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Original Research Article

Typology of the Sunlit Space in the Houses of Mountainous Villages (Case study: Shemiranat villages of Tehran)*

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Abstract

The vernacular architecture of the village is a rare story of connection with nature and landscape, which, while giving identity and integration with the environment, has turned biological crises into the dynamics of life. The energy crisis and the need to use renewable solar energy in cold and mountainous villages is the basis for the recognition of a word called "sunlit space". The sunlit space is an open space or a semi-open space that can be effective in creating a favorable microclimate. The purpose of this research, while introducing this space, is to know the patterns of the sunlit space and introduce its dominant species in the mountainous villages of Shemiranat, and the main question of the research is: what is the typology of the sunlit space in the mountainous villages? and what are the effective characteristics of the dominant species in creating a favorable microclimate? This research has been conducted using a qualitative method and is based on library studies and a wide range of field research. Based on certain criteria, 10 villages were selected, and about 40 houses were visited. To answer the problem, while collecting and preparing complete documents from each house, qualitative conversations and interviews with residents have also been conducted. According to the results of this research, there are 4 different types of sunlit spaces in the surveyed villages. In mountainous and cold villages, the dominant type of sunlit space is the court and area that faces the south front, is on the second floor and above ground level, and is located on the space of the stable and warehouse. Paying attention to the sunlit spaces in the houses of the mountainous villages is focused on vernacular architecture and the past, but paying attention to solar energy is not limited by time. Both the mutual and inevitable connection of the vernacular houses and new constructions represent the fact that to maintain the kinship between structures and reduce energy consumption, it is vital and valuable to reflect on local patterns and create a link in the form of the new architecture for the villages.

Keywords: *Sunlit space, Micro-climate, Mountainous villages, Typology, Rural housing.*

This article is extracted from Ph.D thesis of Sepideh Babazadeh Saloot entitled "Comfort in the sun: The role of Sunlit spaces in architecture of mountainous areas (case study: The villages of Shemiranat)" which is being conducted under supervision of Dr. Mansoureh Tahbaz and

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Introduction

Village can be considered the first habitation experience, which means establishing a meaningful connection between humans and the natural environment. This connection indicates an effort to find identity and to feel belonging to a place (Norberg-Schultz, 2009). sense of belonging and connection with the environment, The same sense and connection are separated in today's architecture. And what links vernacular and contemporary architecture interesting is today's architectural crises, such as the energy crisis! The necessity of saving energy and not paying attention to climate solutions in the contemporary architecture of the village doubles the importance of knowing and typifying the sunlit space. The sunlit space in rural houses is made up of open and semi-open spaces that receive the sun's rays in the best direction, from southwest to southeast in the cold seasons. Therefore, it becomes important and necessary to pay attention to renewable energies, especially the use of heat and solar energy in cold and mountainous villages. In addition to the value of this space in habitable rural houses, this importance should also be paid attention to in new construction. The introduction of the sunlit space and attention to it in creating a micro-climate and the role of contemporary constructions in its quality were just discussed in an article by the authors of this research. The new topic that is considered in this research is the physical typology of sunlit space and the introduction of the dominant species. No research has been done in this field so far.

Research Background

The Islamic Revolution Housing Foundation, Agricultural Jihad, and Ministry of Housing and Urban Development are the government institutions that have achieved significant activities in the field of rural studies. In a summary, activities with the title "typology of rural housing, under the supervision of the Housing Foundation organization, have, after regional and climatic studies, provided design criteria and solutions for new constructions. Such as "Rural Housing Typology of

Tehran Province" (Divandari, 2008) and "Rural Housing Typology of Central Province" (Sartipour, 2013). Regarding the research on rural knowledge and energy discussion in other countries, in the book "Comparative studies of rural housing improvement in India, China, and Turkey," the introduction of planning policies and management of rural housing production in the three countries of India, China, and Turkey has been discussed, especially in China, where passive use of renewable energies is mentioned (Islamic Revolution Housing Foundation, 2011). In a treatise entitled "Bioclimatic Architecture in Libya", three climate zones are considered, and local examples and new constructions are compared in terms of energy (Elwefati, 2007). In an article entitled "Architectural Design of Traditional Buildings in the Mountainous Areas of Cyprus", he discussed the optimal placement of spaces on different floors according to the heat contribution of the land mass (Malaktou, Michael, Philokyprou & Savvides, 2015). According to related studies in Iranian and global experiences, the conclusion is that paying attention to the term "energy in architecture and the use of renewable energies is very worthy, and finally, the closest approach to the present research is an article entitled "The role of the sunlit space in creating micro-climate in rural houses of mountainous areas," which is introduced by the authors of the current research (Babazadeh Saloot, Tahbaz & Karimi Fard, 2022). However, the typology of sunlit space in mountain villages is a new topic that is discussed in this article.

Research Method

This research was done with the aim of identifying the typology of sunlit space in mountain villages. In this research, the survey and evaluation of rural houses, the analysis of the sunlit space, as well as interviews with the residents, were conducted qualitatively, and a significant part of the studies was conducted using the field method. This research is applied research that can have an important role in the new construction of villages. From the sample (Shemiranat, Tehran), 10 villages were selected by considering factors, and 40 vernacular houses

were selected from these villages by non-probability and deliberate sampling for the typology of sunlit space. A lot of effort has been made to select the samples wisely; all the selected houses with sunlit spaces are habitable. It should be noted that all the samples were analyzed in the field in villages by the authors.

Theoretical Foundation

•Typology

Man, consciously or unconsciously, seeks to find order in the chaos of his surrounding environment. This order can be recognized from the main components of the environment, each of which includes a pattern. The patterns repeat themselves throughout the environment. Therefore, they exist everywhere (Bell, 2003). "Each building or city is only alive to the extent that it is committed to the timeless path. The timeless way is a non-acquired process that creates order by itself, and if we let it, it will happen itself" (Alexander, 2008). Alexander's interpretation of the timeless way as a process in which the system of any building or city directly arises from the essence of humans and nature indicates the possibility of free life and growth that can be manifested in the living environment of every human being. In western culture, the word "typology" is derived from the root of the word type. The word type in English is equivalent to the word type, example, etc. In Persian, the word "species" can be attributed to a specific group with a common feature or characteristic (Memarian, 2008). According to John Lang, typology is the classification of samples according to the function they have. Environment and landscape plans, buildings, and urban plans can be categorized according to common purposes or structure and form (Lang, 2011, 70). Preliminary and methodical cognitive typology is aimed at analyzing and modifying the structure of species by classifying them based on major characteristics, components, and relationships for use in sciences such as architecture. The main goals of typology in architecture are to reach design principles through its foundations, analyze and classify problems in architecture in the most obvious and simplest way to solve the identity crisis and transfer typological values through researchers'

understanding of the roots and legibility of architectural works.

• Rural housing

In vernacular housing, the design and execution of the houses are such that there is no imitation, and everything is based on the needs of the residents of the region and the existing natural facilities. According to Elpagonolo, vernacular architecture is spontaneous architecture. Here, spontaneous does not mean that it is accidental but that it is natural" (Alpagonolo, 2005, 25). Villagers have been actively participating in the planning and construction of their housing for a long time, and they have shaped or demanded its architecture in such a way that their needs and expectations from living in the housing have been crystallized. Rural architecture and buildings are clear examples of the application of such ideas in architectural design (Badran, 2009). The rural house has a deep connection with the environment, depends on it, and is the residence of people who are engaged in productive activities (Sartipipour, 2011). The atmosphere of a rural house is a space consisting of the all-around presence of a rural person in the place he has chosen to live; this presence includes all aspects of his personal and social material and spiritual life (Ala Al-Hesabi & Raheb, 2008). When you observe and study rural housing, it seems simple and basic, but in fact, these buildings were built by people, each of whose members is connected to the whole group through all the factors and institutions of social life, and therefore, through knowledge and understanding. It is unlimited that they get from other members (Haji Ibrahim Zargar, 2008). The quality of rural life expresses the efforts and satisfaction of people to improve living conditions and their feelings of security and well-being, but researchers have stated that the quality of life in rural areas is developed when the governments can influence the economic, social, and environmental processes. Draw the level of the village and make the living conditions for the residents of the villages equal to the life of the urban communities (Futa & Ewuola, 2010). The role of housing in villages is better manifested when its dominant role in the set of elements that make

up rural textures is taken into account. Housing is the main component of rural contexts (Sartipipour, 2005).

• Sunlit space

The cold weather and high altitudes have created problems for human settlement, including heat loss due to low ambient temperatures and air movement due to the presence of many elevations and lowlands. In order to deal with these problems, first of all, the effective factors of long-term heat should be controlled, and secondly, it is necessary to provide suitable conditions for obtaining heat as much as possible. It is very difficult to raise the temperature of open spaces because the heat is quickly dispersed in the environment, especially if the wind blows. Therefore, direct solar radiation and wind protection are the two main ways to improve the comfort conditions in open spaces in winter (Brown & Mark, 2008). According to the mentioned information and based on years of research in the field of rural housing in cold regions, open spaces (courtyards) and semi-open spaces (porches) in the body of vernacular rural houses, which can be effective in the level of comfort and functional quality, are characterized as sunlit spaces.” A sunlit space is an open or semi-open space that can be effective in creating a microclimate. This space, especially in cold villages, with the right orientation and structure, can be effective in absorbing and receiving sunlight. It is a little enclosed

and safe from cold winter winds (Babazade Saloot et al., 2022); (Fig. 1).

• Microclimate

Microclimate is the smallest layer after macroclimate, middle climate, and local climate, which depends on land details such as land surface cover, land slope, vegetation, soil moisture, and air conditions such as shade and sun, wind flow, and the like. The architect plays a great role in deciding the type of microclimate and determining its variations (Tahbaz, 2007). For example, the determination of shady or sunny areas, which is the subject of this research, can affect the microclimate. In mountainous villages that experience cold weather most of the year, the optimal use of the sun’s radiation and heat can create a favorable climate, and this doubles the importance of sunny spaces, which are introduced in this research as sunny courtyards. When solar energy shines on an object, some of the energy is absorbed. Absorption of solar energy by external surfaces causes their temperature to rise several degrees above the surrounding temperature (Watson, 2003). The energy received from the sun by the earth is done through radiation and in the form of waves. These waves pass through the empty space between the atmosphere of the earth and the sun, reach the earth, and cause it to heat up. Heated soil, stone, and buildings emit energy and cause the environment

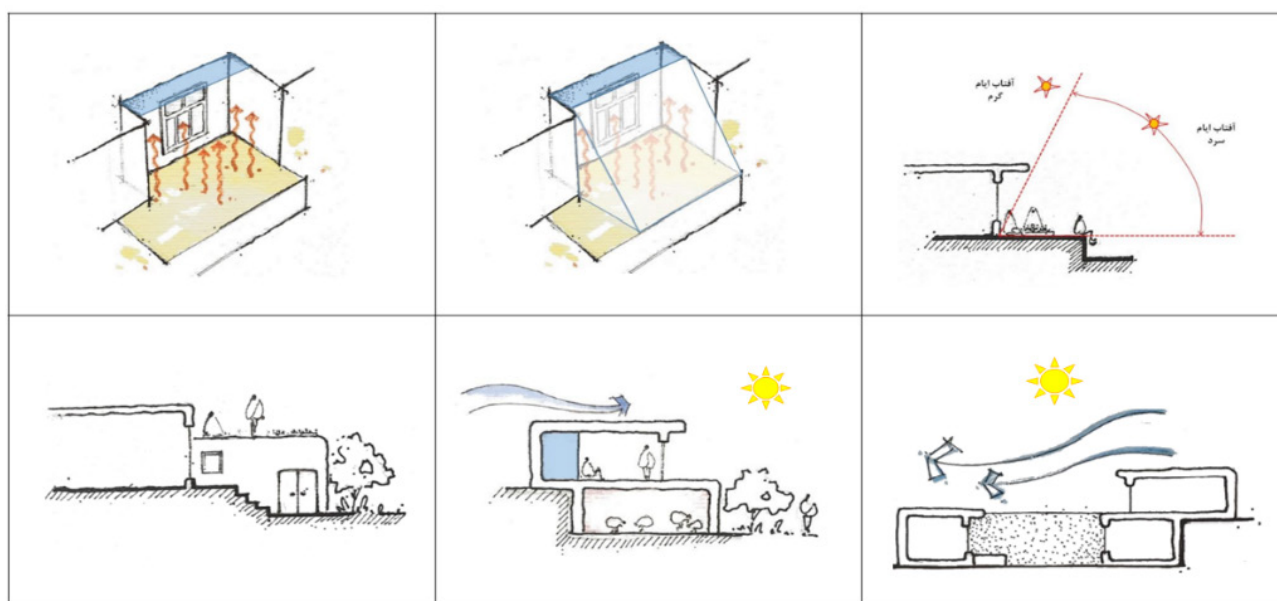


Fig. 1. A collection of sketches of the sunlit space. Source: Authors.

to heat (Edward, 1997, 13). In architecture compatible with the climate, the correct use of the sun's heat means heating the building in cold times with the help of the sun's heat radiation and avoiding receiving it, and preventing the temperature increase on hot days. The sun, as the source of all types of energy and the source of the earth's energy and heat, is one of the most important natural phenomena that play a decisive role in climate design (Tabbaz, 2013, 68).

Discussion and Analysis

The 10 targeted villages in Shemiranat city of Tehran province were selected by applying the following factors (Fig. 2):

- Villages that are at an altitude of about 2000 meters above sea level are considered completely mountainous.
- Villages that have habitable vernacular buildings exist in the vernacular context.
- Villages with an acceptable population and an average population of over 500 people according to the 2015 census. The selected villages have guide plans and study documents (Table 1).

First, after extensive field studies in the mountainous villages of Shemiranat and Tehran, interviews and discussions were conducted with the villagers regarding the research topic. For this purpose, about 40 indigenous houses, including courtyards, were selected to have targeted conversations with their residents. The selection of houses for interviews with the residents was based on the observations and contradictions that were thought-provoking in the field visits, and great efforts were made to include all physical types in the samples. But since the presentation of documents for all 40 samples and related interviews and the volume of information is beyond the standard of writing the article, the presentation of the material will be briefly mentioned. The main purpose of these discussions was to validate the field findings, correctly identify the dominant species, and also assess the amount of attention and value of this space from the residents' point of view.

The Result of Observations and Interviews

According to the residents' and observers' reports, most vernacular mountain houses are two-story. Their sunlit

space is not limited to the porch and includes the yard and roof, as well as any platform and yard that can receive sunlight, protected from the scorching winter winds. The sunlit spaces are often facing the south or in directions close to it and are built with a shallow depth to get the maximum amount of solar energy. In two-story houses, the sunlit space is located on the upper floor and adjacent to the rooms. Since this space is often located in a barn or warehouse, it has more heating in the winter. In the interview conducted with the residents, it was concluded that the rooms are heated through Korsi and oil lamps, and the proper sunlight in the rooms plays an important role in heating the house, although some houses also use gas heaters and the residents wear warm clothes at home. According to the residents, many daily activities are done in this sunlit space in different seasons. The roofed part of it has the role of a living room, and the part that is open to the sky with favorable sunlight is a space for drying agricultural products, drying clothes, etc. In most houses, the porch is enclosed with nylon in winter to preserve the heat received from the sun in the porch and help to heat the rooms better. In this case, while receiving the sun's radiation and heat, a greenhouse effect is also created. According to the residents, this stretched-nylon space is suitable for them to have lunch and rest at noon, sometimes without any heating device in winter. Houses that are gassed and properly heated in winter often have permanent residents. However, a significant percentage of residents have seasonal migration in winter, and as long as their houses are not under the unwanted shadow of new construction, they have good sun exposure in winter. However, in cases where new high-rise buildings limit the hours of sunlight, in addition to reducing thermal comfort, the residents face an unpleasant experience from the perspective of privacy (Figs. 3&4).

Analysis of the Examined Samples

According to the examined samples and many of the vernacular houses observed in the field studies, the rural houses of the sample community are often two-story. The majority of the villagers work in livestock farming

Table. 1. Information of 10 selected villages. Source: Authors.

Name of the villages	Amameh	Afjeh	Ahar	Abnik	Lalan	Rasnan	Konde olya	Barge jahan	Lavasanat bozorg	Garmabdar
Altitude sea level (meters)	2200	2071	2100	1900	2400	1920	2115	2026	1800	1900
Population	1315	1257	583	512	1135	574	1119	912	1800	794
	1395									

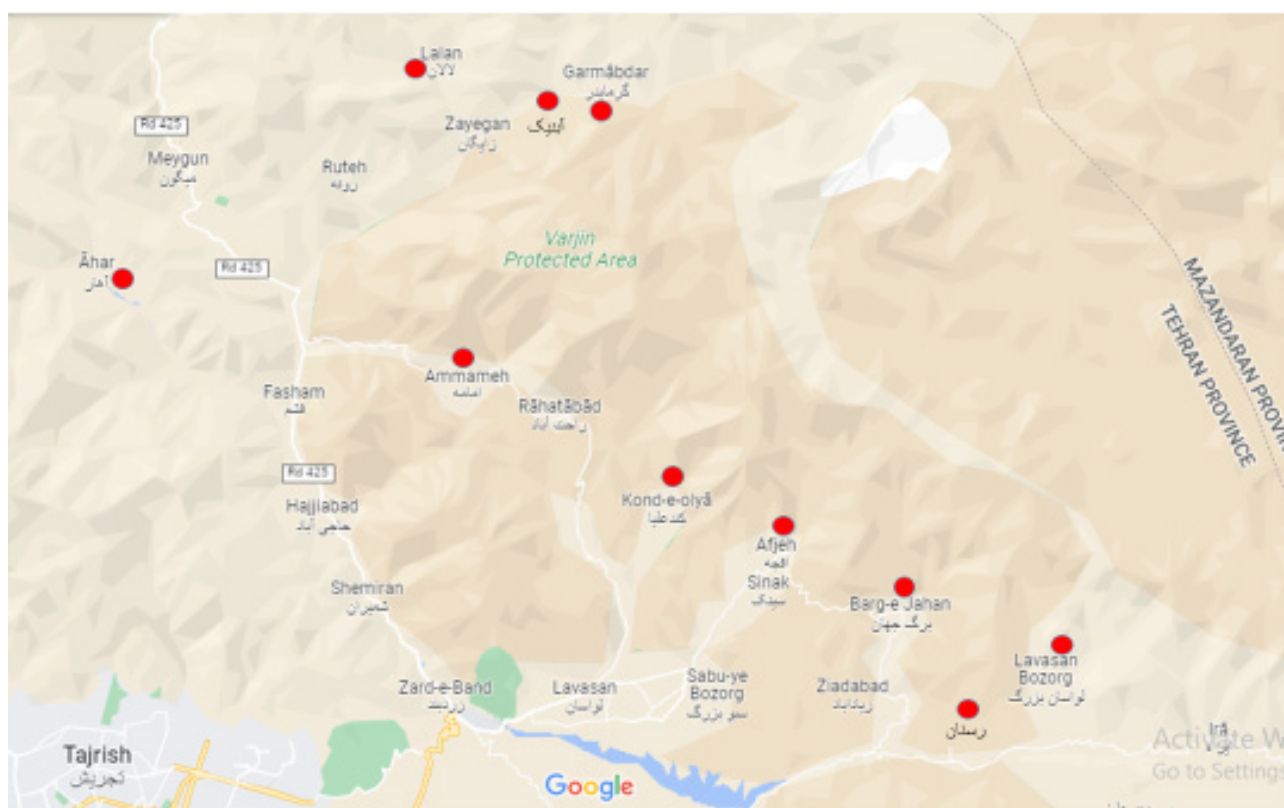


Fig. 2. Geographical location of 10 selected villages. Source: Authors.

or agriculture; even residents who migrate during the winter are involved in these activities. For this reason, in most spaces, in addition to residential spaces, there are living spaces as well. Either they have stables for livestock or warehouses for storing fodder or agricultural products and tools. Since the sunning courtyard is a multi-functional space, due to the occupation of the residents, these spaces are often used for subsistence purposes, and the best direction for sunbathing in these courtyards is the front facing south. Due to the large number of documents in all the samples, only three-dimensional schematics of

them are presented below, and the sun-shaded space in the samples is marked in yellow (Fig. 5).

According to the observations, interviews, and conversations with the residents and the sample community, it can be concluded that the sunlit space that creates a favorable climate can be a porch, a courtyard, or a part of the roof, which is safe from the scorching winter wind. In one-story houses, the courtyard interacts with a small porch can create a sunny patio as a sunlit space. In two-story houses, which include most mountain houses, there are three types of sunlit space: the porch on the upper



Fig. 3. A collection of pictures of the sunlit space in summer. Source: Authors' archive.



Fig. 4. A collection of pictures of the sunlit space in winter (covering the sunlit space). Source: Authors' archive.

floor without a yard and an area around it, the porch on the floor interacting with the yard, and finally the porches that extend on the roof of the lower floor, which is often a stable or a warehouse; that is, the porch interacts with a part of the roof below. This classification of sunlit space typology is presented in Table 2.

Based on 40 samples taken from the studied villages and the observation of countless rural houses in this research, the most frequent and dominant example of the sunlit space in the vernacular houses of this area is the fourth type (Fig. 6).

Conclusion

The sunlit space is an open or semi-open space that can be effective in creating a favorable climate. Paying attention to the sunlit space in the houses of the cold and mountainous villages is directed at the local and past architecture, but paying attention to solar energy is not limited to time. While the sunlit space is an inseparable part of the housing of mountain villages, emphasizing its importance in the past, it is necessary to find character in contemporary and modern houses. The sunlit space can be a yard, porch, roof, or any other open or semi-open space in the body of a rural house that is protected from the harsh winter winds and creates a pleasant climate. In this research, 40 houses were selected from the Shemiranat villages of Tehran to typify the sunlit space and introduce the dominant species.

In addition to taking pictures of the buildings, interviews and conversations were also held with the residents, which played a significant role in validating the research findings. Based on the analysis and review of the samples, in one-story houses, the courtyard in interaction with a small porch can create a sunlit space. In two-story houses, which include most mountain houses, there are three types of sunlit space: the porch on the upper floor without a yard and a surrounding area; the porch on the floor in interaction with the yard; and finally, the porch on the roof of the lower floor, which is often a shed or the warehouse extended; that is, the porch interacts with a part of the roof below. The sunlit space of the dominant type in mountainous rural houses is a courtyard and area that faces south, above the ground, and on the space of the stable and warehouse, so that the livestock section is on the ground floor and the living section is on the first floor. It is placed so that the floor of the biological section is separated from the ground and the heat of this space is prevented from draining to the ground. At the same time, the heat generated by the animals, which are often present in the livestock space during the cold seasons, is also used to help the biological sector. Also, in this case, the heat loss from the roof of the livestock space is controlled to a great extent. For the usefulness and efficiency of the west-facing patio, the prevailing wind that brings the cold winter winds should be controlled. In addition, according to experience, the villagers

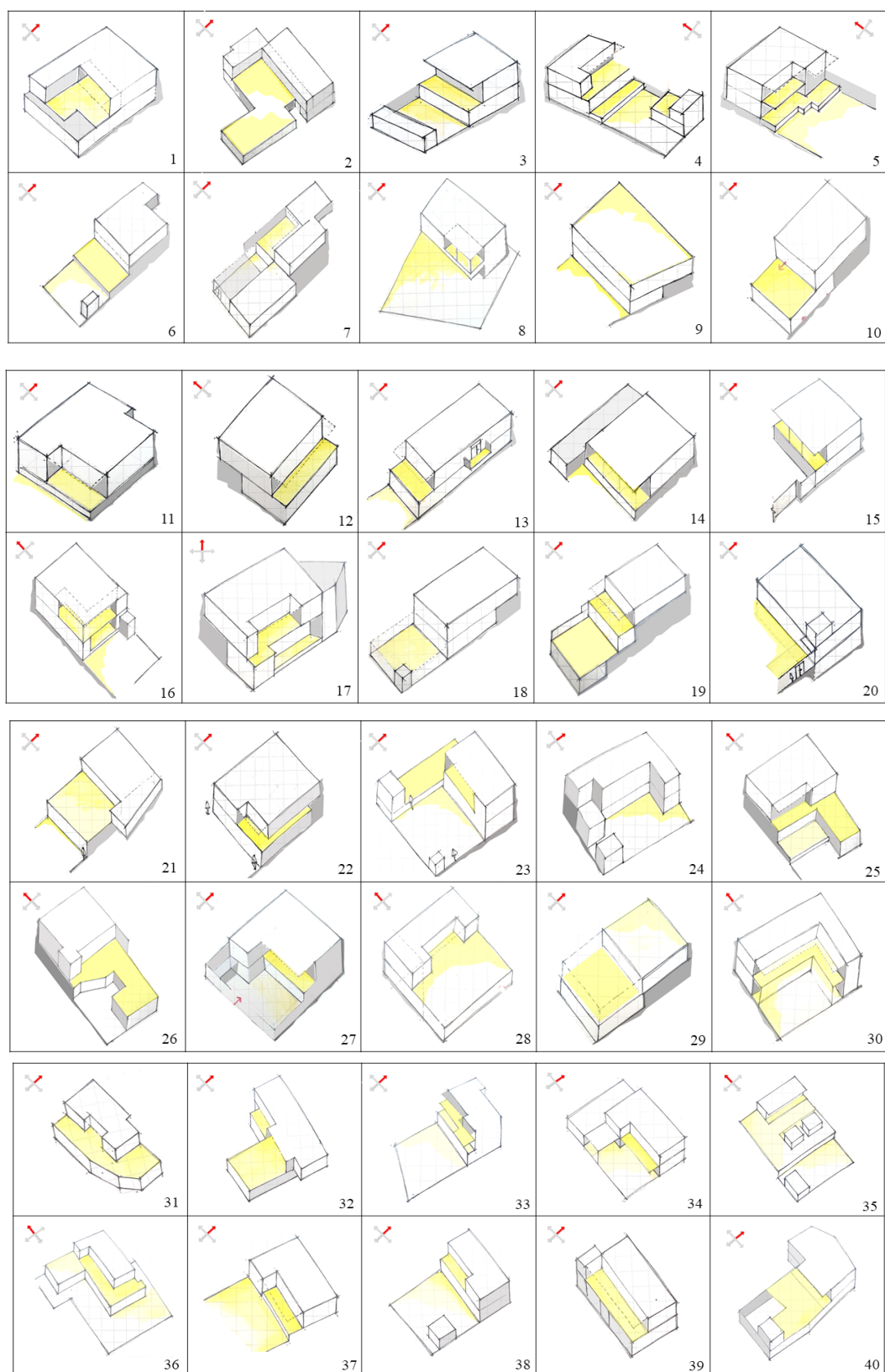


Fig. 5. Schematic perspective of 40 vernacular houses. Source: Authors.

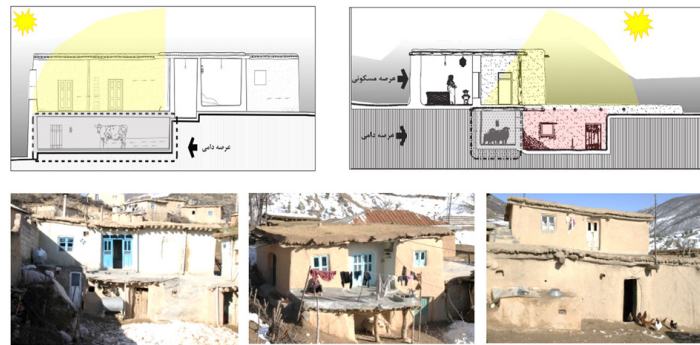


Fig. 6. An example of the dominant specie of the sunlit space. Source: Authors.

Table 2. Typology of sunlit space in houses of mountain villages. Source: Authors.

The type of sunlit space	3d	Plans	Picture
Porch in two-story (houses)			
Porch - yard (one-story houses)			
Porch - yard (two-story houses)			
Porch - roof (two-story houses)			

Wc	Barn	Kitchen	Store	Sunlit space	Coridor	Room

also use nylon covering to enclose the courtyard and porch in winter, which increases the effectiveness of the sun-blocking courtyard by creating a greenhouse effect. It goes without saying that in this research, the typology of Sahn Aftabgir was investigated. However, the performance and efficiency of this courtyard in using renewable solar energy and reducing fossil fuel consumption depend on several factors, which will be discussed in another study.

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