

## ARTICLE

# VERNACULAR ARCHITECTURE COMPATIBLE WITH ENVIRONMENT OF STEPPED VILLAGES; CASE STUDY: PALANGAN VILLAGE, IRAN

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## ABSTRACT

**Background:** Sustainable architecture is one of the up to date issues of architecture and has a direct effect on the global policy making. Iranian traditional architecture, because of huge geographical extent and its old age as human settlement, is a valuable resource of study in this field. Rural, environment and traditional houses of Iran contains important and valuable matters and points that must be considered. Stepped villages like Palangan in Kurdistan, are patterns, compatible with mountainous climate, full of thoughts. **Materials and Methods:** For instance economizing energy, native materials, coordination with topography and earth tissue, residential spaces work full of coordination with environment and ecosystem are examples of their characteristics. The aim of this research is to study the problems related to sustainability in difficult condition, construction and materials, energy and its economization in rural architecture. And in the case study, in stepped village of Palangan as prominent historical rural housing, is to consider the feedback of these rural settlements to various energy sustainability factors in library study method and field studies of these villages' dominant characteristics. **Results and Conclusions:** The final step is to categorize the positive points of rural stair houses in terms of energy sustainability and architecture of the village are the matters that have been discussed in the following parts of this paper.

## INTRODUCTION

As a result of lack of renewable energy resources, pollution of environment and resources such as nature and life environment it is important to have sustainable designs in residential units. One of the researches, with the purpose of widening the extent of information, is the researches over rural houses. Iran is a valuable case to study because it is geographically extended and is known as an old human settlement so in rural areas and villages has special points to be considered.

Although the villages located in the mountainsides of Zagros are unique and special, they have been less considered by researchers. Current research aims to study some kinds of villages located in Zagros as stepped villages and case study of Palangan<sup>2</sup> village and help to make its climatic and biological characteristics of this valuable village known. Main questions of this study are:

1. What are the characteristics of stepped villages in the mountainous areas? 2. How considering the environment can lead us to have a successful climatic design? 3. What are the construction methods in unique areas with difficult conditions? 4. How long villages could response to the biological needs of environment and people and how they have been able to last for such a long time?

## MATERIALS AND METHODS

The aim of current study is to investigate the sustainable architecture, local and rural settlements and describe their importance according to their sustainable design and in the final step to study the historical stepped village of Palangan. Most of the general information for the study has been extracted from library and previous researches in the same subjects. Other information and their analysis is gathered through field visits and generating reports from the study area using the methods such as visiting, taking photographs, sketching, surveying, areal images, information from experts of rural residential and Cultural Heritage Administration of Sanandaj<sup>3</sup> and also local people of Palangan.

### Sustainable Architecture

Sustainable architecture has wide range of definitions and its scope is so wide. These definitions range from problems related to human life, environment and earth to socio-cultural problems; consequently providing a definition which is flexible and comprehensive enough is difficult. But a general definition which can be; suitable for this study, is this : "Eco-housing, green development, sustainable design, environmentally sound housing has as many names as it has definitions, but the Rocky Mountain Institute, in its "Primer on Sustainable Building", flexibly describes this new kind of architecture as taking less from the Earth and giving more to people. In practice, Green housing varies widely. It can range from being energy efficient and using nontoxic interior finishes to being constructed of recycled materials and completely powered by the sun [1].

### KEY WORDS

Iranian Architecture,  
Vernacular Architecture,  
Sustainable  
Architecture, Rural  
Housing, Stepped  
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From sustainability and energy saving point of view, architecture is very important, because lack of attention to the climatic problems and designs, including design of form of structure, orientation, cover and appropriate materials, may result in high energy consumption and damages to environment and nonrenewable resources [2].

Homogeneous design with environment, has to obey the frameworks and conditions of sustainable development; rural design has to be in conformity with principles and conditions of eco-system as much as the rural planning has to obey the environmental conditions for sustainable development of villages. Experiences, globally or nationally, provides principles that using them can help to develop the quality and quantity of local knowledge and can be useful for professional designers and even the villagers [3].

### Rural housing, inspiring to sustainable design

Many believe that house is a place to mean the life and acquire identity and define it using the sense of possession. "Residence represents the meaningful link between human and the environment. Such link originates from identity and belonging to a place. So human finds the identity when finds a house and as a result, their existence is established in the world. He chooses his own place and in this way a kind of reliable empathy with the other man too" [4]. Rural housing is the finest method to contact these aspects of the settlement, which makes it so important.

Rural housing has experienced least changes during the ages .It is important because of having indicators harmony with the environment and context, climate, using canvas binding materials with the least encroachment to the environment around, considering issues related to energy and also because of being in special climatic conditions. Study of how the local and rural housing deals in different areas can give the best and most financial answers in that climate and area. Following parts will discuss about the rural housing and their sustainable design.

### Rural housing and Vernacular architecture

Energies, imageries, impressions and life styles are being reflected directly in the family. Consequently differences in the shape of houses comes from life style distinctions and categories like ideas of ideal life, social organization, concept of territory, methods of meeting basic needs and relation between housing and pattern of settlement. Every place that people live in should be shaped based on real events and responding patterns. To reach a good architecture, nature, needs, major and minor issues must be considered. Unlike the common architectures and modern designs, architecture of rural housings are full of plan, thought and using the capabilities of environment and proportionate with the needs of users [5]. Houses compatible with the climatic conditions and comforts as a suitable pattern of architecture has been repeated during the ages by traditional architects. Such time sequence of accepted patterns has led the local architecture to have its own special shape, texture, volume and logical materials compatible with climate and atmospheric conditions [6].

Settlements, from construction materials, shape and forming point of view, are being affected by geographical conditions of their environment and as a result of this effect they have geographical, biological and method of construction importance. Houses that best match with the geographic environment and reflect the effects of environment well and are compatible with the climate, environment and earth are rural houses [7]. Most of rural houses have a deep relation with the environment and depend on it and it is the secret of this housings resistance. As the house is a concept beyond the framework of the home, settling has a meaning beyond a simple house and needs and represents a meaningful link between man and the environment [8].

Rural man, designs and builds his house considering the natural, social and cultural environment and with knowledge to existence and nature [9]. Local architecture is the most pure and obvious introducer of architecture cultures and is the presenter of best dependency of man to natural environment [10]. Rural housing is affected by both climate and condition of natural environment and has a relation with life pattern of families. Mostly rural families use the materials found in the environment around to build their houses [11]. Villages as a result of traditional society, resists against the changes [12].

Parameters that affect the general appearance of village firstly and architecture of rural housing in the next step are: geography of place, economy, culture and political and social factors [13]. The village is one of the oldest residential areas of stable and highly collaborative settlements [14], so it has lots of key and valuable points in the field of principle of sustainable design that must be extracted and used.

### ARCHITECTURE OF MOUNTAINOUS VILLAGES

#### Establishment and texture

Villages in the mountainous area are classified in 3 classes topographically:

- 1) mountainous class with steep slopes;
- 2) mountainous class with average slopes;
- 3) mountainous class with moderate slopes;

In mountainous and foothill classes, such as Palangan village, most of the villages are located on the sides of low width valley with different slopes. Direction of most of the buildings is to the south and south-east to use the sun energy as much as possible. Spread of villages is from hillside to nearby of the high summits [6].

### Stepped villages

Stepped village is a kind of architecture in the mountainous areas that the distribution of buildings are in a stepped or terraced form and can be applied to the architectural structure of this area, because the architecture of these mountainous areas as a result of texture, spread and establishment in the mountain are built like step.

Morphologically, the architecture of these villages is completely compatible with the natural environment and has the least encroachment to the environment around. In the following parts dominant characteristics of these villages, Palangan as a study case in particular, and resistant aspects and energy usage of them will be discussed.

### Village of Palangan

Appellation of this village according to the ideas of its people is the existence of Leopard in this area, and the other idea can be name which means a place in the slope of hillside that has obstacles and it is because of the structure of the village that is like steps and the fact that every house is an obstacle that does not let sliding of the upper house.

This village is valuable and historical and is known as one of the important centers of Kurdistan<sup>4</sup> province in the Seljuk<sup>5</sup> era. The age of this village comes back to Samanian<sup>6</sup> era because of remaining of mosques, cemeteries and old houses, old gardens, Palangan castle and also Tangivar<sup>6</sup> inscription [15]. [Fig. 1]



Fig. 1: Palangan, a stepped village (Authors)

Morphology and structure of the houses in Palangan is complex, block and step shaped and mostly the roof of a house is the yard of another. In the villages of Hawraman<sup>7</sup>, the place where the study area is located in, because of being mountainous the houses are built on the fold of sheep, in a way that barn, stock and haystack are beside each other in a collection that builds a semi field position on two bases

[16], which will be discussed more about the energy aspects of this architecture in the following parts. [Table 1]

**Table 1:** Adaptive comparison of Palangan and Hawraman takht villages (Authors)

Originality	Population	Direction of the village's development	Paths	General slope of the village	Density architecture	Color of the openings	Materials	Stepped village
The villages is old and original in a way that it has kept its structure for centuries.	Low, most of them have been migrated or come from Kamyaran for work.	To the north and main road, mostly the development of the village is in the direction of river for economic uses.	Are vertical, and horizontal paths are rare.	Too high	Compact houses and high density	Blue and Turquoise	Native, including wood and stone using the method of rigid connection.	<b>Palangan</b>
In addition to village's structure, ceremonies and costumes are good reason for its originality.	Because of good facilities migration is low.	East to west and mostly residential	Horizontal paths are found, perpendicular to the slope direction.	high	Because of big environment village is less compact and density is low.	Because of religious beliefs and availability of pigments, green is used too.	Same as Palangan, but woods are different in some areas because of availability.	<b>Hawraman takht</b>

The main and historic core of village whereas its climate issues, faces river. Although the houses receive sufficient light during the day time, one of the main reasons of destruction in the old part of village, in addition to being far from main roads of village and high slope of the hill, is wrong orientation. The identification of the central core of the village has been like this: 1. Existence of base and ancient mosque in the southern hill, 2. Old age of houses in this area, 3. Security issues of this area in comparison with northern parts, because behind this area there is a castle and also the river is preserver in front of dangers and higher slope of this hill could be a reason to build the central core in the discussed area., 4. Existence of cemetery in the hillside of northern hill, because in the past the cemeteries were built far from the village. In addition to the mentioned cases direction of wind can be an effective factor in the formation of central core of the village.

Eastern part of the village and along the *Sirvan River*, there are many gardens. Extension of the village is from north direction and to the asphalted road of the village and from west, beside the river, because of the consumption for fish farming and tourism and in the path of tourists to the village.

**Geographic location**

Palangan village is located in the northwest of Kamyaran<sup>8</sup> city which is environs of Kurdistan province and is contained within the limits of 46°36' E, 35°4' N.

**Topographic situation and slope**

This village has 2 parts, in the northern part slope is from north to south and in the southern part is vice versa and both of the slopes are very steep and between 35 to 40 degrees. Such steep slope has resulted in the appearance of a unique stepped village and has made it different from other special villages like Hawraman takht<sup>8</sup>, Masouleh<sup>9</sup>, Gelin<sup>10</sup>, Tangivar<sup>11</sup> and others with same structure. The slopes of both hills of village ends in *Sirvan River* and houses are built on the natural slope. The mentioned river is the only river within the limits of the village and the average water volume of it is 3m<sup>3</sup>/s. The reason of formation of this village, like other settlements, is the access to water and the future extension of the village was along the river. The mentioned river is the source of income for most of the villages' people in a way that most of the residents are working in fish farming and selling the products and being a source of income, it is a Tourist attraction for it.

Texture and building of the village is in full coordination with the slope of hills without any manipulation of nature, so the placing of buildings in parallel lines and narrowband pathways, width of 80-120 cm, and the thicker is 2m, is in the direction of slope and is from up to down and unlike other similar villages like Howraman takht, Masouleh and Gelin there exist few horizontal pathways. Its reason is steep slope of hill and compact neighborliness of houses that makes it difficult to have any horizontal pathway. In the older parts of the village pathways are in their primary forms and there exists canals, but in the northern and more steeply parts the pathways are like steps and ease of commuting is important.

Unlike the flat and low slope villages, in stepped village of Palangan, there is not a center of the village that be a place for public meeting, like front of mosque, because the pathways are impassable and village has no vertical elongation and public meetings are in the narrowed pathways that are in the old entrance of village in the west of village.



Climatic situation

Palangan has moderate and hot climate with the annual average temperature of -5.5 to 42°C. Average annual rainfall of the village is 500mm and dominant winds usually are from south, south-east and south-west direction of village. [Fig. 2]

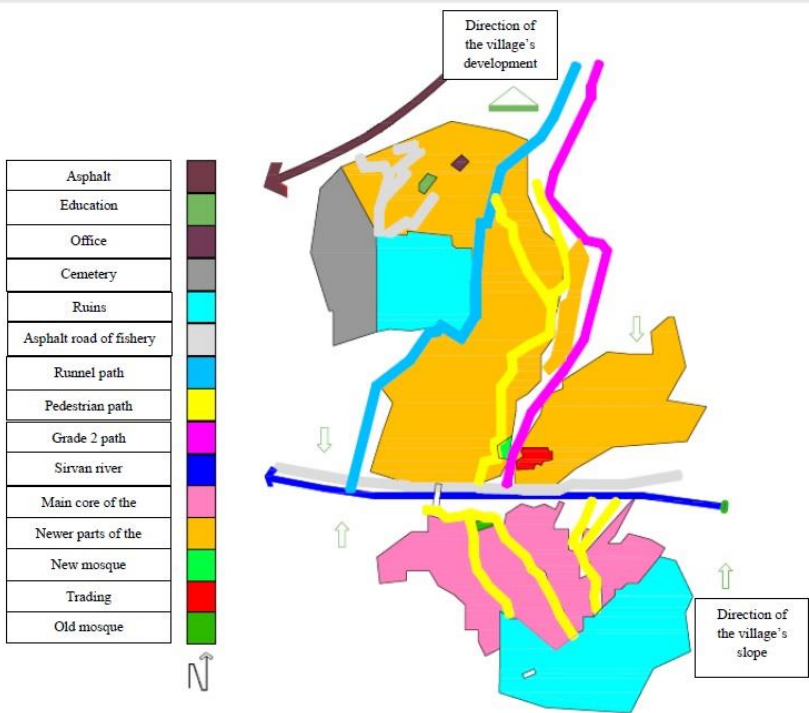


Fig. 2: Analysis of Palangan's maps (Authors)

ARCHITECTURE OF PALANGAN VILLAGE

Materials and structure

Walls of the houses are built using the method of rigid connection by putting the stones on each other without using any mortar between them. All of the material used in the building of the houses are native and are dug by the residents from mountains around and are carried to the village by different animals. To build the houses, after determining the location of house, considering the neighborhoods, direction of shining of sun, direction of wind and path of floodwater from mountains, first they dig the house limits to the depth of 0.5m which is called "Bine Ret". Then the foundation is filled with stones up to 2 to 3 meters higher than foundation such walls are locally called "Diwar Menin". [Fig. 3] When the built walls height reached to 3/5 of the main wall height, in the distance of two parts of wall, up and down wall, the woods from Sycamore, Mulberry or Walnut tree are put because their resistant is high and are native of the area and they are locked to two sides of walls and called "Dimek". Dimek reduces the pressure of walls to the piles of foundation and distributes the entry power equally in the foundation. After building the walls, up to an appropriate height, the roofs are usually short because of area's climate; wooden Sycamore piles are positioned in the width of walls with the distance of 1-1.5m and then covered them with wooden board. So the woods are cut in special sizes and then installed on the piles. In some houses it is usual to use straw or "Çirpi" which is foliage and even sack instead of wood to build a solid roof. After this, covered Çirpis with "Shefte", that's kind of native and traditional concrete, it called "Here Ban".

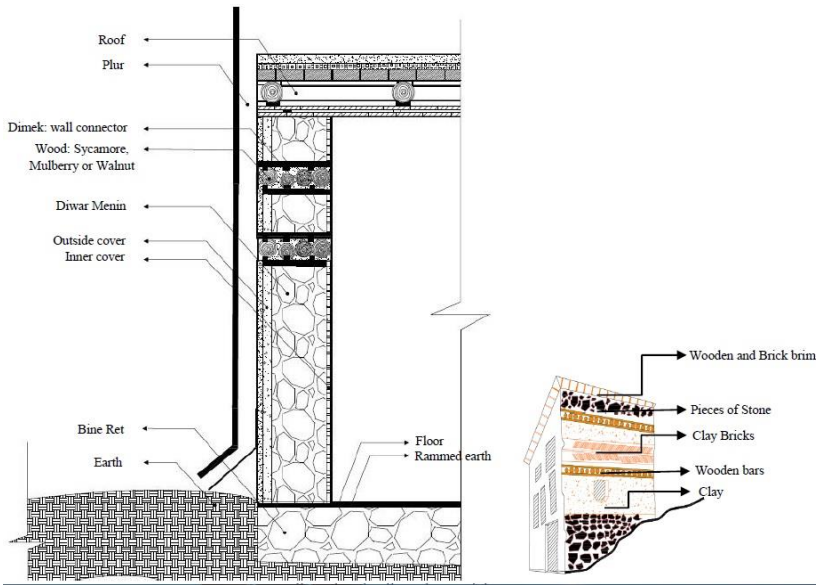


Fig. 3: Wall section details and Materials (Authors)

To avoid the leak of poured mud, before pouring the concrete, woods must be covered by sack and grit. Then using a roller which is called “Ban Tler” or “Ban Kler” surface of roof is being leveled. In the final step haystack is poured on the roof and roll it again. To control the water on the roof in a corner of roof by making a suitable slope to guide the water a pipe made up of mulberry tree’s wood called “Plur” is place. [Fig. 4]

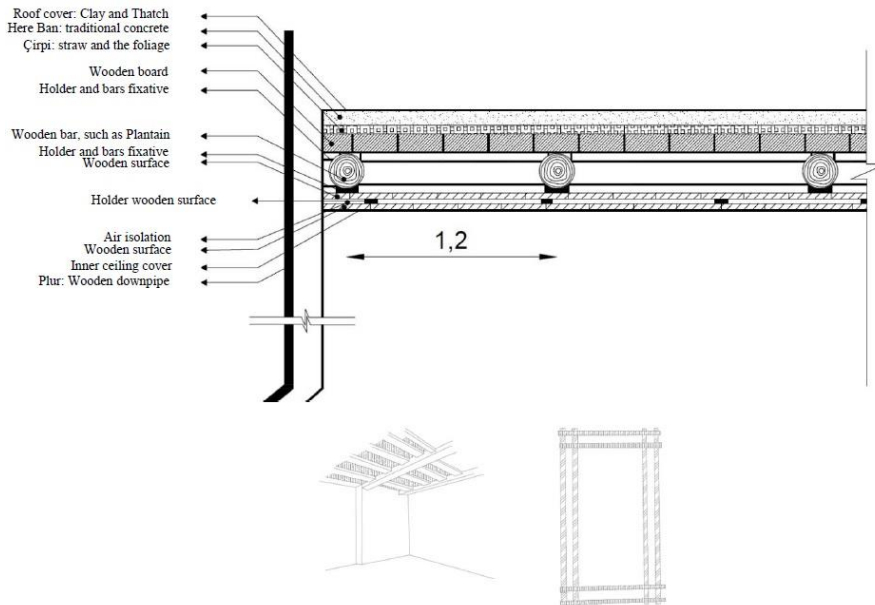


Fig. 4: Details of ceiling (Authors)

As mentioned before all of the materials are extracted from natural environment around and have the least environmental pollution and most of the materials from thermal capacity point of view are good and economical in the village climate. On the roof of the sitting room and baking room there exists a hole called “Roçn” which is for ventilation and light-up.

In Palangan village mud (“Here”) and hey (“Simr”) was used in the past to covered wall’s surface. Whitewashing the internal wall is done using a white soil called “Çermo” this process is called “Suax” locally. The needed soil to do this is provided from mountains around. It is clear that the materials for adornment and joinery of the buildings are natural and can be extracted from environment area. One another structures that has helped the stability of buildings, in such special ground, is “Koleke”. Kolekes are 2-3 wooden piles in the middle of big rooms and stable that transfers the pressure of roof to the

ground. [Fig. 5] In this village some of the houses are attached to the mountain and mostly some parts of mountain are the rear wall of the houses which is important from energy consumption point of view.

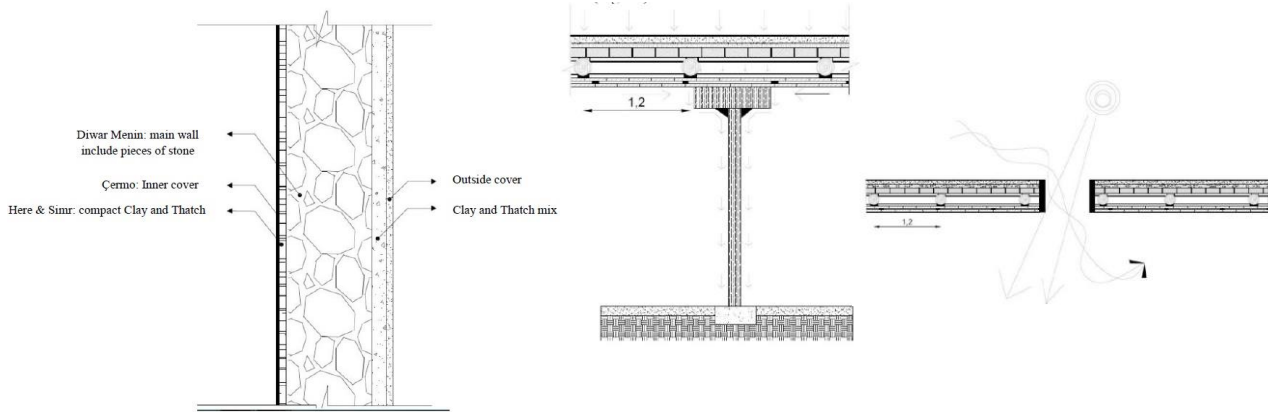


Fig. 5: From left to right: Wall cover; Koleke structure and Force diagram; Roçen, the hole of ventilation and lighting (Authors).

### Spaces and their applications

Usually the bottom floors are used as stable and place to keep livestock and also feedstuff and agriculture instruments and such application can be entrance filter for energy saving, this space is called “Çer Xan”. On the walls of livestock keeping place, “Gewer”, there are square shaped holes called “Wele” that are used for light supply and air conditioning of “Gewer”. The spaces of stable and storage, are as partitions and also as a source to generate heat for upper floors which are living rooms.

Residence halls and baking rooms and kitchens are mostly in the upstairs, because of ventilation and sufficient light and also energy saving matters, this is called “Seru” or “Sere Xan” locally. To control the temperature of inner spaces in summer, a place, “Ser Tenür”, is made beside the houses or inside the covered yard for cooking and baking (oven). Sometimes in the restroom (“Yane”) an oven is made that is used for both cooking and heating the room in winter and for ventilation purposes a hole is made in the ceiling of room called “Roçen” or “Kwnawaçe” or “Kwlance”. [Fig. 5] Naming of spaces in the local language illustrates the fact that spaces and framework of rural houses, which are among the primary human settlements after caveman era are created premonitory and for special purposes and then modified which proves the importance of spatial definition in rural housing.

Balcony, terrace and semi-open in most houses are like dents or bumps on the roof of downer houses, the application of this space is as a place for the meeting of neighbors; so most of the houses being introverted because of areas without border characteristic with the neighbors, is the presenter of an extroverted architecture with free walls and this shows the special architecture of the village which comes from culture and beliefs of villages people. [Fig. 6]

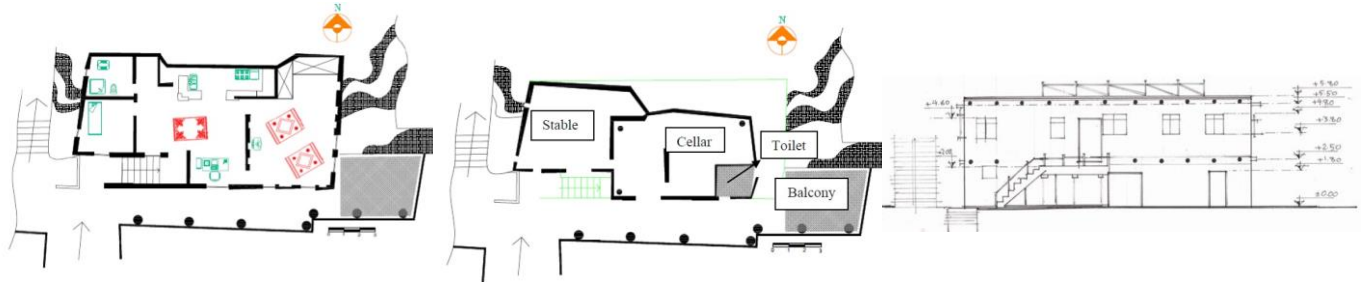


Fig. 6: Plan of ground floor and first floor, and section of a selected house from Palangan village; left to right: Ground floor, First floor, Section (Authors)

### Openings

Windows and doors of old houses are made of wood and most of them are colored blue or green; wooden materials are suitable in terms of availability and being thermal insulation [17] and the reason behind selection of blue, green and blue-green colors is firstly people’s religious and symbolic belief and secondly the availability of natural pigments. Consequently the local people use natural available material to reflect their customs in colors to create a shield. The direction and size of windows have direct relation with the climate of area.

### Importance of improvements in Palangan village

Based on the definitions and solutions, it is important to have improvements in Palangan, because such villages are important in terms of history, tourism and architectural attraction and rate of migration from these villages is worrying. Improvements of Palangan can help in revival of the village and can help the village to show its capabilities, but surely giving effective solutions in this field needs another time.

## RESULTS AND DISCUSSION

Rural houses as a sample of traditional architecture, have original characteristics and factors in the field of stability, which is the main reason of their durability. Obvious aspect in these buildings is the presenter of these buildings response to people's biological need. Palangan village is one of the most extraordinary rural architectures and climatic designs. One the other hand this village like its other counterparts, Masouleh and Howraman, is a valuable heritage that needs considering to its design principles. The points below summarize the sustainable design of study area with principle of climatic design and conclusion in this subject considering scientific principles:

1. The ability of the air flow to cool human body, is ventilation that in the architecture of Palangan shows this with the holes on the wall and roof. To have good ventilation the color of outer view of house must be light like houses of Palangan.
2. Heat transfer plays an important role: 1. Area shell, 2. Thermal resistance of the building shell, 3. Temperature difference. Area shell in buildings of village, is the least possible value and based on the study, sometimes neighborhood of one or two house is mountain.
3. Permeability is entry of cold air from gaps, joints and splits of building. In the mountainous villages and study area in particular, the openings are designed so as to have maximum energy saving.
4. The use of Evaporative cooling of surface and roof, according to the village's structure as every roof is other house's yard, can help to control the temperature of house in warm seasons.
5. The earth is like a temperature discharging dish. Using this capability is clear in the houses of the village, in a way that people use the heat of mountain in the cold seasons and cold of it in the warm seasons.
6. Reduction in the outer surface of walls and roofs in the houses of Palangan, has caused efficient energy saving in the houses of the village.
7. Using the materials, like brick and stone, with high thermal capacity to store the sun energy, it is possible to save the energy during the day to heat it during cold times of night.
8. Design of secondary spaces like store and stable as a central space and using the heating of these spaces.
9. Putting the ground level of houses on the ground to have heat transfer with it.
10. Attention to the direction of openings to have optimum use of sun light and energy from south and south-east.
11. Using native materials with optimum compatibility with the environment around, with high thermal resistance and acceptable thermal capacity.

## CONCLUSION

According to mentioned discussions, it can be concluded that rural houses, because of their history of housing and also the fact that during the ages, have been able to response to sustainable, energy and climatic issues and coordination with the environment, although there were difficult environmental factors such as earth, context and material. Extraction of such principles and using them as pattern by designers, can help to have newer and better designs; because it will be wrong expectation from a designer to have an ideal design without paying attention to such thought which comes from long-term occupancy of human.

## FUTURE WORKS

According to the extracted principles of this study about the architecture of stepped villages it is suggested to study the success these patterns economically, functionally, coordination with environment and energy issues in design of settlements in the same environments and conditions.

### DESCRIPTIONS

1. **Zagros Mountains** form the largest mountain range in Iran and Iraq. This mountain range has a total length of 1,500 km (932 mi). The Zagros mountain range begins in northwestern Iran and roughly corresponds to Iran's western border, and it spans the whole length of the western and southwestern Iranian plateau, ending at the Strait of Hormuz.
2. **Palangan** is a stepped village in Zhavehrud Rural District, in the Central District of Kamyaran Countryside, Kurdistan Province, Iran.
3. **Sanandaj**, also called "Senna" is a city in the Kurdistan Province of Iran. Sanandaj occupies a fertile valley in the Zagros Mountains.
4. **Kurdistan** is a roughly defined geo-cultural region wherein the Kurdish people form a prominent majority population. Contemporary use of Kurdistan refers to large parts of eastern Turkey (Turkish Kurdistan), northern Iraq (Iraqi Kurdistan), northwestern Iran (Iranian



Kurdistan) and northeastern Syria (Syrian Kurdistan) inhabited mainly by Kurds. Kurdistan roughly encompasses the northwestern Zagros and the eastern Taurus mountain ranges.

5. The **Seljuk Empire** was a medieval Turko-Persian empire, originating from the Qynyq branch of Oghuz Turks. The Seljuq Empire controlled a vast area stretching from the Hindu Kush to eastern Anatolia and from Central Asia to the Persian Gulf. The Seljuq Empire was founded by Tughril Beg in 1037 after the efforts by the founder of the Seljuq dynasty, Seljuk Bey, in the first quarter of the 11th century.

6. The **Samanid dynasty** (*Sāmāniyān*), also known as the **Samanid Empire**, or simply **Samanids** (819–999) was a Sunni Persian Empire in Central Asia, named after its founder Saman Khuda, who converted to Islam despite being from Zoroastrian nobility. It was a native Persian dynasty in Greater Iran and Central Asia after the collapse of the Sassanid Persian Empire caused by the Arab conquest.

7. **Hawrāmān** (also Hūrāmān) or **Ōrāmān** or **Avroman** is a mountainous region located within the provinces of Kurdistan and Kermanshah in western Iran and in north-eastern Iraq within Iraq's Kurdistan Region.

8. **Kamyaran** is a city in and capital of Kamyaran County, Kurdistan Province, Iran.

9. **Masuleh** is a stepped village and the capital of Sardar-e Jangal District, in Fuman County side, Gilan Province, Iran.

10. **Gelin** is a stepped village located in Sanandaj and Hawraman region.

11. **Tangivar** is a village in Zhavehrud Rural District, in the Central District of Kamyaran County, Kurdistan Province, Iran.

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### CONFLICT OF INTEREST

There is no conflict of interest.

### FINANCIAL DISCLOSURE

None.

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