

# Evolved Sustainable Building Engineering in Vernacular Architecture of Kurdistan

Dilan M. Rostam

Department of Architectural Engineering, Faculty of Engineering, Koya University,  
Danielle Mitterrand Boulevard, Koya KOY45, Kurdistan Region, Iraq

**Abstract**–Vernacular architecture in Kurdistan is a widely understudied subject. Whilst rapid development is taking place across the Kurdistan region of Iraq, the lack of a clear knowledge of local building traditions has led to the loss of locality and engineering adaptability of newly developed buildings. Advances in mass development in the Kurdistan region need to have clear signs of Kurdish cultural heritage alongside lasting and sustainable solutions. The study of mountain villages of rural Kurdistan will provide valuable information about sustainable building practices as well as cultural values in regional settlements. This, in turn, will be useful in finding more adoptable green choices in the region and identifying the characteristics of the evolved building engineering of these indigenous settlements. This paper will first describe the characteristics of the evolved engineering and sustainable adoptions of Kurdish historical building traditions through selected site visits to Kurdish vernacular settlements and then analyses the building customs of rural communities of Kurdistan for possible adoption in contemporary developments.

**Index Terms**–Evolved engineering, Green solutions, Kurdistan, Sustainable building, Vernacular architecture.

## I. INTRODUCTION

From time to time, many people from the towns and cities in the Kurdistan region leave their busy environment to visit the countryside. Beautiful villages, rural landscapes, and mountains within close distance of cities are the destination for families and individuals seeking a few hours' break from stressful urban life.

People driving through different parts of the Kurdistan region can easily notice that Kurdish traditional houses are not the same. Often the buildings that make up rural landscapes appear noticeably different in their choice of building materials and also in their style, size, and form. Matthew (2010) explains that people gradually realize that these variations are not just random patterns, but each house varies from the next in a logical and pleasantly appealing

way. “These patterns must surely mean something; they must surely tell us something about the history of the household, community, and region” (Matthew, 2010).

In the Kurdistan region, such patterns within rural settlements can reveal the clear variation in building styles and forms of houses which are imposed by the availability of local material, geographical location compared to a major regional center, or ease of access to major communication routes.

Nevertheless, houses are about people. Architecture is a human creation. It is about people acting on their surroundings in building their shelters. The small houses of the countryside can tell us about the lives of the ordinary people who built them and who lived in them. The variation in buildings in different areas reflects the variations in “culture, rituals, ways of life, and social organization, climates and landscapes, and materials and technology available, while the similarities are evidence not only of areas where some or all of these factors have coincided but also of some basic constancies in man’s needs and desires” (Rapoport, 1969). These remarkable evolved buildings are providing know-how for creating modern buildings with local cultural footprint.

Oliver (1997) identifies vernacular architecture as the common dwellings and other native buildings of the people. These creations are directly connected to environmental factors, available resources, and traditional technologies. He emphasizes that “all forms of vernacular architecture are built to meet specific needs, accommodating the values, economies, and ways of life of the cultures that produce them” (Oliver, 1997).

Vernacular architecture is a building process that evolved in response to the basic necessities of life of individuals or communities and reflects many factors such as the environmental, cultural, economic, and technical evolution of the people creating it. Vernacular architecture in Kurdistan has not been subject to wide study and through this lack of knowledge is losing significance amid the rapid developments taking place in traditional communities. The purpose of this study is to shed light on the characteristics of Kurdish vernacular architecture through selected field research, interviews with local people and an analysis of building traditions in rural Kurdistan and to illustrate preserved examples in surrounding communities. The study of vernacular architecture in Kurdistan can provide valuable



data about sustainable local building traditions, which can be useful in identifying sustainable green choices for new developments in the region. The data can provide grounds for further research and understanding as well as transferring knowledge to local and global educational institutions. The wider understandings can help the public to preserve their building traditions and heritage using new design concepts influenced by the characteristics of local culture.

This study began in early 2013 as a course module in the Architectural Engineering Programme (DARE) at Koya University. A total of 19 students from 5<sup>th</sup> year DARE were exposed to the concept of vernacular architecture for the first time and given the opportunity to visit, examine and collect data from two sites at Tewélle and Bîyare. The study continued with visits to sites with various climatic conditions such as Bêxall, Deke, Kifrí, Amédí, and Rewandiz (Table I). This paper provides an overview and analysis of selected findings.

## II. IMPORTANCE OF THIS STUDY

The Kurdistan region of Iraq has been enjoying a semi-independent status in recent years. It has been described as a source of peace and development in the Middle East. In reality, its long history of war and violence has left indelible marks and scars. At the same time, however, it has created a unique situation marked by a free market and developing opportunity (Recchia, 2012).

It is important to know that Kurdistan has been home to many surviving ancient indigenous religions such as Yezidism, Yarsanism, and Alevism as well as Islam, Judaism, and Christianity. Inhabitants with these beliefs have been building structures to satisfy their basic needs using their accumulated skills over millennia. Their structures have been shaped and influenced by their particular beliefs and culture, as well as environmental factors. This study sheds light on the cultural factors that explain how building under these circumstances has allowed for the creation of dwellings that are sustainable and culturally accepted in surrounding environments.

The Kurds and their lifestyle have been noted in the narratives of Western travelers, who have mentioned villages that were built on rocky hills where they were surrounded by strong stone walls and built with the most substantial materials (Shiel, 1836). The rough mountainous

environment clearly imposed characteristic local conditions on sustainable building traditions which have ensured their survival. Mountain villages such as Tewélle and Bîyare and hill towns such as Amidé and Rewandiz, as well as lower plains towns such as Kifrí are good examples of such survival communities which are still inhabited. Studying the dwellings' building conditions reveals that the materials used for the dwellings in the region differ depending on average annual temperature climate variations which range from +50°C to -10°C. Mudbrick, rubble stone, and timber were variously used. "The modern Kurdish domestic vernacular settlements are not any different from those that were unearthed from archaeological sites, as mudbricks and domed roofings are employed in the drier zones, while rubble stone walls and wood beam roofs, serve the wetter, and higher zones" (Izady, 1992).

Lafforgue (2010) clearly captures in Fig. 1 an image of settlements which showcases the environment, materials, and cultural significance of vernacular architecture in the Kurdistan region in general. Studying the building conditions in these settlements shows the richness in cultural and social harmonies that has evolved among the inhabitants. In fact, Oliver (1987) explains that vernacular traditions "are not anachronistic survival(s) of a vanishing world, but are evidently important to the future provision of culturally appropriate and sustainable architecture" (Oliver, 1987). Although the dwellings observed in this study were mostly small houses with a couple of rooms with shared roofs which were built using traditional evolved engineering solutions such as stone arches and flat roofing, they all share a common link of being built by people following local customs using local materials. The study highlights these good practices from local building traditions to exemplify possible future wise choices for developments with a focus on vernacular evolved engineering concepts. Studying such vernacular communities can ensure the survival of a valuable heritage which can contribute to the transformation of our modern communities through greater adaptability.

## III. FOCUS OF THE STUDY

Vernacular architecture is created through simplicity of basic needs influenced by various factors. Arboleda (2006) states that vernacular architecture is a field in architectural studies that deals with the dwellings made by often self-taught builders without the knowledge of architecture as a profession. The author interviewed Mr. Abdulla at a building site in the town of Tewélle, pictured in Fig. 2, who said he learned to become a mason (locally called a *tewentash*) by working with his father from the age of 10. He said he makes a connection with every single stone he prepares and often revisits the buildings that have been built with his stones (Fig. 2).

There are many types of practical architectural applications, from primitive or the shelters in distant communities to urban adaptations of building types that are imported depending on the level of interaction and communication between neighboring communities. Due to that factor vernacular

TABLE I  
GEOGRAPHIC POSITION OF AND CLIMATIC VARIATIONS SITES VISITED FOR THIS STUDY WITH EXTRAPOLATION (PAUW, ET AL., 2015)

Site name	Latitude	Longitude	Sea level (m)	±°C temperature
Amédí	37.0917271	43.4876920	+1190	-10 to +38
Bêxall	35.200733	46.14820250	+1432	-12 to +35
Bîyare	35.2250909	46.11596450	+1076	-12 to +35
Deke	34.4183534	45.29098922	+150	0 to +50
Kifrí	34.6886731	44.9580161	+230	-2 to +50
Rewardiz	36.6085381	44.5238693	+752	-10 to +40
Tewélle	35.2013534	46.18404750	+1477	-12 to +35

\*Some final digits may be missing in the latitude and longitude columns

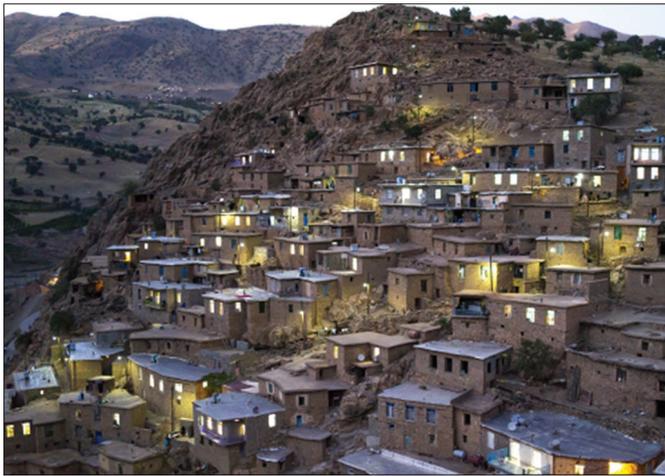


Fig. 1. A view of the well-preserved Kurdish village of Palangan, a UNESCO World Heritage listed site which attracts many tourists every year. (Source: Lafforgue, 2010)



Fig. 2. Mason working on building site in town of Tewelle. (Author, 2013)

architecture is a very open, comprehensive concept (Arboleda, 2006). The average member of such communities “builds his own house, he understands his needs and requirements perfectly; any problems that arise will affect him personally and be dealt with” (Rapoport, 1969). This study explores and focuses on whether the vernacular architecture in Kurdistan’s distant communities presents any characteristics in its building traditions with evolved technologies that can be useful to new developments which have local impacts.

Vernacular architecture in Kurdistan as a topic has not been the focus of wider study before. The only attempt to bring together researchers in the region took place at an International Conference on “Zagros Traditional Settlements” (ZTS, 2008), yet the proceedings of this conference are not publicly available. There have also been other studies on rather traditional trends in building styles of urban environments such as Khayat and Khaznadar (2010).

It is widely believed that culture is dynamic and evolves while maintaining core elements that distinguish one tradition from another. Hardie (1985) states that architecture, viewed as a physical expression of culture, similarly reflects cultural continuities and changes (Hardie, 1985). However,

Rapoport (1969) indicates that not all elements go through transformation but “certain forms are taken for granted and strongly resist change since societies like these tend to be very tradition oriented” (Rapoport, 1969).

Sites visited by the researchers in this study in various parts of the Kurdistan region also represented variations in local culture and lifestyle, from the warm, lower altitude areas to the colder, higher altitude areas, with a sense of physical expression of the various locations.

This study primarily focuses on the Kurdistan region in Iraq and discusses comparative characteristic elements of wider Kurdistan where needed and focuses on three main areas namely:

- A comparative analytical view of vernacular architecture in Kurdistan
- Eco-friendly concepts of vernacular architecture in Kurdistan
- Evolved engineering concepts in the vernacular architecture of Kurdistan.

The methodology of the study was directed toward discovering concepts and definitions related to vernacular architecture and settlements. The research required information to be collected through site visits, photos, and interviews and presented in a descriptive, analytic way. This study introduces lessons from evolved vernacular settlements of Kurdistan valuable for this education and the modern construction industry. There will be other matters that will be identified and outlined for further studies with suggestions for wider research on various aspects of vernacular architecture in Kurdistan.

#### IV. VERNACULAR ARCHITECTURE IN KURDISTAN

The Kurds are the native inhabitants of their land; there are no “beginnings” for Kurdish history and people, writes Izady (1992). “Kurds and their history are the results of thousands of years of continuous internal evolution and assimilation of new peoples and ideas introduced sporadically into their land. Genetically, Kurds are the descendants of all those who ever came to settle in Kurdistan, and not any one of them. Archaeological finds continue to document some of the mankind’s earliest steps toward development of villages and agriculture. Development of domestic technologies such as weaving, fired pottery making and glazing, sun-dried mudbricks and stone cutting for building, metallurgy, and urbanization took place in Kurdistan, dating back between 12,000 and 8000 years ago” (Izady, 1992).

Contemporary Kurdistan as a geographical region has been divided mainly between Turkey, Iran, Iraq, and Syria since the early 1900s (Fig. 3). These sectors of Kurdistan have been in conflict with central governments over their cultural, historical, political, and human rights since the creation of modern local state boundaries in the Middle East in the 1920s. Thus, Kurdistan and its people have not been the focus of wide academic studies, in particular, building environments and traditions.

The climate in the region ranges from a hot desert facing lowland Mesopotamia with an altitude of just 150 m above



Fig. 3. Kurdistan divided between four countries. (Source: Izady, 2015)

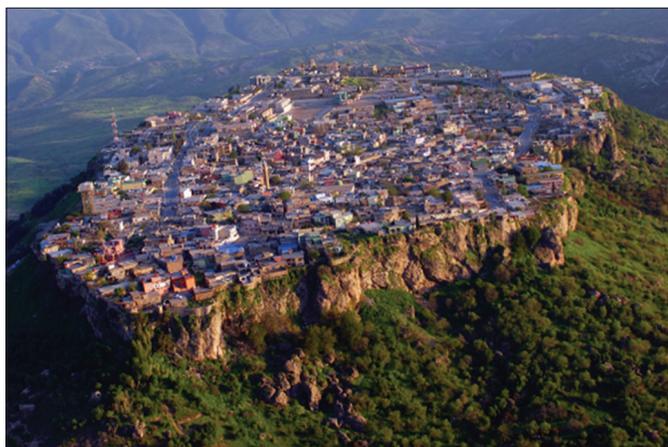


Fig. 4. The picturesque village of Amédî, Kurdistan. (Source: Nelson, 2009)

sea level, with temperatures that can rise as high as  $+50^{\circ}\text{C}$  to a cold mountain environment inside the region with altitudes of above 1500 m above sea level with temperatures as cold as  $-10^{\circ}\text{C}$ . There are signs of climate adaptation in every corner of Kurdistan which indicate the use of local materials to create a sustainable comfort zone for living. This is reflected in vernacular building style using building materials such as typical natural limestone, fieldstone, or fashioned masonry in mountainous areas of the region such as Rewandiz, Amédî, and dolomite rocks in rougher areas such as Tewélle (Jassim and Goff, 2006). The city of Amédî (Fig. 4), in the Northern part of the Kurdistan region, is a perfect example of a community adopting a natural fortress for security, local material for availability, shared cultural values for building a close community and strong thick stone walls for climate adaptability. Houses are built with local materials, creating a cultural representation in perfect harmony with their surrounding environment.

Aristova (1996) stated that most Kurds live in small villages in remote mountain regions. A typical Kurdish house is made of mudbrick with a wooden roof (Aristova

and Testen, 1996). Sun-dried mudbricks, usually quadratic in form, have been common building materials in the warmer, drier lowlands of Kurdistan. The traces of large mudbrick reinforced with animal hair and hay date back millennia. Mudbricks first appeared in the 8<sup>th</sup>-7<sup>th</sup> millennia BC in the walls of the Neolithic settlement at “Ganj Dareh” in the South Kurdistan (Smith, 1974), where they were set in mud mortar. This is almost four millennia older than the Egyptian pyramids. Mudbrick walls and facades are the most common sight across lower Kurdistan as well as in the most studied archaeological sites such as Chermo 7<sup>th</sup> millennium BC, and Béstan Súr 11<sup>th</sup> millennium BC. These are material and climatic characteristics that are still preserved and have become important factors for regional sustainable adaptation.

Ozel, et al. (2014) argue that the main feature of vernacular communities is the “collective living” style. Individuals collaborate to deal with the challenges of everyday life and to resolve common problems such as the need for shelter and the production of food (Ozel, et al., 2014). However, it is quite interesting to note that Kurdistan’s vernacular communities provide efficient solutions to the climatic and topographic constraints of this region and resemble harmonious social and cultural adaptability to their environment with their collective building skills. The environmental sustainability achieved in the mountain villages of Kurdistan includes the settlement patterns, building forms, and topographic locations that are consistent with the region’s microclimatic characteristics and collective skills.

The type and shape of buildings and their orientation, the integration with surrounding nature, and the arrangement of the external and internal space have been carefully evolved to ensure the best possible usability with comfort. The impact of climate on building traditions reveals feasible evolved measures that have been adopted such as natural ventilation systems and passive solar heating. These features are critical given the temperature variations between  $-10^{\circ}\text{C}$  and  $50^{\circ}\text{C}$  in mountainous parts of the region with cold winters and

occasionally heavy snows that melt in early spring, and the region's lowlands with typically mild to cool winters with dry, hot, cloudless summers. Hosseini and Shangapour (2010) believe that the accurate use of local natural materials, the design of openings and their shading, natural cooling, passive solar heating and the all-round arrangement against cold winds are important supporting elements of a well-achieved sustainable conditions in such varying climatic conditions (Hosseini and Shangapour, 2010).

In Kurdish vernacular architecture, colors, patterns and sunlight play a significant role. The required solar energy is obtained through factors such as materials, window placement, spatial arrangement, and suitable terrain. Small square sky blue wooden windows are very common across the Kurdistan region. The shape and the color of the windows follow the same pattern across the village.

Villagers build houses on the southern side of the mountain, which gets the most possible sunlight year round, in particular, morning sunlight. The orientation of the buildings north-south secures maximum penetration of sunshine on cold winter days. Life in the village for shepherds and farmers starts with the first glimpse of early morning light that wakes up the village. The flat rooftops facing the rising sun provide an important open space and a vantage point for interaction and communication in the village, which has great cultural value. Fig. 5 illustrates a good example of a focal point for social interaction, where two Kurdish women are catching the morning sun on a flat rooftop of the UNESCO Heritage listed Kurdish Village of Palangan with its preserved and protected structures not far from the town of Tewéle, sharing many aspects of Kurdish native lifestyles (Fig. 5).

Morning sunlight and the circulation of air have always been recognized as important features of a healthy building to live in (Burgess and Wetherell, 2005). Identifying these characteristics in the vernacular architecture of Kurdistan shows the evolved adaptation of healthy building in relation to facing morning sunlight and fresh air within the buildings.

#### V. CLIMATE, MATERIALS AND EVOLVED TECHNIQUES

It is evident that shelter is a prime necessity to mankind. It has been the dominant factor in the continuous struggle for survival. Consequently in the endeavor to shelter against harsh weather and climate mankind has evolved many types of dwellings (Rapoport, 1969). The type of dwellings varies depending on the available local materials and evolved techniques to respond to extreme regional climate variations.

For this observation, the study looks closely at data collected from the city of Tewéle in the mountainous area of the Kurdistan region for analytical review. This city is wisely situated in a narrow valley between high mountains enclosed on three sides to protect the city from strong winds at an altitude of 1450 m above sea level (Fig. 6).

The high rocky, mountains function as a natural fortress. The inhabitants work mostly in general farming, vine



Fig. 5. Kurdish women catching the morning sun on a flat rooftop in the village of Palangan in the neighborhood of Tewéle. (Source: Powell, 2008)



Fig. 6. The town of Tewéle situated hidden deep in an enclosed triangular valley at +1477 above sea level. (Source: Author, 2014)

farming, honey bee farming, handmade traditional shoes (*Killash*), scarves, and home tools as well as different dried fruits and food conserves. As it is located on the international border between Iraq and Iran, some inhabitants are engaged in exporting and importing locally produced goods. In this area, people have built their houses on the face of this high mountain for centuries using locally available materials such as stones and woods (Fig. 7).

When one observes building practices in Kurdistan, the mountain buildings likely resemble any house type in the Middle East, but a unique feature of Kurdish vernacular architecture is the practice of building stone walls without mortar. The stones are collected and sorted by excavating and preparing the same building site. This sort of dry, irregular stone walls or dry stacking is called *Wushke Kellek* (drywall) by locals. The walls are freestanding structures that use irregularly shaped stones carefully selected and positioned closely together without slipping. They are reinforced by long horizontally positioned wooden/stone



Fig. 7. Owner of an abandoned house explains how he built his stone house and now has a concrete house down in the valley in the town of Tewélle. (Source: Author, 2014)

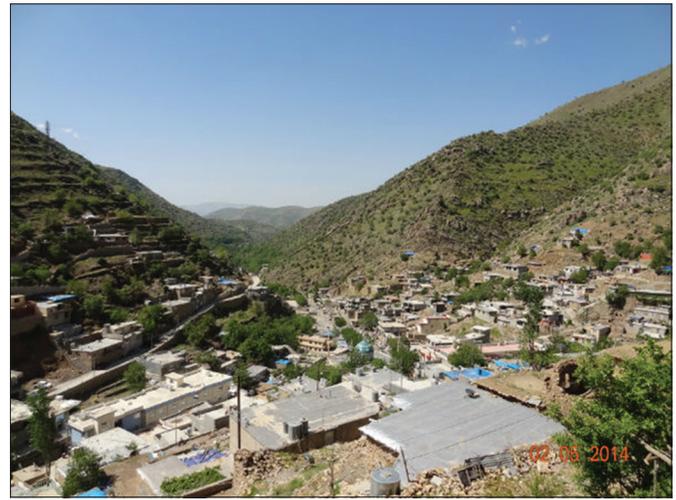


Fig. 9. View from the rooftop of the visited house over the valley, site visit to town of Tewélle. (Author, 2014)



Fig. 8. Positioning *Dimek* in the stone wall for vertical load distribution as well as withstanding earthquakes. Site visit to the town of Tewélle. (Author, 2014)



Fig. 10. Alley road to the visited house on the site visit to town of Tewélle. (Author, 2014)

planks known as *Dimek* or vertically positioned planks known as *Mirolle* in local parlance to distribute dead loads in the wall structure, withstand earthquake movement and absorb the moisture in the wall as exemplified in Fig. 8. Such solutions applied by vernacular builders indicate the evolution of trial and error to perfect workability and structural safety of the dwellings.

Two-storey houses are the most common. The entrances are generally on the ground floor. The ground floor is mostly used for common areas such as livestock, storage spaces and in larger households for a living room, and kitchen. The living areas are commonly on the upper floor. Rooms are divided into living room, kitchen, and bedroom functions.

For the purpose of this study a house was visited which was still occupied. This remarkable native building stands on a spectacular site on the upper edge of the town on the face of a mountain with beautiful views over the valley (Fig. 9).

The steep uphill alley which leads to the house is artistically decorated by irregular dry uncoursed stone walls (Wushke

kellek) on both sides. The local natural stone walls perfectly engineered harmonize with the beauty of the surrounding natural environment (Fig. 10). The wall structures along these steep alley roads are typically wider at the base and thinner as height increases when used as retaining walls. The weight of the stone leans inward to support the structure, and the stones interlock to become stronger. These dry retaining walls allow water to drain through them without causing damage to the stones. They do not require any special tools, only the skill of the craftsman in choosing and placing the stones carefully.

The occupant mother of four children stated that they took over the house half built when she got married. They finished the house by their own bare hands. Since it was so high up, they got a good deal for it. She described the house as she knew every stone used to build it, two rooms for sleeping, living and resting area, and most activities at home are on the rooftops of abandoned lower section, where livestock used to be kept he stated. The lower sections of these houses used

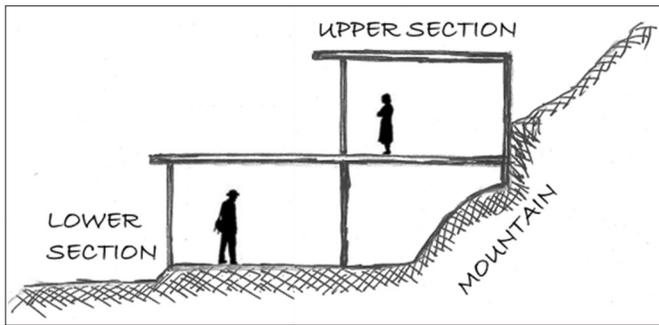


Fig. 11. Sketch showing the positions of the lower and upper sections of the visited house in the town of Tewelle. (Author, 2014)

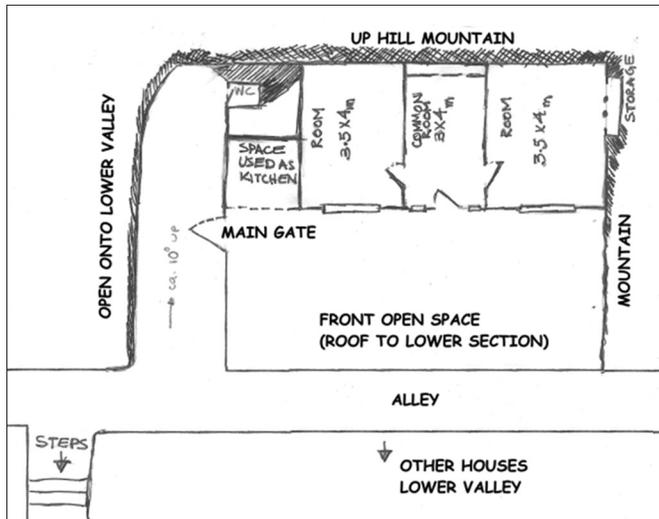


Fig. 12. Sketch showing the plan of the main living area in the upper section of the visited house in the town of Tewelle. (Author, 2014)

to be the main means of keeping the upper section warm in winter (Figs. 11 and 12).

In this house all the walls are constructed with stones and wood is used in making floors and flat roofs. All observed building types in this town lacked structural frames, but all walls in any direction were load bearing walls. The outer walls are erected with a thickness of c. 500 mm with rather small window openings to preserve the heat. The structure of the roof extension that provides cover against sunlight and rain over the outdoor living area and the surrounding walls are built with joists (*tirek*) positioned every 300 mm and beam (*kolleke*) and a post (*hellgir* or *hemall*) (Fig. 13).

Many evolved structural methods equip the building to resist the violent changes in the weather changes as well as providing comfortable living space inside. Such comforts have been achieved by considering all variations in climatic factors and represent an optimum solution. In the visited house during the warm seasons, the occupants spend most of their daytime under the extended roof area outside and sleeping on the flat roof of the lower section area at night. During the cold seasons, they keep the house warm with a single iron chimney and rely on the heat produced by livestock in the lower section of the house. In the old day's people used to build houses with much lower ceiling heights

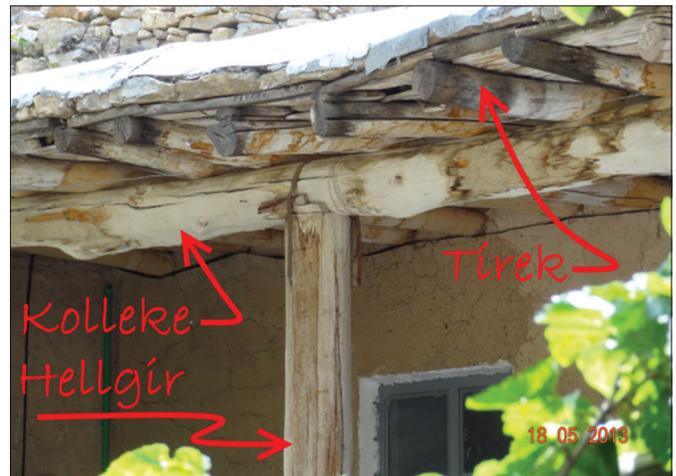


Fig. 13. View of the extended flat roof structure at the visited house in the town of Tewelle. (Author, 2014)



Fig. 14. Height of the ceiling compared with a standing person 1.73 m tall in an abandoned old house in the town of Tewelle. (Author, 2014)

to keep the house warm in the cold nights, says Mr. Faruq, a traditional builder in the town. Nevertheless, they are still using straw clay plaster to coat the inner walls and decorate them with white mud (*gillesipi*), he added (Fig. 14).

The responses to the challenge of climatic variation are clearly different in the lower part of the Kurdistan region. Fig. 15 illustrates an example of such variation of evolved engineering concepts to achieve comfortable indoor air quality by allowing cross ventilation of natural air circulation for maximum output. This evolved solution is built on thermal air movement by letting the cooler air freshen, the higher density air through a filtered opening in the lower shaded section of the house and pushing the warmer lower density out from the upper opening of the opposite wall (Fig. 15). The temperature in the region's lower plain can go up to +50°C in hot seasons.

It is evident that the rugged cold mountain climate has led to the adoption of very close communities with a greater sense of belonging and security. Fig. 16 explains a common housing layout on where cubic buildings on the slope of a

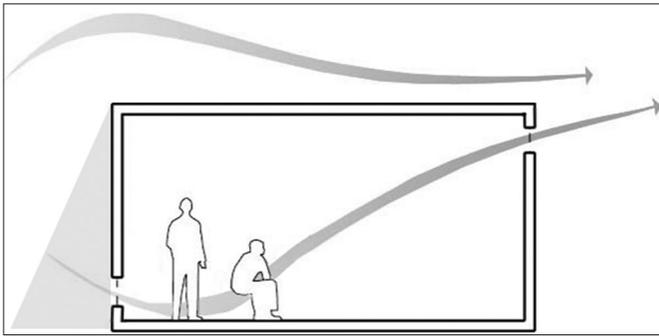


Fig. 15. Kurdistan vernacular cross ventilation solution in Germiyan province. Impression from site visit village of Deke in 2013.

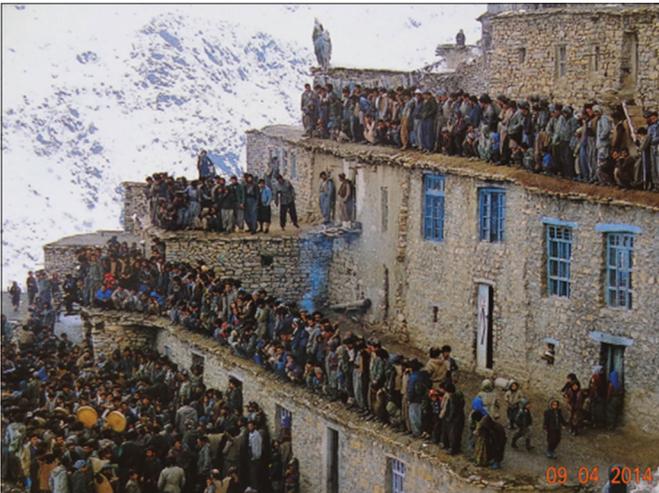


Fig. 16. Space for ritual and social gathering. (Source: Zabihi and Arshi, 1990)

mountain have been organized to allow for social interaction and gathering spaces as well as preserving thermal energy. Here an optimum adoptable solution of durability has been achieved through trial and error and has been passed down the generations. Rooftops are built to withstand the heavy dynamic loads of an assembled crowd for occasional ritual ceremonies as well as public space. The structure of these roofs consists mainly of timbers that are arranged to distribute heavy loads to load bearing stone walls.

The timber framework of roofs in these traditional houses represented roof-frame structures with strong durability (Fig. 17). Such a roof structure is made of large ceiling joists (*tirek*) on which roofing battens (*darerra*) and roofing planks are laid as internal lathing for roof cladding. On top, the timber is coated with daub mixed with chopped wheat straw or something similar. Several thin layers of mud and daub (*topelle qorr*) are added and compacted with a stoneroller (*bangilan* or *sirekollé*) to create a waterproof, durable state. There is also a seasonal pattern to the occupation of space by which people sleep on the front veranda or on the flat roof during summertime. Often an open veranda (*eywan*) is created in front of the house using heavy beams (*kolleke*) supported by columns (*sitún* or *hellgir*) to extend the space created on the roof and shade the outdoor space during the day.



Fig. 17. Roof structure of typical house at the house visited in the town of Tewéllé. (Author, 2013)



Fig. 18. Cube-shaped houses of mountain village on the slope to catch the morning sun and preserve lower land for agriculture, Hawraman Text, Kurdistan. (Source: Tuli, 2010)

## VI. IMPRESSION OF VERNACULAR ARCHITECTURE

Self-sustained societies in various environmental conditions have developed a unique vernacular architecture. The architecture of these communities has been formed for purely basic life needs and protection, to accommodate basic necessities for the inhabitants (Sangiorgi, 2008). The blending of nature and dwellings has developed unique architectural characteristics distinctive to Kurdistan with characteristic techniques. The way buildings are shaped mainly depends on the limits imposed by the local environment, thus providing valuable data for new developments.

In spite of its immense value, the rural vernacular heritage in the Kurdistan region is threatened on several fronts such as rural depopulation, which is in part a result of many social and political changes. The rural population may leave buildings unused and perhaps abandoned. Furthermore, the majority of villages once destroyed by the atrocities of Saddam's regime (1979-2003) have not been repopulated again. However, traditionally rural settlements represent the



Fig. 19. New town houses inspired by vernacular settlement, local materials, small windows, and cubic forms in the town of Tewelle. (Author, 2014)



Fig. 20. A modern design inspired by vernacular concepts, natural local stone and cubic design with small windows in the town of Bellxe. (Author, 2014)

best mixture of people’s ability to modify the environment to their own advantage with the least impact (Battaini-Dragoni, 2008). The harmonious communities in vernacular settlements such the one illustrated in Fig. 18 abandon their lifestyle and migrate to cities in search of a better life and disconnect from centuries of experiences living in traditional buildings in vernacular communities.

The shift of population from rural to urban life may not always make a negative impact on urban building traditions. There are good though rare examples of buildings inspired by vernacular architecture in newly developed townhouses in the town of Tewelle (Fig. 19), which offer far better adaptability to for their native environment than some modern building styles.

Some adventurous new homeowners are taking up the challenge of creating new dwellings that are purely inspired by their local vernacular architecture. The creative new buildings are transforming the landscape and displaying examples of how vernacular architecture can preserve indigenous building traditions and promote sustainable ideas with local characteristics (Fig. 20). This rather modern villa in the town of Bellxe displays how dry stone walls, cubic



Fig. 21. Entrance to the old bazaar before refurbishment. Site visit to the city of Suleimani. (Author, 2013)



Fig. 22. Refurbished section of the entrance to the old bazaar. Site visit to city of Suleimani. (Author, 2015)

forms, and local material can present a more pleasing appearance within their environment.

Learning lessons from vernacular architecture and design can transform our communities and provide better cultural values (TCPA, 2007). The vernacular architecture of regional rural landscapes may bring answers to the challenges imposed by climate change in the region. Vernacular architecture is designed to suit centuries of local climatic variations and is a reflection of the customs and surrounding natural landscape of a community such as in the adoption of local values in the ambitious projects presented in Figs. 21 and 22. The long forgotten, locally inspired buildings in our city, can be restored and claim their rightful place in our urban environment and impress with better locally, adapted engineering and architectural solutions.

An awareness of local issues such as material, climate, space, economy, expansion, and cultural values related to building development and the technological capacity to solve these problems is needed. The cities of the future are going to be the ones which are flexible and scalable. We need nature in the city with access to open space for interaction. “It is not number, crowds, and city size that matter but

sense that city space is inviting and popular that creates a meaningful place” (Gehl, 2013). Creating popular culture surrounding these expectations needs local understanding to introduce solutions with the higher adaptability that are local and environmentally sustainable with green engineering and materials.

## VII. RECOMMENDATIONS

The recent rush in regional developments has deeply affected building materials and techniques as well as the definition of space. Cellular concrete blocks have replaced sun-dried mudbricks or natural stones (Rostam, et al., 2016); galvanized iron, plastic sheets, or precast concrete roofing have replaced timber framed mud straw as a roof covering. Builders are no longer the traditional specialists, but commercial builders. The spatial pattern of these new houses does not resemble the traditional local design. Spaces are more specialized; the seasonal shifts within the domestic space are now compromised, and a sense of privacy is more emphasized within the same community.

This study makes recommendations to create a platform for general debate and further studies as well as the possibility of establishing a permanent academic research group to shed light on valuable human heritage in this region. The study has as far as possible identified the lessons for sustainable solutions using local materials and the significance of preserving the local indigenous building traditions which have evolved to a harmonious engineering perfection with its surrounding environment through millennia. Engaging public opinion with this heritage will allow the public and the industry to have an impact on preserving the culture and the identity of building traditions in Kurdistan. The construction industry can build with these local values and evolved engineering knowledge with greater sustainable impacts.

## VIII. CONCLUSIONS

The vernacular settlements of Kurdistan can be identified as centuries of adaptation to the environment, making use of natural local materials as well as evolving building techniques. Through this study, various characteristics of vernacular architecture were explored and highlighted, with recommendations on how they can contribute to sustainable solutions with greater local authenticity. The key features concerning sustainability in vernacular architecture were identified by analyzing some data collected from vernacular settlements in various topographical regions with a variety of climatic, site, and material factors such as in the towns of Tewelle and Bellxe, and the village of Deke. This building rush and the impact of lack of understanding of local sustainable building traditions has been analyzed. The negative impact on rural and urban development has been outlined, and some rare examples have been presented to show the hidden possibilities that regional vernacular heritage can offer through their local designs.

It is evident that vernacular settlements are clear proof of human activity in certain places with historical building tradition footprints. If they are left to perish, part of our history will be lost forever. This paper has provided an understanding of the landscape, the environment, the land and the people as cornerstones for the creation of our indigenous communities. Our endeavor is to preserve our building traditions not only as a part of our history but also as a valuable resource for the future development of our housing and urban planning. Nevertheless, in a short span of time, the vernacular architecture of the region, an important aspect of Kurdistan’s popular culture and heritage, is on a path to completely vanishing.

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