ENERGY EFFICIENCY REQUIREMENTS IN DESIGNING HYDROTHERAPY BUILDINGS IN IRAN

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ABSTRACT

In recent years due to energy crisis, many countries have been forced to move toward new energies while they hold different approaches to energy issues and environmental pollutions resulted from fossil fuels. Solar energy is a free, clean, and eco-friendly source that has long been used in many ways(1) .Considering the very favorable position of Iran in terms of solar energy resources, using this kind of energy in buildings such as hydrotherapy centers-which are created for human health-with photovoltaic systems, solar water heaters and kinetic energy of water is required for maximum efficiency of energy consumption and pollutant emissions. Requirements for such projects in terms of active and passive solar systems including building orientation to benefit the photovoltaic panels for installation on the facades and roof along with green roof system, provide the electrical energy, use natural ventilation for air dehumidification, utilize the energy of water waves when leaving hot springs and natural springs to supply a part of complex energy. In an analytical-research format, this study tries to describe various types of hydrotherapy buildings and exploit solar energy in four climates of Iran using library resources and case studies.

1. INTRODUCTION

Research indicates that turbulent urban landscapes which lack natural elements due to several reasons such as increased stress, reduced attention and concentration can cause disruption in performance, aggression, and a variety of diseases. Therefore, the goal of such designing is to create a therapeutic complex for those who want to treat themselves naturally by water and water sports, as well as for those who seek a place to escape the fatigue of everyday life. The therapeutic effects of water and water sports on the health of human body and soul is a matter of great concern.(1) Energy is one of the most essential factors in these complexes. The energy crisis in recent years has led the world's nations to move toward new energies with a different approach to energy issues and environmental pollutions resulted from fossil fuels. Solar energy is a free, clean, and eco-friendly source of energy that has long been used in many ways(2).Considering the very favorable position of Iran in the field of solar energy, it is required to use such energy in different buildings especially hydrotherapy centers with photovoltaic systems, solar water heaters and solar panels in order to maximize energy consumption and reduce pollutant emissions.

1.1. Research question

Through designing an architecture based on sustainable energies, how a desirable space

with the least amount of fossil fuels can be created in such hydrotherapy centers?

1.2. Statement of the problem

Nowadays, especially in developing countries, defining different projects requires specific precision.

Due to the lack of hydrotherapy centers in Jolfa city to treat patients and entertain residents or even travelers in this area, and considering the very suitable location of Jolfa to use solar energy, we decided to design this complex. However, the problem is how to build a hydrotherapy complex using active and passive solar systems in Aras free zone to achieve body and soul relaxation, a complex where users' needs are satisfied and the highest energy for buildings are achieved through solar energy.

1.3. Hypotheses

- Designing such complexes can create a calming and healthy environment for patients who come to treat various types of musculoskeletal, bone, skin diseases and etc. Meaning that they can treat themselves with water away from the use of chemical drugs. In addition, healthy people can also use this joyful environment.
- Designing hydrotherapy centers by the use of sustainable energies can be considered as an effective factor in reducing environmental pollution, decreasing the use of harmful fossil fuels and saving costs.

2. The place of solar energy in energy supply

Being a simple technology, not polluting air and environment, and most importantly, storing fossil fuels for the future generations are the main reasons which clarify the necessity and importance of using solar energy for our country. To emphasize the importance of using solar energy, Faber Biram writes: If human destruction is not endangered by the lack of oxygen, nuclear radiations, air and water pollutions and green spaces' destruction, it will surely get into trouble by overlooking the benefits of sunlight and refusing to use it in biological spaces [(3)] .In fact, the easiest way to use solar energy is to convert it to thermal energy through solar thermal collectors. Therefore, it is understood that the primary development of solar energy systems is focused on supplying the spa. However, the direct conversion of sunlight into electricity has attracted the attention of many scholars, because not only this technology could effectively reduce the focus of power generation systems, but also the production of electricity from solar energy at a low cost and high efficiency has always been demanded by mankind [(4)]. Such a system allows the building to operate without external fossil or artificial energy with very low energy consumption.

3. location and climate of Jolfa

Jolfa city with an area of 1670 square kilometers is at a distance of 120 kilometers from Tabriz city. It is located in the northwestern border of Iran and at the southern edge of the Aras River and is limited to Azerbaijan Republic and Armenia from the north. The climate is semi-arid and semi-cold. Good weather days are more than 300 days and cold days are about 50 days. The average annual sunshine hours are 2610 hours. According to statistics, prevailing winds are from the northwest. The highest wind speed in March is 30 m/s. Jolf is the warmest city of East Azarbaijan in terms of temperature, average max and min temperatures are 35°C and 2°C, respectively and the mean temperature is 15 °C.

4. Site Analysis

4.1. Site location

The proposed project site is in an area of approximately 5,000 m² located in the

northwest of Jolfa city, on the outskirts of Aras river and surrounded by mountains. In the following satellite images, the location of the site is specified:

Fig. 1. The effect of process heat temperature on *ESP*

4.2. Reasons to select the site

The selected site for the project has several potentials that made it perfectly suitable for this purpose. Some of them are:

4.3. Suitable lighting

In the selected site, all parts of the building receive enough light and also the construction is in such a way that the southern light (which is the best light in Aras Mountains) can be mostly used.

4.4. Prevailing winds

Wind as one of the most important climatic factors, especially in mountainous areas, has a great influence on the thermal dissipation of the building as well as the creation of favorable weather conditions. Due to the fact that the desirable wind in Jolfa is from the northwest, it is noted that this wind is used perfectly.

4.5. Views and landscapes

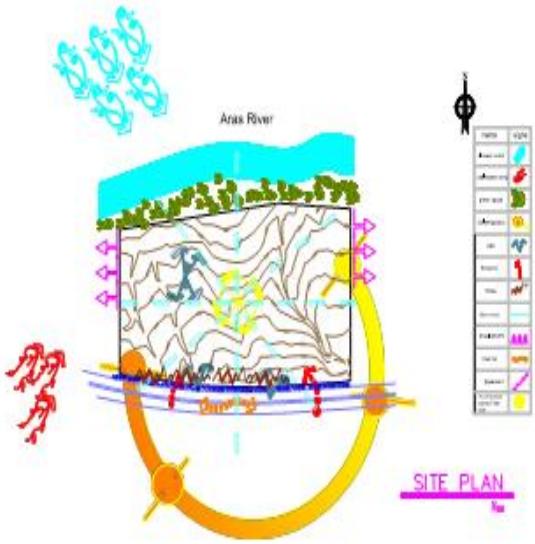
This site has a very beautiful landscape in all directions both inside and outside the building. All four directions of the buildings are full of natural sights. One side overlooks to the Aras river, and other directions to beautiful mountains and green gardens.

4.6. Neighborhood

The selected site is in the neighborhood of Aras mountainous geo park, which itself has the largest touristic pole in the city and attracts many travelers every week. In addition, the site is located on the routes of Jolfa's Historical monuments such as The Saint Stepanos Monastery. For these reasons, our hydrotherapy complex is open to all visitors and can achieve its best status.

4.7. Accessibility

Accessibility to urban services is one of the important factors influencing the formation of any construction project, and infrastructure facilities like power, water, gas and telephone transmission lines are the most important urban services. Different areas of the project site are approved based on the degree of proximity to the facilities and services of the city. Site analysis is presented in the following:

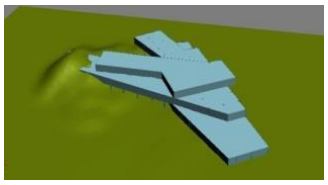


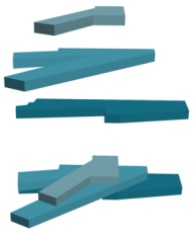
5. Design process

5.1. The process of design formation

Considering that Jolf city is a mountainous area surrounded by various mountains, we have taken our own design idea from the climate of this area. In the design of this project, the attempts have been done to make building less to be seen as an event in nature, more to be consistent and compatible with the surrounding environment which takes maximum advantage of solar energy. The idea of designing this project has been taken from the mountains around the site, which include big rocks with large and small layers placed on each other. Our building also consists of the same large, small and irregular layers by different altitude codes as broken lines, which has special compatibility with the same region. In the following, an example of mountains around the site can be observed:

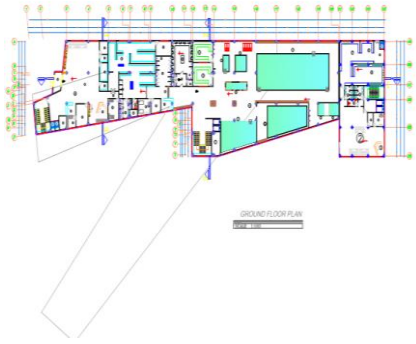
5.2.Initial designs and Plans





5.2.1 *Plan of underground floor*

5.2.2*Ground Floor Plan*



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5.2.3*First Floor Plan*

5.2.4. *Second Floor Plan*

5.3. Physical program

Areas(m2)	Micro spaces	Spaces	Row
440	Main pool- Disabled Persons pool- Pool for treatment- Pool for children- Milk Pool- Cold water pool-Pool for Salt therapy-Pool for Fish therapy- Jacuzzi	pools	1
650	Massage therapy-Stone therapy-Leech therapy-Acupuncture-Aromatherapy-Meditation-Music therapy-Private baths-Solarium-Dry Sauna-Steam sauna	Spas	2
250	Physiotherapy-Physiological childbirth pool- Doctor's room-Beauty doctor-Nutrition Consultant	Therapeutic Spaces	3
1025	Restaurant and coffee shop- Greenhouse of Medicinal Plants-Library- Traditional bathroom	Recreational and Prosperity spaces	4
1250	Kindergarten- Dressing room-WC- Rescuers room- Installations-Storerooms- Laundry room- Ottos 's room-Reception- Kitchens	Service and support	5
210	Management- Archives-Accounting-Coordination affairs	Official	6
546	Multipurpose gym- Gym	Sports	7
2300	The hall and the Restaurant for the wedding – Kitchens and the supported spaces	Ceremonial	8
6671	Total		

Table 1. Physical program

Areas(m^2)	Floor names	Row
1126	Underground	1
2124	Ground Floor	2
2348	First Floor	3
1073	Second floor	4
6671	Total	5
50000	Site	6
117	Number of Parking	
35	Occupation level	

Table 2. Areas(m2)

6. The methods to use solar energy at this center

In this hydrotherapy center, a series of active and passive solar systems are used as shown in the following tables and images.(5)

Types of systems	System
Greenhouse system- green roof- Plants and water on the site- Collect rainwater-Air Conditioning- Building orientation towards the south - Form of the building facing the south	passive solar systems
Photovoltaic systems- Solar water heaters- Solar pool- Solar lights-Solar air heater	active solar systems

Table 3. Types of systems

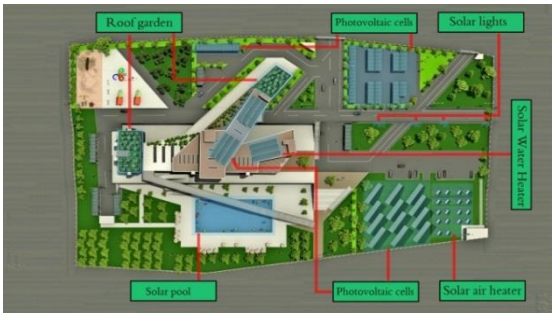

Fig. 1. Introducing the systems used in this project

Fig. 2. Introducing the systems used in this project(6)

Some of these systems are summarized as below:

6.1. South orientation of the building

The building orientation to the south is very effective in using solar energy. The suitable orientation means that the southern transparent walls should be exposed to

sunlight in the shortest days of the year from 9 am to 3 pm. In addition, the building design should be done in a way to protect building from adverse winds during the year and use the breeze and winds during the warm seasons in order to maintain natural ventilation and thermal comfort conditions.

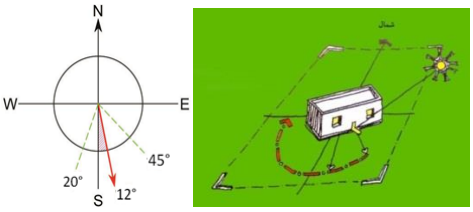

Fig. 3. South orientation of the building

Fig. 4. South orientation of the building(Children's play space)

6.2. Topography

The building is designed on the natural slope of the earth and is located at various stepping levels. Thus, the heat energy of the soil can also be used to maintain the heat of the building.

Fig. 5. Design on a natural slope

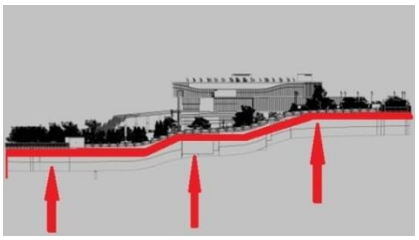

Fig. 6. Utilizing the heat capacity of the soil

Fig. 7. Design on a natural slope

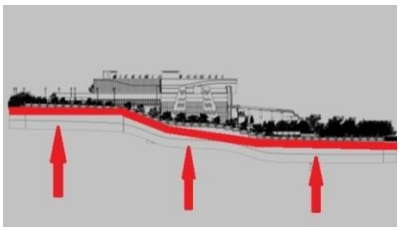

Fig. 8. Utilizing the heat capacity of the soil

6.3. South facing views of the building

According to the calculations, the area of the southern views is 1578 m², from which 80% is capable of installing photovoltaic windows.

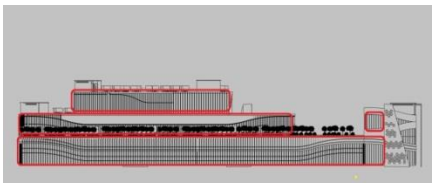

Fig. 9. photovoltaic windows

Fig. 10. South facing views of the building

6.4. Photovoltaic cells and solar water heaters

- **Roof:** According to calculations, the roof area for the installation of photovoltaic panels and solar water heaters is 3100 m², from which about 60% and 40% is allocated to water heaters and photovoltaic panels, respectively.
- **Solar farm:** in this section of the site with an area of 4200 m², a number of photovoltaic panels and air heaters have been placed.
- **Car sunshades:** The area of south facing sunshades is 620 m² which can be used to install pv panels.

Fig. 11. Photovoltaic lights

Fig. 12. Photovoltaic sunshades

6-5 Solar pool

Solar pools are the new innovations of energy production that can be used to provide the energy required for the industry through storing solar energy in the water pools[7]. The area of our solar pool is 1,373 m² and 2746 m^3, that beside solar energy storage is also used for users' recreation.

Fig. 13. Schematic photo of Solar pool

Fig. 14. Total view

Fig. 15. Solar pool(Recreational pool)

7. CONCLUSIONS

One of the effective ways to optimize energy consumption in the building sector is the use of renewable energies and climatic design. This means that the building design should be done in a way to maximize the use of natural energies and reduce energy consumption based on the climate of the studied area. Proper design of buildings has a significant role in reducing the damaging effects of building industry and optimizing energy consumption. The solar energy is one of the natural and renewable natural resources which plays a significant role in designing sustainable buildings with the least energy consumption, especially in the cold climates due to its special advantages. In the present project, the reduction and saving of energy consumption in hydrotherapy buildings is achieved due to the presence of solar pools as well as the deployment of solar panels, solar water heaters, solar air heaters in different parts of the building including the roof, the

solar farm, car sunshades, southern views of the building etc... and the use of different passive solar systems including green roofs, plants and water in the site, building orientation toward south, rainwater collection systems, greenhouses system, etc. According to the calculations, 60% to 70% of the energy is supplied by solar energy.

8. References

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