

# PRINCIPLES OF ENVIRONMENTAL DESIGNING WITH A SUSTAINABLE AND ARCHITECTURAL APPROACH: A CASE STUDY (MALAYER, HAMEDAN)

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## ABSTRACT:

Nowadays, the excessive use of fossil energy sources, on the one hand, and the environmental pollution caused by its consumption, on the other hand, has become a serious health threat not only in architecture but also in many aspects of human life. Therefore, to reduce the energy waste and environmental pollution in the architecture, the concepts of sustainability and the objectives of sustainable development are briefly utilized. In this paper, we examine the principles of environmental designing with a sustainable and architectural approach in Malayer. Ultimately, we concluded our project with 15 strategies for the environmental designing of Malayer when we reviewed and analysed its climate and environmental conditions. The results obtained from this project can stand for the maximum exploitation of the decontaminated energies such as those of the sun, the wind and the water and the reduction of fossil fuel consumption due to the environmental designing, the better use of the available energies in the nature and the efficient methods of insulation to prevent the energy waste. This paper is of a descriptive-analytical essence; meanwhile, it benefits from the findings of the library and field studies.

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## INTRODUCTION

The supply and use of energy have always been a crucial matter in man's life. The attainment to the new sources of energy has played a fundamental role in the advent and change of civilizations [1]. However, man has begun to destroy the environment with the introduction of the industrial era. He has given the priority to the fossil energy so as to spend his life. It is clear that he has given such relentless blows to the structure of the nature that his behavior has led to the destruction of the environment. In fact the list is countless. Ultimately, he has been forced to look for the ways to find solutions for the problems he has imposed to his own surroundings himself. Meanwhile the problems made are so risky that no groups or teams dare feel irresponsible or uncommitted with regard to the environment [2]. Architecture, due to the construction issues and problems arising from improper building practices, contributes to the environmental crisis greatly because it is the construction practices which lead to the nature contaminations including the pollution's of soil, water, air and so on [3]. At first, the environment ought to receive proper attention in architecture so that the surrounding setting is not damaged. However, the important issue concerns the, energy required for the welfare of human settlement in the

areas of architectural spaces following architecture and construction matters. If it is not dealt with properly, architects responding to the residential needs of human beings will face many problems in the future. The application of the sustainability concepts and sustainable development goals to reduce energy waste and environmental pollution in architecture has created a discussion called "sustainable architecture. In this type of architecture, the building not only adapts itself with the environmental conditions of the area but also establishes such a reciprocal relationship with it that, according to Richard Rodgers, "Buildings are like birds dressed their feathers in the winter , adjusted to their new environment and organized their metabolism based on it."

## Sustainable development

The concept of sustainable development means providing solutions against the traditional structural, social and economic patterns of development so that it can prevent problems such as the destruction of natural resources, degradation of ecosystems, pollution, skyrocketing of the population, the prevalence of injustice and decrease of the quality of human life [4]. The generally accepted definition of sustainable development outlined in Brute land's report is the one



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representing the kind of development that meets the needs of the current generation without a compromise and regardless of the future generation potentials [5].

#### **Sustainable architecture**

In general, the sustainable architecture can be considered as a field which reacts to the spatial and environmental characteristics and conditions. It also betters its capabilities to create an optimal setting with the least harm to the environment [6].

#### **Environmental designing**

The environmental designing of a building is a plan which is able to construct the environmentally proper conditions as much as possible among the living spaces man utilizes in terms of the appropriate exploitation of the renewable energies available in the nature. The advent of technology, the feasibility of using fossil energy and mechanical devices, for nearly two centuries, have created chaos in the local as well as environmental designing of buildings in general and cities in particular. Meanwhile, the excessive consumption of the fossil energy, on the one hand, and the environmental pollutions, on the other hand turn out to be a serious and threatening issue.

#### **Sustainable development and environmental designing**

The issue of the environment is one of the basic and determining the debates on the sustainable development. The issue of sustainable development is related to the energy consumption cut, especially the fossil and non-renewable fuels; therefore, the environmental designing of buildings and the main structure of cities will play a significant and determining role in reducing the fuel consumption and preserve it for the coming generations [6].

#### **Sustainable development and vernacular architecture**

An evaluation of the physical designing features in rural areas and the materials and administrative ways indicate that the unfavorably environmental conditions have been avoided and the natural energies have been burnt to provide the comfort heating system. Thus, the vernacular architecture needs the least amount of the fossil energy, cuts the costs and prevents the pollution and destruction of the environment, so it is an obvious instance of sustainable architecture. Accordingly, a survey of the traditional premises enables us to achieve our purposes of designing solutions based on sustainable development.

#### **Environmental condition of malayer**

Based on another type of classification which is derived from the four divisions of Iran environment, Malayer belongs to the second division, namely, the cold environment (West Mountains of the country).

Owing to the fact that Malayer is among the cities with the cold climates, we will investigate the properties of this kind of climate in the following lines.

The west Mountains - which include the western outskirts of the central mountain range in Iran – is considered to be among the cold regions because the average temperature in the warmest month of the year is more than 10 degrees centigrade and the average minimum temperature in the coldest month is less than 3-degrees Celsius. The western mountain range keeps from the penetration of the moist air of the Mediterranean Sea into the Iranian plateau as a barrier, and retains the moisture in its slopes. The extreme heat of the valleys in the summer and their equinox in the winter are the characteristics of this kind of climate. The amount and intensity of the sunlight in this region is very low in the winter and high in the summer. Winters are long, cold and tough, for the ground is covered with the ice for several months of the year. Throughout the region from Azerbaijan to Fars, winters are extremely cold. The cold weather starts in early December and continues until the end of April more or less. The rate of rainfall is low in the summer and high in the winter. It snows most of the winter. Frequent snowing covers the peaks of the mountains and at the altitudes of over 3000 meters, there is always the snowfall. Generally, this area has a short spring which separates the winter from the summer. Tabriz, Orumieh, Sanandaj and Hamedan, are located in this region.

#### **Degrees of Temperature**

In general, the climate of the Hamedan province varies due to the existence of the high mountains, rivers and numerous springs full of water, and lots of ups and downs. Thus the valley weather in the north of Mount Alvand is cold and full of snow and rain in the winter, but it is mild during the summer. However, the amount of the coldness is not the same in all parts of the province because the weather in the southern parts of the province such as Malayer, Nahavand and Tuyserkhan is relatively warm due to the warm Mediterranean climate compared to other areas of the province. The annual mean temperature is the most important indicator of the climate which is obtained by taking the average of daily mean temperatures in the long periods. The same average presents the monthly mean temperatures of the year in terms of monthly periods.

A survey of the temperature indexes shows that the annual mean temperature is equal to 13.4° Celsius in the city. An absolute maximum or minimum temperature occurred so far has respectively been equal to 40° C and 32.8° C. in July and August, but in January it has been negative. The following tables indicate the change trend of the various indexes in temperature during the different



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months of the year for a long period. Table 1 illustrates this issue.

Table 1: Temperature in Malayer during the years 2001 to 2012

Temperature indicators	2001-2005	2005-2008	2008-2012	Total
Minimum temperatures	20.4	20.6	20.8	20.6
Maximum temperatures	6.5	5.6	5.8	6.1
Average temperatures	13.6	14	12.8	13.3

### Humidity

The air humidity offers the amount of water which exists as vapor in the air. The vapor enters the weather through the vaporization processes of both the surface water in oceans and seas, and the moist surfaces of the plants. It is transferred to the other parts of the ground through the air and wind currents. The warmer the air, the more vapor it holds. The amount of moisture in the air can be measured and expressed by the different procedures including absolute humidity, relative humidity and the vapor pressure. What is applicable based on this discussion concerns with the relative humidity.

The maximum mean of relative humidity is about 54.4 percent registered in weather forecast station at the airport; whereas, its minimum mean is 47 percent registered at Malayer weather forecast station. The amount of the relative wetness is two times more than that of the summer. Table 2 illustrates this issue.

Table 2: Humidity in Malayer during the years 2001 to 2012

Year	2001-2005	2005-2008	2008-2012	Total
Relative humidity	44.3	45.2	44.7	44.8

### Days of frost

The frost consists of the conditions in which the temperature falls below zero for a period during the 24 hours. The absolute minimum temperatures occurred in the area show that except for the months of June, July and August, there is a frost in the rest of the year. The days in which the minimum temperature of a twenty-four hour is equal or less than zero are not considered as the frosty times. The distribution of the frosty times is different in terms the various regions of the province because the maximum rate pertains to Soobashi with 161.3 days and the minimum one is related to Malayer with 86 days. Table 3 illustrates this issue.

### Rate of Rainfall

The origin of the rainfall in the province of Hamedan pertains to the Mediterranean air masses

which come from the westward of the country as well as the currents from the North West parts of the province. It originates from the Black Sea and the northern regions of Europe. Table 4 illustrates this issue.

Table 3: Frosty Days in Malayer during 2001 – 2012

Year	2001-2005	2005-2008	2008-2012	Total
Average days of frost	83	93	82	86

Table 4: Rate of Rainfall in Malayer during the years 2001 to 2012

Year	2001-2005	2005-2008	2008-2012	total
Average Rate of Rainfall	346.7	345.4	312.6	334.9

### Review of the Prevailing Wind

The prevailing wind refers to the wind which blows most of the month. in other words the specifications of the prevailing wind show from which direction the wind blows most during a month and how fast its speed is. During the last ten years, the blowing direction of the prevailing wind has been the south east in Malayer with the maximum speed of 27 meters per second. Figure 1 illustrates this issue.

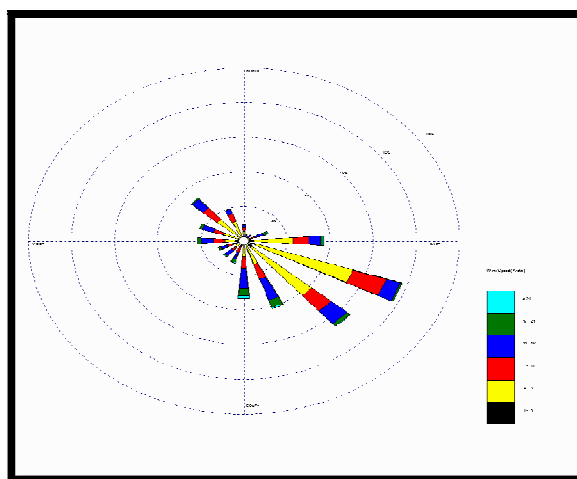


Figure 1: Prevailing Wind in Malayer (Meteorological Organization)

### The effect of solar radiation on the building and its surroundings

Generally speaking, the principles which have been used to prevent the heat dissipation from the different sections of a construction in these regions are mainly the same as those which are applied in the hot and dry areas. The only difference between the architecture of these areas and that of the hot and dry areas concerns with the inclination and requirement of using the heat from the sun inside



the buildings in the winter. However, this requirement is usually overshadowed by the impact of the cold and the wind blowing onto the building. All in all attempts have been made to keep the external surface least influenced. However, to use the energy from the sunlight, the outer surface is selected to be of the dark color while the dimensions of the casements are expanded in accordance to the hot and dry areas [6].

In addition to using the sunlight to illuminate, its light is converted to the heat based on the construction design. To exploit the light arbitrarily, measures must be taken to cause the light be in harmony with the construction type and the environmental conditions of the location. The light amount as well as how it shines onto the external and internal parts of the building should also be taken into consideration. The light state certainly changes in terms of which direction it shines during different seasons whether directly or obliquely. It also needs to be properly attended. It is noteworthy that the intensity of sunlight depends on the type of building materials and sleek colors of the façade. This quality can be used in the impairment practice of the light or heat for the building.

### The vernacular architecture of the region

The premises of the traditional buildings were formed on the basis of the regional climate when they used the least amount of the fossil energy. One of these types of building is the house belonged to Lotfalian which is a traditional premise in Malayer. It was formed on the basis of the sustainable architecture. The central courtyard of the house had a pool of water which helped adjust the air. The courtyard is restricted on three sides to the rooms and on the other side there exists rooms of four arches in the southern part of the courtyard for the summer residence. There are barns and screens at the eastern part of the yard which comes as a barrier for the disturbing western winds. Another part of the building is the basement of 5 meter width, 9 meter length and a brick column of 6 meter height. The cool air and the water which blow and run through a canal into the pool have established a suitable setting for the summer resort. Figure 2, 3 illustrates this issue.

### Water and Architecture

Water plays multiple roles in the architectural spaces because it has the ability to attract to store and to give the heat away little by little. Of its roles the most important ones are as follows [7]:

- Reduction of the temperature difference between day and night as during the day it attracts some of the heat penetrating into the setting and during the night it gives it away bit by bit,
- As the sunshine and the temperature increase cause the evaporation go up in the setting, they can either solve the problems other

environment or intensify them. Based on the situation, it can be used properly.

- The use of water in proper amount is useful in reflecting the sunshine into the space. The light and heat amount can be defined and designed in the architectural spaces based on the above-mentioned fact.

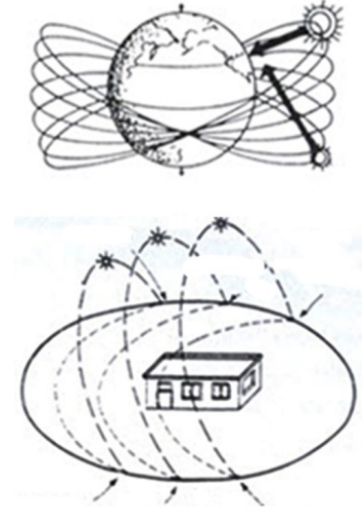


Figure 2: The position of the sun in different seasons (Young Reporters Club)



Figure 3: house belonged to Lotfalian (Young Reporters Club)



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### Plants and Architecture

- The use of trees and green areas around the buildings and green roofs to reduce energy loss along with the paths and green corridors has a great impact [2].
- If trees thickly and intensely, they will have a large impact on the control and reduction of the noise [6].
- The trees create shades in proportion to their environment. This characteristic is of great value for shadowing upon the building because there remains no problem for shining the sunlight into the internal partitions during the winter as the leaves are gone at that time. When the leaves grow again in the summer, trees serve as a canopy effectively and prevents the direct exposure to the sunlight [6].
- The trees can be used as a barrier against the cold and hot weather and they can shield the building against the harmful elements [7].

### RESULTS

In general, Malayer environment possesses "long and cold winters, while its humidity is not high. For this reason, there is a great temperature difference between day and night. Figure 5 and table 5 illustrates this issue.

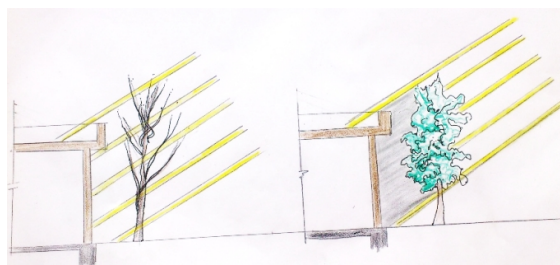


Figure 4: Shade of Trees

Table 5: Strategies for Environmental Designing

Strategies	Definition
Heating Space	Prediction of heating spaces like the kitchen, at the Center of Building Plan
Thermal Insulation	Prediction of non-significant spaces, such as warehouses, cold Thermal Insulation in walls or parts of buildings
Basement	Sinking in the soil and making spaces in the basement for using heat capacity of the soil in various seasons of the year as well as other techniques for climate [8].
Heat Capacity	Use of materials with good thermal capacity.
Awning	Use of Southern balconies in the summer for the penetration of the sunlight into the spaces and the entry of the sunlight in winter
Use of southern light	Open forms or forms whose north side- south sides are not higher than east – west sides are not appropriate.
compressed texture	Design of the Textures in compact and compressed manner (less than the size of the compressed form)
Avoidance of construction in the heights	To locate Sites, the designer must avoid the open areas above and the bottom of hills and valleys that are directly exposed to prevailing cold winds in winter .the very steeply slopes of mountains are not suitable residential places [9].
Avoidance of large spaces	One must avoid making rooms or internal spaces in Cold and snowy because it is very difficult to warm the extensive spaces when the weather is very cold [10].
Annoying Wind dam	The use of evergreen trees as a barrier against nuisance wind
Driving the desired wind	With the use of roughness of the ground, adjacent buildings and plants to utilize most of the summer breeze with planting trees one can direct the wind direction to the house. Here the rows of trees cover the streets and has matched the site.
Flat roofs	Selection of a flat roof and the maintenance and snow on the roof as insulation.
Reflecting surfaces	Reflecting surfaces fitted out of the window for the reflections to increase in winter. Reflecting Pages can be animated to reflect Ray of the sunlight into the building. But in the summer they can be placed in a manner that causes the wind to come in and heat is rejection.
reflecting land	The increase of reflecting the ground in outer surfaces of the windows across from the sun
Planted on steep	Irregular or rough surface is planted to avoid sun exposure and help less reflection even from the green surface such as the grass. To put the bushes or the ground soil on a steep will minimize the sunlight reflection.



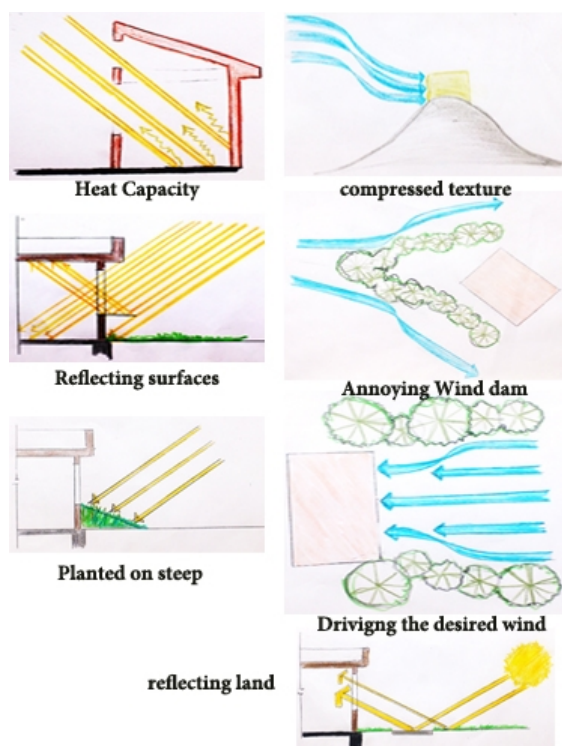


Figure 5: Shade of Trees

## CONCLUSION

Due to the energy crisis in the world, the architects have responsibility of reducing the consumption of fossil fuels and encouraging the use of the sustainable energies.

It is necessary to pay enough attention to the design of the environment and efficient use of energy in nature. Efficient methods of insulation to are to be used to prevent energy losses. These are the affairs which environmental architects and designers of tomorrow are expected to attend properly.

We conclude with a survey carried out that Malayer has a climatic environment with the extreme cold and harsh winter, the mild and ideal weather in the summer. The extreme sunshine, the great temperature differences during days and nights, the blowing of the cold winds and the heavy snow make the climate special. The local architecture of the setting is completely based on the sustainable architecture and the environmental designing principles.

At present, at the age of technology it is possible to conform the environmental principles of the vernacular architecture with current conditions and requirements so that one can make the maximum benefits of the clean energies generated by the sun, the wind and the water. This is the key because the nonrenewable energy does not approximate to its end; the undesirable consequences of destroying the environment do not take place.

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