Original Article

Investigation Of Sustainable Design Parameters In Cold And Dry Climates

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Abstract

Sustainable development with emphasis on meeting the current needs of the general public and without threatening their future, taking into account the environment and future generations has become a prominent issue in various societies. Therefore, identifying and prioritizing the main factors of sustainable architecture according to the climatic characteristics of each region can be the first step in preserving architecture as a process.Because a large portion of greenhouse gases are emitted by the building sector, a change in approach to sustainable architecture has been made that can play a significant role in mitigating the effects of climate change. Although climate change is inevitable, adaptive architectural measures must be taken to reduce its impact. One of the goals of this article is to create an overview of sustainability and finally provide solutions in the field of architecture along with the climate issues of the cold and dry region. Also, the goal of sustainability is to create buildings that are able to withstand the cold and dry climate and to consider the necessary adaptation to the energy required for buildings with changes in the condition of this climate.The literature on this subject has been examined through a search of scientific databases. In the future, it is necessary to pay attention to the compatibility of sustainable design and how it can adapt to its climate.

Keywords: Sustainable architecture, Sustainable development, Environment, Greenhouse gases, Climate.

INTRODUCTION

Entering the 1970s, the energy and oil crisis was recognized as a major problem in the world, increasing the focus on renewable energy. In addition, in the next 20 years, energy consumption by buildings will increase by nearly 40% and about 30 to 45% of the world's energy is consumed by buildings [1]. The rapid growth of energy in the world, in addition to creating fundamental problems in the field of energy supply, has also had devastating environmental effects [2]. Today, the harmful effects of high consumption of fossil fuels in industrial societies in different parts of the climate and soil are evident. Therefore, scientists and researchers are thinking of replacing clean and renewable energy sources with fossil fuels [3]. The energy crisis and the need to save on consumption have made the need to reconsider construction one of the main pillars of planning and design. This is even more important in smaller cities, which always have fewer resources than large cities [4]. In other words, the idea of sustainability is to ensure the use of resources in a way that does not have detrimental effects on human health or make other resources inaccessible in the long run [5].

Sustainable development of human settlements and housing must have at least four aspects [6]:

- Housing must be environmentally sustainable
- Housing must be economically sustainable
- Housing must be socially sustainable according to the culture of its inhabitants
- Housing must be sustainable be functional and consider its performance to be sustainable.

Climate harmony with nature and architecture is one of the things that has occupied the mind of the architect. Architecture and urban planning, taking into account all climatic, cultural, social factors, paying attention to the relationship between man and the environment and the human scale in the city, has been formed and has created a sense of belonging to the natural environment and life and environmental protection [7]. The interaction of each building with the natural environment around it is always emphasized and the use of sustainable energy, construction with committed management that is based on climate and cause minimal damage to the environment. The interaction of each building with the natural environment around it is always emphasized and the use of

sustainable energy, construction with committed management that is based on climate and cause minimal damage to the environment. In this type of architecture, the building not only adapts to the climatic conditions of its area, but also interacts with it. According to Richard Rogers, buildings are like birds that cover their feathers in winter and adapt to new environmental conditions and regulate their metabolism accordingly [8].

The theory of ¨Benttley¨ and colleagues in Responsive Environments selected several characteristics for the response of the environment. The theory of urban design by ¨Ian Benttley¨ et al. Was considered incorrect due to a lack of attention to environmental considerations, and due to criticism, eventually led Benttley, who in 1990 published an article entitled Ecological Urban Design, three related criteria. Raised environmental issues. Environmental sustainability, economic sustainability, social sustainability [9]. Today, the issue of sustainable design and its use in architecture is one of the most controversial challenges, and the lack of attention to these issues, especially in the field of urbanization, has faced a crisis in the contemporary world. Based on this, it seems that the logical solution is to pay attention to the architecture of cold and dry climate and its principles as a result of achieving sustainable architecture and conveying its message in a way that is in line with today's views and using new methods and achievements. A special form of combination of creative components should be offered. The present study descriptively-analytically seeks to provide an overview of the problems of energy crisis that leads to environmental and urban crises, solutions to achieve sustainable architecture and climate change and discuss the principles of sustainable architecture in this climate and review.

Objects of this article are

The purpose of this article is to review the following

- Location and orientation of the building according to the climatic indicators of the cold and dry region
- Use of available local materials to reduce construction costs
- The role of climate in the design of plans
- The effects of high ranking on sustainable development
- The role of semi-public and semi-open spaces in design

Features of cold and dry climate

According to Koppen climate classification, in cold climates, the average temperature in the coldest month of the year is less than minus three degrees and the average temperature in the warmest month of the year is more than positive 10 degrees. In this team, the rain is usually snow and the ground is usually covered with snow for several months of the year. The intense heat of the valleys is high in summer and very low in winter. The winters are long, cold and hard and the rainfall is low in summer but high in winter. Spring is short and separates winter and summer [10].

The issue of climate is one of the main issues in the discussion of sustainable development because sustainability is related to saving on the consumption of non-renewable energy and therefore the climatic design of buildings play a decisive role in reducing fuel consumption and waste [11]. By studying the indigenous buildings of each climate, it is clear that all indigenous buildings are designed and built based on climatic principles and in order to make maximum use of natural energy and deal with annoying cold and heat [12].

The design of the building is the first line of defense against external factors. If the house is designed based on the principles of climate and sustainability, the need for heating and mechanical cooling is reduced to a minimum. Paying attention to this makes the buildings have better comfort conditions [13].

Climatic conditions have a direct impact on the design and texture of the city and create comfort conditions in the city. The job of the designer and urban planner is to use climatic elements by organizing urban elements, controlling the climate and using it through the correct orientation of the arteries, choosing the appropriate height of the walls of buildings, determining the correct width of streets and using appropriate plant species, etc [11].

Sustainable design parameters based on climatic factors

Due to the harsh living conditions in cold regions, discussion and research on the morphology and shape of urban centers in cold regions is necessary and useful. These climates with short wet seasons are more prevalent in the Middle East, Asia and North Europe, North America, high latitudes and above the equator. The habitats in these areas are not as old as other areas, because urbanization has reached the points after all areas. One of the measures

people have taken to deal with the cold and harsh weather in these areas is to use minimal external surfaces to reduce the need for heating equipment. Restrictions imposed on habitats by harsh weather have led to new urban design solutions. The results and measures used in the design have been studied in this section and are given below [11].

Location

The temperature and wind elements play the most important role in locating the project. Therefore, for urban comfort, construction should be done in areas with good weather and favorable thermal conditions [14]. Lack of attention to the correct location of cities has caused many problems for the protection of cities against natural hazards. This trend has caused cities to expand in the area of faults or in the area of rivers and canals. This in itself can increase vulnerability and increase the financial and human losses caused by these events. The truth is that the reflections of human settlements in the face of these natural disasters are catastrophic [15].

Housing is something beyond walls and ceilings. Good housing strengthens solidarity between communities. Good housing brings stability, health and hope to residents [16]. Therefore, housing is the most important element of the city, which in the sustainable development of the city, attention to its sustainability is known as its most basic aspect. The morphology and texture of the dwelling must be affected by climatic conditions. Cities overlooking the mountains with cold weather, due to the healthy and pleasant weather, raise their mountains on the slopes [17].

The location of the project in cold and dry climates can be examined in two ways:

A- Southern slopes in the northern hemisphere and northern slopes in the southern hemisphere

The use of the above strategy in landscaping maps is clearly seen in many historical habitats. Southern slopes are preferred due to their maximum absorption of sunlight and the ability to take advantage of geothermal advantages. Observing the urban centers of the cold and dry climate area, it can be seen that the steeper the selected slope, the colder the weather in that area. The reasons for choosing this position are as follows:

- Increase the level of sunlight absorption
- Shade reduction (combined and individual shadows)
- Take advantage of global warming by using sheltered land

B- Located in the lower half of the height and back to the wind if possible

This position is chosen for cold and dry climates for the following reasons:

- Wind protection at low altitudes
- Use hot air flow in the lower parts

Typing of plans

Better than the floor plan, the cube and the type of floors are optimal, because with the sharing of the ceiling and floor, energy loss is reduced. Insignificant spaces should be on the side from which the winter wind often blows. Doors and windows should be in a part of the plan where there is minimal air pressure. Windward facades by windbreaks, with a design of many protrusions and not smooth [14].

In designing plans, do not use complex roof shapes including slippery slopes to reduce the risk of ice falling. Use complex thermal walls, double glazing and the correct placement of pedestrian access and outdoor amenities such as courtyards. In molding the entrances, canopies and windbreak walls should be used as an effective protection for the entrances and exits of the building. The inlet and outlet side should not be exposed to the cold wind of the winter mold as much as possible. Cool roofs, typically with increased amounts of insulation with light materials, should be used to reduce heat loss [18].

Materials

What needs to be examined more carefully in this climate are the materials used in the body of the walls and the body of the buildings. In most areas and climates, the use of environmentally friendly materials satisfactorily meets the climatic needs of the people of that area. In this climate, especially in mountainous areas, the body of the walls is made of stone, which is not very logical due to the high heat transfer property of the stone. Because the high density of rock molecules causes heat to be transferred faster from the rock through conduction, and by using the stone in the body of the wall, the heat exchange of the outer spaces with the inside increases. In this

case, the outside cold easily enters the interior spaces and the heat from the fuel of fossil sources in the interior spaces is transferred to the outside environment. Therefore, it is recommended to use materials that have a high heat capacity in the body of the walls [19]. Natural materials usually consume less energy than man-made materials, have less processing and environmental degradation, many are like renewable wood, and when used in building and facade, the body will have a stable body [20]. Buildings are responsible for large amounts of energy fuel pollution during construction. Materials that reduce heat transfer from the building facade reduce the use of cooling or heating [21]. Reuse of materials is a sustainable development approach. Reuse means the performance of materials and their longevity. Durable materials that have performed well and have been installed over the years can be easily disassembled and installed elsewhere. The use of construction waste has many environmental benefits. Various types of recyclable materials are currently used in construction applications. These include rubber debris, ground rubber, steel slag, cement kiln dust, silica fume, crushed glass, regenerated asphalt (RAP) and rice husk ash. When this waste is used instead of other common materials, natural energy sources are preserved and the disposal of expensive or harmful waste is prevented [22]. On the other hand, the use of high performance polishing materials reduces soil heat loss. But on the other hand, it causes a lot of snow and ice to accumulate on them, which is dangerous for the residents of the building [18]. Steel is the most recycled building material that is easily separated from other construction debris by magnets. Aluminum and brick are also highly recyclable.

High ranking effect

Since 1990, most cities have seen a steady increase in their population. In 1990, 43% of the world's population lived in urban areas, and by 2015, this figure had risen to 54%, and by 2030, the United Nations expects this figure to reach 60%. Although high-rise buildings are not the only way to accommodate the growing urban population, cities are rapidly building high-rise buildings around the globe [23].

Tall buildings can be generally divided into two parts. Bar shape and tower shape. In the strip mode the more annoying the shadow, the better the view of the towers. The open ground around the towers only creates a good space when combined with shorter buildings, while the strip shape alone can create such a space. In terms of design of high-rise buildings, it is possible to create middle atriums and semi-open spaces. From Benttley's point of view, there are three key factors that can lead to long-term environmental resilience. Building depth, access and height. A wide range of space functions require light and ventilation. Bar buildings can not easily respond to changes in use. By increasing the depth of the building, due to the angle of sunlight, only the parts of the building that can be penetrated by sunlight, can be used for applications that require direct light. Therefore, to mitigate this problem, atriums, skylights and central semi-open spaces can be used to provide adequate lighting. Because the highest degree of flexibility of indoor spaces is provided when it is possible to naturally adjust the environmental conditions in terms of ventilation and type [9]. But visually, skyscrapers often shrink the urban scale by downplaying the surrounding buildings and people, and pedestrians are unable to visually communicate with the occupants, architecture and artistic decoration of the buildings. For example, pedestrians are not able to see the vases in the windows of the upper floors, which creates a sense of human beauty. They can only see the urban valleys built by the towers, which makes them feel lost [24]. But traditional low-rise neighborhoods with curved front porches facilitate street views and increase natural surveillance, thus enhancing the security and morale of the community [25].

Semi-public spaces

Semi-public spaces create a platform for social interactions to occur and make their scale more humane. Semi-public open spaces are spaces between several buildings that residents perceive as the external development of their housing and as a result use and monitor it continuously [26].

Semi-public spaces extend the range of interactions of individuals from the inside out and increase the range of their choice. Spaces such as stairs, elevators, services or interior parts of a residential unit, by their nature, have certain functions and in most cases it is not possible to enter and occupy the type of use in them. If semi-public spaces are those spaces that the range of diversity of activities makes them richer. These spaces can meet a significant number of activities according to the needs of users.

Semi-open spaces

One way to increase the quality of flexibility in tall buildings is to consider semi-open spaces such as balconies on the floors. The design of semi-open spaces such as balconies and atriums in tall buildings has a significant effect on increasing user satisfaction. Such spaces with the ability to develop the interior space outside the building, in addition to increasing the choice of users to achieve newer uses, create a more appropriate environment to increase the flexibility of the building. By adding such small spaces with different personalities, the range of layout options can be increased [9].
The semi-open space provides a good ground for improving the quality of the building. Buildings that are able to adapt to the wants and needs of users over time will be more durable.

Orientation and form of the building

The form of the building, like the urban fabric, is designed and executed based on the climate of the region and to deal with severe cold. The general characteristics of the building in these areas are as follows [12]:

- The buildings have a central and introverted courtyard
- The ratio of the outer shell surface due to the low volume of the building
- The height of the rooms is low
- Roofs are often flat
- Small openings
- Small porches and courtyards
- The walls are relatively thick

Since the weather is cold or very cold most of the year, most of the daily activities take place indoors. For this reason, the dimensions of the yards in these areas are slightly smaller than in other areas.
In order to make optimal use of the sun's radiant energy, it is necessary for the building to have an elongated shape with a larger south façade and a smaller east-west façade. In the study of the lateral level and the density of the plan, it can be seen that all residential buildings have a compact plan and a reduced lateral surface. In such a way that if compared with the plan of native residential buildings in hot and humid areas, we clearly understand the principle of plan density and reduction of the lateral surface of the building [27].
Considering that the maximum heat loss in the cold season and the maximum heat gain in the hot season is done through the roof of the building, so it is recommended to reduce the side surface by reducing the roof area (recommending the construction of multi-storey buildings) and intensive design of the building plan. In order to reduce the impact of climatic factors on the building and its heat loss. In addition to designing a compact plan, it is necessary to use appropriate thermal insulation in the exterior walls of buildings and also to take measures to reduce the effect of cold winds on the building, which plays an important role in heat loss [28].

Conclusion

Sustainable development is an all-encompassing and multidimensional matter that is not only applicable in all areas, but also pays attention to expanding the quality of human life, the environment and changing people's cultural vision. Sustainable thinking refers to the way man approaches the universe and is an attitude that is born from the change of human attitude towards the world. Therefore, in this study, we aimed to study sustainable development strategies in cold and dry climates and presented the results as follows:

- Use of solar collectors, solar water heaters, solar greenhouses, sunny windows, blue walls, thermal walls (based on the circle of the sun in each region): to provide solar thermal energy in winter
- Use of native plant coverings on terraces, roofs: supply of desirable air and filter against air and noise pollution
- Using fountains and circulating water in space: to provide moisture and maintain it
- Use of wind turbines, wind turbines, turbines and wind generators: to provide optimal ventilation
- Use of suitable thermal and moisture insulation and vapor barrier (according to the type of use of the building): to provide comfort temperature
- Use of materials with high and low heat capacity: storage or non-storage of solar heat
- Use shell or wall breaker: to remove dust and unwanted winds
- Use of double-walled walls: to create ventilation inside the building shell
- Use of roof ventilators: for vertical ventilation of indoor air

- Use of double or double glazed windows: to prevent outside air from entering the building
- Use of lattice walls against inappropriate sunlight: to maintain the building temperature

In short, sustainable architecture aims to reduce environmental damage, minimize the consumption of energy resources and harmonize as much as possible with the nature and climate of the region. In other words, the philosophy of sustainable design supports and encourages attitudes and decisions that at each stage of design, construction and then consumption, have also considered the negative effects on the environment and the health of users.

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