

Climatic responsive architecture of Tabriz

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ABSTRACT

Sustainable development means that any encroachment into the ecosystem must be done in such a manner that the survival of future generations is not threatened in any way. In simple terms this means that we should leave the world for our children a better place that we found it. The notion of Sustainability in building and urban development refers to the effects of building on the environment in all their phases from the production of building materials to the use of ecologically sound and non-toxic substances in building and finally to the eventual demolition of the buildings.

It includes factors such as how much energy is produced during the process and how waste is disposed of.

For the last four decades, rapid urbanization in many developing countries has brought about negative outcomes, for instance; disorder, poverty, etc. The most negative effects of all have been on the environment. Pollutants are the most obvious, which are caused mainly by waste materials of urban livings and industrial activities. The main goal of this paper is to present vernacular principles and elements for building design and development, by considering environmental quality and human health. Tabriz, with hot and dry summers and very cold winters, is the capital of East-Azerbaijan province in Iran; it is bordering Turkey and Azerbaijan. The city has about 1.5 million inhabitants, and because of the establishment of new industries, it is rapidly growing, and as a result is facing urbanization and in need for more land for new residential development and habitable districts. 45 percent of its 4600 hectare area is allocated for new residential developments. As a result, the city is faced with high consumption rate of fuel and electricity during hot summers and cold winters. The morphology of the city has been an impetus for high air pollution, and the people comfort and convenience has become a great concern. The vernacular architecture of Tabriz, is one of the best examples of sustainable architecture, which many of its elements and principles are applicable for today's living condition, and could be employed in order to reduce the energy consumption and air pollution. Comparative method and cross-referencing is used, according to the

consumption rate of fuel, to draw the design principles from the occupied and existing vernacular architecture. The findings were obtained after taking many field observation and study from rural as well as urban areas of East-Azerbaijan. Fifteen principles that are based on saving energy and taking advantage of renewable energies were drawn, which will be presented.

By planting trees, allocating spaces to pool, green house and likes we can save energy.

1. INTRODUCTION

Since discovering the fire, human has brought about a great revolution. When he gained access to coal and then steam engine followed by industrial revolution in eighteenth century human felt himself much more dependent on Energy to the extent that he believes life without energy would be meaning less.

Renewable energies such as solar, wind, geothermal ebb and flow, nuclear power, etc are the best choices to take the position on of fossil fuels. The cheapest and the most accessible one among these energies is solar energy. Exploitation of this energy is carried out through two indirect and direct forms. The architects and mechanics deal with the indirect form(indirect system). According to this system, solar power is exploited for heating the building (thermal system) and heating its water by observance of the principles of climatic design.

Designing of Trombe wall, green house, roof pond and the likes are different ways of gaining the solar energy in directly. A practical example can be the solar official – residential building in Yazd city in which the writer had been able to put the theoretical discussions into practice. This building is located 30 kilometers far from the city in the center of Iran and it can take advantages of both solar energy to have the maximum thermal admittance, and wind energy to provide coldness. As it was mentioned that paying attention to climatic design and determining the practical principles to build sustainable buildings in a city like Tabriz are of high importance. While studying the climatic design and determining the practical principles, we will inevitably come across with the following subjects: the effects of fuel consumption

in Iranian building, various capacities of Tabriz, its present climatic conditions, its verdant and green areas, regional and traditional designs of buildings of building in Tabriz, use of roof gardens, the role of culture in decreasing the energy consumption in buildings all of which can be considered as important factors effective in renewable energy in this part of Iran.

2. MAIN TEXT

The amount of fuel consumption in building is about 38 percent of the over all country fuel, which includes a considerable amount in comparison with other sections such as transportation ,industry and agriculture and as a result is important. Having taken the optimum measures in buildings, we can save about 7.6 billion dollars since 2002 until 2010. Regarding the statistics, we find out that Iranian buildings consume energy two to four times more than European countries. The prejudicial effects of such case could be referred as environmental pollutions of water air and soil and thus resulting in thinning ozone,heating of earth (green house effects such 64 percent CO₂, 19 percent CH₄ , 4 percent N₂O and so on), acidic rain-falls, sound pollutions, reducing the width of jungles, increasing width of desserts and abolition of wild life. Energy has not been considered as a remarkable case in our country for long time and government's direct and Indirect supports has resulted in public underestimation of energy value .Today we are all aware of the effects of impolitic energy consumption .But building part consumes more than one third of country's usable energy and its cost can reach more than 6 billion dollars yearly (compared by world prices) .A large amount of energy is wasted in buildings because of non observance of climatic architecture and standards of optimum measures in energy consumption which can be reduced to one third (of its present consumption) and thus it costs 2 billion dollars each year.

3. GOAL OF SUSTAINABLE DEVELOPMENT

- 3.1 Meeting the vital needs of today and tomorrow .
- 3.2 Improving the life level and decreasing of poverty .
- 3.3 Managing the ecosystem and thus making a secure future.
- 3.4 Providing the necessary growth for the descendants .
- 3.5 Paying attention to creatures' natural environment to expand it.

3.1 Three principles which should be considered in industry and building are as follow:

- 3.1.1 Which part of the system consumes the biological

sources? We have to choose the sources which are replaceable and renewable as soon as possible.

- 3.1.2 We should use the unrenovable sources wisely.

- 3.1.3 We should try to keep the ecosystems exploit the sources correctly and encourage the people to do so.

3.2 Goals of Sustainable Development in Building

- 3.2.1 Development should be according to situation, environment and climatic conditions.

- 3.2.2 It should have the least environmental demolition.

- 3.2.3 Designs should consider the stability and quality.

- 3.2.4 Buildings should be designed in a way that they can be used again later or at least for other purposes.

- 3.2.5 While designing , we should consider the people's health.

- 3.2.6 The relationship between and environment should be established.

- 3.2.7 We should take advantage of architecture and the residents experiences.

- 3.2.8 We should design buildings materials of which should be recoverable.

3.2.9 Sustainable Building

Sustainable building is the term most commonly used when describing building carried out according to sound ecological and environmental perspectives. The term sustainable development was first defined in 1987 by the world commission on Environment and Development as that “ which meets the needs of the present without compromising the ability of future generations to meet their own needs. “Sustain ability means preserving the future.

Sustainable development means that any encroachment into the ecosystems must be done in such a manner that the survival of future generations is not threatened in any way. The nation of sustainability in building and urban development in all their phases from the production of building to he use of ecologically sound and non-toxic substances in building and finally to the eventual demolition of the buildings. It includes factors such as how much energy is disposed of.

Sustainability is also take into account during the planning of a house. How long can it continue to serve its purpose, before it will need to be converted or demised? Above all, sustainability Poses questions about the extent to which land is being exploited by the creation of new built-up areas and by the enormous increase in the volume of traffic which this has caused. The most important of these questions: How long can the ecological pressure from building and land development be tolerated?

4. DESIGN PRINCIPLES FOR TABRIZ

Surface to volume ratio (SVR) is a way to determine the

relation between the external surface of the building and its internal space. This ratio should be reduced to minimum amount for the cold and dry climate of Tabriz. This can be achievable via compressed geometrical shapes in building design. Achieving to minimum Surface Area Ratio (SFAR) is possible by dividing the spaces – in away that they have the maximum use – and refusing the high altitudes. A good example for the minimum SVR can be the stone house of Kandovan, a village in south west of Tabriz. Human has made houses of stone. The minimum SVR besides another important factor which is the high thermal mass of rock result in low consumption of energy.

4.1 To take the maximum advantage of solar energy in winter buildings are built in a way that their development would be through east to west.

4.2 To decrease the unsuitable winter winds which usually blow from east in Tabriz, shapes and face of the building are of high importance. Creating levee against the wind would reduce the amount of external air penetration into connections and roof of the building. The shape of the roof would also decrease the amount of energy lost by conduction and convection.

4.3 Use of depth of ground like what is seen in the design of traditional buildings of the district. Ground acts like an insulator and thus reduces the thermal exchange of inside and outside the building. Money spent to heat or cool the underground spaces is about 80 per cent less than that spent in common buildings and it doesn't have any harmful effects on nature.

4.4 Use of renewable energy sources. Advantages of renewable sources of energy are as follow:

4.4.1 They are everlasting.

4.4.2 They are free and available for public (They can be easily exploited in village where use of other forms of energy involves high expenditure and equipment.)

4.4.3 It does not have harmful effects on nature contrary to the present exploitation of energies which produces polluting gasses supposed as a peril for atmosphere.

4.4.4 Considered socially, it is an opportunity for the international technology development.

4.4.5 It does not produce rubbish or problematic remaining

4.5 Storage of eater

4.6 Use of local materials: local materials are used in traditional building of a district. Nature of each district is a wonderful source of material to be used in the buildings. Taking advantage of them in building is because of their facile transportation and low expenditure. Igneous rocks, wood of dense forests in the area, soil and brick are considered the local materials in the district. Obviously iron aluminum are not suitable to be used in buildings. They are heavy and Tabriz is considered as a

susceptible area to have earthquakes. Besides the case that the igneous rocks are excessively found in the district, they are compatible with the climate of the district and are excessively available. They are stable and fortified. A good example is the "city hall" of Tabriz built in 1920 which has kept its stability and fortification after 85 years and introduced as "land mark" of Tabriz.

4.7 Use of renewable materials: use of remained materials of old houses would be pleasing and economical. But in our socieity it is not that much practiced. In fact by using the remained and renewable materials, we avoid buying the same things once more.

4.8 We can allocate a place for green house in the south part of a building. Green house can take the indirect solar energy. Its rubble stones can save the heat and thus by use of 60 to 70 per cent of it in winter is a suitable helping system to heat the building.

4.9 We can also design the buildings double – layered like the cupolas of Iranian mosques. These cupolas prevent thermal exchanges and because of their symmetry with human's feeling they are built in a low altitude from the inside and their external symmetry results in their flaunting as magnificent symbolic building in the city.

4.10 Planting needle – like trees along the east side of usually blows from the east and that is why we plant such trees to decrease the pressure of blowing winds such trees to decrease the pressure of blowing winds in winter.

4.11 Planting wide leaf trees along the south side of buildings: These trees are favored for their shadow in summer and as a result of losing their leaves in winter they are not considered as a barrier against the solar energy.

4.12 Stairway acts like chimney in summer. So they help keeping the buildings cool. They move the hot weather which goes up.

4.13 The whole thermal insulation surface of the building is another way suggested according to the practiced procedure to save the energy both in summer and in winter. Unfortunately we noticed that such a case has not been taken into consideration in district both in traditional and modern design of the buildings.



Fig1. On the northern side of village of Kandovan

4.14 Designing the house in away that the space allocated for pool would lie in the south line of the building. The reason can be the high thermal mass of the water which can heat building

4.15 Use roof gardens and green roofs.

Roof cultivation on a large scale could significantly improve city micro climates.

4.15.1 Improvement to the surrounding microclimate due to the much roof surface and the moisture given off by plants;

4.15.2 Increased thermal mass thereby stabilizing indoor temperature swings;

4.15.3 Absorption of 50-70 % of rain water and resulting reduction in site run-off;

4.15.4 Plant provide habitat for small mammals and birds;

4.15.5 More esthetically pleasing;

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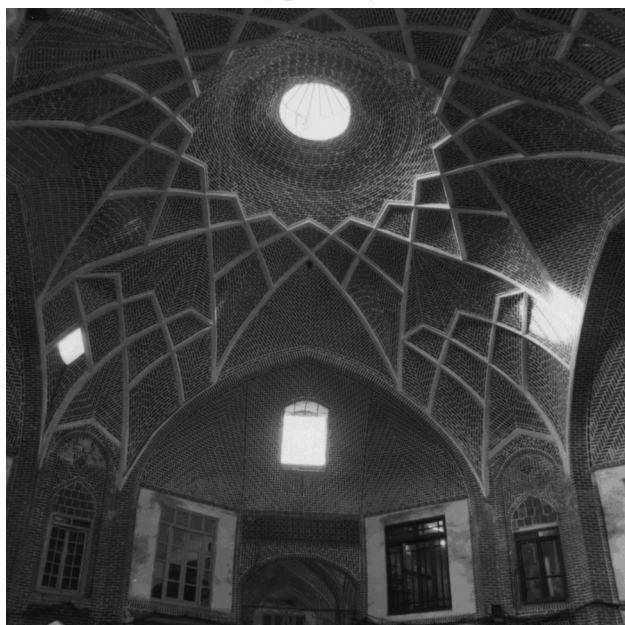


Fig2.The main bazaar route in Tabriz-cold climate

5. CONCLUSION

What was suggested was the result of weeks of endeavor. The findings have been introduced after taking trips to village and cities of east Azerbaijan state. Careful inspection of the district was taken over. According to these inspection fifteen suggestion were offered. These were the solutions toward saving the energy, and even using renewable source of energy. By planting trees, allocating spaces to pool, green house and likes we can save energy.

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