Max	107.00	4.28	0.27	15.00	6.08

Ghoreishi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	104	4.72	0.35	2.81	0.50	1.00
1	H	83	3.77	0.26	3.78	1.33	2.00
2	D	64	2.90	0.18	5.50	1.66	3.00
3	I	49	2.22	0.11	8.55	2.83	6.00
4	2D	69	3.13	0.20	4.91	0.50	2.00
5	HK	68	3.09	0.19	5.02	1.16	3.00
6	3D	69	3.13	0.20	4.91	0.50	2.00
7	S	70	3.18	0.20	4.81	0.16	1.00
8	CY	44	2.00	0.09	10.50	3.25	6.00
9	I	63	2.86	0.17	5.63	1.16	2.00
10	2D	84	3.81	0.26	3.72	0.50	1.00
11	2D	65	2.95	0.18	5.37	0.16	1.00
12	I	59	2.68	0.16	6.24	1.66	3.00
13	3D	78	3.54	0.24	4.12	1.33	2.00
14	P	99	4.50	0.33	3.00	0.50	1.00
15	3D	80	3.63	0.25	3.98	0.33	1.00
16	I	57	2.59	0.15	6.60	1.33	4.00
17	5D	75	3.40	0.22	4.35	1.08	3.00
18	2D	77	3.50	0.23	4.20	0.58	2.00
19	2D	75	3.40	0.22	4.35	1.58	3.00
20	P	96	4.36	0.32	3.12	0.33	1.00
21	B	65	2.95	0.18	5.37	0.16	1.00
22	S	85	3.86	0.27	3.66	0.33	1.00
Min		44.00	2.00	0.09	2.81	0.16	
Mean		72.95	3.31	0.22	4.98	1.00	
Max		104.00	4.72	0.35	10.50	3.25	

Hashemian House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	221	5.52	0.23	4.30	0.50	1.00
1	D	182	4.55	0.18	5.49	1.50	2.00
2	H	145	3.62	0.13	7.42	0.64	2.00
3	CY_o	110	2.75	0.08	11.14	3.33	7.00
4	K	97	2.42	0.07	13.68	1.04	4.00
5	K	101	2.52	0.07	12.78	1.21	4.00
6	T	132	3.30	0.11	8.47	0.50	2.00
7	3D	132	3.30	0.11	8.47	2.25	3.00
8	3D	134	3.35	0.12	8.29	0.58	2.00
9	CY_i	90	2.25	0.06	15.60	10.25	14.00
10	P	171	4.27	0.16	5.95	0.33	1.00
11	K	147	3.67	0.13	7.28	1.14	2.00
12	5D	186	4.65	0.18	5.34	0.50	1.00
13	S	144	3.60	0.13	7.50	0.47	2.00
14	3D	177	4.42	0.17	5.69	2.00	3.00
15	P	216	5.40	0.22	4.43	0.33	1.00
16	3D	177	4.42	0.17	5.69	0.66	2.00
17	K	143	3.57	0.13	7.57	1.14	3.00
18	P	171	4.27	0.16	5.95	0.33	1.00
19	K	127	3.17	0.11	8.96	1.07	2.00
20	K	127	3.17	0.11	8.96	1.07	2.00
21	3D	166	4.15	0.16	6.19	0.50	1.00
22	3D	166	4.15	0.16	6.19	0.50	1.00
23	I	129	3.22	0.11	8.76	0.07	1.00
24	S	129	3.22	0.11	8.76	0.07	1.00
25	S	129	3.22	0.11	8.76	0.07	1.00
26	S	129	3.22	0.11	8.76	0.07	1.00

27	S	129	3.22	0.11	8.76	0.07	1.00
28	3D	156	3.90	0.14	6.72	1.25	2.00
29	3D	158	3.95	0.15	6.61	0.25	1.00
30	I	119	2.97	0.10	9.87	2.07	4.00
31	K	156	3.90	0.14	6.72	1.25	2.00
32	5D	195	4.87	0.19	5.03	0.50	1.00
33	P	195	4.87	0.19	5.03	0.50	1.00
34	S	129	3.22	0.11	8.76	0.07	1.00
35	E	201	5.02	0.20	4.84	0.50	1.00
36	H	162	4.05	0.15	6.39	1.50	2.00
37	D	125	3.12	0.10	9.17	0.57	2.00
38	B	149	3.72	0.13	7.15	0.14	1.00
39	B	129	3.22	0.11	8.76	0.07	1.00
40	B	129	3.22	0.11	8.76	0.07	1.00

Min	90.00	2.25	0.06	4.30	0.07
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Mean	149.02	3.72	0.13	7.78	1.00
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Max	221.00	5.52	0.23	15.60	10.25
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Bafandeh House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	111	4.26	0.26	3.82	0.33	1.00
1	H	86	3.30	0.18	5.41	2.00	3.00
2	D	82	3.15	0.17	5.80	0.53	2.00
3	CY	77	2.96	0.15	6.37	2.66	5.00
4	D	88	3.38	0.19	5.24	0.47	2.00
5	GB	85	3.26	0.18	5.50	5.83	7.00

6	3D	102	3.92	0.23	4.27	0.20	1.00
7	K	98	3.76	0.22	4.51	0.70	2.00
8	3D	121	4.65	0.29	3.42	1.50	2.00
9	P	146	5.61	0.36	2.70	0.50	1.00
10	K	91	3.50	0.20	5.00	1.70	3.00
11	3D	116	4.46	0.27	3.61	0.33	1.00
12	5D	79	3.03	0.16	6.13	1.40	3.00
13	P	104	4.00	0.24	4.16	0.33	1.00
14	2D	88	3.38	0.19	5.24	0.53	2.00
15	Sh	75	2.88	0.15	6.63	2.16	5.00
16	5D	90	3.46	0.19	5.07	0.53	2.00
17	2D	98	3.76	0.22	4.51	1.20	2.00
18	P	123	4.73	0.29	3.35	0.50	1.00
19	2D	79	3.03	0.16	6.13	1.03	3.00
20	D	83	3.19	0.17	5.70	1.47	3.00
21	E	108	4.15	0.25	3.96	0.33	1.00
22	B	110	4.23	0.25	3.86	0.14	1.00
23	B	110	4.23	0.25	3.86	0.14	1.00
24	S	110	4.23	0.25	3.86	0.14	1.00
25	S	110	4.23	0.25	3.86	0.14	1.00
26	S	110	4.23	0.25	3.86	0.14	1.00

Min	75.00	2.88	0.15	2.70	0.14
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Mean	99.25	3.81	0.22	4.66	1.00
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Max	146.00	5.61	0.36	6.63	5.83
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Bakoochi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	120	4.80	0.31	3.15	0.50	1.00
1	H	96	3.84	0.23	4.22	1.33	2.00
2	D	74	2.96	0.16	6.12	1.25	3.00
3	D	70	2.80	0.15	6.66	1.47	4.00
4	D	70	2.80	0.15	6.66	0.53	2.00
5	CY	59	2.36	0.11	8.82	4.00	7.00
6	Sh	55	2.20	0.10	10.00	2.22	5.00
7	GB	63	2.52	0.12	7.89	5.20	7.00
8	T	76	3.04	0.17	5.88	0.39	2.00
9	2D	76	3.04	0.17	5.88	0.58	2.00
10	T	83	3.32	0.19	5.17	0.14	1.00
11	K	59	2.36	0.11	8.82	1.34	4.00
12	3D	79	3.16	0.18	5.55	0.58	2.00
13	3D	81	3.24	0.18	5.35	1.25	2.00
14	P	105	4.20	0.26	3.75	0.50	1.00
15	K	72	2.88	0.15	6.38	1.20	3.00
16	I	79	3.16	0.18	5.55	0.20	1.00
17	S	83	3.32	0.19	5.17	0.14	1.00
18	B	71	2.84	0.15	6.52	0.64	2.00
19	B	71	2.84	0.15	6.52	0.64	2.00
20	B	87	3.48	0.20	4.83	0.14	1.00
21	B	87	3.48	0.20	4.83	0.14	1.00
22	3D	87	3.48	0.20	4.83	0.14	1.00
23	3D	87	3.48	0.20	4.83	0.14	1.00
24	S	75	3.00	0.16	6.00	0.64	2.00
25	S	75	3.00	0.16	6.00	0.64	2.00

Min	55.00	2.20	0.10	3.15	0.14
Mean	78.46	3.13	0.17	5.98	1.00
Max	120.00	4.80	0.31	10.00	5.20

Esfahanian House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	143	3.97	0.16	5.88	0.75	2.00
1	H	143	3.97	0.16	5.88	0.75	2.00
2	D	109	3.02	0.11	8.63	1.39	4.00
3	CY_o	120	3.33	0.13	7.50	2.25	4.00
4	I	89	2.47	0.08	11.88	2.70	7.00
5	1D	121	3.36	0.13	7.41	1.47	3.00
6	P	156	4.33	0.19	5.25	0.33	1.00
7	1D	120	3.33	0.13	7.50	0.80	3.00
8	1D	121	3.36	0.13	7.41	1.47	3.00
9	P	156	4.33	0.19	5.25	0.33	1.00
10	I	155	4.30	0.18	5.29	0.25	1.00
11	1D	124	3.44	0.13	7.15	0.14	1.00
12	K	85	2.36	0.07	12.85	1.55	5.00
13	K	84	2.33	0.07	13.12	1.21	4.00
14	D	98	2.72	0.09	10.16	0.77	3.00
15	I	77	2.13	0.06	15.36	5.11	13.00
16	CY_i	99	2.75	0.10	10.00	1.07	3.00
17	1D	119	3.30	0.13	7.59	0.53	2.00
18	T	114	3.16	0.12	8.07	0.45	2.00
19	1D	117	3.25	0.12	7.77	1.25	2.00
20	P	152	4.22	0.18	5.43	0.50	1.00

21	E	145	4.02	0.17	5.77	0.50	1.00
22	D	110	3.05	0.11	8.51	1.07	2.00
23	SY	107	2.97	0.11	8.87	1.91	4.00
24	S	142	3.94	0.16	5.94	0.25	1.00
25	S	138	3.83	0.16	6.17	0.50	2.00
26	S	108	3.00	0.11	8.75	0.66	3.00
27	S	111	3.08	0.11	8.40	0.41	2.00
28	S	112	3.11	0.12	8.28	0.07	1.00
29	E	145	4.02	0.17	5.77	0.50	1.00
30	D	110	3.05	0.11	8.51	1.07	2.00
31	HK	108	3.00	0.11	8.75	1.24	4.00
32	2D	109	3.02	0.11	8.63	0.82	3.00
33	2D	109	3.02	0.11	8.63	0.66	3.00
34	B	116	3.22	0.12	7.87	0.58	2.00
35	B	137	3.80	0.16	6.23	0.75	2.00
36	B	127	3.52	0.14	6.92	0.83	2.00

Min	77.00	2.13	0.06	5.25	0.07
Mean	119.89	3.33	0.13	8.04	1.00
Max	156.00	4.33	0.19	15.36	5.11

Barforoush House

		TDn	MDn	RA	I	CV	NCn
0	Ent	86	3.90	0.27	3.60	0.33	1.00
1	H	65	2.95	0.18	5.37	1.83	3.00
2	D	60	2.72	0.16	6.07	0.47	2.00
3	D	63	2.86	0.17	5.63	1.03	3.00

4	CY _o	45	2.04	0.09	10.04	2.90	7.00
5	CY _i	50	2.27	0.12	8.25	2.06	5.00
6	3D	70	3.18	0.20	4.81	0.20	1.00
7	3D	70	3.18	0.20	4.81	0.20	1.00
8	5D	54	2.45	0.13	7.21	0.54	3.00
9	K	49	2.22	0.11	8.55	2.67	5.00
10	K	49	2.22	0.11	8.55	2.17	5.00
11	3D	64	2.90	0.18	5.50	0.53	2.00
12	3D	70	3.18	0.20	4.81	0.20	1.00
13	I	79	3.59	0.24	4.05	0.66	2.00
14	K	62	2.81	0.17	5.77	1.64	3.00
15	K	62	2.81	0.17	5.77	1.64	3.00
16	S	83	3.77	0.26	3.78	0.33	1.00
17	2D	66	3.00	0.19	5.25	0.20	1.00
18	S	83	3.77	0.26	3.78	0.33	1.00
19	I	67	3.04	0.19	5.13	2.20	3.00
20	3D	88	4.00	0.28	3.50	0.33	1.00
21	3D	88	4.00	0.28	3.50	0.33	1.00
22	B	71	3.22	0.21	4.71	0.14	1.00
		Min	45.00	2.04	0.09	3.50	0.14
		Mean	67.13	3.05	0.19	5.58	1.00
		Max	88.00	4.00	0.28	10.04	2.90

Mohtashami House

		TDn	MDn	RA	I	CV	NCn
0	Ent	206	5.15	0.21	4.69	0.50	1.00
1	H	167	4.17	0.16	6.14	1.33	2.00
2	D	130	3.25	0.11	8.66	1.33	3.00
3	K	147	3.67	0.13	7.28	1.03	3.00
4	D	109	2.72	0.08	11.30	0.40	2.00
5	CY_o	118	2.95	0.10	10.00	2.53	5.00
6	CY_i	80	2.00	0.05	19.50	7.03	14.00
7	S	155	3.87	0.14	6.78	0.70	2.00
8	5D	184	4.60	0.18	5.41	0.83	2.00
9	I	155	3.87	0.14	6.78	1.20	2.00
10	5D	194	4.85	0.19	5.06	0.50	1.00
11	5D	97	2.42	0.07	13.68	1.93	5.00
12	K	106	2.65	0.08	11.81	0.77	3.00
13	K	106	2.65	0.08	11.81	0.77	3.00
14	3D	143	3.57	0.13	7.57	1.33	2.00
15	3D	143	3.57	0.13	7.57	1.33	2.00
16	P	182	4.55	0.18	5.49	0.50	1.00
17	P	182	4.55	0.18	5.49	0.50	1.00
18	I	136	3.40	0.12	8.12	0.20	1.00
19	K	117	2.92	0.09	10.12	1.07	2.00
20	S	156	3.90	0.14	6.72	0.50	1.00
21	K	115	2.87	0.09	10.40	1.57	3.00
22	K	113	2.82	0.09	10.68	1.07	3.00
23	3D	154	3.85	0.14	6.84	0.33	1.00
24	3D	150	3.75	0.14	7.09	1.33	2.00
25	5D	148	3.70	0.13	7.22	0.66	2.00
26	P	189	4.72	0.19	5.23	0.50	1.00

27	K	115	2.87	0.09	10.40	1.57	3.00
28	K	115	2.87	0.09	10.40	1.57	3.00
29	3D	154	3.85	0.14	6.84	0.33	1.00
30	3D	154	3.85	0.14	6.84	0.33	1.00
31	5D	150	3.75	0.14	7.09	0.66	2.00
32	2D	154	3.85	0.14	6.84	0.33	1.00
33	2D	156	3.90	0.14	6.72	0.50	1.00
34	K	115	2.87	0.09	10.40	2.07	3.00
35	K	117	2.92	0.09	10.12	1.07	2.00
36	I	154	3.85	0.14	6.84	0.33	1.00
37	S	119	2.97	0.10	9.87	0.07	1.00
38	B	119	2.97	0.10	9.87	0.07	1.00
39	B	119	2.97	0.10	9.87	0.07	1.00
40	B	157	3.92	0.15	6.66	0.20	1.00

Min	80.00	2.00	0.05	4.69	0.07
Mean	140.97	3.52	0.12	8.44	1.00
Max	206.00	5.15	0.21	19.50	7.03

Taj House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	192	5.64	0.28	3.55	0.50	1.00
1	H	159	4.67	0.22	4.48	1.25	2.00

2	D	128	3.76	0.16	5.96	2.14	4.00
3	CY	105	3.08	0.12	7.90	4.25	7.00
4	5D	192	5.64	0.28	3.55	0.50	1.00
5	D	159	4.67	0.22	4.48	1.25	2.00
6	3D	161	4.73	0.22	4.41	0.25	1.00
7	K	132	3.88	0.17	5.72	1.47	3.00
8	K	132	3.88	0.17	5.72	0.97	3.00
9	S	165	4.85	0.23	4.28	0.33	1.00
10	3D	159	4.67	0.22	4.48	1.66	3.00
11	S	127	3.73	0.16	6.03	0.66	2.00
12	S	138	4.05	0.18	5.39	0.14	1.00
13	P	192	5.64	0.28	3.55	0.33	1.00
14	I	100	2.94	0.11	8.50	0.89	3.00
15	I	99	2.91	0.11	8.63	1.50	4.00
16	Sh	110	3.23	0.13	7.38	2.72	3.00
17	3D	128	3.76	0.16	5.96	2.25	3.00
18	P	161	4.73	0.22	4.41	0.33	1.00
19	P	161	4.73	0.22	4.41	0.33	1.00
20	3D	130	3.82	0.17	5.84	1.25	2.00
21	P	163	4.79	0.22	4.34	0.50	1.00
22	GB	131	3.85	0.17	5.78	4.66	7.00
23	I	137	4.02	0.18	5.44	1.83	3.00
24	3D	170	5.00	0.24	4.12	0.33	1.00
25	3D	168	4.94	0.23	4.18	1.33	2.00
26	P	201	5.91	0.29	3.35	0.50	1.00
27	S	164	4.82	0.23	4.31	0.14	1.00
28	S	164	4.82	0.23	4.31	0.14	1.00
29	5D	162	4.76	0.22	4.38	1.14	3.00
30	S	163	4.79	0.22	4.34	0.47	2.00
31	S	163	4.79	0.22	4.34	0.47	2.00

32	B	164	4.82	0.23	4.31	0.14	1.00
33	B	138	4.05	0.18	5.39	0.14	1.00
34	B	138	4.05	0.18	5.39	0.14	1.00

Min	99.00	2.91	0.11	3.35	0.14		
Mean	150.17	4.41	0.20	5.10	1.00		
Max	201.00	5.91	0.29	8.63	4.66		

Sadooghi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	219	5.61	0.24	4.11	0.33	1.00
1	H	181	4.64	0.19	5.21	2.03	3.00
2	D	147	3.76	0.14	6.86	1.53	3.00
3	CY	117	3.00	0.10	9.50	2.28	5.00
4	S	185	4.74	0.19	5.07	0.33	1.00
5	S	219	5.61	0.24	4.11	0.33	1.00
6	S	155	3.97	0.15	6.38	0.20	1.00
7	K	151	3.87	0.15	6.61	0.70	2.00
8	K	103	2.64	0.08	11.57	2.22	5.00
9	2D	187	4.79	0.19	5.00	1.50	2.00
10	3D	141	3.61	0.13	7.26	0.20	1.00
11	P	225	5.76	0.25	3.98	0.50	1.00
12	Sh	92	2.35	0.07	13.98	2.82	8.00
13	3D	104	2.66	0.08	11.40	1.32	4.00
14	2D	135	3.46	0.12	7.71	0.45	2.00
15	2D	140	3.58	0.13	7.33	1.25	2.00
16	P	178	4.56	0.18	5.33	0.50	1.00

17	S	137	3.51	0.13	7.56	0.70	2.00
18	K	125	3.20	0.11	8.61	1.12	3.00
19	K	126	3.23	0.11	8.51	1.62	3.00
20	5D	159	4.07	0.16	6.17	0.66	2.00
21	2D	164	4.20	0.16	5.92	0.33	1.00
22	2D	148	3.79	0.14	6.79	0.83	2.00
23	S	130	3.33	0.12	8.14	0.12	1.00
24	K	126	3.23	0.11	8.51	1.62	3.00
25	K	120	3.07	0.10	9.14	2.12	4.00
26	3D	154	3.94	0.15	6.44	0.58	2.00
27	1D	158	4.05	0.16	6.22	0.25	1.00
28	1D	164	4.20	0.16	5.92	0.33	1.00
29	D	154	3.94	0.15	6.44	0.75	2.00
30	H	190	4.87	0.20	4.90	1.50	2.00
31	E	228	5.84	0.25	3.92	0.50	1.00
32	GB	116	2.97	0.10	9.62	7.12	8.00
33	B	154	3.94	0.15	6.44	0.12	1.00
34	B	154	3.94	0.15	6.44	0.12	1.00
35	B	154	3.94	0.15	6.44	0.12	1.00
36	S	154	3.94	0.15	6.44	0.12	1.00
37	S	154	3.94	0.15	6.44	0.12	1.00
38	S	154	3.94	0.15	6.44	0.12	1.00
39	S	154	3.94	0.15	6.44	0.12	1.00

Min	92.00	2.35	0.07	3.92	0.12
Mean	153.90	3.94	0.15	6.98	1.00
Max	228.00	5.84	0.25	13.98	7.12

Tabatabaei House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	421	5.39	0.11	8.75	0.50	1.00
1	H	344	4.41	0.08	11.28	1.50	2.00
2	D	269	3.44	0.06	15.72	0.55	2.00
3	CY.	196	2.51	0.03	25.44	8.50	18.00
4	K	263	3.37	0.06	16.23	1.80	4.00
5	K	263	3.37	0.06	16.23	1.13	4.00
6	I	338	4.33	0.08	11.55	1.25	2.00
7	3D	340	4.35	0.08	11.46	0.25	1.00
8	3D	338	4.33	0.08	11.55	0.58	2.00
9	K	269	3.44	0.06	15.72	0.30	2.00
10	K	267	3.42	0.06	15.88	0.88	3.00
11	5D	415	5.32	0.11	8.91	0.50	1.00
12	OS	328	4.20	0.08	12.01	2.00	4.00
13	OS	336	4.30	0.08	11.63	1.58	3.00
14	K	336	4.30	0.08	11.63	1.33	3.00
15	K	331	4.24	0.08	11.86	1.16	3.00
16	3D	403	5.16	0.10	9.24	0.58	2.00
17	3D	399	5.11	0.10	9.35	0.58	2.00
18	5D	331	4.24	0.08	11.86	1.66	4.00
19	K	269	3.44	0.06	15.72	0.55	2.00
20	3D	339	4.34	0.08	11.50	0.83	2.00
21	D	263	3.37	0.06	16.23	0.88	3.00
22	3D	331	4.24	0.08	11.86	1.66	3.00
23	P	408	5.23	0.10	9.10	0.33	1.00
24	E	415	5.32	0.11	8.91	0.50	1.00
25	H	338	4.33	0.08	11.55	1.33	2.00
26	3D	405	5.19	0.10	9.18	0.25	1.00
27	3D	413	5.29	0.11	8.96	0.33	1.00

28	K	271	3.47	0.06	15.55	1.05	2.00
29	I	246	3.15	0.05	17.87	0.55	3.00
30	I	246	3.15	0.05	17.87	0.55	3.00
31	K	271	3.47	0.06	15.55	1.05	2.00
32	K	317	4.06	0.07	12.56	1.16	3.00
33	3D	348	4.46	0.08	11.12	0.50	1.00
34	3D	369	4.73	0.09	10.31	0.50	2.00
35	5D	294	3.76	0.07	13.90	2.33	6.00
36	K	300	3.84	0.07	13.52	1.00	3.00
37	3D	367	4.70	0.09	10.39	0.83	3.00
38	3D	348	4.46	0.08	11.12	0.50	1.00
39	K	251	3.21	0.05	17.35	0.86	4.00
40	K	236	3.02	0.05	19.00	0.86	4.00
41	I	291	3.73	0.07	14.09	0.83	3.00
42	5D	360	4.61	0.09	10.64	1.00	3.00
43	I	320	4.10	0.08	12.40	1.08	3.00
44	I	305	3.91	0.07	13.22	1.08	3.00
45	3D	389	4.98	0.10	9.65	0.64	2.00
46	5D	464	5.94	0.12	7.77	1.00	2.00
47	3D	389	4.98	0.10	9.65	0.64	2.00
48	CY_i	314	4.02	0.07	12.72	4.75	7.00
49	K	383	4.91	0.10	9.84	0.47	2.00
50	K	344	4.41	0.08	11.28	0.47	2.00
51	CY_i	275	3.52	0.06	15.24	3.41	7.00
52	K	348	4.46	0.08	11.12	1.64	3.00
53	K	348	4.46	0.08	11.12	1.64	3.00
54	3D	421	5.39	0.11	8.75	0.66	2.00
55	3D	425	5.44	0.11	8.65	0.33	1.00
56	3D	425	5.44	0.11	8.65	0.33	1.00
57	5D	328	4.20	0.08	12.01	0.64	2.00

58	I	343	4.39	0.08	11.33	0.29	2.00
59	I	341	4.37	0.08	11.41	0.62	3.00
60	SY	376	4.82	0.09	10.07	5.83	8.00
61	3D	376	4.82	0.09	10.07	0.62	2.00
62	E	427	5.47	0.11	8.60	0.50	1.00
63	D	350	4.48	0.09	11.04	1.14	2.00
64	E	528	6.76	0.14	6.67	0.50	1.00
65	D	451	5.78	0.12	8.05	1.12	2.00
66	S	453	5.80	0.12	8.00	0.12	1.00
67	B	453	5.80	0.12	8.00	0.12	1.00
68	B	453	5.80	0.12	8.00	0.12	1.00
69	B	453	5.80	0.12	8.00	0.12	1.00
70	B	273	3.50	0.06	15.40	0.05	1.00
71	B	273	3.50	0.06	15.40	0.05	1.00
72	B	273	3.50	0.06	15.40	0.05	1.00
73	B	391	5.01	0.10	9.59	0.14	1.00
74	B	391	5.01	0.10	9.59	0.14	1.00
75	B	391	5.01	0.10	9.59	0.14	1.00
76	B	352	4.51	0.09	10.95	0.14	1.00
77	I	264	3.38	0.06	16.14	0.63	3.00
78	I	263	3.37	0.06	16.23	0.63	3.00

Min	196.00	2.51	0.03	6.67	0.05
Mean	344.75	4.41	0.08	12.02	1.00
Max	528.00	6.76	0.14	25.44	8.50

Boroujerdi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	293	5.52	0.17	5.74	0.33	1.00
1	H	241	4.54	0.13	7.32	1.83	3.00
2	H	215	4.05	0.11	8.50	0.66	2.00
3	D	187	3.52	0.09	10.28	0.93	3.00
4	CY_o	162	3.05	0.07	12.64	4.58	10.00
5	I	233	4.39	0.13	7.65	1.83	3.00
6	5D	244	4.60	0.13	7.21	0.66	2.00
7	3D	285	5.37	0.16	5.93	0.33	1.00
8	3D	262	4.94	0.15	6.59	0.33	1.00
9	K	208	3.92	0.11	8.89	1.60	3.00
10	S	260	4.90	0.15	6.65	0.33	1.00
11	S	214	4.03	0.11	8.55	0.10	1.00
12	K	210	3.96	0.11	8.77	2.10	3.00
13	I	212	4.00	0.11	8.66	1.10	2.00
14	S	264	4.98	0.15	6.53	0.50	1.00
15	K	183	3.45	0.09	10.60	1.80	4.00
16	K	185	3.49	0.09	10.43	0.80	3.00
17	3D	235	4.43	0.13	7.57	0.25	1.00
18	3D	233	4.39	0.13	7.65	0.83	2.00
19	5D	232	4.37	0.12	7.69	0.75	2.00
20	K	198	3.73	0.10	9.50	1.43	4.00
21	K	198	3.73	0.10	9.50	1.43	4.00
22	I	234	4.41	0.13	7.61	0.75	3.00
23	3D	248	4.67	0.14	7.06	1.25	2.00
24	3D	248	4.67	0.14	7.06	1.25	2.00
25	P	300	5.66	0.17	5.57	0.50	1.00
26	P	300	5.66	0.17	5.57	0.50	1.00
27	CS	276	5.20	0.16	6.17	1.66	4.00

28	T	324	6.11	0.19	5.08	2.25	3.00
29	CS	240	4.52	0.13	7.36	0.50	2.00
30	CS	240	4.52	0.13	7.36	0.50	2.00
31	3D	376	7.09	0.23	4.26	0.33	1.00
32	3D	376	7.09	0.23	4.26	0.33	1.00
33	D	264	4.98	0.15	6.53	1.08	3.00
34	S	314	5.92	0.18	5.27	1.33	2.00
35	5D	366	6.90	0.22	4.40	0.50	1.00
36	3D	338	6.37	0.20	4.83	0.25	1.00
37	K	286	5.39	0.16	5.91	2.66	4.00
38	S	338	6.37	0.20	4.83	0.25	1.00
39	I	304	5.73	0.18	5.49	1.58	3.00
40	HK	356	6.71	0.21	4.54	0.33	1.00
41	CY_i	279	5.26	0.16	6.09	1.66	3.00
42	K	251	4.73	0.14	6.95	1.16	3.00
43	5D	259	4.88	0.14	6.68	1.16	3.00
44	CS	306	5.77	0.18	5.44	0.66	2.00
45	2D	236	4.45	0.13	7.53	0.86	3.00
46	2D	230	4.33	0.12	7.78	0.53	2.00
47	CY_i	202	3.81	0.10	9.24	1.75	5.00
48	E	334	6.30	0.20	4.90	0.33	1.00
49	H	282	5.32	0.16	6.01	1.83	3.00
50	D	246	4.64	0.14	7.13	0.86	3.00
51	S	262	4.94	0.15	6.59	0.33	1.00
52	B	214	4.03	0.11	8.55	0.10	1.00
53	B	331	6.24	0.20	4.95	0.33	1.00
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	Min	162.00	3.05	0.07	4.26	0.10	
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	Mean	261.37	4.93	0.15	7.04	1.00	
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	Max	376.00	7.09	0.23	12.64	4.58	

Abbasian House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	325	7.73	0.32	3.04	0.50	1.00
1	D	284	6.76	0.28	3.55	1.50	2.00
2	H	245	5.83	0.23	4.24	1.00	2.00
3	H	208	4.95	0.19	5.18	1.00	2.00
4	D	173	4.11	0.15	6.57	1.00	2.00
5	OS	140	3.33	0.11	8.78	0.75	2.00
6	K	109	2.59	0.07	12.85	1.06	4.00
7	Sh	97	2.30	0.06	15.65	4.28	11.00
8	GB	133	3.16	0.10	9.46	5.45	7.00
9	K	118	2.80	0.08	11.32	2.06	5.00
10	K	142	3.38	0.11	8.61	1.58	3.00
11	5D	183	4.35	0.16	6.10	0.33	1.00
12	I	147	3.50	0.12	8.20	1.03	3.00
13	K	156	3.71	0.13	7.55	0.53	2.00
14	S	175	4.16	0.15	6.47	0.33	1.00
15	S	159	3.78	0.13	7.35	0.20	1.00
16	K	134	3.19	0.10	9.35	2.09	3.00
17	2D	175	4.16	0.15	6.47	0.33	1.00
18	K	134	3.19	0.10	9.35	2.09	3.00
19	K	136	3.23	0.10	9.15	0.59	2.00
20	5D	175	4.16	0.15	6.47	0.33	1.00
21	3D	175	4.16	0.15	6.47	0.33	1.00
22	3D	169	4.02	0.14	6.77	0.83	2.00
23	CS	130	3.09	0.10	9.78	0.84	3.00
24	K	132	3.14	0.10	9.56	2.59	4.00
25	K	136	3.23	0.10	9.15	0.59	2.00
26	I	171	4.07	0.14	6.67	0.75	2.00

27	HK	173	4.11	0.15	6.57	0.25	1.00
28	S	173	4.11	0.15	6.57	0.25	1.00
29	E	240	5.71	0.22	4.34	0.50	1.00
30	D	199	4.73	0.18	5.48	1.33	2.00
31	H	160	3.80	0.13	7.29	1.08	3.00
32	K	129	3.07	0.10	9.89	0.75	3.00
33	D	158	3.76	0.13	7.42	1.25	4.00
34	K	129	3.07	0.10	9.89	1.67	4.00
35	3D	162	3.85	0.13	7.17	0.83	3.00
36	2D	170	4.04	0.14	6.72	0.25	1.00
37	S	138	3.28	0.11	8.96	0.09	1.00
38	B	174	4.14	0.15	6.52	0.14	1.00
39	B	174	4.14	0.15	6.52	0.14	1.00
40	B	174	4.14	0.15	6.52	0.14	1.00
41	B	174	4.14	0.15	6.52	0.14	1.00
42	S	174	4.14	0.15	6.52	0.14	1.00

Min	97.00	2.30	0.06	3.04	0.09
Mean	166.55	3.96	0.14	7.60	1.00
Max	325.00	7.73	0.32	15.65	5.45

Taghavi House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	96	5.33	0.50	1.96	0.50	1.00
1	D	79	4.38	0.39	2.50	1.50	2.00
2	H	64	3.55	0.30	3.32	1.00	2.00
3	H	51	2.83	0.21	4.63	1.00	2.00

4	K	40	2.22	0.14	6.95	0.59	2.00
5	CY	31	1.72	0.08	11.76	8.83	11.00
6	K	46	2.55	0.18	5.46	1.09	2.00
7	3D	63	3.50	0.29	3.40	0.50	1.00
8	K	44	2.44	0.16	5.88	1.59	3.00
9	K	46	2.55	0.18	5.46	0.59	2.00
10	5D	59	3.27	0.26	3.73	0.83	2.00
11	3D	61	3.38	0.28	3.55	0.33	1.00
12	3D	61	3.38	0.28	3.55	0.33	1.00
13	5D	61	3.38	0.28	3.55	0.33	1.00
14	S	61	3.38	0.28	3.55	0.33	1.00
15	B	48	2.66	0.19	5.10	0.09	1.00
16	B	48	2.66	0.19	5.10	0.09	1.00
17	B	48	2.66	0.19	5.10	0.09	1.00
18	S	48	2.66	0.19	5.10	0.09	1.00

Min	31.00	1.72	0.08	1.96	0.09
Mean	53.47	2.97	0.23	4.96	0.99
Max	96.00	5.33	0.50	11.76	8.83

Masoudifar House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	357	8.11	0.33	3.02	0.50	1.00
1	D	314	7.13	0.28	3.50	1.50	2.00
2	H	273	6.20	0.24	4.13	1.00	2.00
3	H	234	5.31	0.20	4.97	1.00	2.00
4	D	197	4.47	0.16	6.18	1.00	2.00
5	OS	162	3.68	0.12	8.01	1.00	2.00

6	K	129	2.93	0.08	11.12	0.59	2.00
7	Sh	98	2.22	0.05	17.51	3.55	11.00
8	GB	129	2.93	0.08	11.12	6.09	7.00
9	K	137	3.11	0.09	10.17	1.59	3.00
10	K	137	3.11	0.09	10.17	1.59	3.00
11	3D	180	4.09	0.14	6.95	0.33	1.00
12	3D	180	4.09	0.14	6.95	0.33	1.00
13	3D	176	4.00	0.13	7.16	0.66	2.00
14	K	139	3.15	0.10	9.95	1.09	2.00
15	S	182	4.13	0.14	6.85	0.50	1.00
16	K	133	3.02	0.09	10.62	1.59	4.00
17	K	133	3.02	0.09	10.62	1.59	4.00
18	3D	174	3.95	0.13	7.27	1.25	2.00
19	3D	174	3.95	0.13	7.27	1.25	2.00
20	I	170	3.86	0.13	7.50	0.50	2.00
21	5D	170	3.86	0.13	7.50	0.50	2.00
22	P	217	4.93	0.18	5.46	0.50	1.00
23	P	217	4.93	0.18	5.46	0.50	1.00
24	I	129	2.93	0.08	11.12	1.75	4.00
25	S	172	3.90	0.13	7.39	0.25	1.00
26	K	168	3.81	0.13	7.62	1.75	3.00
27	K	168	3.81	0.13	7.62	1.75	3.00
28	5D	207	4.70	0.17	5.80	0.66	2.00
29	S	211	4.79	0.17	5.66	0.33	1.00
30	S	211	4.79	0.17	5.66	0.33	1.00
31	K	135	3.06	0.09	10.39	1.09	3.00
32	K	137	3.11	0.09	10.17	1.09	3.00
33	3D	174	3.95	0.13	7.27	0.66	2.00
34	3D	176	4.00	0.13	7.16	1.33	2.00
35	3D	176	4.00	0.13	7.16	0.66	2.00

36	K	137	3.11	0.09	10.17	1.59	3.00
37	S	180	4.09	0.14	6.95	0.33	1.00
38	P	219	4.97	0.18	5.40	0.50	1.00
39	B	172	3.90	0.13	7.39	0.14	1.00
40	B	172	3.90	0.13	7.39	0.14	1.00
41	B	172	3.90	0.13	7.39	0.14	1.00
42	B	172	3.90	0.13	7.39	0.14	1.00
43	S	172	3.90	0.13	7.39	0.14	1.00
44	S	172	3.90	0.13	7.39	0.14	1.00

Min	98.00	2.22	0.05	3.02	0.14		
Mean	178.75	4.06	0.14	7.76	1.00		
Max	357.00	8.11	0.33	17.51	6.09		

Abbasi Moghaddam House

		TDn	MDn	RA	I	CV	NCn
0	Ent.	154	6.16	0.43	2.32	0.50	1.00
1	D	130	5.20	0.35	2.85	1.50	2.00
2	H	108	4.32	0.27	3.61	1.00	2.00
3	D	88	3.52	0.21	4.76	1.00	2.00
4	H	70	2.80	0.15	6.66	0.64	2.00
5	CY	54	2.16	0.09	10.34	3.70	7.00
6	K	72	2.88	0.15	6.38	1.14	3.00
7	K	72	2.88	0.15	6.38	1.14	3.00
8	5D	90	3.60	0.21	4.61	0.66	2.00
9	2D	94	3.76	0.23	4.34	1.33	2.00
10	2D	94	3.76	0.23	4.34	1.33	2.00

11	P	118	4.72	0.31	3.22	0.50	1.00
12	P	118	4.72	0.31	3.22	0.50	1.00
13	I	64	2.56	0.13	7.69	2.64	5.00
14	1D	86	3.44	0.20	4.91	1.20	2.00
15	P	110	4.40	0.28	3.52	0.50	1.00
16	1D	88	3.52	0.21	4.76	0.20	1.00
17	1D	86	3.44	0.20	4.91	1.20	2.00
18	P	110	4.40	0.28	3.52	0.50	1.00
19	K	86	3.44	0.20	4.91	1.20	2.00
20	S	110	4.40	0.28	3.52	0.50	1.00
21	K	74	2.96	0.16	6.12	2.14	3.00
22	3D	98	3.92	0.24	4.10	0.33	1.00
23	3D	98	3.92	0.24	4.10	0.33	1.00
24	B	78	3.12	0.17	5.66	0.14	1.00
25	B	78	3.12	0.17	5.66	0.14	1.00

Min	54.00	2.16	0.09	2.32	0.14
Mean	93.38	3.73	0.22	4.86	1.00
Max	154.00	6.16	0.43	10.34	3.70