

CHARACTERISTICS OF COURTYARDS OF TRADITIONAL HOUSES IN KURTGAZI, BİRGİ

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**by
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ABSTRACT

CHARACTERISTICS OF COURTYARDS OF TRADITIONAL HOUSES IN KURTGAZI, BİRGİ

The aim is to understand the characteristics of the courtyards in traditional Kurtgazi houses and discuss their preservation problems.

Four traditional houses with courtyards, which are continued to be lived in, accessible and have partially preserved their authenticity were selected. The qualities of the selected courtyards were documented at the site, analyzed and evaluated.

Courtyards are positioned at east, southeast or south. Comparison of the current and the authentic states revealed that, mass additions, roof renewals and renewal of ground covering materials in the courtyards were widespread.

Natural ventilation increases as the ratio of the courtyard length in the north-south direction to the related courtyard wall height increases since the prevailing wind direction is the north. As the length of a courtyard is decreased and the height of the courtyard wall is increased, the amount of exposition of the courtyard to direct sunlight is decreased. In order to benefit from sunlight in all seasons, this ratio must be at least two. Deciduous plants such as fig trees and vines block the sunlight to reach the courtyard in summers and allow sunlight to reach the courtyard in winters. Materials with a low amount of reflecting capability are used as a covering on the ground and on the walls in the authentic state. Resting, eating, doing hobbies, washing and drying laundry and dishes are the activities in four seasons of the year, and food drying and wood cutting are seasonal activities realized in the courtyards.

Keywords: *Traditional Courtyard, Open Spaces, Historical Settlements, Birgi Houses*

ÖZET

BİRGİ, KURTGAZİ'DEKİ GELENEKSEL EVLERİN AVLULARININ ÖZELLİKLERİ

Amaç, geleneksel Kurtgazi evlerindeki avluların özelliklerini anlamak ve koruma sorunlarını tartışmaktır.

İçinde yaşanılmaya devam edilen, ulaşılabilir ve özgünlüğünü kısmen korumuş dört avlulu geleneksel ev seçilmiştir. Seçilen avluların nitelikleri yerinde belgelendi, analiz edildi ve değerlendirildi.

Avlular doğuda, güneydoğuda veya güneyde konumlanmıştır. Mevcut ve özgün halleri karşılaştırıldığında avlularda toplu eklemeler, çatı yenilemeleri ve zemin kaplama malzemelerinin yenilenmesinin yaygın olduğu ortaya çıktı.

Hakim rüzgar yönünün kuzey olması nedeniyle kuzey-güney yönündeki avlu uzunluğunun ilgili avlu duvar yüksekliğine oranı arttıkça doğal havalandırma da artmaktadır. Avlu uzunluğu azaldıkça ve avlu duvarının yüksekliği arttıkça avlunun doğrudan güneş ışığına maruz kalma miktarı azalmaktadır. Güneş ışığından her mevsim faydalanabilmek için bu oranın en az iki olması gerekir. İncir ağacı ve asma gibi yaprak döken bitkiler yazın güneş ışığının avluya ulaşmasını engellerken, kışın güneş ışığının avluya ulaşmasını sağlıyor. Yansıtma yeteneği düşük olan malzemeler özgün haliyle zeminde ve duvarlarda kaplama olarak kullanılmaktadır. Dinlenmek, yemek yemek, hobi yapmak, çamaşır ve bulaşık yıkamak ve kurutmak yılın dört mevsimi yapılan aktiviteler olup, avlularda mevsimlik olarak yiyecek kurutma ve odun kesme aktiviteleri yapılmaktadır.

Anahtar Kelimeler: *Geleneksel Avlular, Açık Alan, Tarihi Yerleşimler, Birgi Evleri*

TABLE OF CONTENTS

LIST OF FIGURES	viii
LIST OF TABLES	xii
CHAPTER 1. INTRODUCTION	1
1.1. Problem Definition	4
1.2. Aim and Objectives.....	5
1.3. Limit of the Study	6
1.4. Research Questions.....	6
1.5. Methodology	6
1.6. Thesis Structure	17
CHAPTER 2. THEORETICAL BACKGROUND.....	18
2.1. Characteristics of Traditional Open Spaces	18
2.1.1. Altitude.....	20
2.1.2. Form.....	21
2.1.3. Positioning	23
2.1.4. Relations with Spaces	23
2.1.5. Material.....	25
2.1.6. Architectural Elements.....	26
2.1.7. Greenery and Water	27
2.1.8. Natural Illumination.....	28
2.1.9. Ventilation	29
2.1.10. Climatic Conditions	30
2.2. Geographical Aspects	31
2.3. Historical Aspects	34
2.4. Characteristics of Birgi Houses	37

CHAPTER 3. CHARACTERISTICS OF THE CASES	40
3.1. Case 1: The Courtyard in Block 338 / Lot 7	40
3.2. Case 2: The Courtyard in Block 326/ Lot 5 and Block 326/ Lot 6	48
3.3. Case 3 The Courtyard in Block 326 / Lot 8	56
3.4. Case 4: The Courtyard in Block 350/ Lot 4	64
CHAPTER 4. RESULTS AND DISCUSSION	75
4.1. Location	75
4.2. Form	76
4.3. Area	77
4.4. Ratio of Length to Width	77
4.5. Ratio of Height of Courtyard Wall at North to Depth	78
4.6. Ratio of Depth to Height of Courtyard Wall at South	78
4.7. Activities and Spaces	79
4.8. Elements	81
4.8.1. Architectural Elements	81
4.8.2. Greenery Elements	84
4.9. Contribution to Continuous Urban Green Areas	86
4.10. Construction Technique and Material Usage	86
4.10.1. Finishing of the Ground	86
4.10.2. Courtyard Walls	87
4.11. Illumination and Ventilation	88
4.11.1. Exposition to Direct Sunlight	88
4.11.2. Ventilated Areas	90
CHAPTER 5. CONCLUSION	91
REFERENCES	94

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Figure 1. Inventory sheet of open spaces in Birgi Traditional Houses	8
Figure 2. Legend of the drawings	10
Figure 3. Measured drawings in the current and authentic states in case 1	11
Figure 4. The width and length	12
Figure 5. The depth and height	12
Figure 6. Solar data for the case 1 on 21 st December at 12.30	13
Figure 7. Solar data for the case 1 on 21 st June at 12.30	14
Figure 8. Summer sun (A) at 08.30, (B) at 12.30 and (C) at 17.30 in case 1	14
Figure 9. Shadow's lengths in Birgi	15
Figure 10. Shadow's length in sections in case 1	15
Figure 11. Exposition of the courtyard to sun light in plan of case 1	16
Figure 12. The areas exposed to sunlight, case 1	16
Figure 13. A courtyard of a house in Spain	19
Figure 14. A courtyard in Bursa	20
Figure 15. Climate altitude relations	21
Figure 16. Ratio of width/length in courtyards	22
Figure 17. Cooling and heating loads in courtyards which have different forms for	22
(A) winter and for (B) summer	22
Figure 18. A house with taşlık	23
Figure 19. Plan of Morocco traditional houses	24
Figure 20. Lot organization in Tarsus	24
Figure 21. Houses made of mud: (A) Iran and (B) United States , and wood: (C) Africa and (D) Amazon	25
Figure 22. A fireplace in Spain	26
Figure 23. An Anatolian <i>hayat</i> house	27
Figure 24. Cooling effects with water element	28
Figure 25. The illumination and shading area	29
Figure 26. Wind effects to the courtyards	30
Figure 27. Air flow in the courtyards	30

<u>Figure</u>	<u>Page</u>
Figure 28. Location of Birgi	32
Figure 29. Day length throughout the year in Birgi.....	33
Figure 30. Wind direction in Birgi	34
Figure 31. Section of the Birgi Settlement	34
Figure 32. Map of the districts in Birgi	35
Figure 33. Additional masterplan of Birgi	36
Figure 34. The entrance of a courtyard in Birgi	37
Figure 35. First floor plan in a Birgi house	38
Figure 36. Ground floor plan in a Birgi house	39
Figure 37. Ground floor plan a Birgi house	39
Figure 38. Locations of the cases	40
Figure 39. Location of the case 1	41
Figure 40. Section of the case 1 in the current state	41
Figure 41. Ground Floor Plan of the case 1 in the current state	42
Figure 42. (A) Authentic pot, (B) authentic timber stairs and (C) authentic stone steps	43
Figure 43. The contemporary a fireplace (left) a sink (right)	44
Figure 44. Ground floor plan of the case 1 in the authentic state	44
Figure 45. Section of the case 1 in the authentic state	45
Figure 46. The courtyard of the case 1	45
Figure 47. The amount of sunlight in the section and the plan for the current state in the case 1	46
Figure 48. The amount of sunlight in the section and the plan for the authentic state in the case 1	47
Figure 49. The amount of sunlight in the case 1	47
Figure 50. Location of the case 2	48
Figure 51. The entrance of the case 2	49
Figure 52. Ground floor plan of the case 2 in the current state	50
Figure 53. Section of the case 2 in the current state	50
Figure 54. The taşlık (left) and the courtyard (right)	51
Figure 55. (A) The wall of the courtyard, (B) the courtyard, (C) the mass addition	51
Figure 56. (A) The toilet, (B) the mass addition and (C) the fireplace.....	52
Figure 57. Ground floor plan of the case 2 in the authentic state	53

<u>Figure</u>	<u>Page</u>
Figure 58. Longitudinal section of the case 2 in the authentic state.....	53
Figure 59. The amount of illumination in the case 2	54
Figure 60. The amount of illumination in the plan for the current state in the case 2 ...	54
Figure 61. The amount of illumination in the plan for the authentic state in the case 2	55
Figure 62. Location of the case 3	56
Figure 63. Ground floor plan of the case 3 in the current state	57
Figure 64. The portico	57
Figure 65. Cross section of the case 3 in the current state	58
Figure 66. The entrance of the case 3 and its street façade.....	59
Figure 67. (A) The building addition, (B) the concrete stairs and (C) the barn.....	60
Figure 68. The fireplace (left) and the courtyard (right)	60
Figure 69. Ground floor plan of the case 3 in the authentic state	61
Figure 70. Cross section of the case 3 in the authentic state	62
Figure 71. The amount of illumination in the case 3	62
Figure 72. The amount of illumination in the plan for the current state in the case 3 ...	63
Figure 73. The amount of illumination in the plan for the authentic state in the case 3	64
Figure 74. Location of the case 4.....	65
Figure 75. The bottom portion plan of the courtyard in the case 4 in the current state .	66
Figure 76. Courtyard walls in the case 4	66
Figure 77. The upper portion plan of the courtyard in the case 4 in the current state	67
Figure 78. Section of the case 4 in the current state	67
Figure 79. The ground level courtyard (left) and the upper level courtyard (right)	68
Figure 80. (A) The <i>taşlık</i> of the annex and (B) (C) the <i>hayat</i> of the annex.....	69
Figure 81. The bottom portion plan of the courtyard in the case 4 in the authentic state	69
Figure 82. The upper portion plan of the courtyard in the case 4 in the authentic state.	70
Figure 83. Section of the case 4 in the authentic state	70
Figure 84. The amount of illumination in the case 4	71
Figure 85. The amount of illumination in the plan for the current state in the case 4 ...	72
Figure 86. The amount of illumination in the plan for the authentic state in the case 4	73
Figure 87. The contemporary fountain (left) and pool (right) in the case 4	74
Figure 88. Location of the case studies	75

<u>Figure</u>	<u>Page</u>
Figure 89. The slope of the case studies	76
Figure 90. (A) Washing dishes and (B) (C) drying food in the case 2.....	79
Figure 91. The existence of daily and seasonal activities in courtyards in the current state	80
Figure 92. The existence of daily and seasonal activities in <i>taşlıks</i> in the current state	81
Figure 93. (A) Stepping stone, (B) timber stair and (C) <i>hayat</i> in the case 1	82
Figure 94. <i>Abdestlik</i> in the case 4	82
Figure 95. Flower pots in the case 4 (left) and case 1 (right)	83
Figure 96. Drainage in the case 3	83
Figure 97. The oven on the Umurbey street (left) and the fountain (Bıçakçı fountain) on the Şehit Gürol Madan street (right)	84
Figure 98. Deciduous trees (a linden tree (left) and a pomegranate tree (right)) in the case 4	85
Figure 99. Green elements in the courtyards	85
Figure 100. Percentage of the covering of the ground of courtyards and <i>taşlıks</i>	87
Figure 101. Amount of the area exposed to direct sunlight in the current state	89
Figure 102. Amount of the area exposed to direct sunlight in the authentic state	89

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 1. The topics researched in relation with courtyards	1
Table 2. Ratio of length to width	77
Table 3. The ratio of the height of the courtyard walls at north to the depths	78
Table 4. The ratio of the depths to the height of the courtyard walls at south	79



CHAPTER 1

INTRODUCTION

Many of the houses in Anatolia have courtyards, which are private outdoor spaces used for daily and seasonal activities of the family members and visitors. These courtyards are three-dimensional voids around which all of the building elements are organized. These elements are the high courtyard walls, the main building with *hayat* and *taşlık*, the annexes and green elements (Eldem 1984).

Courtyards of buildings at different parts of the World have been studied with their various aspects. Courtyard's thermal comfort is influenced by factors such as orientation, ratio of courtyard wall height to courtyard width (H/W), ratio of width and length (W/L), materials, and greenery elements.

The orientation of North- South and Northeast- Southwest are recommended and RayMan is used in a research carried out in Cuba (Rodriguez-Algeciras et. al. 2018), Northeast- Southwest in Malaysia and Egypt, and North-South in Italy and Sweden are recommended and CourtSun is used as a tool (Muhaisen and Gadi 2006), East-West is not recommended in Israel and ENVI-met is used as a tool (Berkovic et. al. 2012), the Northeast-Southwest direction with slight rotation from the North is recommended in Iran and Design Builder is used as a tool (Soflaei et. al. 2017), North-South orientation is thermally more comfortable in Mardin (Sözen and Oral 2019) and it is more advantageous than East-West since prevailing wind is North wind in Greece (Andreou 2014).

The ratio of height to width (H/W) of 4/5 and 5/5 for warm regions, 3/5 and 4/5 for cool regions are recommended in Italy (Martinelli and Matzarakis 2016). Narrow and deep courtyards are better suited to hot climates (Akbari et. al. 2021) (Guedouh et. al. 2019). Aspect ratio of 1.2 is acceptable for thermal comfort compared to ratio of 0.7 in Egypt (Abdallah 2019). Designing courtyards with aspect ratio values ranging between 1 and 3 is recommended, providing a certain level of wind permeability through the surrounding walls for an efficient ventilation (Rodriguez-Algeciras et. al. 2018).

Courtyard shading is mostly affected by the ratio of courtyard width to courtyard wall height, while courtyard orientation is the least effective factor (Al-Hafith et. al. 2017).

The ratio of width to length (W/L) of lower than 1 is not recommended and square courtyards have less sun exposure than rectangular ones and offer better possibilities for solar control in Cuba (Rodriguez-Algeciras et. al. 2018). Rectangle courtyard is not recommended in Israel (Berkovic et. al. 2012). The ratio of 1 is the best choice since this ratio allows minimum radiation during summer and maximum radiation during winter (Yaşa and Ok 2014). For short courtyards, an isolated standing vortex is formed while for more elongated courtyards the flow submerges at one end and surfaces at the other end (Moonen et. al. 2011).

Increasing the height of the walls is insufficient for improving thermal conditions, application of shading devices or greeneries are recommended (Rodriguez-Algeciras et. al. 2018). Greenery elements are able to block high solar radiation and produce the cooling effect from the evapotranspiration process (Seyam 2019). Arranging trees to maximize canopy shading and minimum wind disturbance (clustered planting, rectangular planting or double tree-row) in the windward corridor is an effective way to lower urban heat and improve thermal environment (Fu et. al. 2022).

Surfaces reflecting, receiving, storing and transmitting longwave radiation include wall surfaces, ground, grass, bodies of water and tree canopies (Zhu et. al. 2023). As materials, grass and soil paved courtyards have lower temperatures than concrete paved ones (Sözen and Oral 2019). Elements forming shadows include walls and trees affected by geometry and orientation. Percentage of shaded and sunlit area equal or the situation of shaded area less than sunlit area is recommended in the courtyards (Muhaisen and Gadi 2005) (Table 1).

Table 1. The topics researched in relation with courtyards

(Source: Prepared by author 2024)

Research Topic	Climate	Location	Results	References
Orientation	Hot-humid Hot-dry Temperate Cold	Kuala Lumpur, Egypt Italy Sweden	NE-SW NE-SW and N-S N-S N-S are recommended	(Muhaisen and Gadi 2006)
	Warm Humid	Cuba	N-S and NE-SW are recommended	(Rodriguez-Algeciras et.al. 2018)
	Hot-Dry	Israel	E-W is not recommended	(Berkovic et. al. 2012)
	Hot- Dry	Iran	The Northeast- Southwest direction with slight rotation from the North is recommended.	(Soflaei et. al. 2017)
	Mediterranean	Greece	North- South orientation is more advantageous than East-West since prevailing wind is North Wind	(Andreou 2014)
	Hot-Dry	Turkey	N-S orientation thermally more comfortable	(Sözen and Oral 2019)
Orientation and Ratio (H/W)	Hot-Dry	Iraq	Courtyard shading is mostly affected by the ratio of courtyard width to height, while courtyard orientation is the least effective factor.	(Al-Hafith et. al. 2017)
Ratio (H/W)	Hot- Dry	Egypt	Courtyards with a H/W ratio of 1.2 achieved acceptable thermal comfort better than H/W ratio of 0.7 during the hot period.	(Abdallah 2019)
	Mediterranean	Italy	H/W 4:5 to 5:5 for warmer regions, 3:5 to 4:5 for cooler regions are recommended.	(Martinelli and Matzarakis 2016)
	Hot- dry	Iran	Narrow, deep courtyards are better suited to hot climates	(Akbari et. al. 2021)
	Hot-Dry	Algeria	Deep courtyard seems the ideal model for thermal comfort in summer	(Guedouh et. al. 2019)
	Warm-Humid	Cuba	Designing courtyards with aspect ratio values ranging between 1 and 3 is recommended, providing a certain level of wind permeability through the surrounding walls for an efficient ventilation	(Rodriguez-Algeciras et. al. 2018)
Ratio (W/L))	Warm-Humid	Cuba	Lower than 1 are not recommended and square courtyards have less sun exposure than rectangular ones and offer better possibilities for solar control.	(Rodriguez-Algeciras et. al. 2018)
	Hot-Dry	Turkey	1:2 ratio provided thermally more comfortable	(Sözen and Oral 2019)
	Hot-Dry	Israel	Rectangle courtyard is not recommended	(Berkovic et. al. 2012)
	Hot-dry Hot-Humid Cold	Turkey	Ratio of 1 (square) is the best choice for the three climate regions in terms of heat gain	(Yasa and Ok 2014)
		Simulation	For short courtyards, an isolated standing vortex is formed, while for more elongated courtyards the flow submerges at one end and surfaces at the other end	(Moonen et. al. 2011)
Courtyard Wall Height	Hot-humid Hot-dry Temperate Cold	Kuala Lumpur, Egypt Italy Sweden	H: three storey H: two storey H: two storey H: one storey are recommended	(Muhaisen 2006)
	Warm-Humid	Cuba	Increasing the height of the walls is insufficient for improving thermal conditions, application of shading devices or greeneries are recommended.	(Rodriguez-Algeciras et. al. 2018)
Material	Hot-Dry	Turkey	Grass and soil paved courtyards have lower temperatures than concrete paved ones.	(Sözen and Oral 2019)
Function		Bangladesh	The court might play many roles: transitory space, religious space, social space, climate modifier, domain divider etc.	(Rahman and Haque 2001)
Greeneery Elements		Simulation	Greeneery elements are able to block high solar radiation and produce the cooling effect from the evapotranspiration process.	(Seyam 2019)
		Simulation	Arranging trees to maximize canopy shading and minimum wind disturbance (clustered planting, rectangular planting or double tree-row) in the windward corridor is an effective way to lower urban heat and improve thermal environment.	(Fu 2021)

1.1. Problem Definition

There exists a substantial body of research both within the country and at global scale on the architectural characteristics of traditional houses; for example, Rapoport (1969), Eldem (1984), Reynolds (2001) etc. A significant number of these studies emphasize the harmony of traditional houses with the climatic conditions of their respective regions. However, courtyards, which are a critical component of these structures, have been addressed in a much more limited number of studies.

Previous studies related to the characteristics of courtyards have been reviewed. These studies have examined various parameters such as orientation, aspect ratio, wall height, material, function, and greenery elements. As indicated in the table above, thirteen out of the sixteen studies reviewed focused on the courtyards of traditional houses. Among these studies, four cases pertain to settlements in the Mediterranean basin, three to the Middle East region, one to settlements in both the Mediterranean and Middle East regions, one to East Asian settlements, three to African settlements, and one to a settlement in South America.

The number of studies addressing courtyard orientation is seven, while those focusing on ratios within courtyards amount to nine. There is only one study on the functions of courtyards, and three studies examine elements within courtyards, of which two focus on greenery elements and one on the materials used in courtyards. Several software programs (CourtSun, RayMan, ENVI-met, Design Builder etc.) are used to search on orientation without considering the impact of sun altitude and azimuth, in rare studies the impact of sun altitude and azimuth are considered (Al-Hafith et. al. 2017).

Studies that examine multiple parameters simultaneously are fewer in number. For example, orientation and ratio parameters have been examined concurrently in four studies. There is only one study that combines ratio and material parameters. Such studies that cover multiple parameters tend to be interdisciplinary, often involving contributions from both architecture and planning as well as mechanical engineering.

No study has been encountered that evaluates all of these parameters collectively to comprehensively reveal the characteristics of traditional courtyards. This study

considers the impact of sun altitude and azimuth together with all of the above mentioned parameters.

1.2. Aim and Objectives

Birgi is one of the historic settlements in Ödemiş, which has preserved its authentic architectural and urban characteristic and integrity, and is known for its historical and cultural significance. The courtyards of the traditional houses also contribute to the character of Birgi. They have outstanding aesthetic, functional, climatic and constructional qualities.

The aim is to identify the parameters that define the qualities of courtyards of the traditional houses, and present a way to characterize these courtyards with a holistic approach. The study is limited with the tools of the discipline of architectural conservation. It is also limited with four courtyards of the traditional houses in Kurtgazi district of Birgi, Turkey.

The objectives of the research are:

To identify the parameters that define the qualities of traditional courtyards, e.g; usage, spatial organization, elements, construction technique and material, exposition to sunlight and natural ventilation

To analyze the qualities of courtyards of traditional houses in Kurtgazi district in Birgi today and in the authentic situation,

To map the corresponding spatial organization, elements and material on plans and sections for today and for the authentic situation,

To analyze the exposition of courtyards to sunlight and natural ventilation in different time intervals and seasons for today and for the authentic situation,

To evaluate the authentic characteristics considered in the traditional courtyards of Birgi houses in Kurtgazi district.

1.3. Limit of the Study

In Birgi, local people go to their gardens and work in their gardens in the summer and stay there for a few months. Since most of the local people went to their gardens during the site survey, not every courtyard desired to be reached could be reached. Four case studies were selected from the Kurtgazi district, where measurements could be made in the courtyard, where there were homeowners from whom information could be learned about the authentic situation. The study was carried out within the framework of architectural conservation discipline; no interdisciplinary perspective is included.

1.4. Research Questions

This study attempts to answer the following questions:

1. What are characteristics of the courtyards and related spaces of Birgi houses?
2. Which qualities make these courtyards sustainable?
3. What are the contemporary interventions in the courtyards of Birgi houses in Kurtgazi district?
4. How do the interventions affect the authentic spatial quality of courtyards in terms of sustainability?
5. What has changed in terms of courtyard qualities after the interventions made in the selected Birgi houses in Kurtgazi district?

1.5. Methodology

A preliminary literature review was made on sustainability and traditional courtyards in the World and Türkiye. The traditional settlements of Birgi was selected. The site is on the temporary list of UNESCO World Heritage (UNESCO 2024). It has preserved its authenticity and integrity to a great extent at a settlement scale. Then, case

studies were defined to identify the characteristics of the traditional courtyards. In the selection of these houses, continuation of usage, preservation of authenticity to some extent, but the presence of some interventions in the courtyards, and accessibility were considered. The four selected courtyards were talked to the homeowners about daily and seasonal activities, the changed and preserved parts of the courtyards, natural ventilation and illumination through the location, layout and limiting elements of the courtyard. Natural ventilation was researched for all days of the year and illumination was researched on 21 June, the longest day of the year, and 21 December, the shortest day of the year. SunCalc was used to get information about azimuth and altitude. The current and the authentic characteristics were compared among themselves and with each other.

Studied cases were numbered as in the following: Their blocks and lots are 338/7 (case 1), 326/5 (case 2), 326/8 (case 3), and 350/4 (case 4). Case 1 and case 4 are among the second group structures that need to be preserved. They were listed on 07.07.1988 (RT, 1988). Case 2 was listed on 12.01.1974 (RT, 1974) and it was unlisted on 07.07.1988 (RT, 1988). Case 3 was not listed.

Then, the geographical, climatic and historic characteristic of Birgi, and morphologic qualities of its houses and courtyards were reviewed in the previous studies.

Physical survey sheets specific to understand the characteristics of courtyards of traditional houses of Birgi and their compatibility in terms of sustainability were developed based on the parameters revealed in the literature review presented in the above. They were filled in for each of the studied cases during the site survey in August and September in 2022. These physical survey sheets include the following:

Form (square, rectangle and L plans), orientation (long edge and short edge), and alteration (mass, room, storey and roof additions; loss, of courtyards, gardens, *hayats*), dimensions (length, width and height), and materials (stone, solid-brick, mud-brick, stone-solid brick, stone-mudbrick, tile, hollow brick, aerated concrete, plastered, white-washed, earth, and timber), for each architectural element such as: wall, ground covering, roof covering, projections, posts, balustrades, eaves, doors, windows, and sub elements such as fountains, wells, fireplaces, stepping stones, foot paths, drainage channels, benches, tables, hoses and flowerpots, type, scent, height and shadow orientation of green elements (evergreen elements which are foliage rich and foliage poor trees, and deciduous trees) were documented (Figure 1).

 IZTECH MS Thesis in Architectural Restoration Inventory Sheet of Open Spaces in Birgi Traditional Houses Prepared by: Sena Keleş Supervisor : Prof. Dr. Mine Turan Surveyor: Sena Keleş Survey Date: Address: Building lot: Sheet No:																			
Characteristic				Open Spaces			Courtyard			Taşlık			Hayat						
Form	Square plan																		
	Rectangle plan																		
	L plan																		
Orientation	Long edge																		
	Short edge																		
	Openings	Door																	
		Top window																	
		Bottom window																	
Alteration	Mass addition or loss																		
	Room addition or loss																		
	Storey addition or loss																		
	Roof addition or loss																		
Architectural elements	Wall	Retaining																	
		Courtyard																	
		Main building																	
		Annex																	
	Covering	Ground	Cortyard																
			Garden																
			Sofa																
			Street																
	Roof	Cortyard																	
		Garden																	
		M.Build.																	
		Annex																	
	Projection																		
	Posts																		
	Balustrades																		
	Eaves																		
	Door																		
	Window																		
	Sub elements	Fountain																	
		Well																	
Fire place																			
Stepping stone																			
Foot Paths																			
Drenaj Channel																			
Bench																			
Table																			
Hose																			
Flowerpot																			
Green elements	Plants	Shadow	Evergreen tree	Type			Scent			Height			Season			Shadow orientation			
				Foliage-rich trees									summer						
				Foliage-poor trees									winter						
													summer						
			Deciduous tree												winter				
	Negligible Shadow	Deciduous tree												summer					
		Vegetable												winter					
		Flower												summer					

Figure 1. Inventory sheet of open spaces in Birgi Traditional Houses

(Source: Prepared by Author 2022)

In the next step, social survey sheets were filled in by interviewing with the occupants of each of the studied cases and also other local people living in the

neighborhoods and who could be interviewed during the site survey in August and September in 2022. The survey forms included identification information on name, age, gender and job of the person surveyed, address of the houses, and ownership pattern. In its second part, it questioned the authentic state of the courtyard, daily and seasonal activities, usage of the units in the courtyards, greenery and water elements in the courtyards, additions or other interventions in the courtyards and related spaces. The questions asked to the homeowners are as in the following.

1. Describe the relation between your housing unit and the street.
2. Describe your courtyard, *taşlık*, *hayat* and annexes.
3. How long have you been living in this house?
4. How many times is the courtyard used in a day and when?
5. Which activities take place in the courtyard in summers and winters, and why?
6. Which vegetables, fruits or trees grow in the open spaces of your house, and why?
7. How many times are plants watered in summers, and how?
8. Which interventions were made, and why?

Next, sketching and visual analyses of the courtyards were made at the site on 23.08.2022-24.08.2022 and 12.09.2022. This included the mapping of functional distribution, authentic elements such as the eaves, annexes, greenery, semi-open spaces etc. their traces and remains, and alterations. The width and length of the courtyards, and the height of the courtyard walls were measured with conventional techniques. This phase was supported with photographic documentation.

After the site survey, studied case plans and sections were drawn. The current plans were drawn according to maps from Google Earth, sketches, measurements and photos, the authentic plans were drawn according to traces and remains, interviews with homeowners, comparative information coming from other surveyed Birgi houses (Cami Kebir district: 290/3, 248/20, 303/24, Cumhuriyet district: 272/1, 261/3, Kurtgazi district: 358/3), plan drawings of Birgi houses in the thesis of Filiz Diri and the sketch archive of

Prof. Dr. Mine Turan, and aerial photos from the archive of the Ministry of National Defense General Directorate of Mapping. The areas of the courtyards and related spaces were noted for their current and authentic states. The usages of the spaces for their daily or weekly activities were classified as resting, eating, doing hobbies, laundry washing and drying, dishwashing and drying. For seasonal activities, it was classified as food drying and storage, and wood cutting and storage. The schemes of natural ventilation and natural illumination were mapped on the plans and sections based on observations and also controlled ventilation was mapped based on position of gates and elevated roofs (Figure 2) (Figure 3).

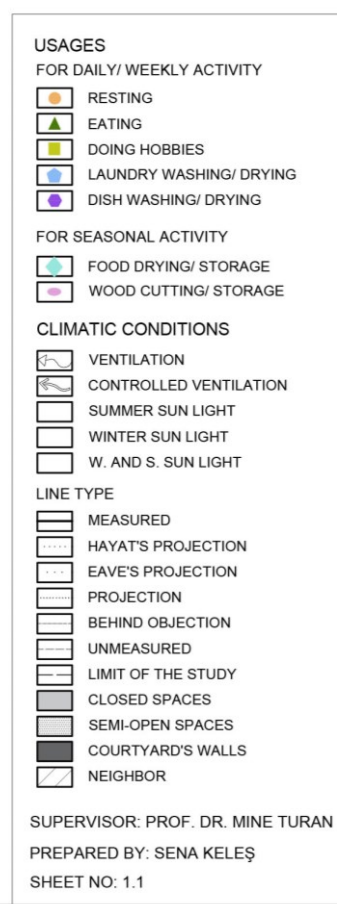


Figure 2. Legend of the drawings (Source: Prepared by Author 2024)



Figure 3. Measured drawings in the current and authentic states in case 1
(Source: Prepared by Author 2024)

All of the information about courtyards such as form, architectural characteristics, usage, and climatic conditions are evaluated between their current and authentic states. The area of the courtyards and related spaces are measured in their current and authentic states.

Length is the long edge of the courtyard and width is the short edge of the courtyard. The ratios of lengths to widths are calculated by dividing the length of each courtyard by its width. In the calculations, the boundaries of the transition from open space to semi-open spaces were determined as the courtyard boundary: the beginning of *taşlık* and entrance eaves etc. (Figure 4).

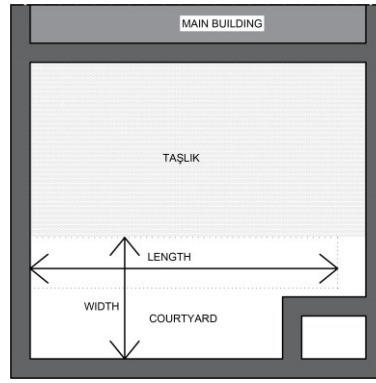


Figure 4. The width and length (Source: Prepared by Author 2024)

Depth is the perpendicular distance from the southern courtyard wall to the northern boundary of the courtyard. Height corresponds to the height of the southern courtyard wall for the analysis of the natural illumination and the height of the northern courtyard wall for the analysis of the natural ventilation. The ratio of height to depth is calculated by dividing the height of the courtyard wall to the depth of the courtyard. In the calculations, the boundaries of the transition from open space to semi-open spaces were determined as the courtyard boundary: the beginning of *taşlık* and entrance eaves etc.(Figure 5).

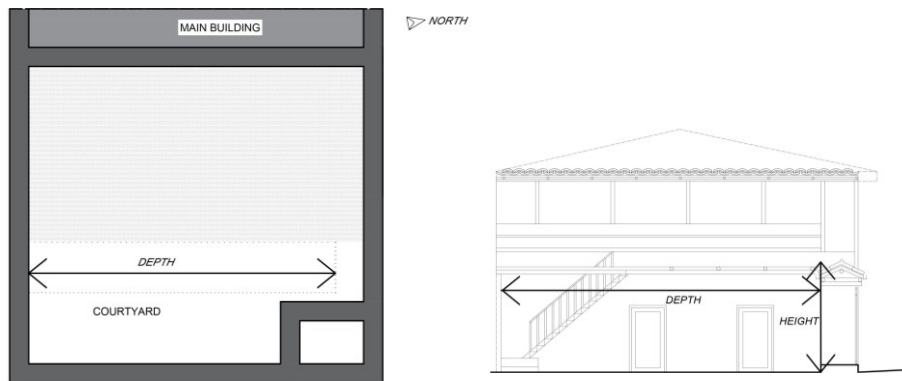


Figure 5. The depth and height (Source: Prepared by Author 2024)

The architectural elements are related to the periodic activities which have been realized as a part of the traditional life pattern. The presence of the following elements is questioned: timber stairs, a stepping stone (which is a step out of slate stone at the

beginning of the timber stairs), a ceramic water pot, *abdestlik*, a fireplace, a drainage channels, a flower pot, a fountain, a pool, a bench, a table, and a hose.

Greenery elements were analyzed in five groups according to their shades and their reasons for plantation. These are evergreen trees (foliage-rich trees, foliage-poor trees), deciduous trees, vegetables and fruits, and flowers.

Since most of the building cases are located at the west of their lots, the afternoon sun does not reach the courtyards. The orientation of the case studies is suitable for the morning sun and noon sun. The illumination area exposed by the summer sun in the mornings, the summer sun, and the winter sun in the noon could be measured in all study cases. The longest day (21st June) and the shortest day (21st December) of the year were considered at 08.30 for the mornings and at 12.30 for the noons (Figure 6) (Figure 7).

The amount of natural illumination was calculated with respect to the orientation of the studied courtyards and azimuth and altitude values. The portion exposed to direct sunlight in the mornings (08.30 AM) and the noons (12.30 PM) during winters and summers for each courtyard was calculated with respect to altitude and the length of the shadow. In winters, sunlight reaches at a more horizontal angle than in summers so the value of the altitude is less in winters than in summers. The azimuth and the altitude values and shadow lengths were taken from Sun Calculator (2022). (Figure 8).

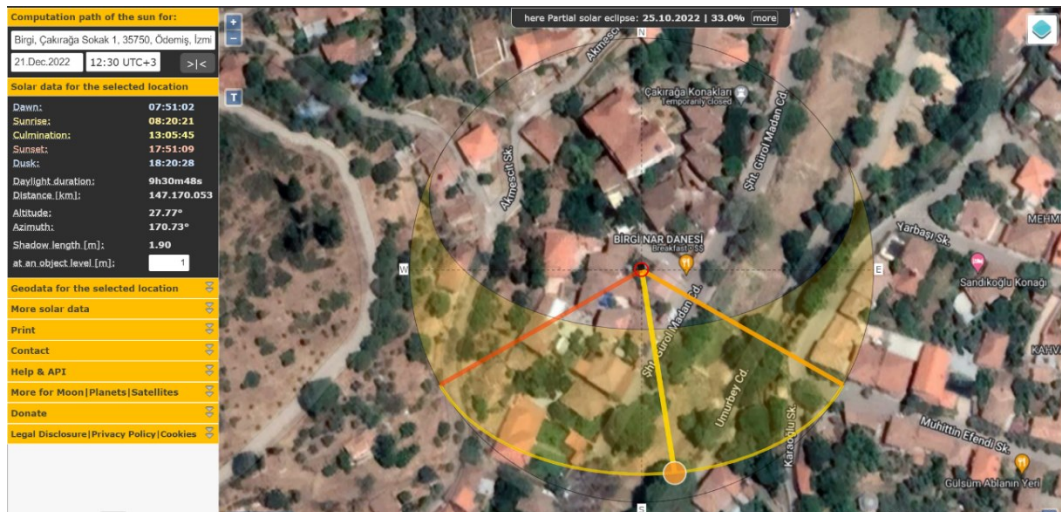


Figure 6. Solar data for the case 1 on 21st December at 12.30

Source: Revised from (Suncalc 2022)

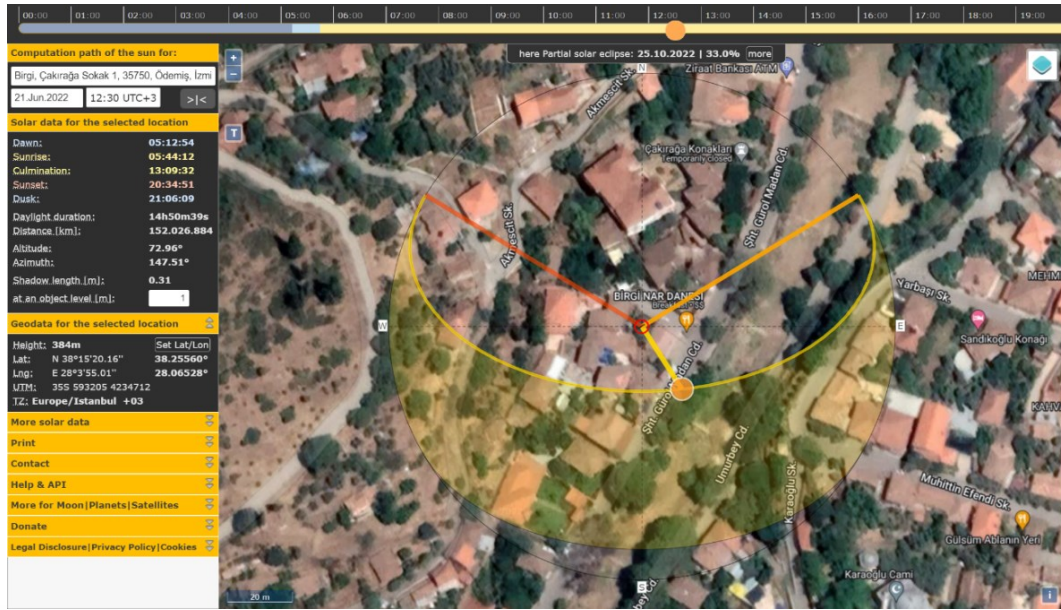


Figure 7. Solar data for the case 1 on 21st June at 12.30

Source: Revised from (Suncalc 2022)



(a)

(b)

(c)

Figure 8. Summer sun (a) at 08.30, (b) at 12.30 and (c) at 17.30 in case 1

Source: Revised from (Suncalc 2022)

The shadow's length depends on the height of the object, which is at the sun's direction, and azimuth and altitude values. The shortest shadow's length is in summers at noon: if the object is 1 meter high, the shadow's length is 0.31 meters. The longest shadow's length is in winters in morning: if the object is 1 meter, the shadow's length is 50.88 meters. The shadow's length was measured by using shadow's length information from the Sun Calculator (Figure 9).

TIME	SEASON	SHADOW LENGHT (object level is 1 meter)
08.30	SUMMER	1.00 m 1.76 m
	WINTER	1.00 m 50.88 m
12.30	SUMMER	1.00 m 0.31 m
	WINTER	1.00 m 1.90 m
17.30	SUMMER	1.00 m 1.52 m
	WINTER	1.00 m 19.76 m

Figure 9. Shadow's lengths in Birgi (Source: Prepared by Author 2024)

The illuminated area on the ground of courtyards and *taşlıks* was measured according to information on the orientation of the sun and the shadow's length on the objects (courtyard walls, roofs, eaves, etc.). The area of the shadow was measured according to objects in sunlight and their height, and the illuminated area was measured by using sections and plans (Figure 10) (Figure 11). The illuminated area is calculated and divided by the total area for each courtyard for the current and authentic states of the cases (Figure 12).

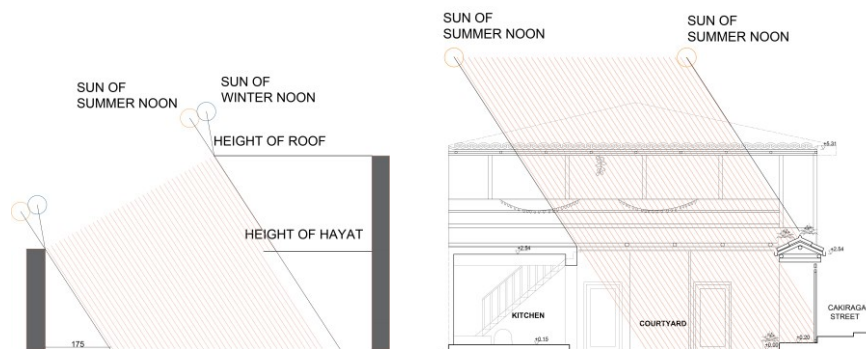


Figure 10. Shadow's length in sections in case 1 (Source: Prepared by Author 2024)

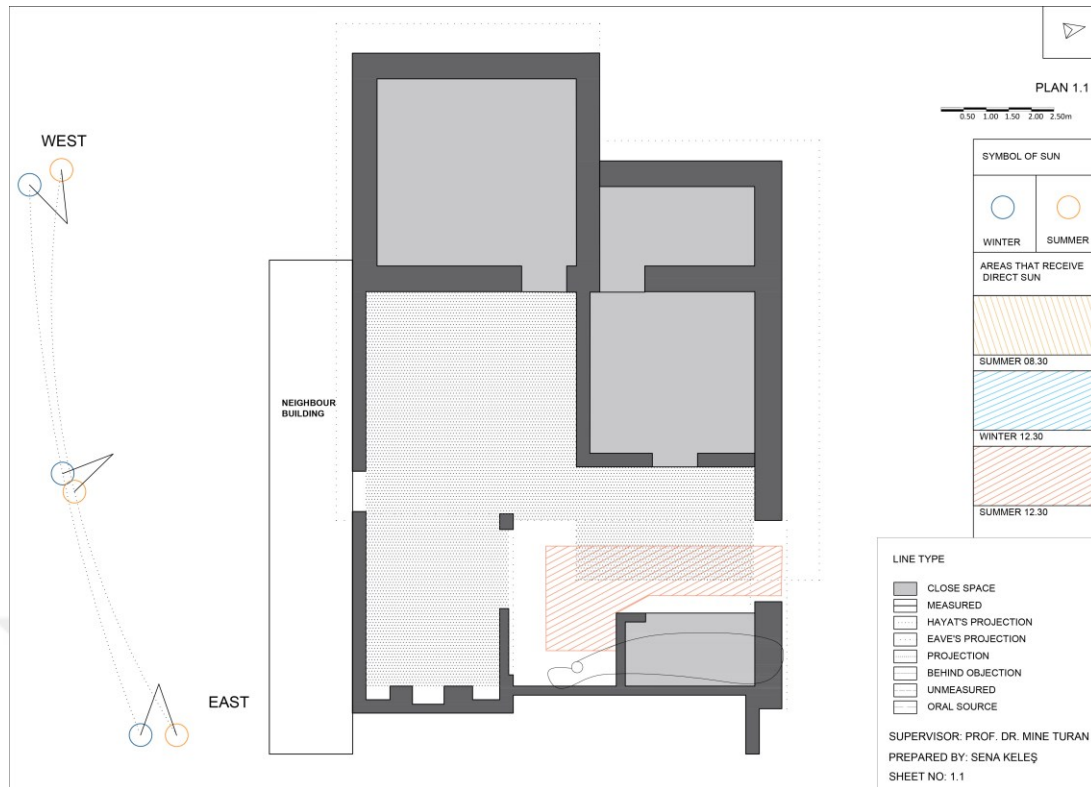


Figure 11. Exposition of the courtyard to sun light in plan of case 1
(Source: Prepared by Author 2024)

CURRENT STATE		AUTHENTIC STATE	
TOTAL AREA : 58.5 M ²		TOTAL AREA : 81 M ²	
			
SUMMER SUN - MORNING (08.30)	0 M ²	SUMMER SUN - MORNING (08.30)	29 M ²
WINTER SUN - NOON (12.30)	0 M ²	WINTER SUN - NOON (12.30)	9 M ²
SUMMER SUN - NOON (12.30)	7.5 M ²	SUMMER SUN - NOON (12.30)	17 M ²
DIFFERENCES AMOUNT OF SUN BETWEEN 1.1 AND 1.2			
SUMMER SUN - MORNING (08.30)	29 M ²	- 0 M ²	= 29 M ²
WINTER SUN - NOON (12.30)	9 M ²	- 0 M ²	= 9 M ²
SUMMER SUN - NOON (12.30)	17 M ²	- 7.5 M ²	= 9.5 M ²

Figure 12. The areas exposed to sunlight, case 1 (Source: Prepared by Author 2024)

Studied cases were compared for the current and authentic states under the headings of activities, alterations, dimensions, materials, architectural elements, greenery and water elements, natural ventilation, and illumination.

1.6. Thesis Structure

The thesis is composed of five chapters: introduction, theoretic, geographic, historic and morphologic aspects, characterization, results and discussion, and conclusions.

Chapter 1 defines the problem related to traditional courtyards and clarifies the research questions, the aim and objectives of the study, the methodological approach and the content of the thesis.

Chapter 2 lays out the background information necessary for developing the thesis: Theoretical aspects of the traditional courtyards with examples from the world and Turkey, geographical, historical, and morphological aspects of Birgi, characteristics of Birgi houses are presented.

Chapter 3 characterizes the studied cases. The current and authentic states of the courtyards are identified according to site surveys, literature reviews, oral sources, and comparative studies. The characteristics of the courtyards are mapped on the drafted plans, and sections, and photographs. Alterations are pointed out

Chapter 4 compares the authentic and current states of the courtyards. The qualities that are relevant in terms of sustainability with an emphasis on location, form, area, the ratio of length to width, the ratio of the height of courtyard wall at the north to depth, the ratio of depth to the height of courtyard wall at south, activities, and spaces, architectural elements, greenery elements, construction technique and materials usage, illumination, and ventilation are discussed. Bar graphs and pie charts support the discussions.

Chapter 5 evaluates all the information about the studied cases. The characteristics of the traditional courtyards are presented. Conservation problems and possible solutions are pointed out.

CHAPTER 2

THEORETICAL BACKGROUND

In this chapter, the characteristics of traditional open spaces that contribute to their sustainability are introduced with examples from the world and Türkiye. Then, the geographical and historical characteristics of Birgi, and the morphological characteristics of Birgi houses are presented.

2.1. Characteristics of Traditional Open Spaces

Sustainability is a way of making an ecologic design that is respectful and compatible with nature in architecture. Traditional rural settlements have their authentic design characteristics, which make them sustainable; e.g. indigenous material usage and construction techniques, and design characteristics that adapt them to local topography and climatic conditions (Tönük 2001).

The courtyard (*avlu*), is known as *sahn* in early Islamic and Egyptian Mamluk architecture and *harim* in Ottoman architecture (Cantay 2024). It is an open area which is surrounded by buildings or parts of the buildings (Türk Dil Kurumu 2024). It is an open space that relates close spaces with each other. It is a gathering area with cultural significance. It is seen in many cultures around the world and in Türkiye (Erdoğan 1996).

In Spain, the courtyards are located in the traditional settlements with an organic street layout. There are water elements such as fountains and wells, flowerpots, and fruit trees in these courtyards. Water has roles such as providing coolness, freshness and naturalness. The courtyard is used as a resting area. Its ground is covered with white marble, and it reflects daylight. The courtyard walls are plastered and painted (Reynolds 2001) (Figure 13).



Figure 13. A courtyard of a house in Spain (Reynolds 2001)

In Saudi Arabia, Iraq, and Syria; the courtyards are located in the traditional settlements consisting of narrow and organic street layouts. The houses are built with brick material, and their roofs are flat. They have two inner courtyards. There are decorations, water elements, and plants in the courtyard where the house is circulated (Erdoğan 1996).

In Mexico, houses with courtyards are adjacent buildings. They are made of wooden materials and their windows and balconies are made of iron. The facades of houses are painted with light color. They are plants in the courtyard. The courtyard floor is covered with bricks and stones. Water elements such as pools and fountains are located in the courtyard. Service units such as kitchens are located in the courtyard, and large houses have two different courtyards (Erdoğan 1996) (Schoenauer and Seeman 1962).

In the Anatolian traditional houses, built before the Ottoman modernization are introverted and organized around their courtyards traditional houses are positioned on sloping lands by terracing. The main materials of the houses are stone and wood found in the region. Traditional houses were built with a sustainable design approach, with the ability to be dismantled and rebuilt (Sümerkan 1990). It is designed to be open to nature and water elements were used in the courtyards. The traditional courtyards are entered through a wooden gate finished with tiles. The courtyard walls are made of rubble and stone, and the courtyard floor is covered with indigenous material which is slate. There are plants in the courtyard. Units such as the kitchen, storage barn and laundry are located

around the courtyard. Activities such as sitting, resting, drying food, drying laundry and cooking take place here throughout the year (Kuban 1995) (Figure 14).



Figure 14. A courtyard in Bursa (Erdoğan, 1996)

In Turkish traditional rural settlements, streets follow to slope of the topography, and they have organic textures. The courtyards were isolated from the street by their high walls. *Taşlıks* and *hayats* are the semi-open spaces neighboring the courtyards at the ground and upper levels (Eldem 1984).

Courtyards may be analyzed in terms of altitude, form, positioning, relations with spaces, architectural elements, greenery and water, material, and climatic conditions.

2.1.1. Altitude

Positioning the house with minimum intervention to the landform is one of the sustainability criteria. Therefore, buildings should be positioned in harmony with the slope of the land (Tönük 2001). Local climatic conditions such as mountain valley winds, cold air currents, and solar radiation may vary in relation to altitude. High places receive more solar radiation during the day than low places, and after sunset, they release the heat energy they gain to the atmosphere through reverse radiation. This radiation exchange occurs at different temperatures between the land surface and the atmosphere (Zeren

1978). The extent of the sun's impact on the land surface depends on the altitude (Figure 15) (Gregersen 2024).

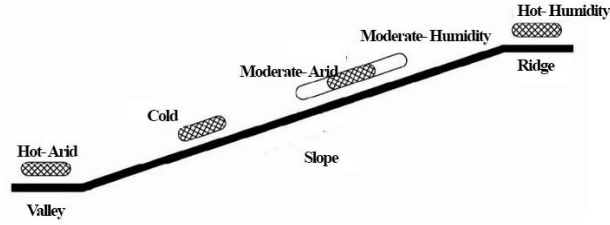


Figure 15. Climate altitude relations Source: Revised from (Zeren 1978)

In the rural settlements, the housing zones are always located in high places, because the cold air mass in winters and the hot air mass in summers are accumulated in hollow and flat areas (Müftüoğlu 2011). Such a settlement provides natural air conditioning and saves the possible energy that is to be used for air conditioning (Yılmaz 2005).

2.1.2. Form

The forms of spaces are shaped in accordance with environmental characteristics such as; climate, topography, and materials found in the region, cultural characteristics such as; social relations, lifestyle, and economic characteristics (Gür 2000).

The form has a significant effect on the shading of the courtyards. Generally deep courtyard forms achieve maximum shaded area (Muhaisen and Gadi 2006).

Cooling and heating loads for courtyards surrounded by walls or building masses have been calculated in the previous studies:

In the inner courtyard example, the ratio of the width of the courtyard to the length of the courtyard for 100 m² ground area; if the ratio (W/L) is 2; it provides the minimum heating and total loads, if the ratio (W/L) is 0.2, it provides minimum cooling loads and minimum sunlight gain. The ratio for 200 m² ground area; if the ratio (W/L) is 0.2; it provides the maximum heating and maximum total loads, if the ratio (W/L) is 1.2; it

provides the minimum cooling and minimum sunlight gain (Manioğlu and Oral 2015) (Figure 16).

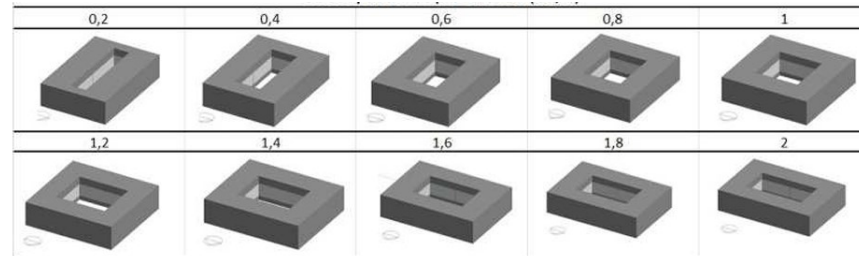


Figure 16. Ratio of width/length in courtyards (Manioğlu & Oral, 2015)

Among the courtyards, possessing the same heights and same floor areas; heating and cooling loads increase as the ratio of the total surface area (A) that loses heat to the total volume (V) that is sheltered within the building increases. When with L-planned, U-planned, inner and center-planned courtyards are considered; the L-planned courtyards provide the highest heating and cooling loads. The inner ones provide the lowest heating and cooling loads (Kocagil and Oral 2015) (Figure 17).

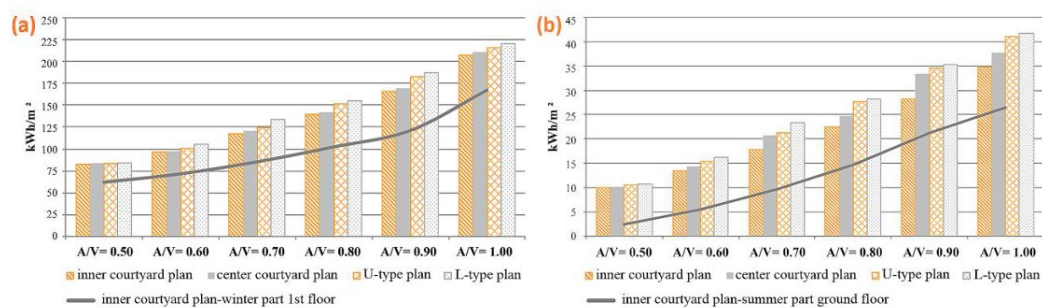


Figure 17. Cooling and heating loads in courtyards which have different forms for (a) winter and for (b) summer (Kocagil and Oral 2015)

2.1.3. Positioning

In many of the *hayat* houses, the main building is positioned generally at the west of the lot. The upper floor is the elevated living place, and the rooms are open to the semi-open *hayat* with a view of the scenery. There is a kitchen and storage on the ground floor, and they are actively used in the winters, they have been located at the south of the building lots as much as possible (Figure 18). Similarly, they are actively used in the summers. The courtyard in between them is entered through a gate from the street (Onat 1990). Minimum heat gain is desired on hot days. In order to minimize energy losses, spaces that need to be hot during winter are located at the south (Nikolic 1983).

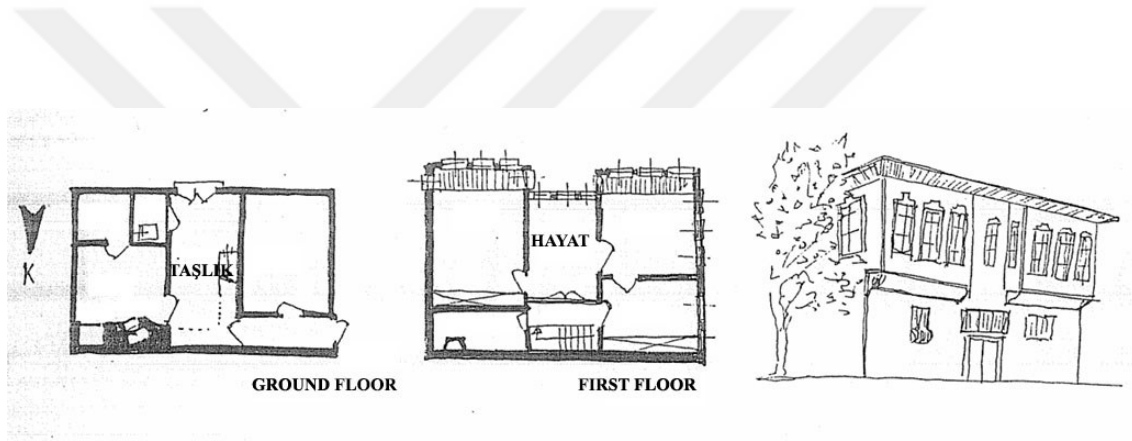


Figure 18. A house with *taşlık* Source: Revised from (Onat 1990)

2.1.4. Relations with Spaces

Almost all of the traditional houses have open or semi-open spaces in the rural settlements (Oliver 2003). The design of these spaces and the closed ones around them has been shaped by geographical and cultural factors (Birol et. al. 2019).

In Morocco, the courtyard was surrounded by closed spaces on all four sides and used as a kitchen, toilet and storage. Circulation between spaces and illumination of the rooms, kitchen, toilet and storage are provided from the courtyard. An inner courtyard design was preferred to protect it from sun and sandstorms. This also provides privacy for domestic life (Figure 19) (Schoenauer and Seeman 1962).

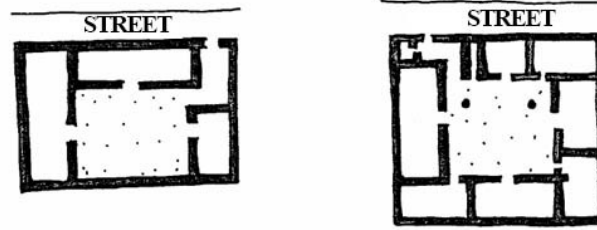


Figure 19. Plan of Morocco traditional houses

Source: Revised from (Schoenauer and Seeman 1962)

In Anatolia, the building is between two neighboring houses. The courtyard is at the back. The *taşlık* is reached from the street, through the courtyard and then to the *hayat* by timber stairs in the *taşlık*. There are storages on the ground floor, rooms are on the first floor, service elements such as kitchen, and toilet are on the mezzanine floor (Onat 1990) (Figure 20).

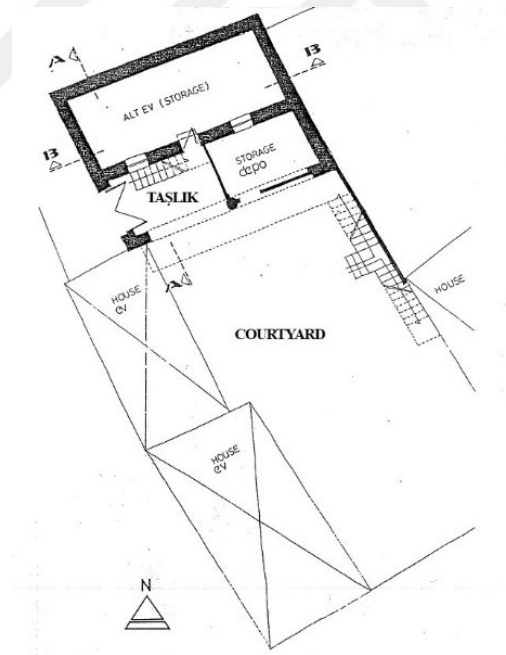


Figure 20. Lot organization in Tarsus

Source: Revised from (Onat 1990)

2.1.5. Material

Due to the geographic, climatic, and cultural differences, even if the same material is used, it is used in different ways. The construction techniques make the designs authentic. In Arabia, stone and mud, which demand heavy walls structurally, are used. In Africa, palm logs and mud are used in huts. The structure of the hut is a wooden skeleton frame that carries a roof of wing, on top of which is a roof of beaten mud for the purpose of climatic control. (Figure 21) (Rapoport 1969).

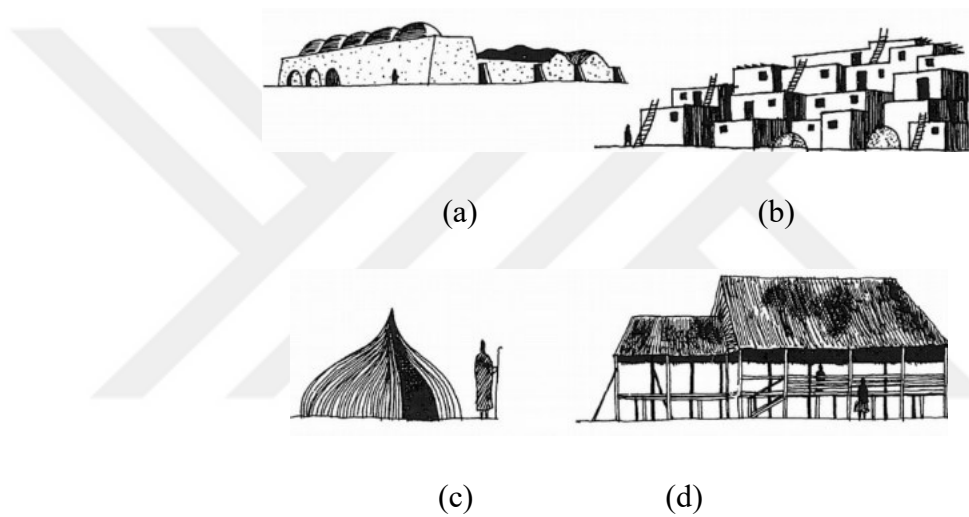


Figure 21: Houses made of mud: (a) Iran and (b) United States , and wood: (c) Africa and (d) Amazon (Source: Revised from (Rapoport 1969))

Selecting the natural and regional materials and selecting materials from the surroundings of the land for reducing transportation energy and eliminating pollutants are characteristics seen in the traditional constructions (Yalçinkaya 1995).

In the traditional courtyards of Iran, walls are made with mud and mud brick to warm the interiors passively and painted with light colors to reflect solar radiation in the exteriors. Natural elements are used as a passive cooling method in traditional courtyards (Soflaei et. al. 2017).

In the traditional courtyards of Syria, walls are made with rubble stone and brick masonry or plastered stone. Stories of the houses painted with different colors (Kuban 1995).

In the traditional courtyards of Anatolian Hayat houses, the courtyards are surrounded by walls as high as the first floor of the houses. High walls are out of rubble stone and sometimes they are white-washed. Stone is used for the construction of the foundations and the walls of the ground floor. The construction of the upper floor is timber with sun-dried brick filling (Kuban 1995).

2.1.6. Architectural Elements

In Spain, fireplaces, fountains, plants, and furniture such as tables and chairs are the elements of the courtyards. Fireplaces radiate heat to the courtyard and heat it in winter, illuminate the courtyard with the light from the fire, and are used for cooking (Figure 22). They are in the wall and at the center of the courtyard. Fountains provide cooling in hot summer, and they add an aesthetic value. The courtyards are used as a kitchen, especially in hot summers. Some courtyards are used permanently as kitchens and there are sinks, fireplaces, and sideboards. Flowerpots and candlelights are on the wall (Reynolds 2001).



Figure 22. A fireplace in Spain (Reynolds 2001)

In Anatolian houses, according to daily activities such as eating, washing and drying laundry, washing and drying dishes, cooking, drying foods and meeting with neighbors, elements are added to the courtyards. Fountains, fireplaces, timber stairs, furnitures are the elements of the courtyards. Ceramic pots to store olive oil and foods are used on the ground floor (Erdoğan 1996). Generally, fountains, first steps of stairs, and fireplaces made of stone or brick are elements of the courtyards. Fireplaces are on the wall of the courtyards and the location of the fountains are dependent on the courtyard. The stairs could be outside the gallery or under its roof (Figure 23). The timber stair is provided access from the *taşlık* to the upper floors (Kuban 1995).



Figure 23. An Anatolian *hayat* house (Kuban 1995)

2.1.7. Greenery and Water

The use of plants and water in the courtyard has soothing and cooling effects in a hot and dry environment and helps provide an outdoor living space. In Southern Arabia, houses were built underground, so that rooms and courtyards are under a layer of earth. The courtyard acts as a cooling ground and alters the microclimate by lowering ground temperatures and radiation and evaporating water. There is cross ventilation between rooms and outside the courtyard because the high courtyard walls act as a chimney (Rapoport 1969) (Figure 24).

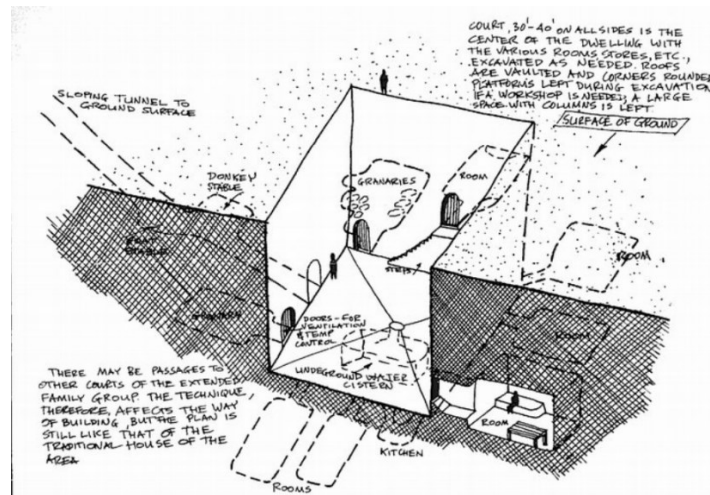


Figure 24. Cooling effects with water element (Rapoport 1969)

Greenery elements contribute to the cooling by shading and affect sustainability with their heat transfer, shade effect, wind protection and insulation abilities. Water elements contribute to decrease the temperature by the solar radiation absorption (Brenda and Vale 1996) (Bozkurt and Altınçekiç 2013).

A green corridor is a part of urban land designed with a variety of vegetation and different types of trees. The main purpose of a green corridor is an extension of natural areas and connect green spaces in a city. This is a characteristic contributing to the control of overheating of the building islands during summers (Repsol 2023).

In the courtyards of Anatolian *hayat* houses, natural shading and cooling in summers are provided by using trees. Trees, which are broad-leaved and shed their leaves in winters, are planted around the buildings (Erdoğan 1996). Trees, which are *figus carica* (fig), *erobotrya japonica* (Japanese medlar), *olea europea* (olive) and *punica granatum* (pomegranate), are planted in Turkish courtyards (Wallace 2007).

2.1.8. Natural Illumination

The height of the courtyard walls affects to amount of sunlight in the courtyards. Shallow and wide courtyards are exposed to more sunlight than deep and narrow courtyards (Reynolds 2001).

The natural illumination can be maximized by increasing the width to the length ratio of the courtyard and when the long axis is along the North-South direction (Al-Hafith et. al. 2017) (Figure 25).

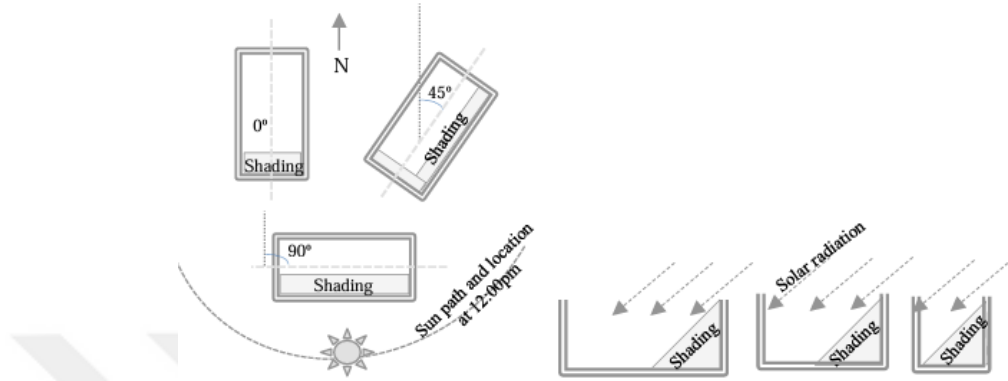


Figure 25. The illumination and shading area (Al-Hafith et. al. 2017)

In Birgi, the length of the shadow is longer in winters than it is in summers. The courtyards can generally be illuminated by sunlight in winters just at noons, since the courtyard wall blocks sunlight, and the length of the shadow is fifty times the courtyard wall in the mornings, and it is twenty times in the afternoons. The ratio of the depth of the courtyard to the height of the courtyard wall in winter noons, is more than 2 (Suncalc 2022).

2.1.9. Ventilation

The ratio of the height of the courtyard wall to the width of the courtyard (H/W) should be between 0.3 and 1 to ensure normal natural ventilation. It has been determined that in examples where the wall height is the same or greater than the width of the courtyard, recirculation currents occur in the courtyard and the air flows are fast (Hall et. al. 1998) (Figure 26). For short courtyards, and isolated standing flow is formed, while for more elongated courtyards the flow submerges at one end and surfaces at the other end (Moonen et. al. 2011) (Figure 27).

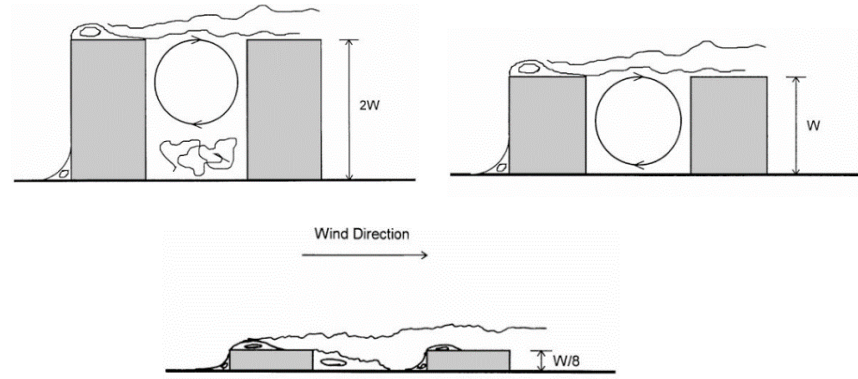


Figure 26. Wind effects to the courtyards (Hall et. al. 1998)

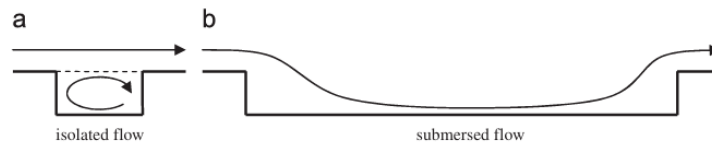


Figure 27. Air flow in the courtyards (Moonen et. al. 2011)

Natural ventilation is seen in the traditional houses in Anatolia. Natural ventilation is provided through the *hayats* on the first floor, and courtyards and *taşlıks* on the ground floors. The *hayats* and the courtyards together act as a chimney to expel hot air (Bekar 2007). Providing coolness in courtyards by keeping the street gate open is also experienced (Erdoğan 1996).

2.1.10. Climatic Conditions

In the Middle East, a shaded area between the enclosed interior and the exterior is a suitable arrangement for hot climates. These are a portico, a gallery, a roofed recess, *eyvan* and their combinations with a courtyard. For the examples of these patterns are: *hilani* for the Hittite, *bayt* for the Arabian, *tarma* for the Mesopotamian, *talar* for the Iranian, and *hayat* for the Turkish (Kuban 1995).

In Turkey, the location of the open and closed spaces and their layout are formed to be compatible with climatic conditions. Patterns of Turkish *hayat* houses have been seen in hot climatic zones and they are open to nature (Günay 1989).

Courtyard, *hayat* and *taşlık* are used quite commonly in the hot and dry climate region. The walls of the *hayat* are protected it from excessive wind effects (Sözen 2001). Traditional rural settlement is located according to the positive and negative effects of the climate and climate condition effects architectural designs. Houses are built according to climate effects such as airflow, wind direction, sun position, and displacement of hot and cold air (Aran 2000). Mountain skirts are suitable for natural ventilation in hot and dry climate regions (Zeren 1978). In hot and humid rural settlements, the main purposes are protecting from high humidity and the sun, and providing cooling. Rural settlements are built on sloping streets since excessive moisture can occur on valleys. The location and direction of the streets help to take the wind into the settlement (Aktuna 2007).

2.2. Geographical Aspects

Birgi is in the Küçük Menderes Basin, which is between Boz Mountains and Aydın Mountains. It is located at the skirt of Boz mountains. It is a town of Ödemiş district within the border of İzmir Metropolitan City. Boz Mountains are at the north of Birgi and Birgi is located at the skirt of Boz Mountains.

The river called with the same name of the Küçük Menderes Basin. The Küçükmenderes river starts from the Boz Mountains and Bey Mountains. Water flowing from the river in Kiraz plain is collected and irrigated the plain. The Küçükmenderes river has filled the plain over time with the alluviums it carries. After passing through the south of Ödemiş district, the river moves towards the south of Tire and flows into the Aegean Sea after the plain full of small lakes in front of the ancient city of Ephesus in Selçuk district.

The river has made the region a productive agricultural and livestock region by increasing the productivity of the greenery and vegetation on both sides of the river. Ödemiş region is included in the Eastern Mediterranean flora. Natural vegetation includes maquis on the slopes of Boz Mountains and Aydın Mountains, red pine forest at altitudes of 700 meters and above, and black pine and Scots pine species at altitudes of 1000-1500 meters.

There are many sun-loving plants in the region. There are dwarf plants in places where the altitude is low, and coniferous forests in high places. There are acorn oak, holm oak, labdanum and chestnut trees in the mountains. There are maquis elements such as chaste berry, oleander, plane tree, laurel, and myrtle in low areas. Stone pine, walnut, fig, poplar, citrus, pomegranate and other fruit trees were planted in the plain.

Mediterranean climate is observed, and summers are hot and dry, winters are warm and rainy in Küçük Menderes Basin. While the temperature is around 42 degrees in summer, it can be around -7 degrees in winter. The annual rainfall is around 700 mm. The most rainfall occurs in November, December, January and February. Snowfall at the summits of Boz and Aydın Mountains last around 18-30 days. Karayel, southwest and north winds blow in the Ödemiş plain. Agriculture constitutes a large part of the economy of Ödemiş. Agricultural products such as potatoes, figs, watermelons and cotton are produced (RT 2014) (Figure 28).



Figure 28. Location of Birgi

Source: Revised from (RT 2014)

The geographical coordinates of Birgi are 38.250 latitude and 28.059 longitude, and the average altitude is about 350 meters. The altitudes of the studied cases are between 368 meters and 395 meters (Google Earth 2024).

Mediterranean climate is seen in Birgi. The hottest month of the year is July and the highest temperature is 34 degrees in Celsius scale and the coldest temperature is 20 degrees in this month. The coldest month of the year is January and the coldest temperature is 1 degree and the highest temperature is 10 degrees in this month.

The shortest day in Birgi is on December 21st with 9 hours and 30 minutes of daylight, while the longest day is on June 21st with 14 hours and 50 minutes of daylight (Figure 29).

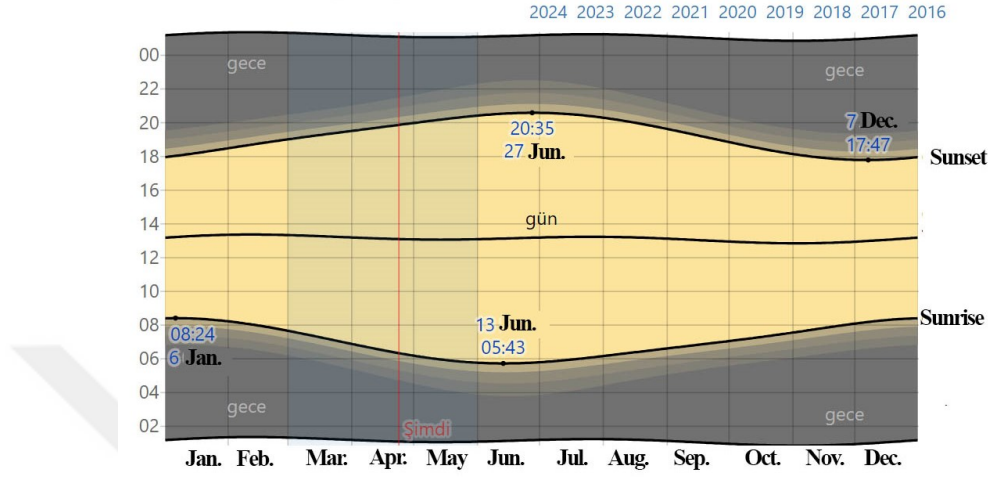


Figure 29. Day length throughout the year in Birgi

Source: Revised from (Weatherspark 2024)

In Birgi, the wind blows from the north most of the time of the year. The wind generally blows from the east for 2.9 weeks: from January 5th to January 25th and from November 8th to November 13th, with the highest rate of 34% on January 9th. The wind generally blows from the south for 1.1 months: from January 25th to February 27th, from March 25th to April 16th for 3.1 weeks, and from November 13th to January 5th for 1.7 months, with the highest rate of 35% on February 19th. The wind generally blows from the north for 3.9 weeks from February 27th to March 25th and for 6.7 months from April 16th to November 8th, with the highest rate of 35% on July 16th (Weatherspark 2024). Especially the north wind is the prevailing wind in summer and the south wind is the prevailing wind in winter (Figure 30).

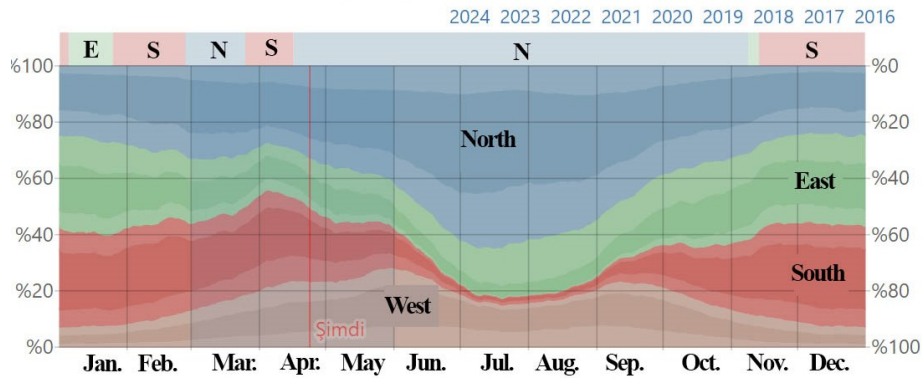


Figure 30. Wind direction in Birgi (Source: Revised from (Weatherspark 2024))

Birgi settlement is limited by slopes of up to 50% at its Northwest- Southeast ends. There are two types of urban texture in Birgi: organic and grid-iron. Kurtgazi district has organic urban texture. The streets in Kurtgazi are narrow and sloping. The land slope in the *Kurtgazi* district varies between 4 to 33% at the Northwest–Southeast direction (Google Earth 2024) (Figure 31).

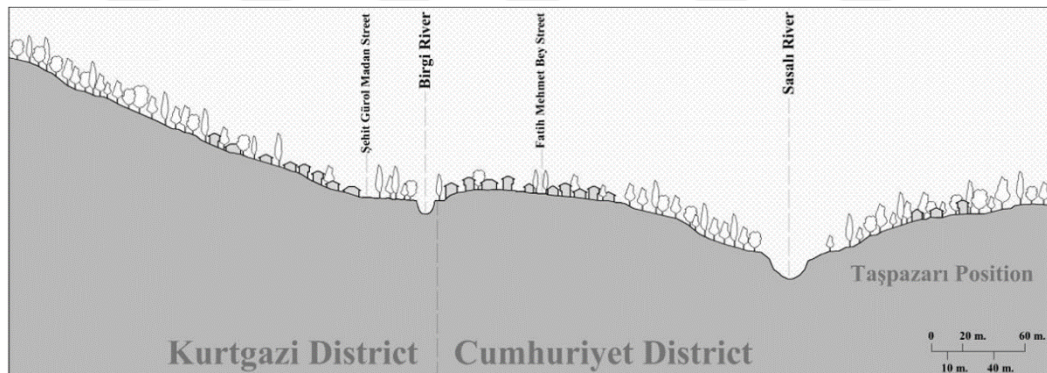


Figure 31. Section of the Birgi Settlement (Diri 2010)

2.3. Historical Aspects

It is thought that the first settlers in the region were the Lydians. After the Lydians, Persians, Ionians, Alexander the Great, Hellens, Roman Empire, Aydın Principality, and Ottomans ruled the region (RT 2014).

Birgi was a settlement of the Lydians. It was not called as a city in the Lydian period, in the Persian period (6th century BC) and in the Hellenistic period (4th century BC). First, Birgi was called as a city in the Roman period (1st century BC) (Yavuz 2005). Aydın Principality declared Birgi as its capital in 1308 (RT 2014).

The name of Birgi comes from the ancient name of the city, which is ‘Pyrgion’ and it means tower or fortress. ‘Pyrgion’ was ‘Berki’ in Turkish. Birgi was typically a fortified place with towers and a castle during the Middle Ages. Architectural structures, which have become symbols of the Birgi and affect the social and cultural life of the Birgi, were built during the Ottoman period such as Ottoman baths, mosques (Ulu Mosque), houses (Çakırağa Mansion) and fountains were built during the Ottoman period (Yavuz 2005).

Birgi had ten districts: Kurtgazi, Çörekbaşı and Kızıl Mescid districts at the northwest of the Birgi brook, and Hisar içi, Sasalı, Taş Bazar, Dernek Pazarı, Demür Boğa, Hızırlık and Saru Bey at the southeast of the Birgi brook. Kurtgazi, Hisar içi, Sasalı, Taş Bazar, Dernek Pazarı and Demür Boğa were first mentioned in a document dated 1451, Hızırlık, Saru Bey, and Kızıl Mescid were first mentioned in a document dated 1528, Çörekbaşı was mentioned in a document dated 1662 (Ünal 2001). Three of the studied cases are within the earliest portion at the west but one studied cases are in the relatively later development zone in Kurtgazi district. They were shown as red-hatched circles on the map (Figure 32).

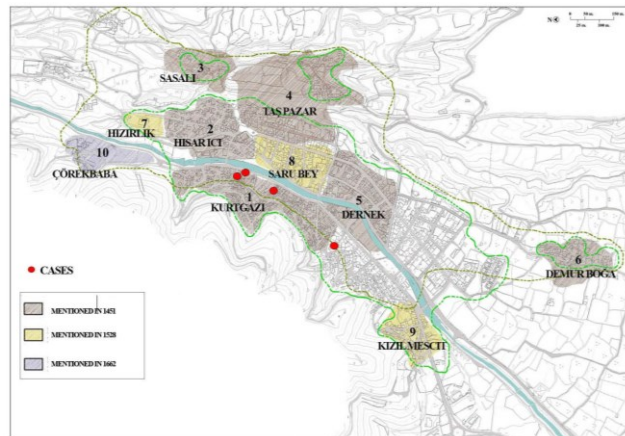


Figure 32. Map of the districts in Birgi (Source: Revised from (Diri 2010))

Kurtgazi district was listed as ‘historic urban site’ in 1988 (RT 1988). The surrounding of Birgi settlement was listed as a natural and archaeological site and the first Conservation Aimed Development Plan for Birgi prepared in 1990 (Eruzun and K peli 1990). This Conservation Plan was further developed by Ahmet Uzel and Kamutay T rko lu in 1991 (Uzel and T rko lu 1991). Two of the studied cases (case 1 and case 4) are in the border of the listed historic urban site and two of the studied cases (case 2 and case 3) are in the residential area with special conditions. This means that the use of traditional construction techniques and materials in the buildings continues, and the traditional texture is intact, and the area will be consolidated. (Figure 33).

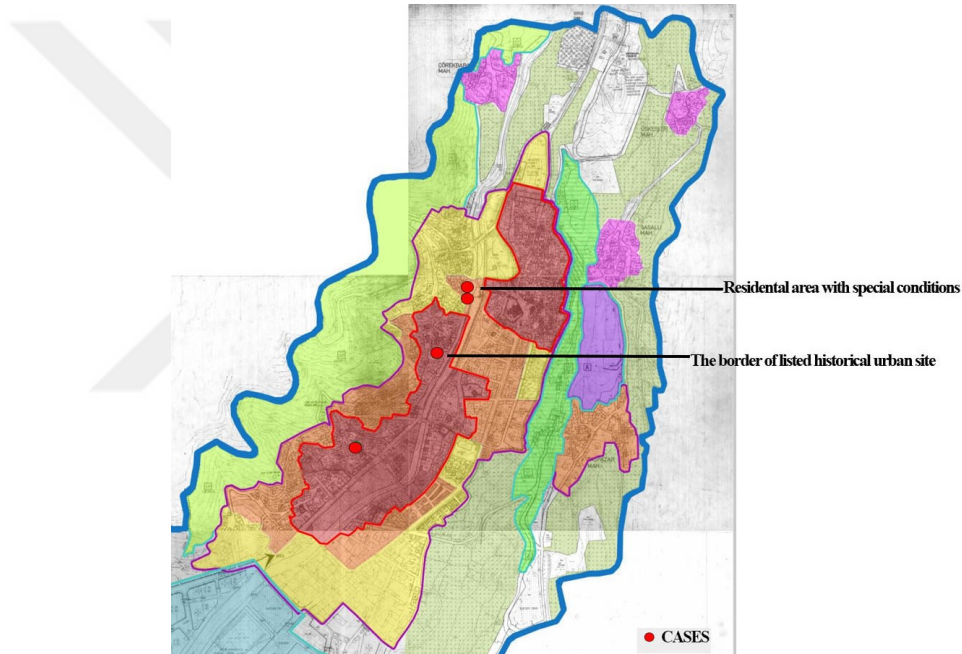


Figure 33. Additional masterplan of Birgi (Source: Revised from (Diri 2010))

Culture and Tourism Ministry registered over 100 traditional Birgi houses. Some of these traditional houses had been restored or conversation work continues. Birgi has been on the tentative list of UNESCO since 2012 (UNESCO 2024).

2.4. Characteristics of Birgi Houses

The physical features of Ottoman towns: such as the organic settlement pattern is seen in Birgi. The courtyard walls follow the organic pattern: According to the positioning of courtyards, three types of housing units can be defined: buildings with rear courtyards, buildings with side courtyards, and buildings with rear and side courtyards (Gülhan 2016). At least one of the edges of the building lot flanks the street.

Birgi houses that have reached today were built in the 18th century and the following centuries in general (UNESCO 2024). Open spaces are courtyard, and semi-open spaces are *taşlık* and *hayat*. The Birgi houses have two different types of connections between the street and the courtyard: from the street to the courtyard, and from the street to the *taşlık*, then to the courtyard. The connections between the street and the courtyard or *taşlık* is provided with wide wooden doors with two-leaves (Ekinci 2005). Since the main source of income is agriculture and animal husbandry. Barns, and storages are units of the ground floors. Multi-purpose rooms are units of the first floor and this floor is organized around a *hayat*, where many living activities take places The houses were built facing the south and southeast (İşeri 1998) (Figure 34).



Figure 34. The entrance of a courtyard in Birgi (İşeri 1998)

Some of Birgi houses have just one storey, some of Birgi houses have three storeys but generally the Birgi houses have two storeys: ground floor and first floor. Ground floor

walls are stone masonry, which is made with rubble stone, slate stone, river stone, brick and tile pieces. First floor walls are in timber frame system, and they have semi-open space, which is called *hayat*. The *hayat* is open to the courtyard. It was designed with *abdestlik* and fireplace (İşeri 1998). It is used as a kitchen and *abdestlik* is used as a cupboard and sink of the kitchen. *Abdestlik* is made of wood, and it has a shelf. It is located on the balustrade and in the courtyard direction of the *hayat*. Dishes are washed and water flows directly to the courtyard (Figure 35) (Diri 2010).

The connection between the ground floor and the first floor was ensured with timber stairs in the *hayat*. The connections between the courtyard and the house ensure with *taşlık*. It calls *taşlık* because its ground is covered with stone. The *taşlıks* are another semi-open space on the ground floor. The ground covering of the *taşlık*, and the ground floor spaces are slate stone, which is indigenous material in Birgi (İşeri 1998). The *taşlıks* designed also as service spaces connected with kitchens, courtyards, toilets, barns, storage, and animal sheds, and it connected by timber stairs to the main floors. It has fountains, pools, wells and fireplaces (Kuban 1995) (Ekinci 2005). Olive oil, water and grain are stored in clay pots in the storage (Keleş 2022). The functions of the *taşlık* are eating and resting (Uzel and Türkoğlu 1991). The courtyard is open spaces of Birgi houses. The ground covering of the courtyard is earth or slate stone. The courtyard is designed isolated from the street and neighbors. The elements of the courtyards such as fireplaces, fountains, animal sheds and toilets are along the sides (Figure 36) (Figure 37) (Diri 2010).

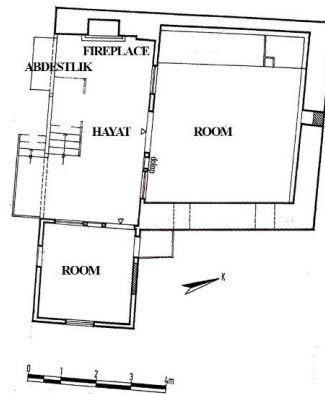


Figure 35. First floor plan in a Birgi house (Source: Revised from (İşeri 1998))

CHAPTER 3

CHARACTERISTICS OF THE CASES

The courtyards of the four traditional houses studied in Kurtgazi Neighbourhood of Birgi are characterized in this chapter (Figure 38). Their blocks and lots are 338/7 (case 1), 326/5 (case 2), 326/8 (case 3), and 350/4 (case 4) respectively.



Figure 38. Locations of the cases (Source: Revised from (Parsel Sorgu 2024))

3.1. Case 1: The Courtyard in Block 338 / Lot 7

The case 1 is at the altitude of 389 meters. The lot of the courtyard is flanked by neighboring lots on its three sides. It is reached from a secondary street (Çakırağa) from the fourth sides (Figure 39). The lot coverage is 108.5 m². The form of the lot is L-shape. The lot comprehends the main building, the courtyard and three additional masses. The main building is at the west part of the lot and the courtyard is at the northeast part of the lot. The main building is two storey high. The form of the courtyard is a rectangle.



Figure 39. Location of the case 1 (Source: Revised from (Parsel Sorgu 2024))

The courtyard is directly accessed from the Çakırağa street and the entrance of the courtyard is from the north (Figure 40). The circulation system is from the street to the courtyard through a gate, then to the *taşlık* and finally to the closed spaces.

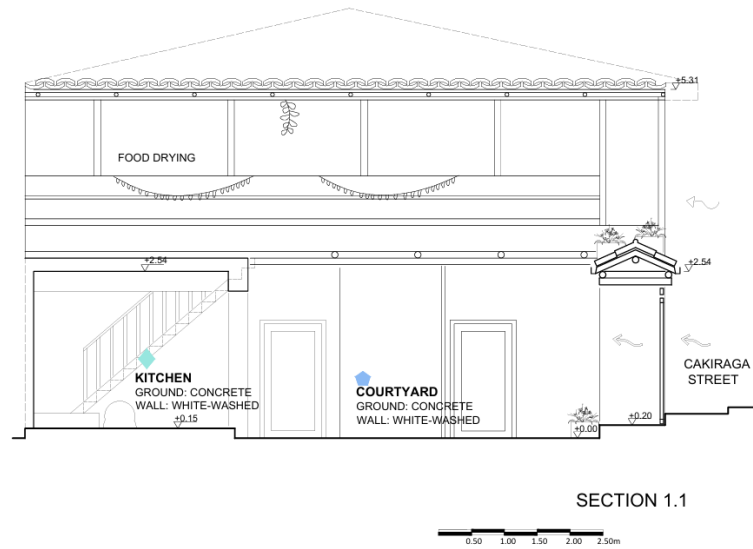


Figure 40. Section of the case 1 in the current state
(Source: Prepared by Author 2022)

The courtyard is 34.5 m². There are mass additions: a kitchen at the southeast, a storage at the northwest and a toilet at the northeast. In the authentic state, the courtyard was more spacious 39 m² and the *taşlık* was 42 m².

The courtyard wall flanking the street has preserved its authenticity (It is out of slate stone, brick, tile pieces, and mortar.). This wall is plastered and white-washed only

at the interior. A timber roof with tile finishing crowns the wooden gate (Figure 41). The gate is kept open for increasing the air flow throughout the day in summers. There is a flowerpot, which is made with slate and rubble stones as well, next to the gate.

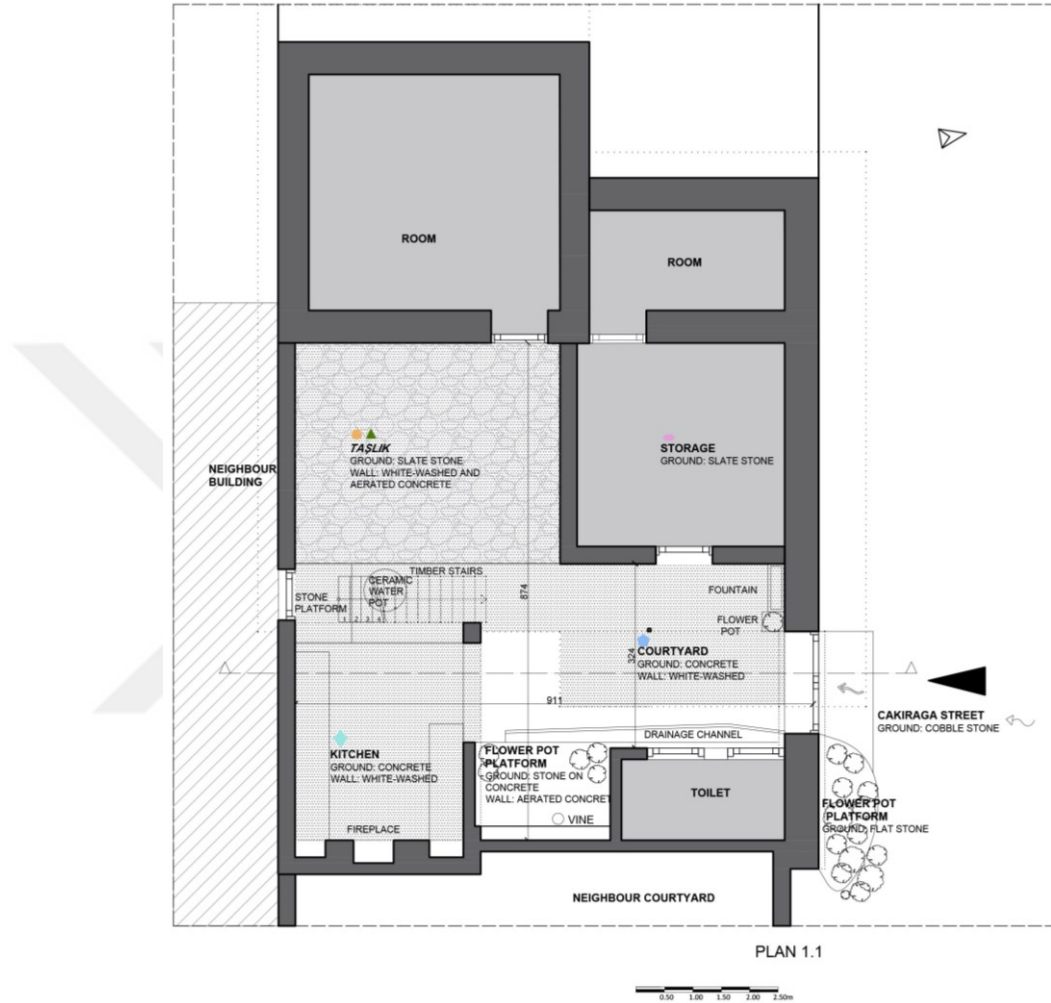


Figure 41. Ground Floor Plan of the case 1 in the current state
(Source: Prepared by Author 2022)

There is a contemporary fountain and a storage at the north of the courtyard. The wall of the storage is made with aerated concrete and it is white-washed. Portable water was carried from the fountain on the street until the contemporary infrastructure was established (Keleş 2022).

The semi-open *taşlık* (24 m²) was preserved at the west of the courtyard. It is almost square in plan. Since the storage addition (14 m²) at its north had diminished its

size. Authentic slate stone finishing at the ground of the *taşlık* have been preserved. The walls of the *taşlık* are a courtyard wall, a building wall and a storage wall. The bordering courtyard and building walls, which are masonry out of rubble stone, slate stone, brick and tile pieces, are plastered and white-washed, and the storage wall is just white-washed.

There are authentic elements such as a ceramic pot (which is used to store olive oil, water and grain, it is used as a decorative element at present), timber stairs, and stone steps (Figure 42). Contemporary furniture like couches, a table, chairs, stools and cupboards are also present in the *taşlık*. Resting and eating are the functions of *taşlık*.



Figure 42: (a) Authentic pot, (b) authentic timber stairs and (c) authentic stone steps
(Photos taken by Author 2022)

There is a kitchen (11 m²) at the south of the courtyard. The area of the courtyard decreased after the kitchen was added. The ground covering of the kitchen is concrete. The walls of the kitchen are plastered and white-washed. There are contemporary elements such as a fireplace, a sink and cupboards in the kitchen (Figure 43). Washing and drying dishes, and cooking are the functions realized in the kitchen (Figure 44) (Figure 45).



Figure 43. The contemporary a fireplace (left) a sink (right)
(Photos taken by Author 2022)

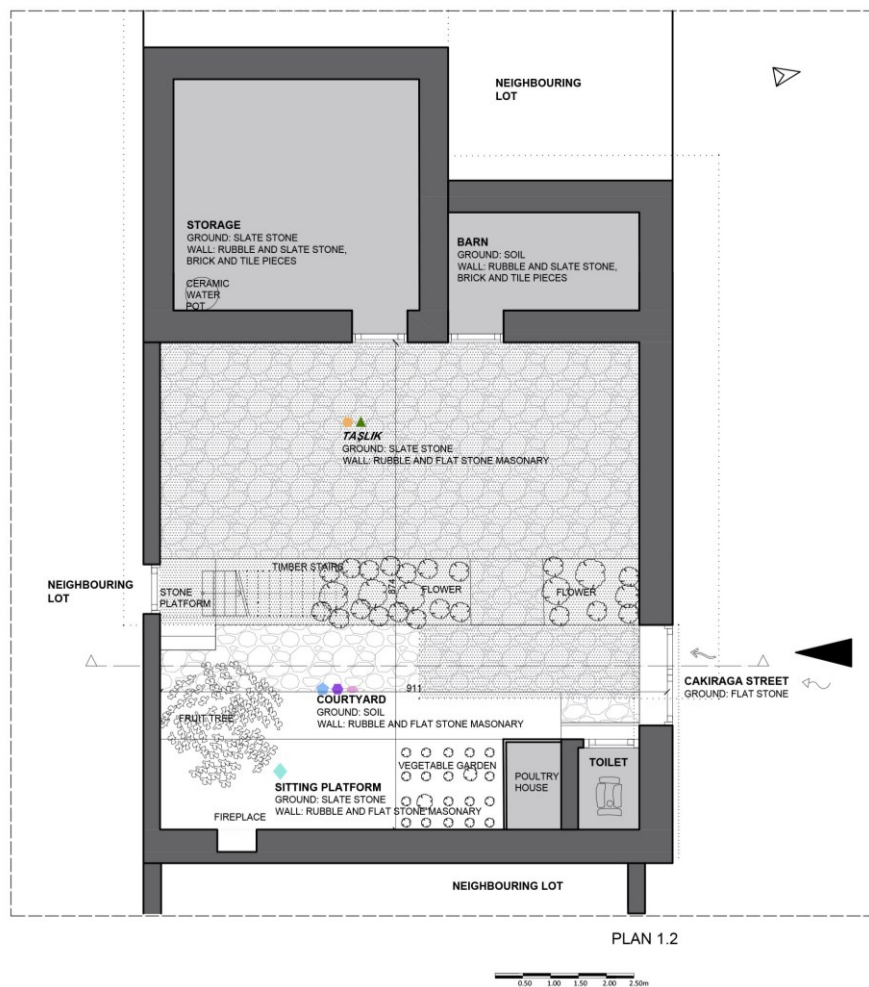


Figure 44. Ground floor plan of the case 1 in the authentic state
(Source: Prepared by Author 2022)

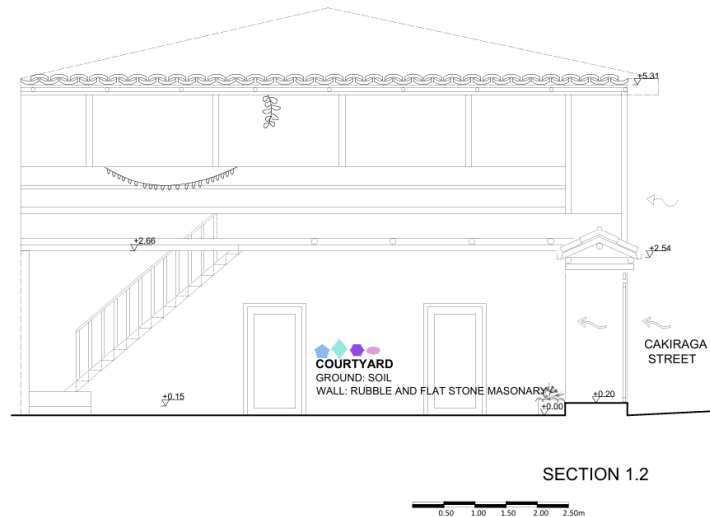


Figure 45. Section of the case 1 in the authentic state
(Source: Prepared by Author 2022)

There is a flowerpot platform in the east of the courtyard. The ground of the platform is concrete. The wall of the platform is aerated concrete and it is white-washed. Gardening is the function of the platform. There was a fruit tree in the platform but now there are flowerpots and an ivy (vine) on the platform.

There is a toilet at the east of the courtyard. There is a drainage channel in front of the toilet. It collects rainwater or water after the toilet and the courtyard are washed. The wall of the toilet is plastered and white-washed (Figure 46).



Figure 46. The courtyard of the case 1 (Photos taken by Author 2022)

Washing and drying laundry is the basic function of the left-over portion of the courtyard. The ground covering of the courtyard was slate stone in the authentic state. It is screed at present. The amount of the reflection of the sunlight increased after changing the covering material of the courtyard's ground. All of the walls of the courtyard are white-washed. They reflect sunlight at a high amount.

The amount of the courtyard ground directly exposed to the sunlight today is 7.5 m² in the summer noons but it is not directly exposed to the sunlight in the winter noons and summer mornings because there is mass additions in the courtyard. The amount of the courtyard and *taşlık* grounds directly exposed to the sunlight was 17 m² in the summer noons and 9 m² in the winter noons before the mass additions (Figure 47). The amount of the courtyard and *taşlık* grounds directly exposed to the sunlight was 29 m² in the summer mornings before the mass additions. The courtyard ground was not exposed to the sunlight in the winter mornings today even before the mass additions because the length of the shadow of the courtyard wall is long in the winter (Figure 48) (Figure 49).

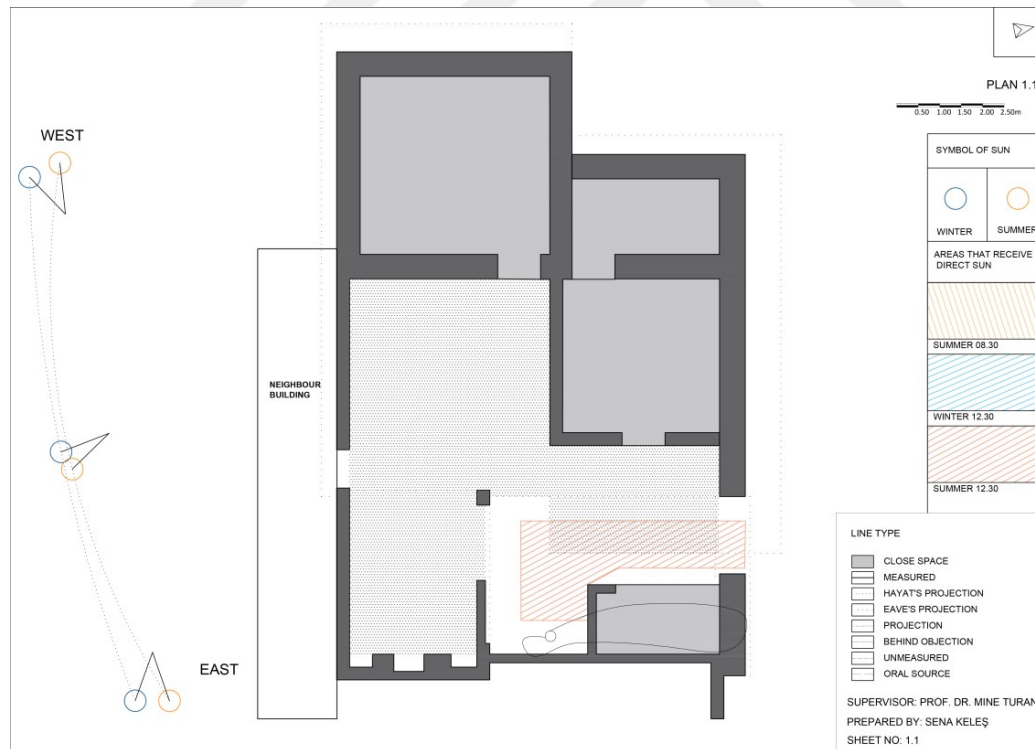


Figure 47. The amount of sunlight in the section and the plan for the current state in the case 1 (Source: Prepared by Author 2024)

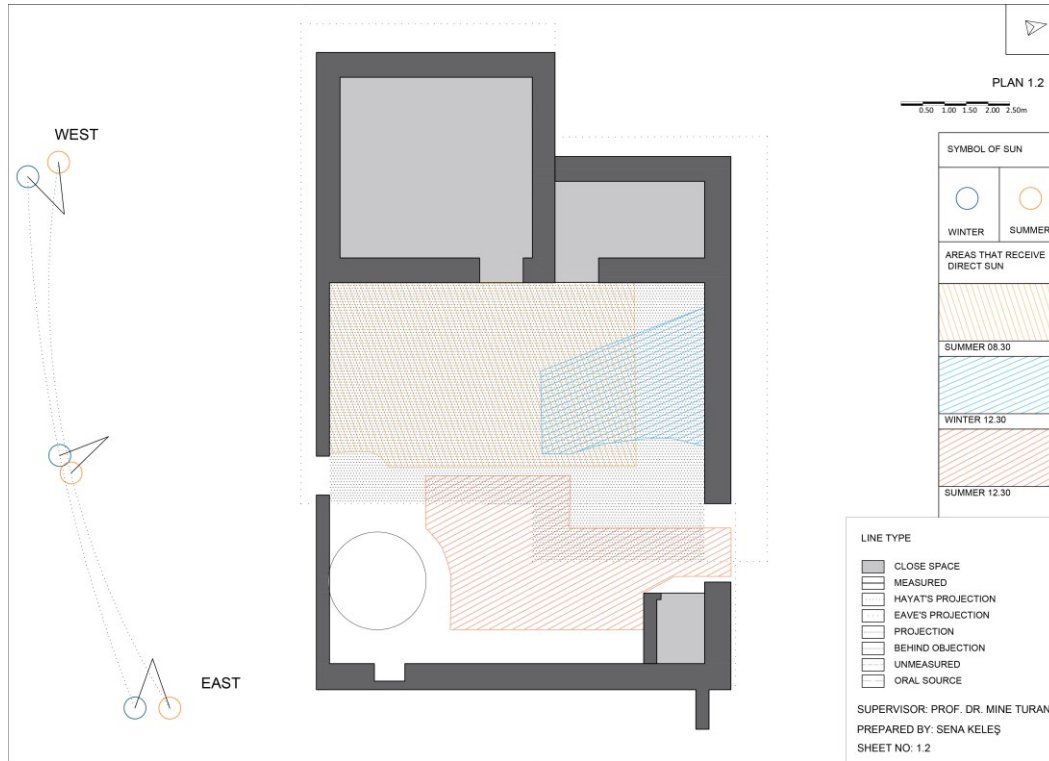


Figure 48. The amount of sunlight in the section and the plan for the authentic state in the case 1 (Source: Prepared by Author 2024)

CURRENT STATE	AUTHENTIC STATE
TOTAL AREA : 58.5 M²  SUMMER SUN - MORNING (08.30) 0 M² WINTER SUN - NOON (12.30) 0 M² SUMMER SUN - NOON (12.30) 7.5 M²	TOTAL AREA : 81 M²  SUMMER SUN - MORNING (08.30) 29 M² WINTER SUN - NOON (12.30) 9 M² SUMMER SUN - NOON (12.30) 17 M²
DIFFERENCES AMOUNT OF SUN BETWEEN 1.1 AND 1.2 SUMMER SUN - MORNING (08.30) 29 M² - 0 M² = 29 M² WINTER SUN - NOON (12.30) 9 M² - 0 M² = 9 M² SUMMER SUN - NOON (12.30) 17 M² - 7.5 M² = 9.5 M²	

Figure 49. The amount of sunlight in the case 1 (Source: Prepared by Author 2024)

The wind blows from the north most of the time of the year. Especially the north wind is the prevailing wind in summer. The storage restricts this natural ventilation since it is on the north wind direction in summer. The air flow comes from the gate to the courtyard and from the upper of the courtyard walls to the courtyard. Then it continues to the elevated roof from *hayat* or to the closed space from *taşlık*. The south wind is the

prevailing wind in winter. The kitchen and the courtyard wall restrict this natural ventilation since they are on the south wind direction in winter. The air comes from the upper of the courtyard walls to the courtyard and *taşlık*. Then it continues to the hayat and elevated roof. The airflow occurs after the plants are watered. Hot air rises up the courtyard as the plants here are watered and the courtyard is washed in the summers.

The airflow decreased in the courtyard and in the *taşlık* in summer because the storage was added to the north wind direction. The airflow decreased in the courtyard and in the *taşlık* in winter because the kitchen was added to the south wind direction.

3.2. Case 2: The Courtyard in Block 326/ Lot 5 and Block 326/ Lot 6

The case 2 is at the altitude of 395 meters. The related lot is at the corner of the building block. The case 2 is on two flanking lots (Figure 50). The total area the surveyed housing unit covers is 264.6 m². The courtyard is directly accessed from a secondary street (Tarih street). The entrance of the courtyard is from the northeast. The studied unit comprehends the courtyard, the main building and two additional masses referred as the room and the toilet. The form of the courtyard is U-shape. The main building is at the northwest of the lot. It is two storey high. The circulation system is from the street to the courtyard through a gate, then to the *taşlık* and finally to the closed spaces. The housing unit flanking the case 2 at its northwest can be through a gate at the northeast, and also a gate from the main street (Şehit Gürol Madan Street).



Figure 50. Location of the case 2 (Source: Revised from (Parsel Sorgu 2024))

The courtyard is at the southeast of the main building. The *taşlık* is at northwest of the courtyard. The area of the courtyard is 78 m². There is a mass addition: a room (35m²) at the west that divides the courtyard into two portions. The mass addition is one storey high. In the authentic state, the courtyard was more spacious (109.5 m²).

The courtyard wall is masonry out of rubble stone, slate stone, brick, tile pieces, and mortar plastered and painted from the inside of the courtyard. This gate has a wooden roof with tile finishing (Figure 51). There is a contemporary fireplace within the northeastern courtyard wall.



Figure 51. The entrance of the case 2 (Photo taken by Author 2022)

The semi-open *taşlık* (26m²) was preserved at the northwest of the courtyard. It has a rectangle plan. The ground finishing of the *taşlık* was renewed with concrete. The walls of the *taşlık* are building walls and mass addition's walls. Building walls and mass addition's walls at the sides of the *taşlık* are white-washed. The reinforced concrete columns between the *taşlık* and the courtyard are plastered and painted. There are a contemporary dinner table and chairs. Resting and eating are the basic activities realized in the *taşlık* (Figure 52) (Figure 53).

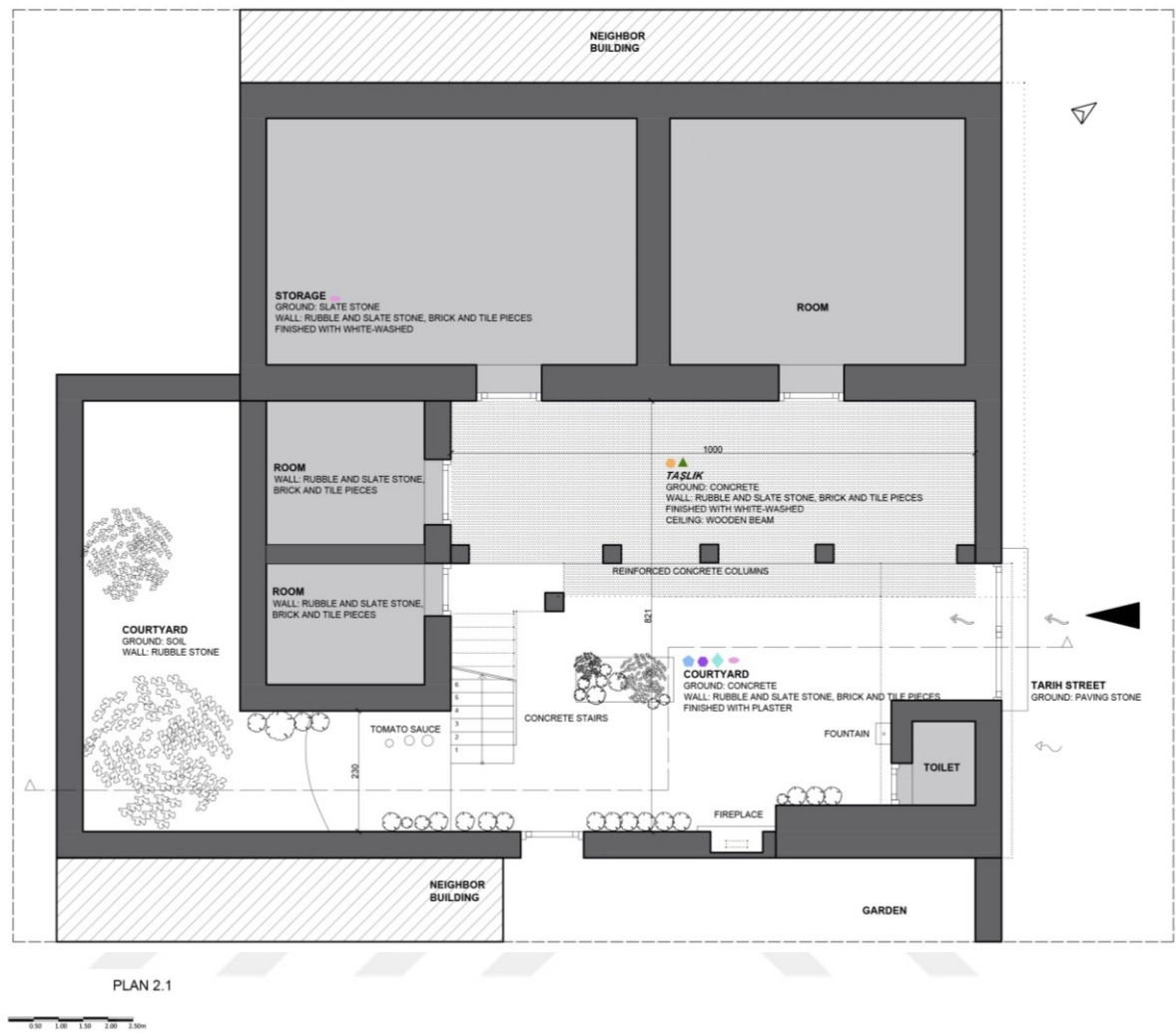


Figure 52. Ground floor plan of the case 2 in the current state
(Source: Prepared by Author 2022)

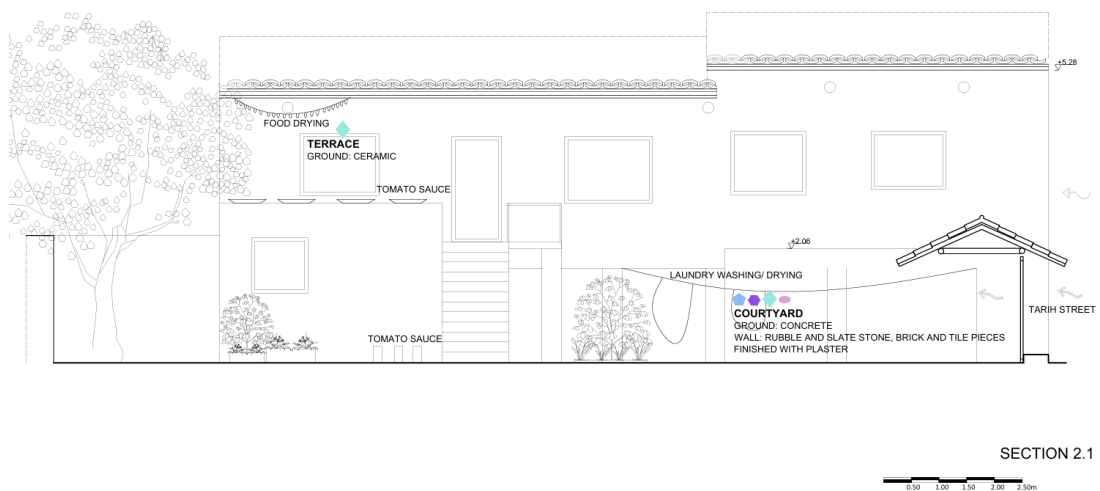


Figure 53. Section of the case 2 in the current state (Source: Prepared by Author 2022)

The mass addition (35m²) has masonry walls out of rubble stone, slate stone, brick, tile pieces and mortar. The wall portion facing the *taşlık*, is plastered and painted. The reinforced concrete stairs juxtaposing the mass addition at its northeast leads to the first floor (Figure 54).



Figure 54. The taşlık (left) and the courtyard (right) (Photos taken by Author 2022)

The southwest of the courtyard has a lemon and magnolia tree. The ground is soil and courtyard walls are dry masonry out of slate and rubble stones (Figure 55). Gardening of tomatoes, flowers is the activity realized here.



Figure 55. (a) The wall of the courtyard, (b) the courtyard, (c) the mass addition (Photos taken by Author 2022)

There is a toilet at the eastern corner of the courtyard. The toilet was constructed together with the courtyard wall and they are plastered and painted (Figure 56). There is a contemporary sink next to the toilet wall.



Figure 56: (a) The toilet, (b) the mass addition and (c) the fireplace
(Photos taken by Author 2022)

The ground covering, which was compacted earth, is screed at present (Keleş 2022). The amount of reflection of sunlight increased after changing the covering material of the courtyard's ground. The courtyard walls are plastered only at the portions, close to the *taşlık* and the toilet. Washing and drying laundry, and washing and drying dishes are the activities realized in the courtyard (Figure 57) (Figure 58).

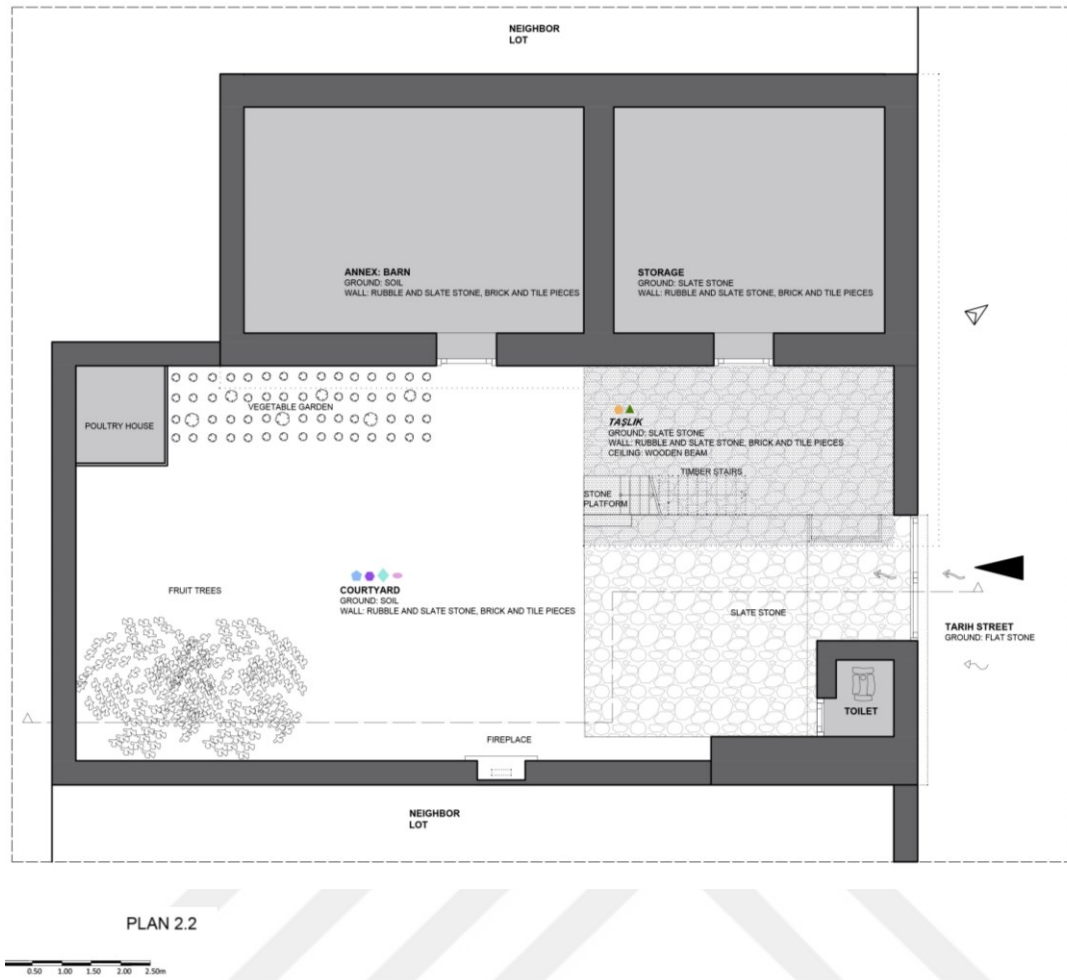


Figure 57. Ground floor plan of the case 2 in the authentic state
(Source: Prepared by Author 2022)

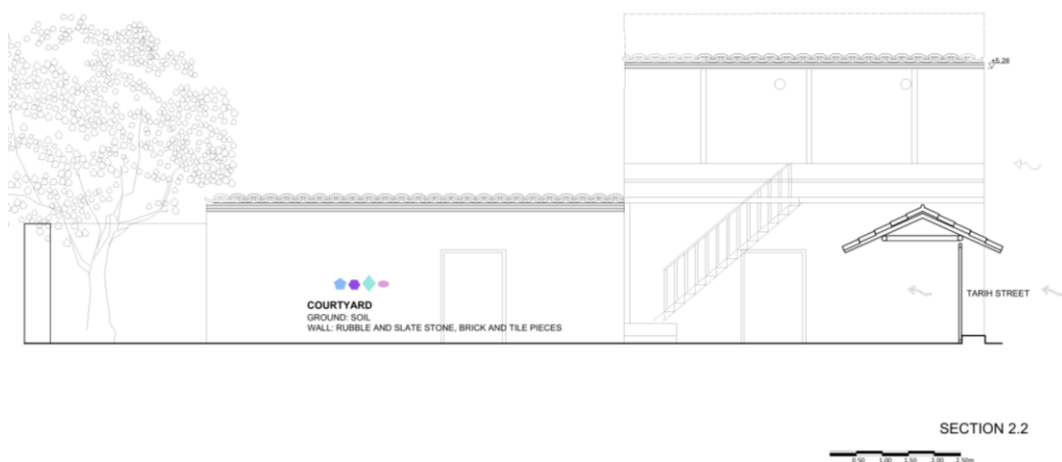


Figure 58. Longitudinal section of the case 2 in the authentic state
(Source: Prepared by Author 2022)

The amount of the courtyard and *taşlık* grounds directly exposed to sunlight today is 40 m² at noon in the summers and 19.5 m² at noon in the winters. It was 87 m² at noon in the summers and 44.5 m² at noon in the winters before the mass addition. *Taşlık* receives less direct sunlight at summer noons. Eave length blocks summer sun to enter completely the *taşlık* in noons. The amount of the courtyard and *taşlık* grounds directly exposed to the sunlight today is 23 m² in the summer mornings (Figure 59). In the winter mornings, no sunlight reaches the courtyard ground since the courtyard wall blocks it (Figure 60) (Figure 61).

CURRENT STATE		AUTHENTIC STATE	
TOTAL AREA : 108 M ²		TOTAL AREA : 135.5 M ²	
			
SUMMER SUN - MORNING (08.30)	23 M ²	SUMMER SUN - MORNING (08.30)	47 M ²
WINTER SUN - NOON (12.30)	19.5 M ²	WINTER SUN - NOON (12.30)	44.5 M ²
SUMMER SUN - NOON (12.30)	40 M ²	SUMMER SUN - NOON (12.30)	87 M ²
DIFFERENCES AMOUNT OF SUN BETWEEN 2.1 AND 2.2			
SUMMER SUN - MORNING (08.30)	47 M ²	- 23 M ²	= 24 M ²
WINTER SUN - NOON (12.30)	44.5 M ²	- 19.5 M ²	= 25 M ²
SUMMER SUN - NOON (12.30)	87 M ²	- 40 M ²	= 47 M ²

Figure 59. The amount of illumination in the case 2 (Source: Prepared by Author 2024)

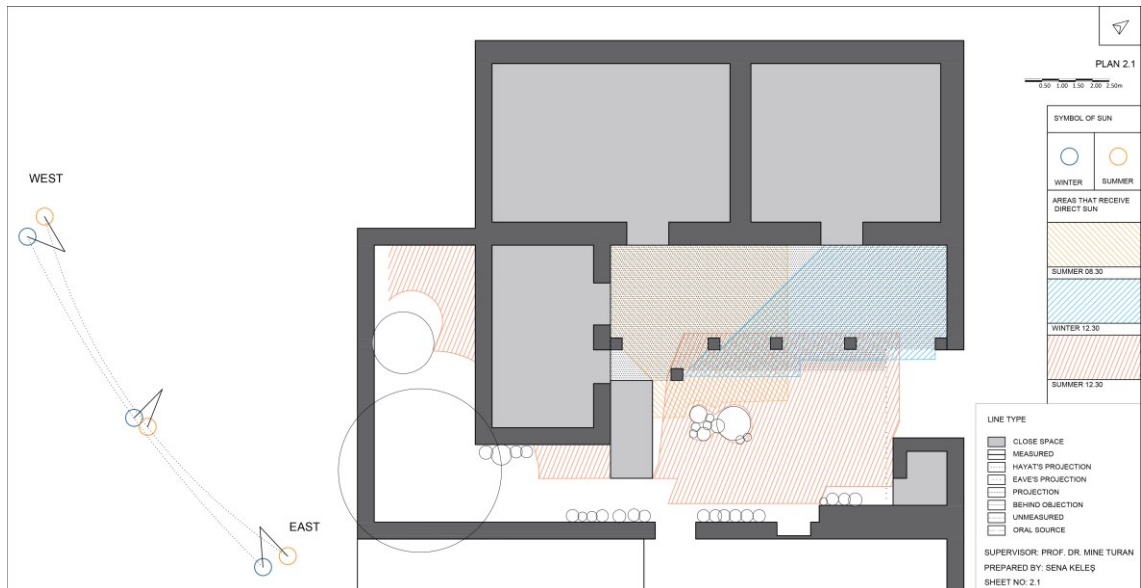


Figure 60. The amount of illumination in the plan for the current state in the case 2
(Source: Prepared by Author 2024)

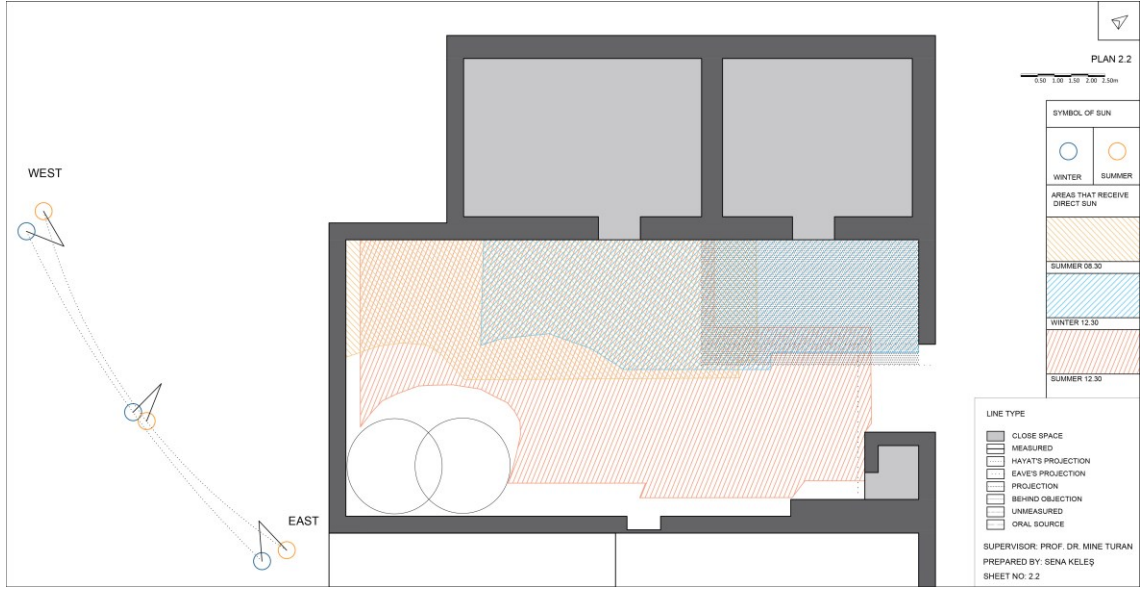


Figure 61. The amount of illumination in the plan for the authentic state in the case 2
(Source: Prepared by Author 2024)

The wind blows from the northwest and is blocked by the main building. The wall of the *taşlık* restricts natural ventilation since it is on the northwest wind direction in summer. The airflow from the northeast, comes from the gate to the courtyard and from the upper of the courtyard walls to the courtyard. The south wind is the prevailing wind in winter. The room restricts natural ventilation since it is on the south wind direction in winter. The airflow from southeast, comes from the upper of the courtyard walls to the courtyard and to the *taşlık*. The airflow occurs by hot air rises up the courtyard as the plants here are watered and the courtyard is washed in the summers.

The airflow was from the gate to the courtyard, then to the *hayat* and to the elevated roof. Conversion of the semi-open *hayat* on the upper floor into a closed space and room added to the *hayat* on the upper floor. Alteration of the elevated form of the roof restricted this natural ventilation. The airflow decreased in the courtyard and in the *taşlık* in winter because the room was added to the south.

3.3. Case 3 The Courtyard in Block 326 / Lot 8

The case 3 is at the altitude of 393 meters. The related lot is located at the corner of the southeast building block 326. The lot coverage is 274.8 m². The form of the lot is trapezoid (Figure 62).



Figure 62. Location of the case 3 (Source: Revised from (Parsel Sorgu 2024))

The lot comprehends a main building, a courtyard, an additional mass (barn), an additional mass (room), an additional mass (building addition), an additional portico, and an additional canopy. The main building is at the west of the lot, the room addition at the east of the main building, the portico at the east of the main building, the courtyard is at the south, the building addition at the northwest, the barn at the north, the canopy at the southeast. The main building is two storey high, the room addition is one storey high, the building addition is two storey high, the barn is one storey high and there is one storey on the barn. The courtyard is directly accessed from Akmescit street at the south. The form of the courtyard is trapezoid (because the building addition wall has a trapezoidal shape that follow the border of the lot). The circulation system is from the street to the courtyard through the gate, then to the semi-open space (portico) and finally to the closed spaces (Figure 63) (Figure 64) (Figure 65).

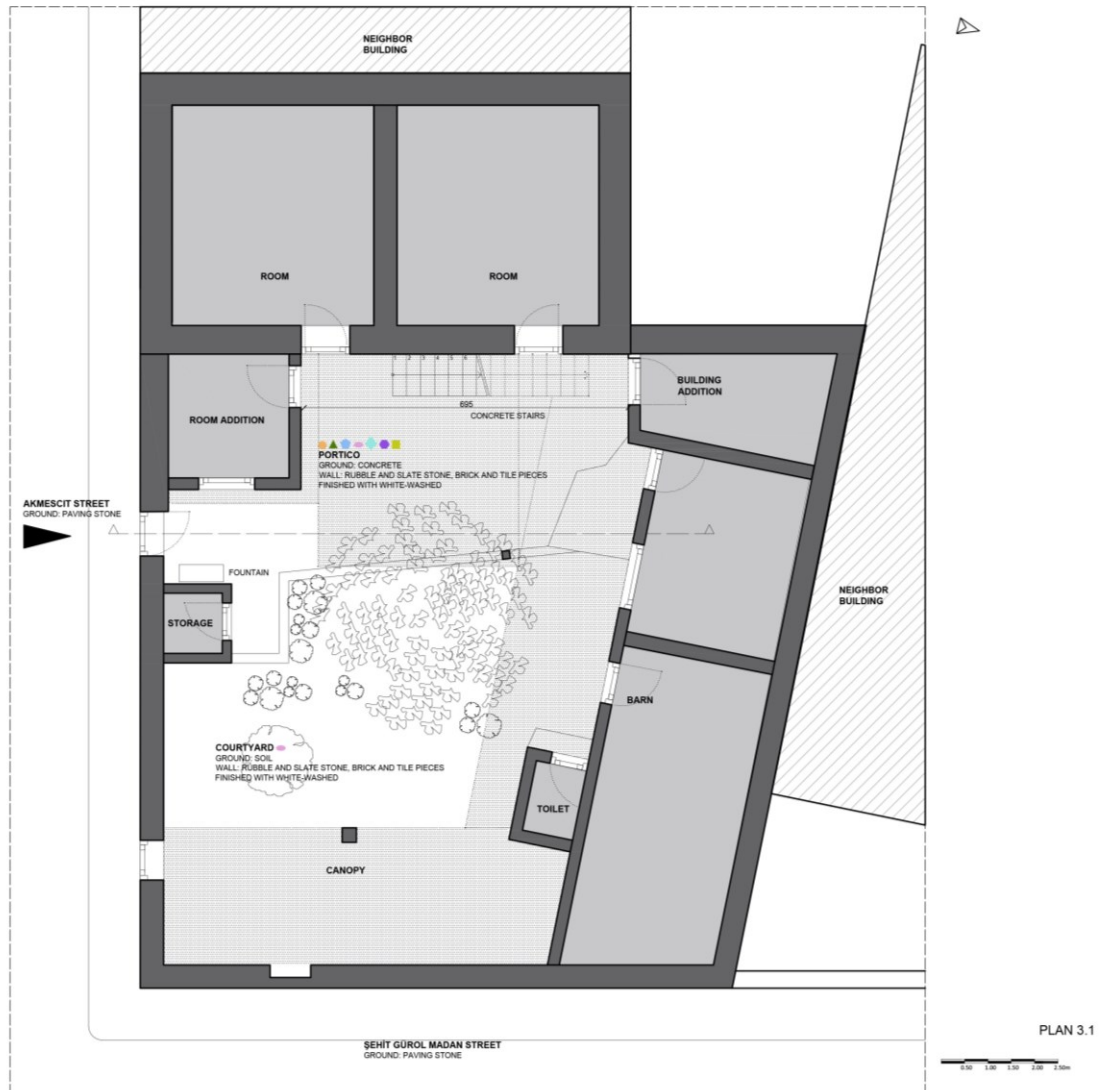


Figure 63. Ground floor plan of the case 3 in the current state
(Source: Prepared by Author 2022)



Figure 64. The portico (Photos taken by Author 2022)

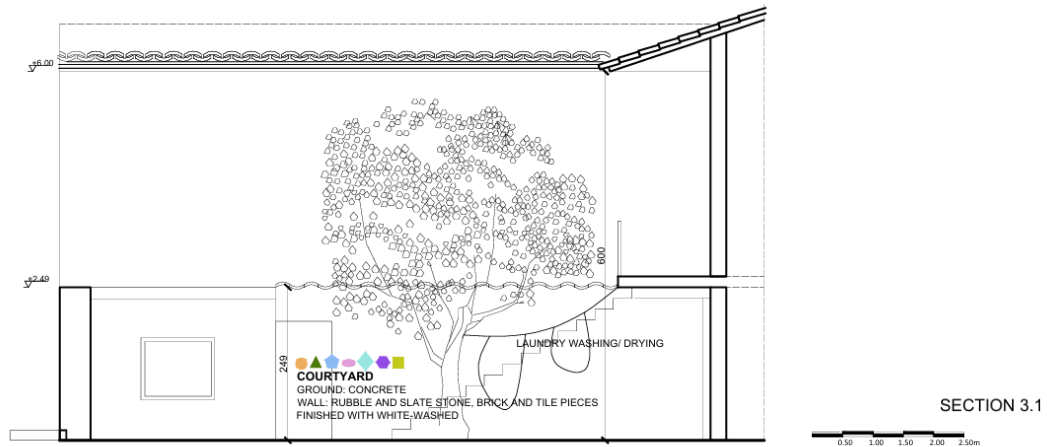


Figure 65. Cross section of the case 3 in the current state
(Source: Prepared by Author 2022)

The courtyard is 104 m². There are additions that have diminished the size of the courtyard: a building addition (13 m²) at the northwest, a barn (55m²) at the north, a room addition (9m²) at the southeast, a canopy (24.5m²) at the east, and a toilet (2.7m²) is in the north. The old toilet (2.5m²), which is used as a storage, is at the south of the courtyard. In the authentic state, the courtyard was more spacious 176m².

The gate of the courtyard is single-leaf and wooden. It has an over and under tile roof. There is a contemporary fountain and a storage on the right of the gate.

The walls of the courtyard have preserved their authenticity slate stone, brick, and tile pieces, put together with mortar and reinforced with wooden beams. The height of the wall was increased with the construction of the additional structures. This additional wall portion is white-washed from the inside of the courtyard (Figure 66).



Figure 66. The entrance of the case 3 and its street façade
(Photos taken by Author 2022)

There is a portico in the entrance of the main building. Its walls are plastered and white-washed. The finishing of its ground is screed. There is reinforced concrete stairs at the west. Access to the upper floor of the building at the west is provided with these stairs. There is a table and chairs in the portico. Resting and eating are the activities of the space.

Location of the barn at the north. The total height of the barn and the upper floor of the barn is almost the same as the width of the courtyard. Natural ventilation has decreased after the barn and the upper floor of the barn was added (Figure 67).

There is a canopy at the east of the courtyard. There is a fireplace in this semi-open place (canopy). Cooking and storing are the activities of the canopy (Figure 68).



(a)

(b)

(c)

Figure 67. (a) The building addition, (b) the concrete stairs and (c) the barn

(Photos taken by Author 2022)

The ground covering is compacted earth in the courtyard. There are fruit trees, ivy, flowers, and vegetables in the courtyard. Gardening, washing and drying laundry, washing and drying dishes and drying foods are the activities of this area (Figure 68) (Figure 69) (Figure 70).



Figure 68. The fireplace (left) and the courtyard (right) (Photos taken by Author 2022)

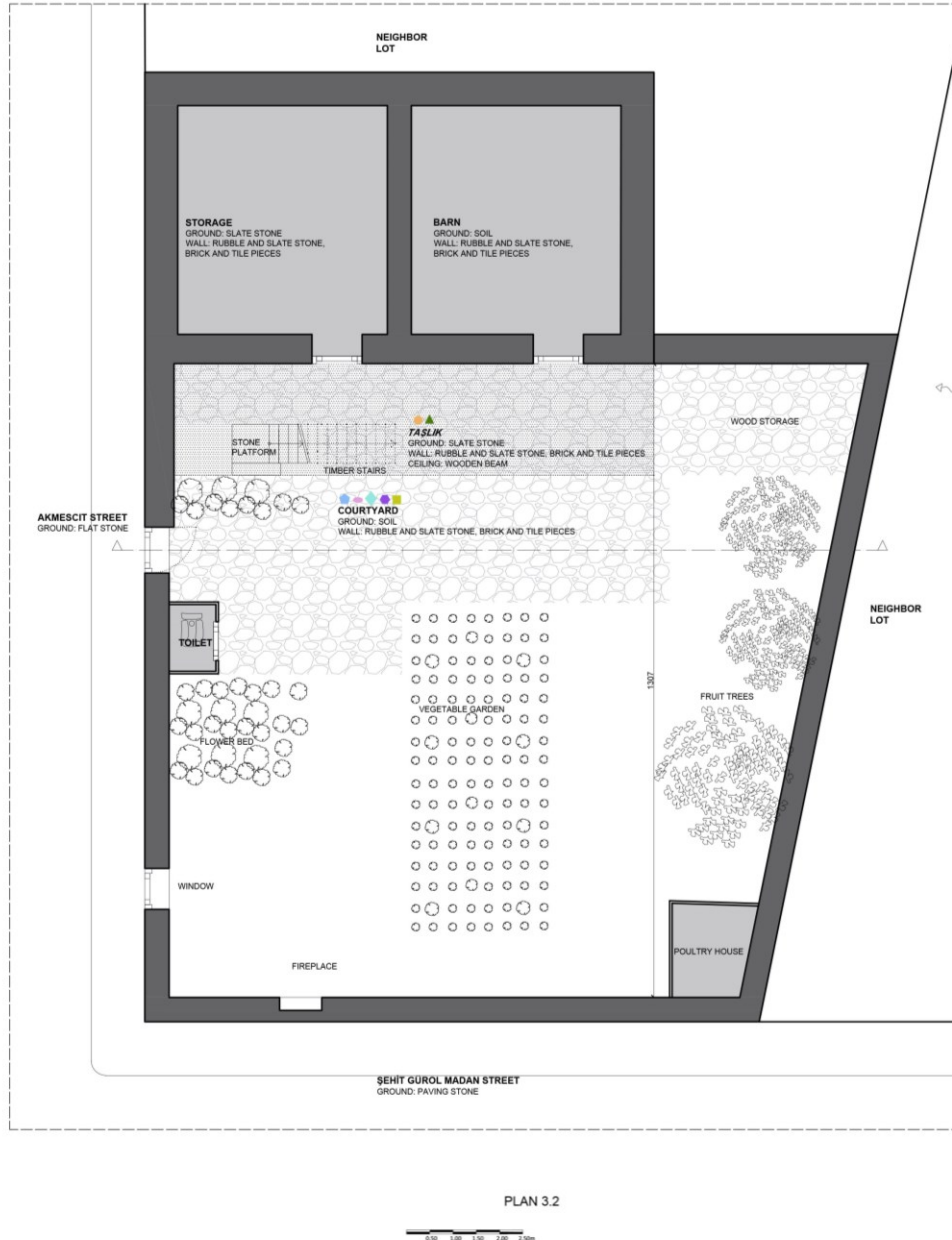


Figure 69. Ground floor plan of the case 3 in the authentic state
(Source: Prepared by Author 2022)

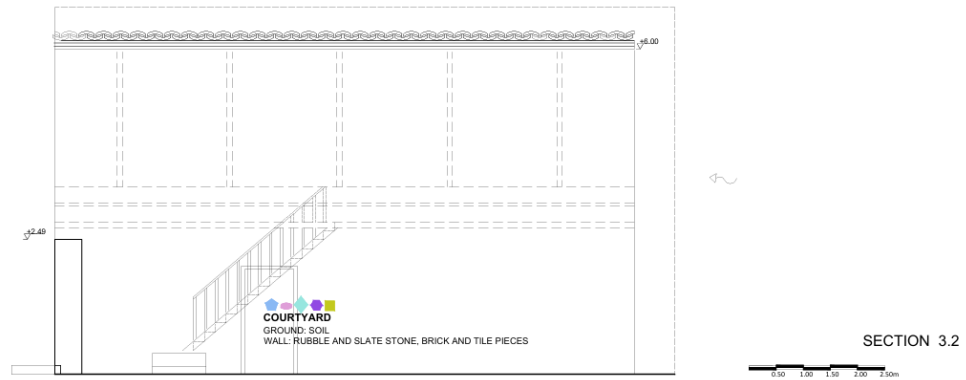


Figure 70. Cross section of the case 3 in the authentic state
(Source: Prepared by Author 2022)

The amount of the courtyard ground directly exposed to the sunlight today is 29 m² in the summer noons and 6 m² in the winter noons. It was 111 m² in the summer noons and 69 m² in the winter noons before the mass additions. Also, portico and canopy additions block summer sun to enter completely the courtyard. The amount of the courtyard ground directly exposed to sunlight today is 15 m² in the summer mornings. It was 93 m² in the summer morning previously. The courtyard ground has not ever been exposed to sunlight today in the winter mornings because of the high courtyard wall (Figure 71).

CURRENT STATE		AUTHENTIC STATE	
TOTAL AREA : 104 M ²		TOTAL AREA : 200 M ²	
			
SUMMER SUN - MORNING (08.30)	15 M ²	SUMMER SUN - MORNING (08.30)	93 M ²
WINTER SUN - NOON (12.30)	6 M ²	WINTER SUN - NOON (12.30)	69 M ²
SUMMER SUN - NOON (12.30)	29 M ²	SUMMER SUN - NOON (12.30)	111 M ²
DIFFERENCES AMOUNT OF SUN BETWEEN 3.1 AND 3.2			
SUMMER SUN - MORNING (08.30)	93 M ²	- 15 M ²	= 78 M ²
WINTER SUN - NOON (12.30)	69 M ²	- 6 M ²	= 63 M ²
SUMMER SUN - NOON (12.30)	111 M ²	- 29 M ²	= 82 M ²

Figure 71. The amount of illumination in the case 3 (Source: Prepared by Author 2024)

The northern air flows are blocked by additions at the north in summers. The south wind comes from the upper of the courtyard walls to the courtyard in winters. Hot air rises up the courtyard as the plants here are watered and the courtyard is washed in the summers. The airflow was from the north to the courtyard, then to the *hayat* and to the elevated roof. The airflow decreased because of the building was added to the north of the courtyard. The closing of *hayat* and the elevated roof with walls also restricted the natural ventilation. Airflow from south decreased because the additional structure added on the courtyard wall (Figure 72) (Figure 73).

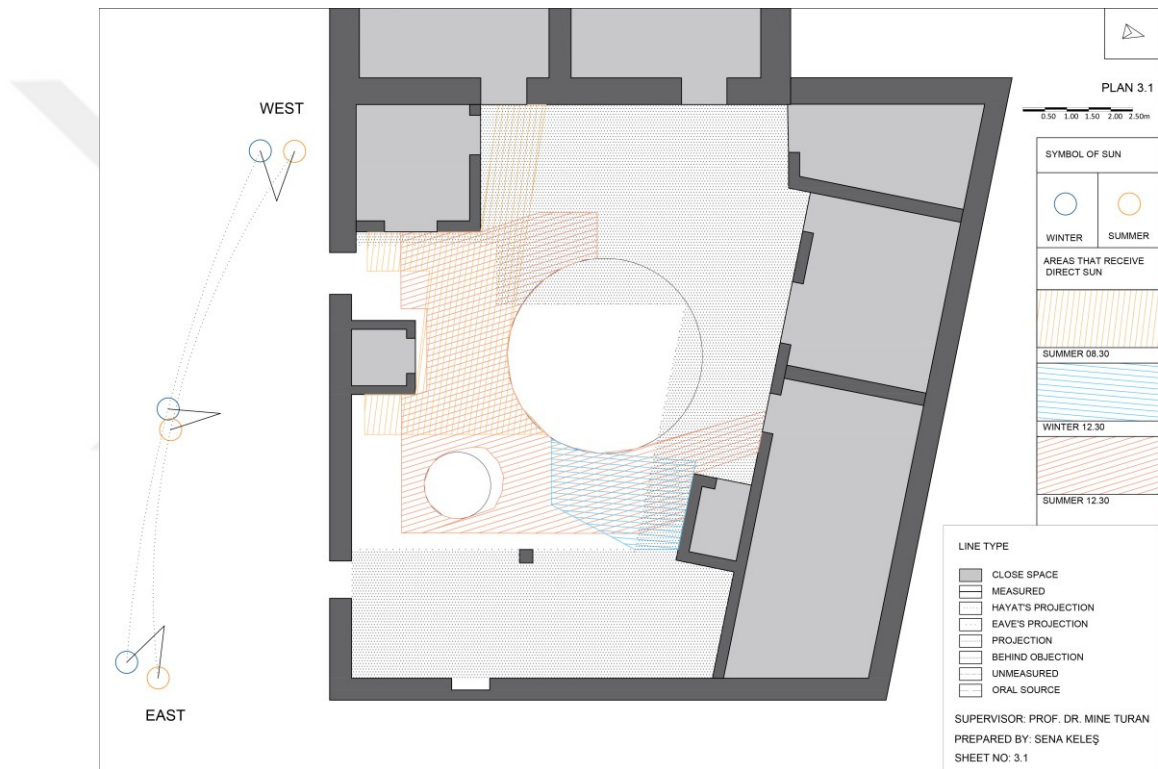


Figure 72. The amount of illumination in the plan for the current state in the case 3
(Source: Prepared by Author 2024)

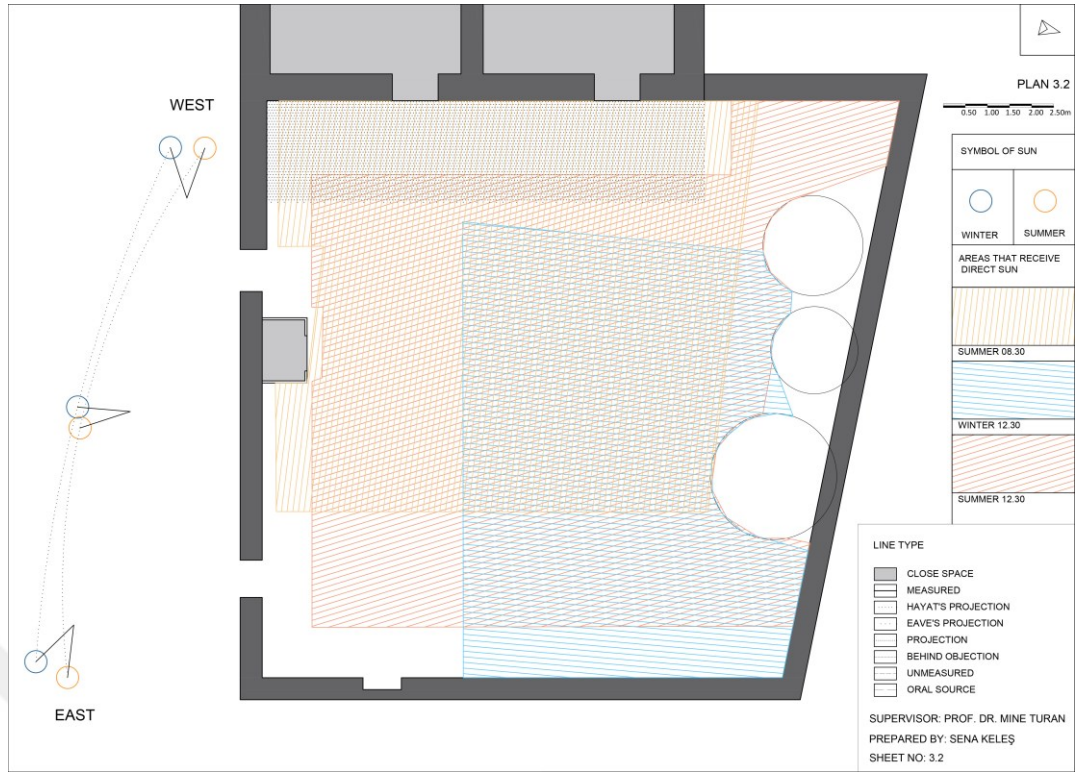


Figure 73. The amount of illumination in the plan for the authentic state in the case 3
(Source: Prepared by Author 2024)

3.4. Case 4: The Courtyard in Block 350/ Lot 4

The case 4 is at the altitude of 369 meters. The lot of the courtyard is flanked by two neighboring lots at its west and east. The form of the lot is trapezoid. The lot coverage is 343.3 m². The lot comprehends the main building, the annex, the bottom portion courtyard, the upper portion courtyard, and two additional masses. The main building is at the southwest and the annex is at the southeast, there is a courtyard between them. The form of the courtyard is L-shape and this courtyard has two different levels. The circulation system is from the secondary street (Kocaçeşme) to the *taşlık* through a gate at the south, then to the courtyard and finally to the closed spaces (Figure 74).



Figure 74. Location of the case 4
(Source: Revised from Parsel Sorgu 2024)

The courtyard has two different levels: the bottom and the upper portions (164.5 m²). There is the *taşlık* of main building (22.5 m²) at the southwest of the courtyard, a contemporary pool next to the garden wall, a toilet (6 m²) next to annex wall at the east, the *taşlık* of annex (39 m²) at the southeast of the courtyard, and a contemporary fountain, and fruit trees are at the south of the courtyard. There is a mass addition (19 m²) at the northwest, a canopy at the Northeast, flower pots at the north next to courtyard wall and in the middle next to garden wall, a fireplace at the north and under the canopy. In the authentic state, the bottom portion courtyard and the upper portion courtyard were more spacious (180.5 m²). The area of the bottom portion courtyard decreased after the toilet was added. The area of the upper portion courtyard decreased after the mass addition (19 m²) and canopy addition (Figure 75).

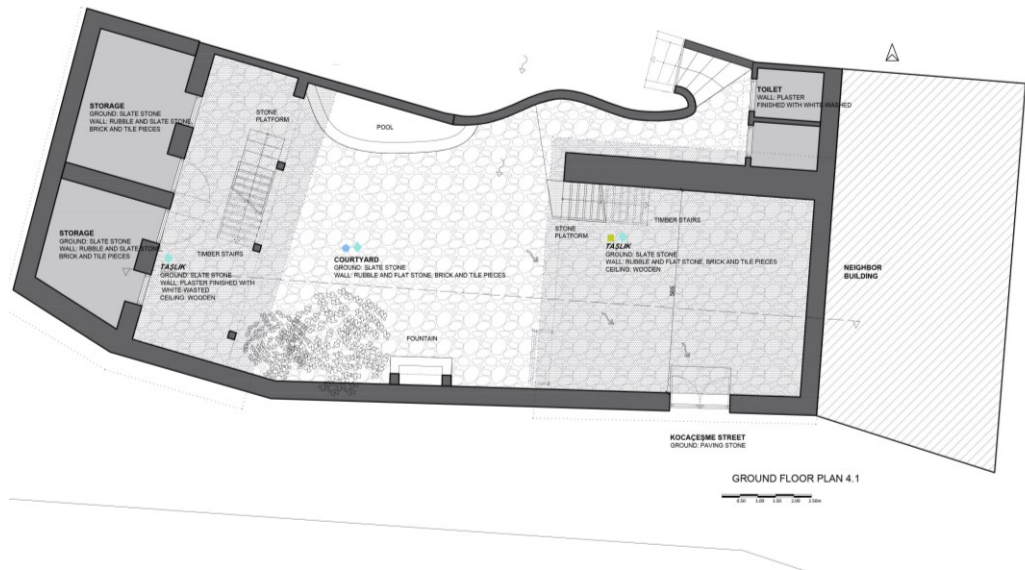


Figure 75. The bottom portion plan of the courtyard in the case 4 in the current state
(Source: Prepared by Author 2023)

The courtyard walls have preserved their authenticity slate stone, brick, and tile pieces, put together with mortar, reinforced with wooden beams and crowned with tiles (Figure 76). The wall between the two courtyards and flower pots were built with rubble stone and mortar (Figure 77) (Figure 78).



Figure 76. Courtyard walls in the case 4 (Photos taken by Author 2022)



Figure 77. The upper portion plan of the courtyard in the case 4 in the current state
(Source: Prepared by Author 2024)

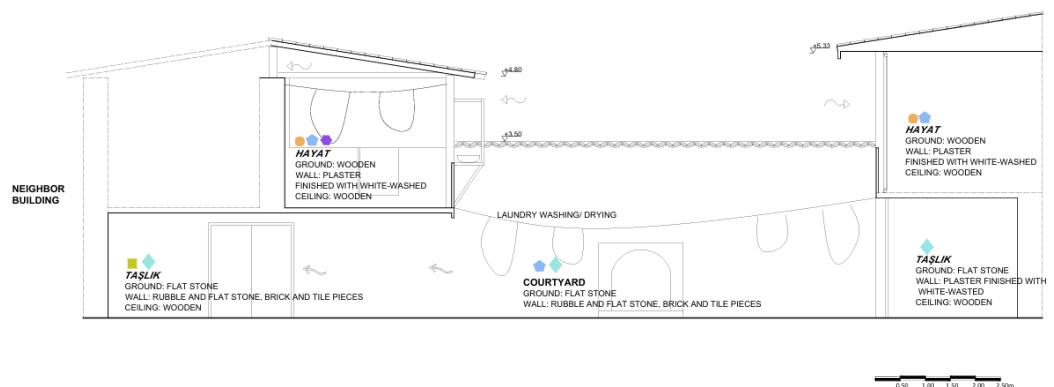


Figure 78. Section of the case 4 in the current state (Source: Prepared by Author 2024)

The ground covering of the courtyard is slate stone and it is preserved throughout the courtyards and semi-open spaces.

Washing and drying laundry are the activities of the courtyard at the bottom portion. There is a swing, a table and chairs at the upper portion. Resting and eating are the activities realized here (Figure 79).



Figure 79. The ground level courtyard (left) and the upper level courtyard (right)
(Photos taken by Author 2022)

The *taşlık* of the main building and the *taşlık* of the annex are preserved. There are stone steps and timber stairs between the *taşlıks* and the *hayat*'s at their upper levels. The *hayat* of the main building is closed with glass panels. The *hayat* of the annex is preserved and this *hayat* has *abdestlik*. The wall of the *taşlık* in the main building is plastered and white-washed. There is a ceramic pot and wardrobe in the *taşlık* of the main building. Storing is the basic activity realized in the *taşlık*. The wall of the *taşlık* in the annex has preserved its authenticity slate stone, brick, and tile pieces put together with mortar exposed without plaster and paint. The *taşlık* of the annex is used as an entrance space (Figure 80). At the same time, cutting and storing wood, and doing hobbies are realized (Figure 81) (Figure 82) (Figure 83).



(a)

(b)

(c)

Figure 80. (a) The *taşlık* of the annex and (b) (c) the *hayat* of the annex

(Photos taken by Author 2022)

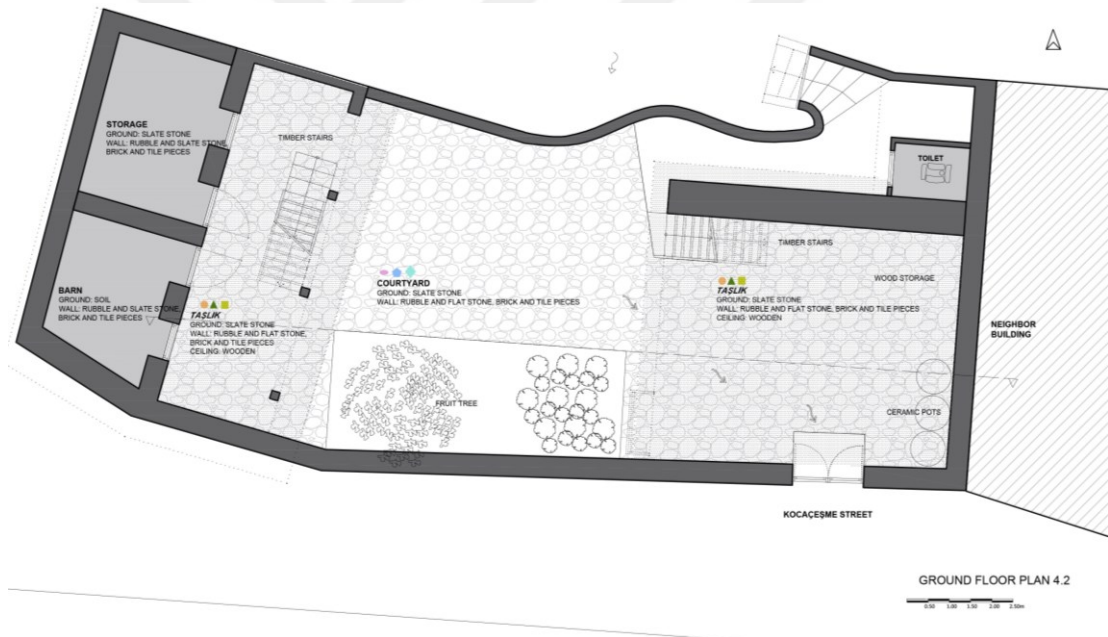


Figure 81. The bottom portion plan of the courtyard in the case 4 in the authentic state

(Source: Prepared by Author 2023)

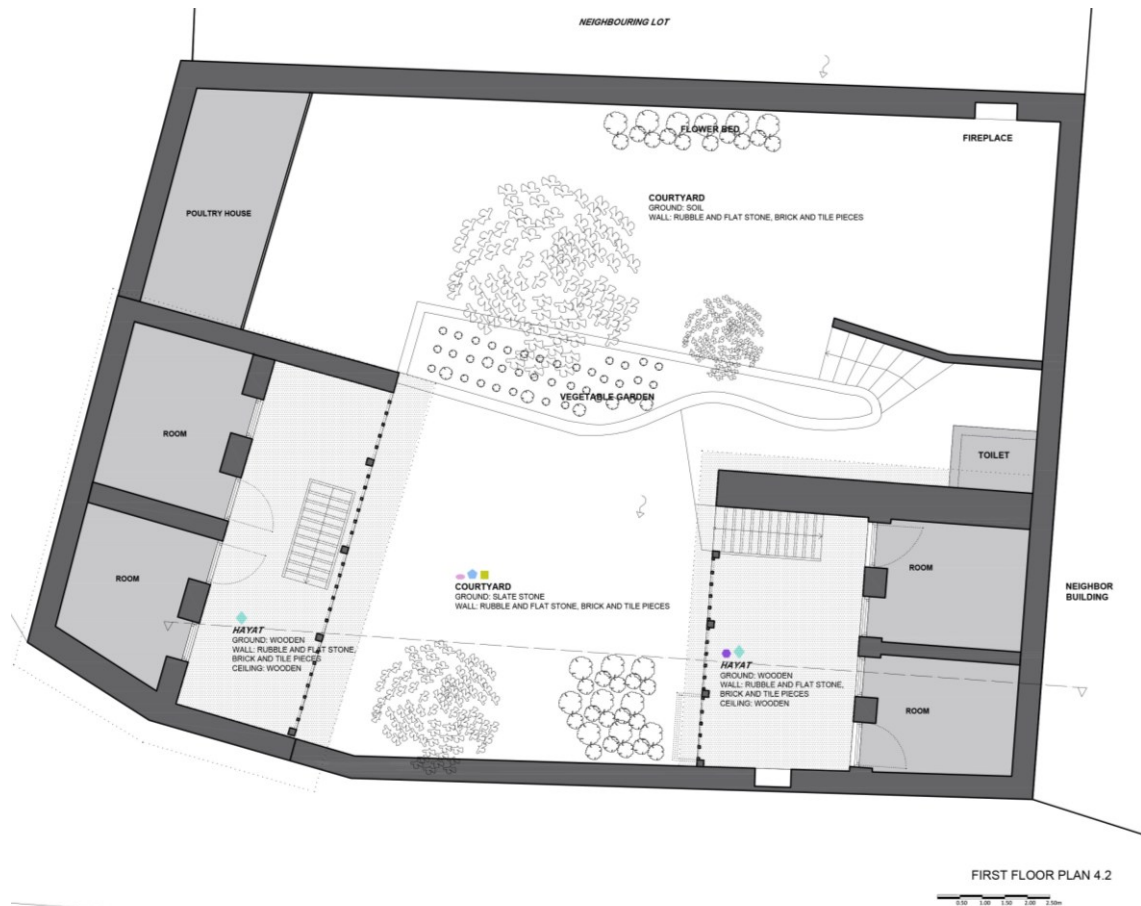


Figure 82. The upper portion plan of the courtyard in the case 4 in the authentic state
(Source: Prepared by Author 2023)

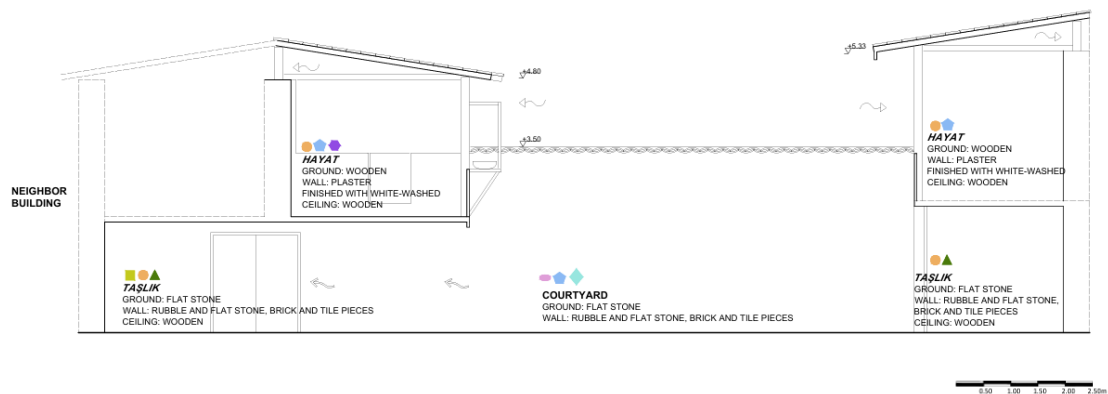


Figure 83. Section of the case 4 in the authentic state
(Source: Prepared by Author 2023)

The area of the bottom portion ground and the upper portion courtyard directly exposed to the sunlight today is 78 m² in the summer noons. The area of the bottom

portion courtyard and the upper portion courtyard ground directly exposed to sunlight today is 39.5 m² in the winter noons. The area of the bottom portion courtyard and the upper portion courtyard ground directly exposed to sunlight today is 46 m² in the summer mornings. The courtyard ground is not directly exposed to sunlight today in the winter mornings since the courtyard wall blocks it (Figure 84).

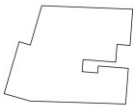
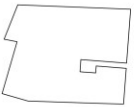
CURRENT STATE		AUTHENTIC STATE	
TOTAL AREA : 226 M ²		TOTAL AREA : 252 M ²	
			
SUMMER SUN - MORNING (08.30)	46 M ²	SUMMER SUN - MORNING (08.30)	80.5 M ²
WINTER SUN - NOON (12.30)	39.5 M ²	WINTER SUN - NOON (12.30)	61.5 M ²
SUMMER SUN - NOON (12.30)	78 M ²	SUMMER SUN - NOON (12.30)	108 M ²
DIFFERENCES AMOUNT OF SUN BETWEEN 4.1 AND 4.2			
SUMMER SUN - MORNING (08.30)	80.5 M ²	- 46 M ²	= 34.5 M ²
WINTER SUN - NOON (12.30)	61.5 M ²	- 39.5 M ²	= 21 M ²
SUMMER SUN - NOON (12.30)	108 M ²	- 78 M ²	= 30 M ²

Figure 84. The amount of illumination in the case 4 (Source: Prepared by Author 2024)

In the authentic state, the amount of sunlight was 108 m² in the summer noons and 61.5 m² in the winter noons, since there were no service masses. The area of the bottom portion courtyard and the upper portion courtyard ground directly exposed to sunlight was 80.5 m² in the summer mornings (Figure 85) (Figure 86).

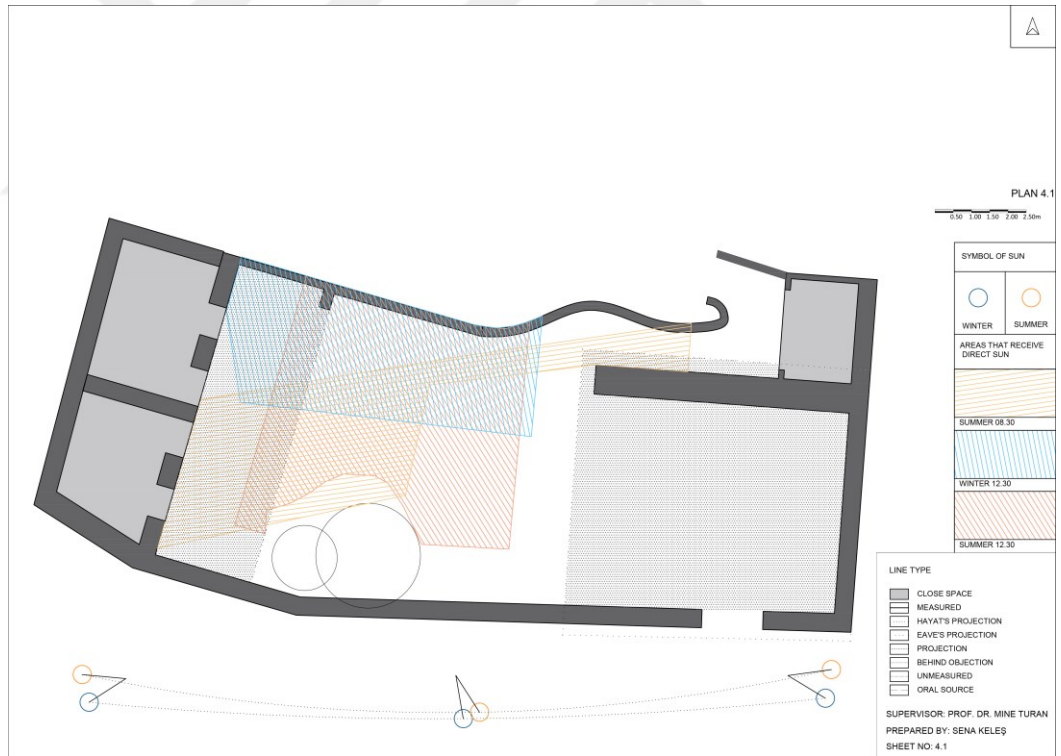
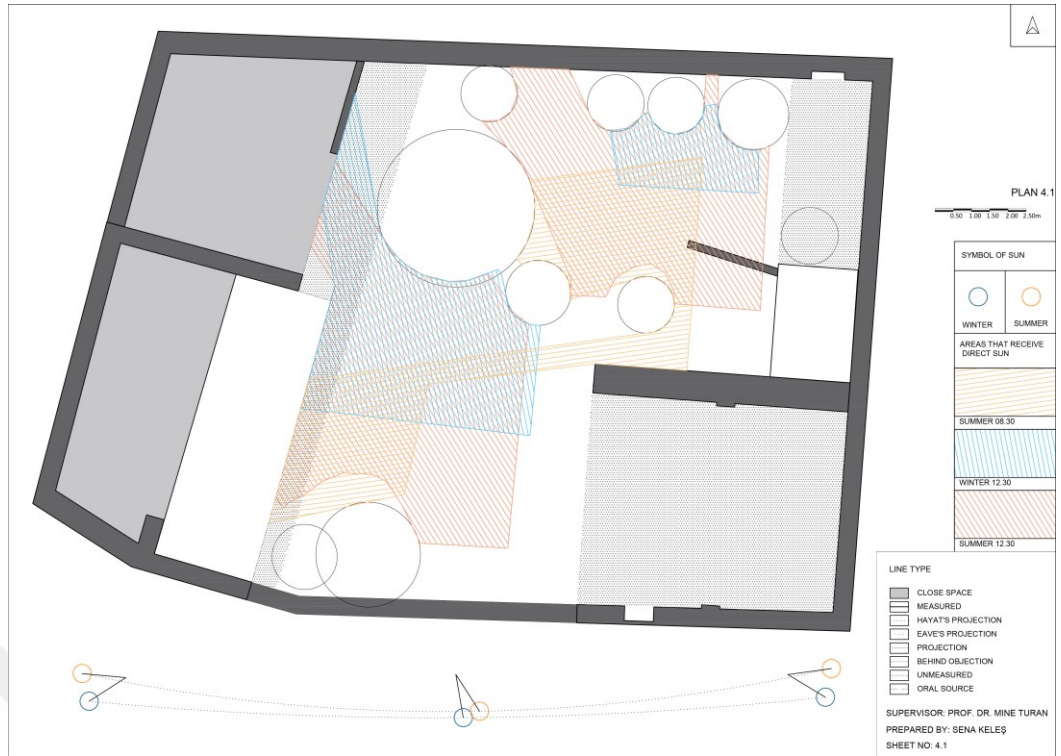


Figure 85. The amount of illumination in the plan for the current state in the case 4
(Source: Prepared by Author 2024)

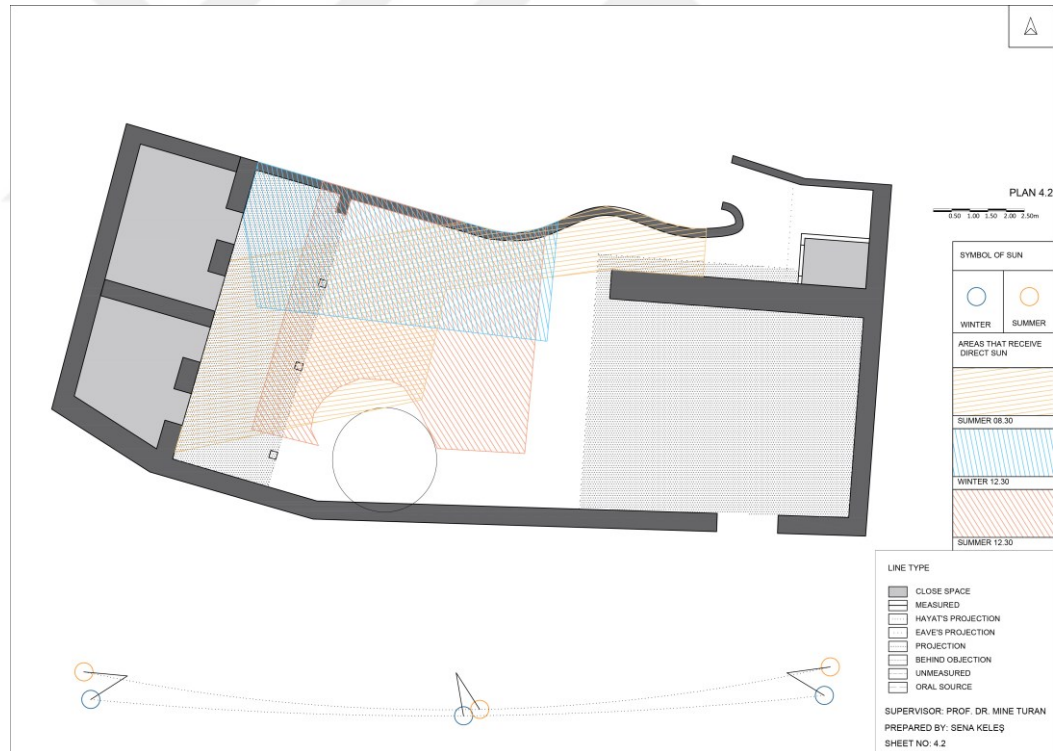
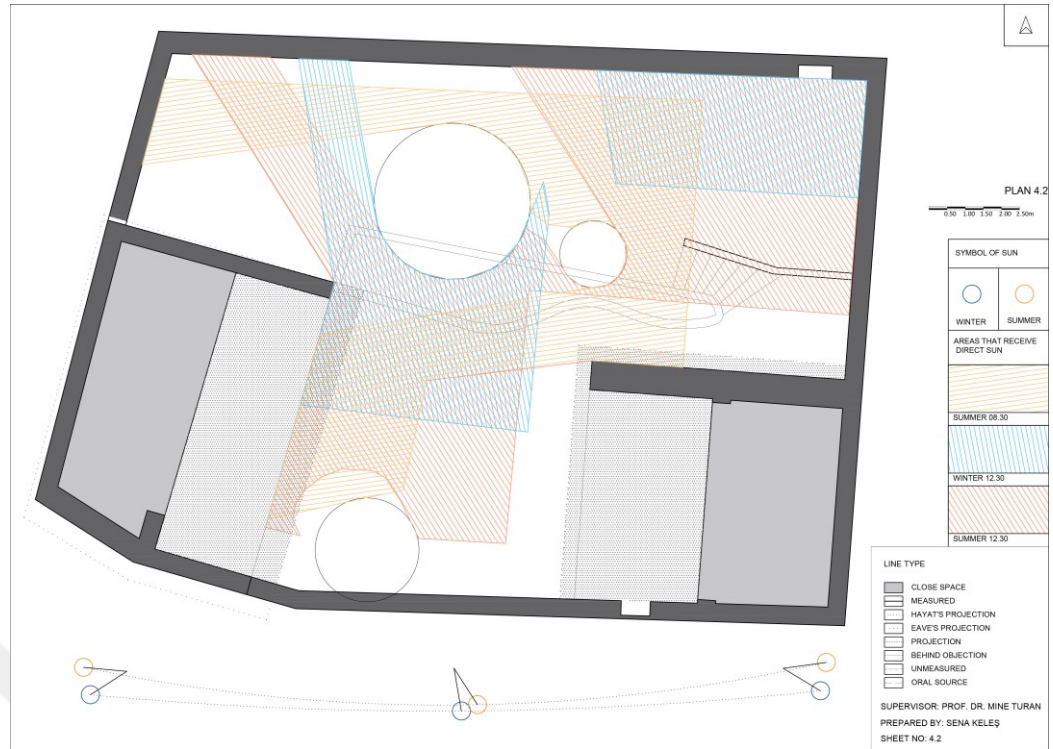


Figure 86. The amount of illumination in the plan for the authentic state in the case 4
(Source: Prepared by Author 2024)

The northern wind comes from the upper of the courtyard wall to the courtyard, through to the *hayat* then to the elevated roof of the annex and the northern wind comes

from the upper of the courtyard wall to the courtyard, through to the *taşlık* of the annex then to the gate. The southern wind comes from the upper of the courtyard wall to the courtyard or the southern wind comes from the gate to the *taşlık* and to the courtyard. Evaporation of water the fountain basin, the pool and the watered garden during summer days decrease the temperature on the courtyard surfaces, and creates an airflow between the courtyard, the *taşlık* and the *hayat*.

In the authentic state, the northern wind came to the courtyard, through the *hayat* of the annex and the main building, then it moved to the elevated roof of the annex and the main building. Watering of the courtyard was a tradition that helped cooling of the spaces in the summers (Figure 87).



Figure 87. The contemporary fountain (left) and pool (right) in the case 4
(Photos are taken by Author 2022)

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter, the results for the locations, forms, areas, ratios of edges, ratios of height of the courtyard walls and the depths of the courtyards, activities, elements, material usages, illumination and ventilation amounts are presented for each case considering their current and authentic states. Comparison between the authentic and current states, and also among the cases is made.

4.1. Location

All of the four studied cases are in the *Kurtgazi* neighborhood. Birgi river flows in the northeast-southwest direction and they are at the northwest of the *Birgi* river. So, they are oriented to the southeast (Figure 88).



Figure 88. Location of the case studies (Source: Revised from Google Earth 2024)

The land slope in the *Kurtgazi* neighborhood varies between 4 and 33% at the Northwest–Southeast direction. The studied cases are between *Birgi* river and the crest of

the *Boz* Mountains, and the studied cases are close to the *Birgi* river. The land slopes of the cases are 21% (case 1), 18% (case 2), 12% (case 3), and, 11% (case 4). The altitude of the cases is between 368 meters and 395 meters (Figure 89).



Figure 89. The slope of the case studies (Source: Revised from Google Earth Pro 2024)

The lots of the studied cases are at the corner of their building blocks in 2 out of 4 cases (case 2 and case 3). The other two lots are flanked by neighboring lots on their two sides. The courtyards are at the southeast of the lots in case 2, at the northeast in case 1, and at the north in the upper courtyard of the case 4, and at the south case 3 and the ground level courtyard of the case 4 of the lots.

Access to the housing units is from the street to the *taşlık* in 1 out of 4 cases (case 4), and in the others, its from the street to the courtyard.

4.2. Form

Three different courtyard forms are seen at present: rectangle plan (case 1), U plan (case 2) and trapezoid plan (case 3, and case 4). In three cases, a *taşlık* is observed. Rectangle plan is the common plan type in 2 out of 3 *taşlıks* (case 1 and case 2). One has trapezoidal plan (case 4).

The organic pattern of the settlement is defined by irregular lot forms and meandering streets. Therefore, in the authentic state, trapezoidal planned courtyards were seen 2 out of 4 courtyards (case 3, and case 4). Rectangular plan was also seen in 2 out of 4 courtyards (case 1, and case 2). Rectangular plan was the characteristic of the *taşlıks*: 3

out of 4 (case 1, case 2 and case 3). Trapezoidal plan was considered only in the 1 out of 4 *taşlık* (case 4).

4.3. Area

The current areas of the courtyards are 34.5m² (case 1), 78m² (case 2), 104m² (case 3), and 164.5m² (case 4) respectively. In the authentic state, they were 39m² (case 1), 109.5m² (case 2), 176m² (case 3), and 180.5m² (case 4). The large courtyard area is used in two stages on sloping land in case 4. Mass additions (kitchen, toilet, etc.) and building additions have decreased the size of the courtyards.

The current areas of the *taşlıks* are 24m² (case 1), 30m² (case 2), 22.5m² (main building of case 4), 39m² (annex of case 4). In the authentic state, they were 42m² (case 1), 26m² (case 2) and 24m² (case 3). The area of the *taşlıks* of the case 4 have been preserved.

4.4. Ratio of Length to Width

As the length is the long edge of the courtyard and the width is the short edge of the courtyard. The lengths of the courtyards in the case 4 (the bottom portion) have preserved its length to width ratios: 1.1. In the current state, the ratio of lengths to widths is between 1.1 and 1.5 in the case 1, case 2, case 3, and upper portion of case 4. In the authentic state, these ratios were between 1 and 2.3 (Table 2).

Table 2: The ratio of length to width (Source: Prepared by Author, 2024)

	CASE 1	CASE 2	CASE 3	CASE 4
(L/W) Current state	1.5	1.4	1.5	1.1 (bottom) 1.3 (upper)
(L/W) Authentic state	2.3	1.8	1	1.1 (bottom) 2 (upper)

4.5. Ratio of Height of Courtyard Wall at North to Depth

The ratios of the heights of the courtyard walls (at the north) to the related depths are less than 1 in all of the courtyards excluding case 3 in the current state. The ratios of all of the cases were less in their authentic state, excluding case 4. Since the kitchen was added in the case 1, the room addition was added in the case 2, the courtyard wall was moved and the building addition was added at the north of the case 3. In the case 4, the authentic ratio has been preserved because the courtyard walls which are at the north and depths were not altered (Table 3).

Table 3. The ratio of the height of the courtyard walls at north to the depths
(Source: Prepared by Author, 2024)

	CASE 1	CASE 2	CASE 3	CASE 4
H/D Current state	0.6	0.4	1	0.3
H/D Authentic state	0.3	0.2	0.2	0.3

4.6. Ratio of Depth to Height of Courtyard Wall at South

The ratio of the perpendicular depths of the south edge of the courtyards to the height of the south courtyard wall is more than 2 in most of the cases: case 2, case 3 and case 4. It is around 2 in the case 1, indicating a problem in terms of natural illumination. The ratios of case 2 and case 4 have preserved, since the height of the courtyard walls and the depths were not changed with additions. In other cases, their ratio were more in the authentic state because the height of the courtyard walls were less height in case 3, and the depth were more in case 1 (Table 4).

Table 4. The ratio of the depths to the height of the courtyard walls at south

(Source: Prepared by Author, 2024)

	CASE 1	CASE 2	CASE 3	CASE 4
D/H Current state	2.1	5.5	3.3	3.5
D/H Authentic state	3.4	5.5	5.6	3.5

4.7. Activities and Spaces

At the ground level of a Birgi house, the courtyard is a three-dimensional datum element of the spatial organization. The *taşlık*, the service spaces at the ground level of the main building, the *hayat* at the upper level of the main building, and the ground levels and the roofs of the annexes are arranged around it. There are daily and seasonal activities realized in the courtyard and the surrounding spaces. There are seven different categories of daily and seasonal activities: resting, eating, doing hobbies, washing and drying laundry, washing and drying dishes, drying and preparing food and, storing and cutting wood (Figure 90).



Figure 90. (a) Washing dishes and (b) (c) drying food in the case 2

(Photos taken by Author 2022)

In the current state, washing and drying laundry, and doing hobbies such as planting indigenous flowers such as roses, velvet flower are seen in all of the cases. Drying fruits and vegetables such as tomatoes and eggplants, storing and cutting wood are also outstanding activities (3 out of 4, excluding case 1). Mass additions restrict a courtyard's usage for example, in the case 1, the balustrades of the *Hayat* are used for drying vegetables; the street portion in front of the gate is used for cutting wood. Washing and drying dishes are sometimes seen: case 2 and case 3. Either mass additions (case 1) or the *hayat* (case 4) are used for washing and drying dish, if there are limitations in the courtyard. The ground level closed spaces of the main building are used for storage of food or wood, room or kitchen. The annex is used for room. Their flat roofs are used for drying foods such as peppers, eggplants, tomatoes sauces (Figure 91).

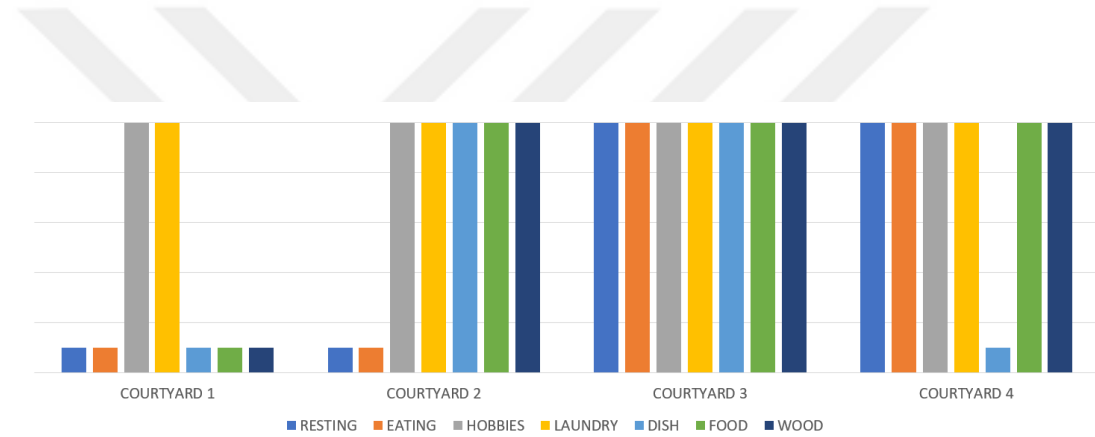


Figure 91. The existence of daily and seasonal activities in courtyards in the current state (Source: Prepared by Author 2024)

At the current state, three buildings out of four buildings have *taşlıks* (case 1, case 2 and case 4). Other case closed their *taşlıks* by building wall (case 3). Resting and eating are outstanding activities in the *taşlıks* (2 out of 3). The function of the *taşlık* was changed by the new owner of the case 4 as hobby space (repairing of objects) (Figure 92).

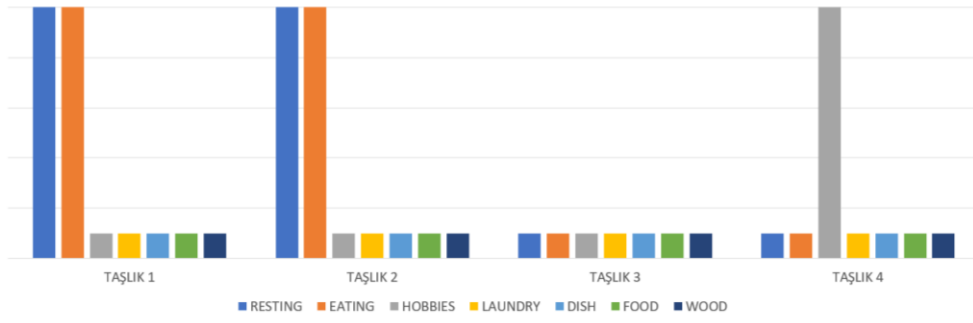


Figure 92. The existence of daily and seasonal activities in *taşlıks* in the current state
(Source: Prepared by Author 2024)

In the authentic state, washing and drying laundry, drying fruits and vegetables, storing and cutting wood, and doing hobbies (gardening) were outstanding activities in all of the courtyards. *Taşlıks* were used for resting and eating. *Hayats* were used for washing and drying dishes. The closed spaces at the ground level of the main mass were used for storage and barn. Annexes were used for the room. The flat roofs of the annexes were used for drying foods or laundry.

4.8. Elements

The elements of the courtyards and related spaces are architectural elements and green elements.

4.8.1. Architectural Elements

In the current state; timber stairs, stepping stones and ceramic water pots are represented in 2 out of 4 cases: case 1 and case 4 (Figure 93). In these cases, the location of ceramic water pots was changed and the usage of water pots was changed after the establishment of the fresh water infrastructure. Ceramic water pot are used for decorative purpose instead of storing water. In other cases, timber stairs were converted into concrete ones (2 out of 4, cases: case 2, and case 3). In the half of the cases (cases 2, and case 3),

hayat and *abdestlik* are not represented. *Abdestlik* is represented in only one case: case 4 (Figure 94). Although *Hayat* is sustained *abdestlik* is not in case 1.



Figure 93. (a) Stepping stone, (b) timber stair and (c) *hayat* in the case 1
(Photos taken by Author 2022)



Figure 94. *Abdestlik* in the case 4 (Photos taken by Author 2022)

A flower pot is seen only in one courtyard: 4. A new flower pot was constructed by the gate in the street side by the owner of the first case, using the slate stones. The owners have constructed flower pots in the courtyards with new material: pavement stone, concrete etc. in all cases except case 4 (Figure 95).



Figure 95. Flower pots in the case 4 (left) and case 1 (right)
(Photos taken by Author 2022)

There are new fireplaces and fountains in all of the courtyards. There are often drainage channels in the courtyards: the cases 1, case 3 and case 4 (3 out of 4). Surface water flows out to the street through a pipe inserted into the courtyard wall: case 3 (Figure 96). In the other cases, water does not drain to the street. There are stone channels on the street. Fireplace, fountain, concrete stairs, pool, concrete flower pot, benches, tables and hoses are contemporary elements of the courtyards.



Figure 96. Drainage in the case 3 (Photos taken by Author 2022)

Wooden posts and lintels at the borders, wooden gates, wooden stairs, wooden *abdestlik*, stepping stones, ceramic water pots, drainage channel and flower pots are the authentic courtyard elements of Kurtgazi houses. Since embodied energy in wooden architectural elements are low the preference of wood in majority of the architectural

elements contributes to the sustainability through reducing overall warming (Falk, 2009). Fireplaces and fountains are not authentic in the current courtyards since ovens and fountains on the streets were shared by neighbors in the authentic state (Figure 97). Some ovens and fountains were preserved on the streets.



Figure 97. The oven on the Umurbey street (left) and the fountain (Bıçakçı fountain) on the Şehit Gürol Madan street (right) (Photos taken by Author 2022)

4.8.2. Greenery Elements

Greenery elements categorized for flowers, deciduous trees, which shed their leaves in winter and grow new leaves in summer, evergreen trees, which have green leaves throughout the entire year. Evergreen trees categorized for foliage-rich trees, which have densely leaves, and foliage-poor trees, which have sparsely leaves. In the current state, flowers (rose, climbing hydrangea, velvet flower), vegetables and fruits (tomato, gourd, pepper, watermelon, strawberry,), evergreen trees (citrus fruit tree, olive tree, plane tree, lemon tree) and ivies (grape vine) are common plants in all of the four courtyards. The number of flowers in case 2 and case 3 are more than in other cases. Deciduous trees (Japanese persimmon tree, fig tree, pomegranate tree, mulberry tree, linden tree, walnut tree) are rarely seen in the studied courtyards (Figure 98) (Figure 99).



Figure 98. Deciduous trees (a linden tree (left) and a pomegranate tree (right)) in the case 4 (Photos taken by Author 2024)

The number of deciduous trees in case 4 are more than in other cases. There are deciduous trees in the south part of the courtyard of the case 4, and deciduous ivies (grape vine) in the south part of the courtyards (cases 1 and case 3). There are evergreen trees in the south part of the courtyards (case 2) and in the central part of the courtyards (case 3, and case 4). The number of foliage-rich trees in case 4 is more than in other cases.

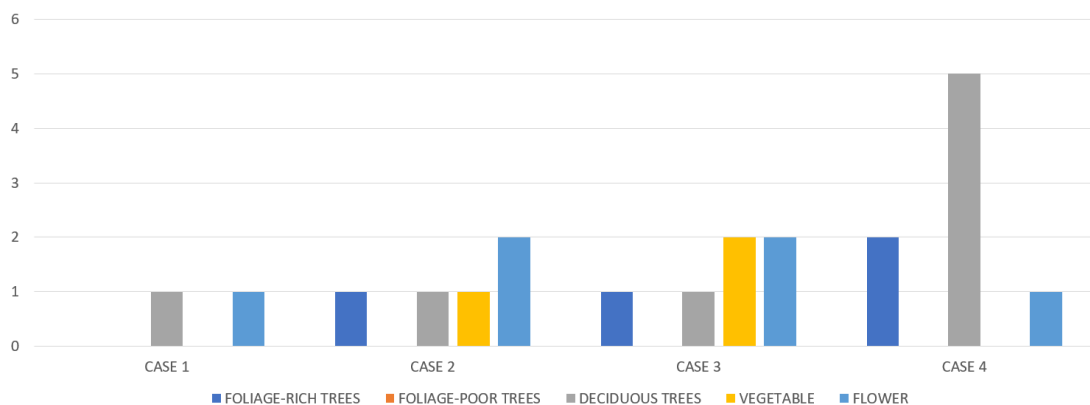


Figure 99. Green elements in the courtyards (Source: Prepared by Author 2024)
(X: Cases Y: Amount of the green elements)

In the authentic state, trees were chosen according to these categories for various purposes, such as providing seasonal shade or allowing sunlight, and the use of their fruits

and leaves. For example, the mulberry tree was chosen for reasons such as allowing sunlight in winter and its leaves being used for silkworm breeding. Other trees chosen for similar reasons were trees such as plum, almond, apricot, peach, cherry, pomegranate and loquat because they did not grow very large and produced fruit. Large trees such as plane tree and walnut were preferred in large courtyards or village squares. The use of trees in rows was not a common occurrence in courtyards (Wallace 2007).

4.9. Contribution to Continuous Urban Green Areas

The case 3 and case 4 contribute to the formation of continuous urban green areas since their green elements establish a continuity with those of the neighboring courtyards. However, the reduction of overall warming through continuation of green elements in open areas in neighboring lots and streets is not present in the half of the case 1, and case 2 since neighboring lots do not have green elements next to the green elements of the studied cases (case 1, and case 2).

4.10. Construction Technique and Material Usage

Materials in the finishing of courtyard and *taşlık* grounds, and in the courtyard walls are presented one by one in the below.

4.10.1. Finishing of the Ground

In the current state, three different materials are seen: slate stone, earth and screed. The original slate finishing is preserved in only one of the courtyards (case 4) and in two of the *Taşlıks* (cases 1 and 4). The rest of courtyards and *taşlıks* are finished with screed. Screed is seen especially at the entrances of the buildings and around of the fountains and toilets. Earth ground is left for fruits, vegetables and flowers in all of the courtyards. However, half of the open space is left as earth in only one of the courtyard (3). In the

majority, it is around 30% of the courtyards (cases 1, and 2) and around 10% in one courtyard (4) (Figure 100).

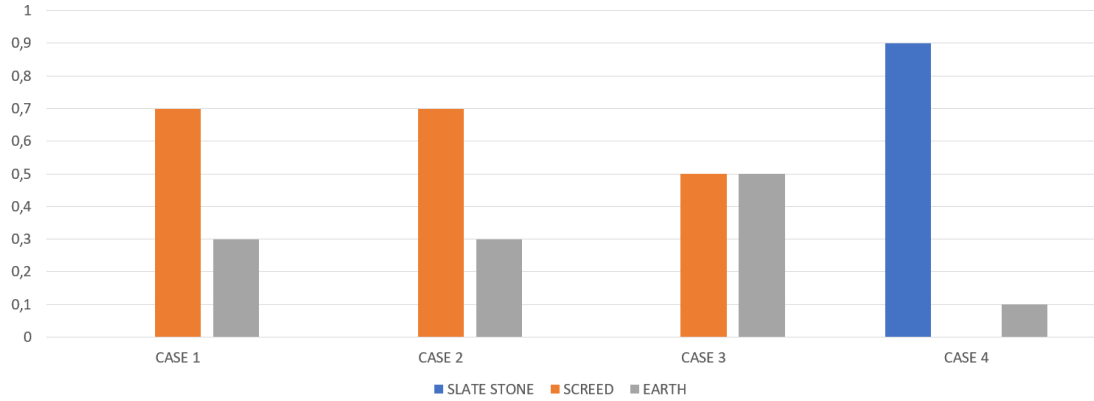


Figure 100. Percentage of the covering of the ground of courtyards and *taşlıks*
(Source: Prepared by Author 2024)

In the authentic state, slate stone was used as ground covering of courtyards and *taşlıks*. It is an indigenous material collected from the riverbed. Earth was used as ground covering of limited portions of the courtyards.

4.10.2. Courtyard Walls

All of the courtyard walls have preserved their authentic constructions: In the authentic state, all of the courtyard walls were exposed without plastering: their bonding out of rubble stone, slate stone, brick and tile pieces in lime-mud mortar bed were legible. However, the heights of courtyard walls were sometimes increased around one meters by piling up of wooden rafters along the long wall of the courtyards (2 out of 4, the case 3 and case 4) or using aerated concrete blocks (1 out of 4, case 1). These concrete blocks were also used to construct mass additions in the courtyards (case 1 and case 3). In the other courtyards, partial plastering and white-washed is seen around the entrance and in the areas close to the *taşlık*. The rest is exposed without plaster.

4.11. Illumination and Ventilation

In this section, the percentage of the illumination and the types of the ventilation are presented one by one for the studied cases.

4.11.1. Exposition to Direct Sunlight

In the current state, sun light reaches the courtyard ground during winter mornings and afternoons in none of the open and semi-open spaces. Sunlight reaches the courtyard grounds in summer and winter noons (12.30) In the mornings, due to the azimuth, long shadows of the courtyard walls cover the studied open and semi-open spaces. So, sunlight does not reach any of the studied courtyards.

All of the open and semi-open spaces receive more sunlight during summers. The courtyard and the *taşlık* of case 4 have the maximum area among the studied cases and it is exposed to direct sunlight at a maximum amount both in winters (39.5 m²) and in summers (78 m²). This is followed by the case 2 (19.5 m²), case 3 (6 m²), and the courtyard of the case 1 does not receive direct sunlight in the winters; and case 2 (40 m²), case 3 (29 m²), and case 1 (7.5 m²) in the summers. The case 2 has the best ratio of the depth to the height of courtyard wall at south. When the ratios of the area exposed to direct sunlight to the whole of the courtyard area are compared, the case 2 is the best in terms of receiving direct sunlight in winters (18 %) and in summers (37 %). This is followed by the case 4 (17 %) and case 3 (5 %), in the winters; case 4 (34 %), case 3 (27 %) and case 1 (12 %) in the summers (Figure 101).

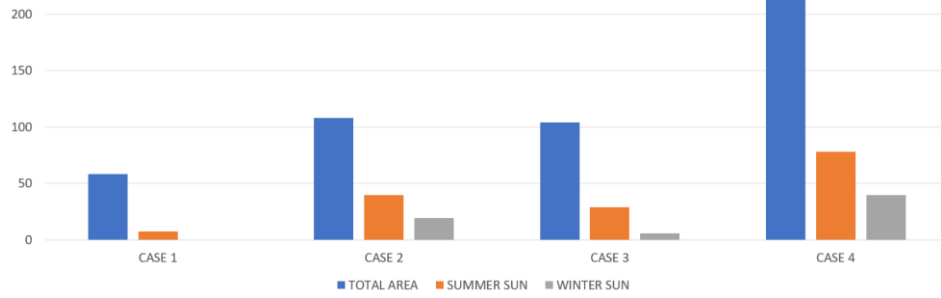


Figure 101. Amount of the area exposed to direct sunlight in the current state
(X: Cases Y: Meter square) (Source: Prepared by Author 2024)

All of the courtyards receive maximum sunlight in summers because sunlight coming to the courtyards with a larger angle compared to the winters can escape through the long eaves and courtyard walls. The Sun culminates at 27.77° altitude in winters (21st December) and 72.96° altitude in summers (21st June) at noons (12.30). Winter sun reaches to the *taşlıks* according to the orientation of the sun.

In the authentic state, the courtyard of case 3 (111 m²) was exposed to direct sunlight at maximum amount in summers. This was followed by case 4 (108 m²), case 2 (87 m²), and case 1 (17 m²). The courtyard of case 3 (69 m²) was exposed to direct sunlight at maximum amount in winter. This was followed by case 4 (61.5 m²), case 2 (44.5 m²), and case 1 (9 m²). When the ratios of the area exposed to direct sunlight to the whole of the courtyard area; the case 2 (64 %), case 3 (55 %), case 4 (42 %), and case 1 (20 %) in summers. The courtyard of case 3 was the best in terms of receiving direct sunlight in winters (34 %). This was followed by case 2 (32 %), case 4 (24 %) and case 1 (11 %) (Figure 102).

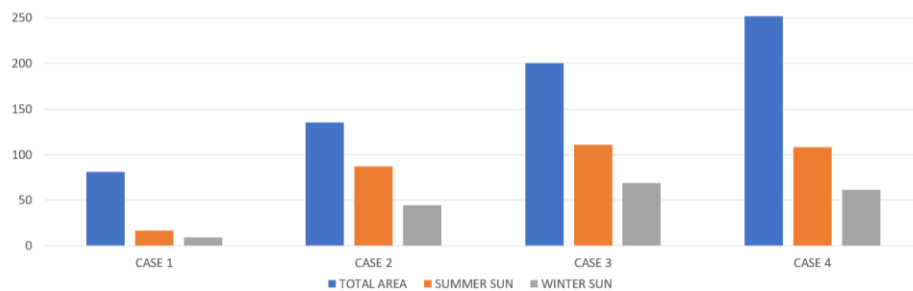


Figure 102. Amount of the area exposed to direct sunlight in the authentic state
(X: Cases Y: Meter square) (Source: Prepared by Author 2024)

4.11.2. Ventilated Areas

The wind blowing from the north to the courtyards used to make cross ventilation between the gate, taşlık, hayat and elevated roof. But today, it is restricted by storage (case 1), main building (case 2), and building addition (case 3). The wind blows from the south to the courtyard are restricted by the kitchen (case 1), the extended courtyard wall (case 3). The wind enters to the courtyard from the gate of the courtyard or taşlık in a controlled way or from the top of the courtyard wall and it flows throughout the courtyard. The northern wind comes from the gate or from the upper of the courtyard walls to the courtyard in all the cases. The southern wind comes from the gate in case 4 and it comes from the upper of the courtyard walls in all the cases.

In the authentic state, the route of airflow, from the courtyard to the elevated roof has been preserved. After plants were watered, hot air has been rising up the courtyard to the elevated roof in case 1 and case 4. Also in the other cases, the wind blows used to enter the courtyards in a controlled way through the gate of the courtyards or taşlıks and it flowed through the courtyard, hayat and the elevated roof.

CHAPTER 5

CONCLUSION

It is important to consider the courtyards as a whole with the related traditional houses and maintain their spatial relations. It is necessary to develop and use specialized inventory slips in accordance with the scope of the field studies to be organized to determine the features of the courtyard within the framework of the architectural conservation discipline. Along with the courtyards, semi-open spaces adjacent to the courtyard such as *taşlık* and *hayat*, outbuildings within the courtyard, mass annexes and flat roofs should also be evaluated. The tools of architectural conservation disciplines should be used to determine the current and authentic conditions of the courtyards. It is also important to determine the phases for greenery elements. In addition, it is necessary to increase interdisciplinary studies.

The contribution of each parameter to the courtyard character, specifically for the four houses in Kurtgazi examined, can be evaluated as follows:

Orientation: The traditional houses in Kurtgazi District are positioned on the skirt of Boz Mountains. This provides an advantage for natural ventilation. The traditional houses are positioned at the west of their lots. Hayats are positioned at east. The taşlıks of the traditional buildings are at the west of the courtyard. Courtyards of Kurtgazi houses are positioned at south, southeast or east.

Ratio: In the studied courtyards, natural ventilation increases as the ratio of the courtyard length in the north-south direction to the related courtyard wall height increases since the prevailing wind direction is the north in Birgi.

Ratio of dimensions: As the length of a courtyard is decreased and the height of the courtyard wall is increased, the amount of exposition of the courtyard to direct sunlight is decreased. In order to benefit from sunlight in all seasons, this ratio must be at least two.

The area exposed to sunlight is less in courtyards which have similar widths and heights.

Greenery elements: Deciduous plants, such as fig trees and vines are located in the southern courtyards in Kurtgazi district. They block the sunlight to reach the courtyard in summers and allow sunlight to reach the courtyard in winters. They contribute to the cooling by shading and heat transfer.

The numbers of deciduous trees are seen more in the courtyards, which have no canopy to protect from sunlight in the courtyard, than in other courtyards.

Water elements: Water drainages, fountains, and pools are used as water elements, and they contribute to decrease the temperature by the solar radiation absorption. In the authentic state, watering to plants contributes to decrease the temperature by evaporation.

Materials: Materials with a low amount of reflecting capability are used as a covering on the ground and on the walls in the authentic state. These are compacted earth, and wood.

Some part of the courtyard is left as compacted earth and the amount of sunlight reflected from the ground is reduced. In turn, the rate of heating caused by the reflection of sunlight from the ground has decreased. The slate stone pavement is only used in the zones close to *taşlık* and toilet, where maximum circulation is seen.

It is observed that in most of the cases, the covering of the ground is changed as screed. So, sunlight reflectivity increased. The finishing of the walls are also altered. They are plastered and white-washed. In turn the rate of heating caused by the reflection of sunlight from the ground and wall have increased.

Function: Washing and drying laundry, drying fruits and vegetables, storing and cutting woods, doing hobbies, resting, eating, and washing and drying dishes are outstanding activities in the studied courtyards. These activities are changed according to size of the courtyards e.g. case 1 does not have the activity of cutting wood. *Taşlık* is used for living in summers since it is the best space in terms of natural ventilation and shadow in summers. On rainy and cold days, it has also advantages for realizing resting and eating activities. In the authentic state, washing and drying dishes was outstanding activity in *hayats*.

Natural ventilation: The roof interventions and the addition of high masses have partially prevented the flow of prevailing wind (north wind). Cross airflow occurs in all of the courtyards since the ratios of the height of the courtyard wall at the north are less

than 1 excluding case 3, isolated standing flow occurs in case 3 in the current state. In the authentic state, cross airflow occurs in all of the courtyards since case 3 did not have a building mass.

Natural illumination: The area exposed to direct sunlight's amount is between 37 % and 12 % in summer and 18 % and 5 % in winter in the studied courtyards in the current state. Amount of the sunlight in summer is more than in winter since the altitude of the sun is higher in summer. All of the area is not exposed to direct sunlight since the width of the eaves and trees restrict sunlight exposition in the courtyards. The area exposed to direct sunlight's amount was between 64 % and 20 % in summer and 34 % and 11 % in winter in the studied courtyards in the authentic state. Amount of the sunlight in the authentic state was more than in the current state since the courtyards did not have building additions.

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