Middle-East Journal of Scientific Research 23 (5): 823-834, 2015
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2015.23.05.101

Energy Management Strategy in Rural Housing (Case Study: Cold Climate)

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Abstract: Today, energy conservation, prevention of land and pollute the environment, reduce the consumption of fossil fuels and coexistence with the natural and climatic conditions to become one of the most important measures in architecture and urban planning, architecture and urbanism must abide by principles special the field of construction. With regard to rural housing problems in terms of access to energy resources - which are available in cities - and mechanical equipment for heating and cooling buildings, where more than a third of its energy is spent on matters related to the construction sector, find a role model for efficient energy savings are necessary. The lack of similarity between the villages of topographic diversity, livelihoods, social conditions, economy, water resources, soil type and land type, achieving a common pattern of energy utilization in rural housing is not expected. To achieve this goal, the current study cold climate and the North West has been selected as a case study. Certainly not expected in cities, villages and modern energy management to take the traditional approach, but bearing in mind the provisions of the techniques used in vernacular architecture, they can utilize.

Key words: Rural Architecture · Vernacular Architecture · Energy Management · Rural Housing · Cold Climate

INTRODUCTION

The characteristics of rural communities can be a great view of them from both physical and social aspects interacting reflecting on the overall appearance of the rural population of the figure they. Within these divisions based on various features, finer divisions are included: example, villages in different aspects such as how to settle, kind of living, geography and the divisions But the torn. Livelihood approach, villages are divided according to the following classification: rural farm, rural, mining (mining), fishing villages, villages, forests, villages, tourist resorts and villages of rural industry. The general characteristics for permanent rural settlements have been considered, including having clear boundaries and scope, motives and reasons for certain specific economic activities.

In all these villages, there are common factors that have played a decisive role in the design of rural housing. The basic elements of the countryside, the rural context, the structure of the street network and land use are among them according to the rural context and design based on the most important factor in order to optimize energy consumption. Dynamics of rural energy planning should be considered in the context of energy planning and its impact on macro-level analysis is herewith.

At the national level, rural development and its role is very important in terms of land use patterns and energy consumption and supply of energy in the country to determine. However, the excessive use of fossil energy sources on the one hand and on the other hand, environmental pollution resulting from its use, has a serious and threatening. The attention to rural housing problems in terms of access to energy resources - which are available in cities - and mechanical equipment for heating and cooling buildings, where more than a third of the country's energy consumption is spent on matters related to the building sector, by model for saving energy are necessary. The lack of similarity between the villages of topographic diversity, livelihoods, social conditions, economy, water resources, soil type and land type, achieving a common pattern of energy utilization in rural housing is not expected. In order to be able to design and

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build better rural houses both in terms of energy efficiency and comfort, it is essential to have a good understanding:

- On a global scale, of what are the main heat transfers phenomena in a house and how these heat transfers occur;
- On a more detailed scale, what are the main parameters driving these heat phenomena [1].

MATERIALS AND METHODS

For conducting the research we used a case study approach as a particular method of qualitative research. Data collected from field studies and library documents, reports, articles, scientific and other publications, internet resources, reports of self-government and organizations websites. Research type is of application one and study method is descriptive -analytic. It uses analytical description techniques.

Architecture in Cold Climates

Characteristics of Cold Climate: Located within the region between the central Zagros and Alborz Mountains of Iran and the Caspian Sea to the north and the plains of Mesopotamia separate the West. Mountains of the western slopes of the western mountains of the central plateau and the Zagros Mountains in Iran are also regions of the country are cold. The general climate of the area is as follows:

- Extreme cold weather in winter and mild in summer
- Huge difference in air temperature between night and day temperatures
- Heavy Snow
- Low air humidity [2]

Average air temperature in the warmest month of the year in this region, more than 10°C and the mean temperature in the coldest month of the year is less than 3 - degrees Celsius or more. Temperature fluctuations during the day at mountainous areas further. In the valleys the climate is very hot in summer and winter are mild. Too much sun in summer and in winter this area is very low. Cold winters and long and hard for several months of the year the ground is covered with ice and snow. Most of the precipitation in the winter snow and generally in the area of short spring, winter and summer can be separated. Despite abundant rainfall, humidity is low in this region [3]. Western Mountains as well as the barrier prevents the penetration of moist air into the Mediterranean, the Iranian plateau and humidity is just looking to have their own domain. Unlike areas of northern Iran and the Caspian Sea air concentrations due to high rainfall lowland and cold climates, this concentration is lower and this reduces the use of natural ventilation air [4].

The Architecture Features a Cold Climate: Cold amend them. Other features of the design of low and narrow passages to make better use of the heat and prevent the exchange of heat and cold. Usually in this type of climate, biological complexes at the middle and high range to the south and the land on which to raise the heat capacity of the body wall of the northern and interior volume increases towards the outer surface are established. In fact, the establishment of the first villages in the valley below the village there is the risk of flooding and destruction. Secondly, the heavy cold air through the canyons at night will increase the severity of the cold. Thirdly, the northern side of the mountain has always been in the shadow of the cold, while the villages and towns in order to make the most of the sun, the valley and the sun will be built. Fourthly, due to the increased roughness and wind velocity at the top of the mountain and access to water sources and rivers at lower elevations are currently deployed in rural and urban fabric on top of the mountain is not correct [5].

Factors Affecting the Architecture of the Village:

- Natural factors include climate, vegetation, climate, temperature, light and shadow, wind, ventilation and air flow
- Social factors: religion, culture, beliefs, customs and population and family
- Economic factors: income and living conditions, material costs, construction costs and most importantly, the value of land
- such as street network access and transport system. (Figure 1) (Table 1, 2, 3).

Influential Factors in the Design of Rural Housing: Buildings, as they are designed and used today, contribute to serious environmental problems because of excessive consumption of energy and other natural resources. The close connection between energy use in buildings and environmental damage arises because energy-intensive solutions sought to construct a building and meet its demands for heating, cooling, ventilation and lighting cause severe depletion of invaluable environmental resources.

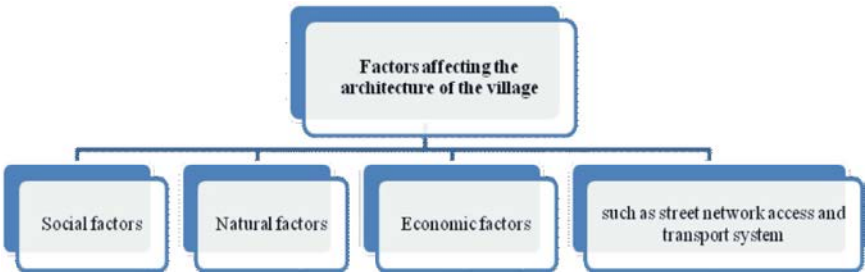


Fig. 1: Factors affecting the architecture of the village- Source: authors

Table 1: Summarizes the influence of social factors in design of rural housing -Source: authors

General Criteria	Variable	Factors
-Place a multiplicity of worship and religious rituals	Religion	Social factors
-Multiple retail units on main and secondary roads	Overpopulation	
-Widening of roads being trapped, resulting in incomplete separation of parts living in tribal villages that were formerly	St living	
Introspection and Privacy homes	Culture and beliefs	

Table 2: Influence of environmental factors on rural housing design- Source: authors

General Criteria	Variable	Factors
-Shadowy condition or security measures chosen shade and sun block sites	Temperature	Natural Factors
-Planting trees shaded the water flow path	& radiation	
-Created with the east -west thoroughfares to reduce levels of sun block		
-North- south oriented street network to receive more sun light, cold		
-Reduce the width of the air passages to create shade and stylized		
-Contraction of the physical fabric of the smaller residential areas to prevent heat loss in mountain areas		
-Establishment of residential units degrees East and West for more sun mountain areas		
-Construction of buildings with a two-floor family living spaces upstairs and living spaces downstairs		
livestock and storage of agricultural products, with the aim of absorbing heat generated in the fold		
-Elevated ground floor of the building to prevent moisture transfer through the building foundation in mountain areas	Moisture &	
-The use of stone, mud and clay and sometimes in combination with wood, insulation suitable for mountainous areas	Precipitation	
- Select the rural locations of wind and air flow conditions exist Curran	Airflow	
- Perpendicular to the direction of the winds and the formation of sandy streets perpendicular to the cold winds		
- Direction of the wind direction with the width of the street network in high		
- Avoid creation of orthogonal intersection to facilitate the passage of wind Curran		
- Remove the window, the cold winds in the mountainous areas of the building		
- The establishment of such applications requires a water bath, a mosque and a mortuary near water sources	Water	
- Select a subterranean springs or symbol as a focus area of public land and the formation of aggregation centers	Resources	
or community centers		
- Follow the main path of the village from the direction of water flow (rivers, springs and canals)		
- Physical development, thereby forming a linear pattern of residential units located in the water		
- Length, width and less of perpendicular streets in villages, steep slope	Slope	
- Follows the curve of the main street (the same height)		
- Establishment of animal or storage spaces on the lower floors non-coplanar due to the high slope of the land		
- Settlement housing units in the slope		
- Construction of two storey residential units on sloping land		

Table 3: The impact of economic factors in design of rural housing- Source: authors

General Criteria	Variable	Factors
- Use of land for the establishment of a production capability and low fertility land use	The production value of land	Economic Factors
- Reducing the area of artial components, thereby increasing the number of floors in		
residential land prices due to increased cost of land		
- Widening examination determined the direction needs to move livestock	Livelihood and income	
- Passages orientation towards agriculture		
- The establishment of trading centers along the paths of the village and deployment service uses the	Access and transport network.	
main thoroughfares of the village		

However, buildings can be designed to meet the occupant's need for thermal and visual comfort at reduced levels of energy and resources consumption. Energy resource efficiency in new constructions can be affected by adopting an integrated approach to building design. The primary steps in this approach are listed below.

- Incorporate solar passive techniques in a building design to minimize load on conventional systems (heating, cooling, ventilation and lighting).
- Design energy-efficient lighting and HVAC (heating, ventilation and air-conditioning) systems.
- Use renewable energy systems (solar photovoltaic systems / solar water heating systems) to meet a part of building load
- Use low energy materials and methods of construction and reduce transportation energy [6].
- Material forming the outer shell of the building (in this case, the maximum effect of the thermal resistance of the layer forming the outer shell and the heat transfer coefficient of the shell).
- The amount of air leakage from cracks and openings Slough (frequency of air changes hr).
- The ratio of the outer shell of the building's useful space (the physical form of the building).
- Compared to the useful roof area of the building.
- Openings in the outer shell surface (such as opening doors and windows to air or controlled atmosphere) to help level the building.
- To establish the building to the four cardinal directions.
- Characteristics of radiation absorbed by the outer surfaces of buildings.
- The use of passive solar systems

The use of active solar systems (solar collectors) [7]

Architecture Principles and Guidelines: Including measures to deal with the cold weather and rough that people have used these areas include:

Settlement on the Mountain: Generally, the main reason for the establishment of rural settlement in the mountain range, the range of flood risk aversion is well sheltered from the cold winds at altitude. Putting the house in the middle of rural mountain residents to maintain flood and wind are natural factors. In addition, the placement of houses on the mountain makes it possible to always downstream areas of land for agriculture and horticulture, agriculture and horticulture exploiting (Figure 2).

Use of Local Materials: Due to the availability of high strength and more important of the two, consistent with the climate of the area, the use of stone in building long been highly regarded and opinion makers have been building.

The aggregate result of phonetic features is walled village. The latter creates a visual harmony in the village and its Cultural Landscape in the form of a single form and continuous exposure to the observer being. The use of stone as a material canvas, he represents the genius resides in the utilization of natural resources in order to maintain life (Figure 3).

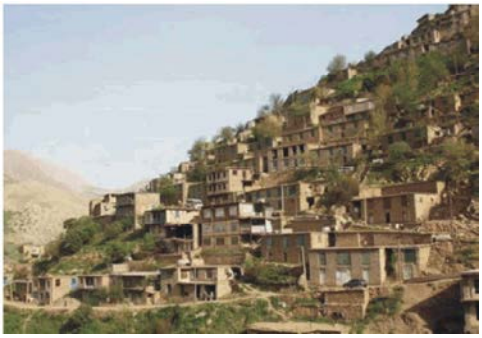
Dense Texture of Interior: Security authentication and protection against invading cold and dry climate of the Zagros two major factors are in creating a dense fabric with a width of a few rural roads. Dense texture of streets and public spaces, the village has united face. All residential buildings in this climate of intense planning and the lateral surface is reduced, So that if a local plan for residential buildings in hot and humid regions are compared, the lateral surface of the reduced density clearly planned and we realized [8] (Figure 4).

Development of Organisms (Organic): Physical development of model villages that no previous planning application for the management of rural development there, but the models developed based on the needs of the residents and the opportunities and constraints of normal is defined. For example, the edges of rivers, mountains, plains, grassland and other natural factors may be due to the expansion of the village. On the other hand, other factors such as soil strength can encourage rural construction in rural areas of the earth [9] (Figure 5).

In this regard, given the extent of the cold and dry climate in the Northern Hemisphere, due to the design of buildings and cities of body cold and dry climate, can consume a major part in reducing the pollution caused by the consumption of reduce.

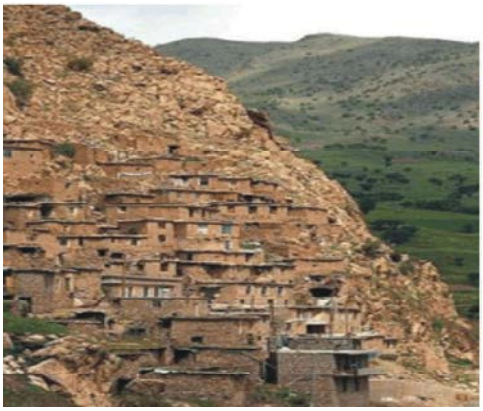
Main Heat Transfers in a Rural House

Overall Perspective: Main heat transfers occurring in a rural house during heating season (Figure 6).



A-Uraman Village (Kurdistan province)

B-Kandovan Village (East Azerbaijan province)



C-Palangan Village (Kurdistan province)

Fig. 2: Deployment on the mountain

A-Geshani Village (Hamadan province)

B-Kandovan Village (East Azerbaijan province)

C- Varkane Village (Hamedan province)

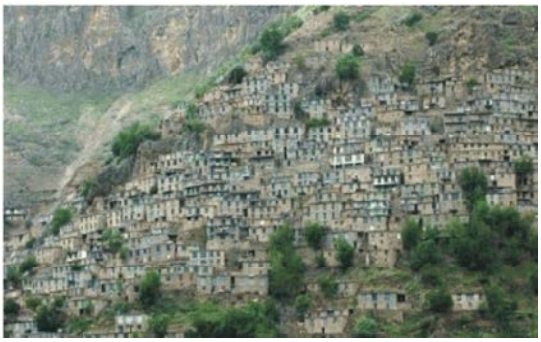
Fig 3: Use of local materials

A - Khoiin Village (Zanjan Province)

B- Kandovan Village (East Azerbaijan Province)

C- Gilvan Village (Ardebil Province)

Fig. 4: The village of dense tissue



A-Uraman Village (Kurdistan province)

B-Ola village (East Azerbaijan Province)

C- PalanganVillage (Kurdistan province)

Fig. 5: Development of an organism

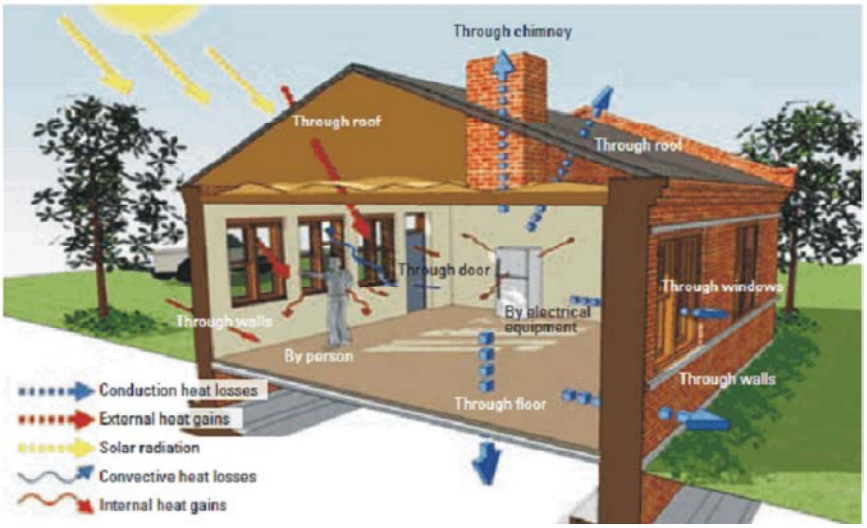


Fig. 6: Main heat transfers in a rural house

Heat Losses: The heat losses consist of the conduction (and radiation) heat losses and the convective heat losses:

- Conduction heat losses through the building envelope whether they are opaque components (roof, walls, floor, door) or transparent components (windows and other glazed surfaces);
- Convective heat losses which are due to cold air infiltration and ventilation through the houses. These cold and fresh air infiltrations:
- Mostly occur through windows and door cracks (and even sometimes through wall cracks if they are not well sealed and mortared), through door openings when people move in and out, through chimney and, in some buildings, through specific c forced ventilation systems;
- Are necessary for health purposes in order to allow people to breath and evacuate internal pollutants (moisture, smoke, odors, ...) and to allow combustion of stove and boilers…;
- But should not be too high in terms of volumetric flow rates because they bring a lot of cold inside the houses, thus decreasing comfort and increasing heating expenses.

Heat Gains: The heat gains are from the exterior the interior:

- External heat gains due to solar radiation energy entering the house through windows and glazing and also, to a smaller extent, through opaque surfaces like walls and roof (in fact solar gains through opaque building surfaces contribute to slightly reduce heat losses through such surfaces). These solar heat gains are called passive solar gains. Obviously the closer to the South the windows are, the more passive solar heat gain they will bring inside the house;
- Internal or indoor heat gains due to occupants (each adult person sitting still releases an average heat power of about 100 W) and heat released in the building by electrical equipments like lighting, appliances, etc … Such heat gains contribute to the heating of the house and lower the energy consumption of the heating systems and this is why they are called “free heat gains”. This contribution can be extremely significant in a well designed energy efficiency house.

So called “passive solar houses” is a category of energy efficient houses making large use of very energy efficient windows and other solar collection technologies to minimize the use of conventional fuel for heating. This contribution to heat balance in a house is not negligible even in a conventional poorly insulated house because winter solar radiation availability is high in Heilongjiang and because rural architecture usually makes good use of passive solar collection by designing houses with South orientation and using large windows to the South.

Heat Balance and Heating Needs: Once these basic principles are set, it is easy to understand that heating needs of a house that will have to be supplied by various heating systems (khan, boiler,…) making use of various fuels (agricultural residues, coal, …) will be, for every day of the heating season the difference between heat losses and free heat gains:

heat needs =
heat losses – (solar gains + indoor gains)

The heating consumption of a house will be:

house heating consumption =
heat needs / global heating system efficiency

One will never stress enough the basic fact that energy efficient house design consists in working simultaneously in the following directions:

- Reducing heat losses;
- Optimizing components affecting heat gains;
- Optimizing the energy efficiency of the various heating systems [1].

Thermal Comfort in a Rural House: If it is essential to minimize fuel uses in a house in order to reduce energy expenses and contribute to environmental protection, it is also essential to do so while bringing inhabitant's optimal thermal comfort. The main parameters that have a significant influence on winter comfort in a rural house are the following:

- Internal air temperature;
- Inner building envelope temperature (walls, glazing, roof, floor);
- Mean radiant temperature, also called resultant temperature, which is the temperature effectively felt by occupants and related with the two previous parameters;
- Internal relative air humidity that should be kept below 60% for better comfort and for avoiding condensation and moisture appearance on inner walls;
- Air streams on occupants with air colder than skin temperature (about 32°C) that should be kept below 0.2 m/s;
- Temperature gradient in the room (air temperature difference at various heights within the room) that should be kept minimal by preferring radiant heating systems rather than convective. Envelope insulation not only reduces heat consumption by lowering heat transfer through building envelope, it also contributes to improve energy efficiency by giving better comfort with relatively lower air temperature because of positive effect on higher internal surfaces temperatures [10].

Strategic Policy: The destruction of the ozone layer, the greenhouse effect, the Earth's temperature to rise, drought and famine, increase concentration and reduce the oxygen concentration in air emissions, acid rain falling and poisoning the soil and water, dangerous and incurable diseases, melting of polar ice, The use of befouls could increase deforestation, soil erosion and soil fertility decline is. However, fuel wood or biomass is not the only cause of the problem, as timber trees and clearing land for agriculture, the environment and environmentalists do more damage. To solve this problem, the development of rural Gas lines can be useful, of course, the natural gas supply to be stable and develop refining capacity and the capacity of transmission lines, etc. For the village could be gas piping [11].

For Gas country villages and providing access to technical services such as road safety is necessary and appropriate prerequisites in this regard should be provided. The most important strategic policies to manage non-renewable energy sources, energy conservation and declining fossil fuel preservation and utilization of these funds extravagantly incorrect and malversation and unforgivable crime against humanity. Dissipate energy not only cold and dark future for the future generations will inherit, but for the present generation but also increasing environmental pollution and the destruction of nature is no other gift [12]. Executive Strategies for the cold climate of Iran include:

- Greenhouse property
- The height and size of buildings in architectural design and urban landscape
- Specifications, color and material being polished façade

Greenhouse Property: Approach in which solar thermal energy can be absorbed and imprisonment is called the greenhouse effect. In this way, large glass walls that completely seals are good heat and light the building are installed. Large glass walls allow sunlight short wavelength (5/2-4/0 microns) into that space. Sunlight passes through glass interior walls, floors, walls and

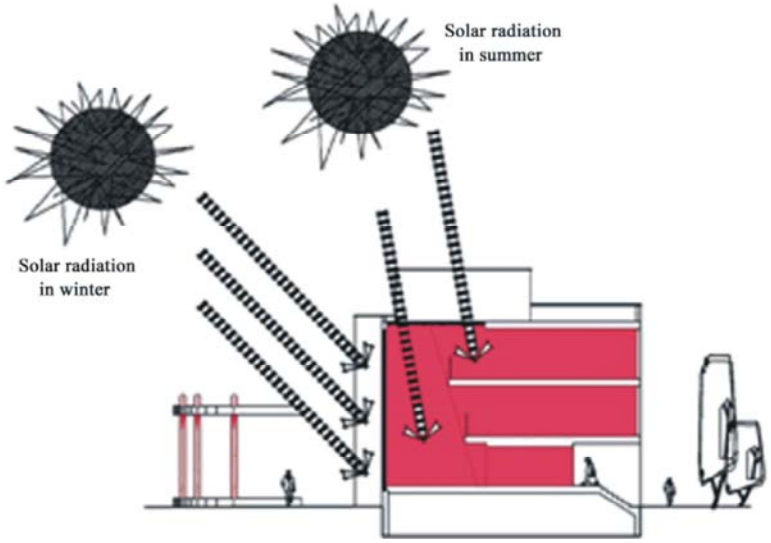


Fig. 7: Greenhouse effect: heat trapped within the glass due to the inability to remove heat from wall to wall glass is marked by the color that is seen in Fig.

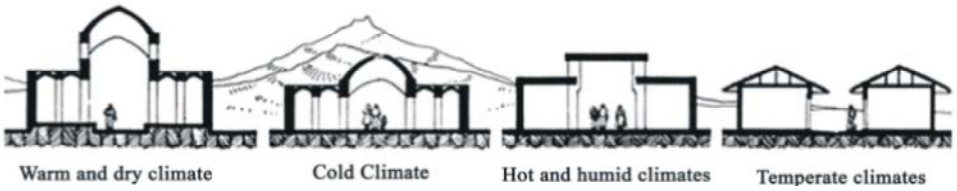


Fig. 8: Typology buildings in the region of 4 - Traditional buildings of low height and compact buildings in cold regions of the country as well as is evident

furniture are treated and heat production. The energy and long wavelengths (10 microns) and cannot leave the glass wall. After continuous exposure to the sun's heat into space and is imprisoned, the heat inside the space increases. This warm atmosphere can be very useful as an energy source for the building can be used after sunset. In (Figure 7) colored areas, area heated by the rays of the sun entered into the show. Specific measures include changing the color of the glass, the glass reflector (reflection), the use of curtains, glow bracelet or canopy mounted on the front glass and other similar approaches can prevent the summer sunlight penetration into the space and the heat [13]

The Height and Size of Buildings, Urban Design and Landscape Architecture: the design process of modern cities climate tall buildings of architectural scale limited to the use of multi-wall windows and the occasional use of insulation blocks that are available in the construction market. But the consequences of such a scale tall buildings, neighborhoods, regions, districts and cities are considering?.

Building height to facilitate the heating of the building, the better it will be mentioned in all buildings except low altitude and plans are made. Traditional buildings in our country compared to other climates, the cold climate building height is shorter than intended. (Figure 8).

The design of high-rise buildings in urban scale only by taking measures would be desirable. As a natural skylight important issues in the design of buildings in cold climate, therefore the design of high-rise buildings will not result in ghosting on neighboring blocks. With increasing height, the building acts as a barrier against wind stream flowing in the region. In Figure 9 the behavior of a high-rise building adjacent urban fabric is shown. Two items ghosting on high-rise building adjacent tissue and the area adjacent to the winds as the main problem with this type of design is considered. Obviously, due to the volume of the smallest and shortest explained that the shadow will have less height (Figure 9, 10).

The tall building practices can be found in urban arrangement, as is shown in Figure 6, would spotting so that we can resolve the problems of the previous scheme.

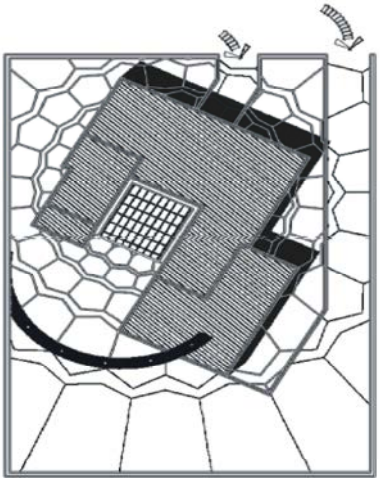


Fig. 9: Short shadow of a building with low height and compact size

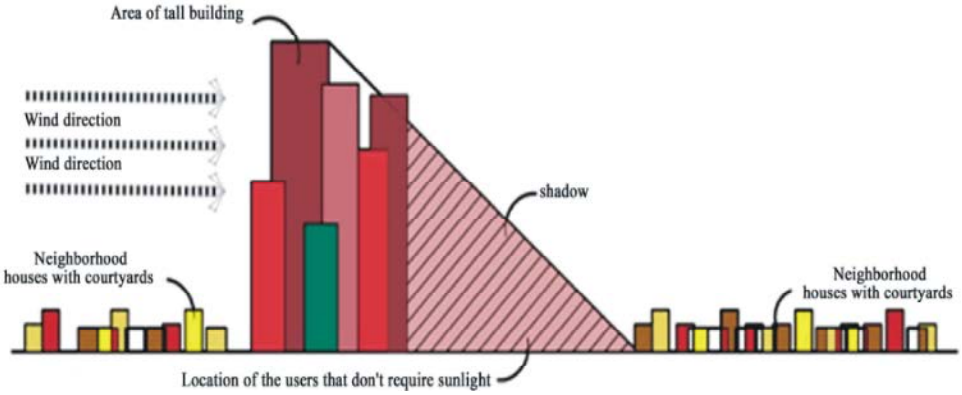


Fig. 10: Ghosting and neighborhood an urban high-rise building in a cold

This image is of a tall building in the area that is located in an urban area ghosting is owned by the user will have that required a lot sunlight. (Landscaping) [14].

The dense high-rise buildings on each other together so that they can somehow defeat ghosting wind flow around the building to adjust the intensity of the weather. Building density in a particular area of the city, when a high-rise building with space-efficient (in cold climates to prevent ghosting in hot climates to avoid intense sun exposure) can WINDCHILL the extreme preventing the streams be. Although this type of layout, terminal block area exposed to the wind in the tall building located in a safe area turn against cold winds and annoying tall building in the heart of the area will create. The easiest and perhaps the most effective way to design a city sky line, which must be considered by urban planners involved in it. (New York and Beijing are examples of important cities such urban design), but the lack of attention to the structure, resulting in a mess similar to what happened in Iran will see the cities [15].

Specifications, color and material being polished façade with the boom in the construction market, a wide range of material types with different specifications available to users located in all parts of the country and almost all materials regardless of climate regulations are implemented. Here are a few of the little bag where it is necessary to implement a number of different types of building materials and its effects in regulating the climate of the building is given. According to the record performance of buildings in cold climate, it is always recommended that the building be used materials darker color on the walls and it just help to absorb the sun's energy is more.

Conclusions and Suggestions

Conclusions: Principles and methods used in the architecture of the villages mentioned points rose during construction and compliance with respect to the factors influencing the shape and texture of the village. These guidelines are also applicable in the villages of Iran.

But given the increasing progress of science and technology, industry and technology, the implementation of some of the architectural styles of the past in modern societies do not appear correctly. With the increased facilities for rural development including gas lines, water, electricity and telecommunications effective steps have been taken to meet the needs of residents.

After the construction phase, the points in the operation of rural housing, it should be noted that in line with the habits of saving and energy efficiency. Larger scale in the economy will also play a role. Saving natural and renewable energy, solar energy, renewable turning to be a valuable step in improving the rural economy and consequently macroeconomic country. This is fully consistent with the culture of each region is defined architecture provides native habitat.

Urban and rural areas in order to cope with the extreme cold climate and cool mountain is formed.. Urban and rural characteristics of the climate, such as compact structure, small, enclosed spaces, enjoying the sun and the direction (as the determining factors for the establishment and expansion of the urban and rural landscape to) and the spaces in parallel to the narrow ground, all the things that are in line with the efficient use of energy in nature are applied.

Suggestions: The role of climate on texture and traditional buildings are among the most important programs and priorities in reducing energy consumption and use of natural resources rather than mechanical systems and create a comfortable living space, is safe and durable [16].

Architectural development of local techniques and materials used to create the canvas; often the process is relatively simple and easily responds to the needs of the residents of performance. That's why some designers, as it clearly now identify and evaluate "model, accountable and sustainable architecture" should be interpreted [17].

The modern use of traditional patterns and construction boom could be an effective step towards creating prosperity, sustainable development and energy saving [18]Some of these proposed measures are:

- National regulation of rural buildings (consistent with the climate) in order to reduce energy consumption in housing
- Use of local expertise in every area of ??the construction of rural housing.
- Raise awareness regarding the impact of architecture in harmony with the climate in the category of household savings in energy consumption.
- Rural housing proper orientation with respect to the sun in the sky for optimal utilization of solar thermal energy in different seasons.

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