Abstract. The relevance of the work. In modern society, the problem of reducing the consumption of primary energy is becoming more acute. Scientists around the world are solving problems related to global energy efficiency. At the same time, issues of environmental protection, reducing energy costs, ensuring energy security and many others are considered. Construction, as one of the largest energy consumers on the planet, cannot stay away from this problem. The search for energy-efficient solutions in construction has been going on for a long time. However, at the same time, the main attention is paid to the engineering equipment of construction objects and the creation of shells impermeable from a heat engineering point of view. In the context of the gradual exhaustion of opportunities for further improving energy efficiency in construction using traditional methods, this work aims to draw attention to the influence of the constructive solution of buildings on their energy consumption. It can be assumed that the optimization of the supporting structures of buildings will become a new driver for the development of the energy efficiency of buildings and structures.

1 Introduction

The work set the following tasks:

- Carry out a literature review of the main design solutions for energy efficient buildings [1-5].

The scientific novelty of the work lies in the formulation and calculation substantiation of the hypothesis about the possibility of increasing the energy efficiency of buildings and structures with a steel frame by optimizing them, by changing the paradigm for choosing the optimality parameters obtained in the design of structural solutions. The practical importance of the work lies in the development of recommendations for the design of some elements of steel frames of energy-efficient buildings and structures. Through the possibility of increasing the energy efficiency of the structure by improving the design solutions of some load-bearing elements, by changing the approach to selecting optimal solutions; Economic feasibility of using this method [6-11].

Approval to work. The reliability of the results obtained is ensured by the good convergence of theoretical and practice results, the use of MS Excel, SCAD Office tools for calculations, and statistical processing of the results Here we discuss the basic standards in
city design that help reduce energy consumption in buildings. Through their application, it is possible to achieve an environmentally friendly building that avoids the defects of a sick building. These principles and standards revolve around the following points [12-22].

2 Design standards

2.1 Using natural energies

The effect of climatic factors - whether in cold or hot regions - on humans and the built environment appears through the use of energy for cooling or heating according to the climatic region to provide what is called (thermal comfort inside the building). Some define thermal comfort as the physiological sensation (Physical) and mental complete comfort, and in this regard it was necessary to clarify energy-conscious climate design strategies that seek to achieve two basic goals, which are:

First: In the winter, the building design must take into account the maximum benefit from heat gain through solar radiation while reducing heat loss from inside the building.

Second: In the summer, when the building needs cooling, care should be taken to avoid solar radiation, reduce heat gain, work to reduce heat loss from inside the building, and cool its internal spaces by various architectural means. In order for the building to be heated or cooled, this requires means and systems, whether they depend on electrical energy (such as air conditioners) or natural energy (using natural energies such as sun, wind, and rain).

With a careful look at modern buildings, we find that most of them depend completely for heating or cooling operations on air conditioners, despite the negatives related to them.

Which can be summarized as follows:

1- The body is exposed to large differences in temperature between the air-conditioned building and the street or hot outdoor spaces, which leads to reducing the body’s immunity to microbes.

2- Air conditioners help bacteria and dust enter buildings, and tightly closing air-conditioned rooms leads to an increase in the percentage of various pollutants in these closed places compared to well-ventilated places.

3- The process of maintaining air conditioners is expensive, and failure to clean them and replace filters results in the growth of bacteria and fungi that are harmful to human health.

4- Mechanical air conditioning at the city level requires great efforts and costs in terms of providing electrical energy to operate these air conditioners.

2.2 Environmentally friendly building materials

It is noted that buildings in ancient civilizations used highly durable building materials available in the environment, such as stone, clay, wood, and straw. Clay and baked bricks are among the most famous and oldest used building materials. In order for building materials to be environmentally friendly, they must meet two basic conditions:

1- It should not be a high energy consumption material, whether during the manufacturing, installation, or even maintenance phase.

2- Do not contribute to increasing the internal pollution of the building, that is, complain about the group of building materials (and finishes) that are called the correct building materials, and they are often natural building materials.

Attention must also be paid to excluding materials and finishes that have been proven to have a harmful effect on health or the environment, and to try to search for alternatives to them. Among these harmful materials and finishes are P.V.C and formaldehyde, which is used as an adhesive, vinyl used in flooring, and (plasticizers) that Furniture, curtains, doors,
shutters, and floors are made from it, as it emits gases that are harmful to health. Therefore, many experts recommend the importance of using natural materials and paints that depend in their composition on natural oils such as flaxseed oil or. Cotton, excluding modern chemical paints that emit volatile organic compounds that are harmful to health.

3 Methods of conserving water inside buildings:

Some people may think that water is only used in buildings for drinking, bathing, or cooking food, but water is also used to irrigate home gardens, beautify the building, and moisturize it through fountains, water basins, waterfalls, or even in swimming pools. Water has uses. Aesthetic and environmental. It helps to control the relative humidity on the site and also purifies and cools the air passing over it. The process of reusing used water, which is called gray water, which is the result of the use of bathrooms, showers and kitchens, has a significant impact in reducing water consumption in buildings, as it is collected in a ground tank, treated and filtered using sand, gravel and biological filters, then reused to irrigate gardens or used again in waste bins.

The process of collecting rainwater is also considered one of the important processes in reducing water consumption, as this water falls in some dry areas in the form of dense rainwater for a short period of time, as it is collected and stored in various methods, and the most famous of these methods are wells and ground tanks, where This water can be used in bathrooms, irrigating gardens, and washing cars. It can also be used after ensuring that it is free of pollutants in swimming pools and water fountains.

4 Indoor air quality

Breathing is life, and if breathing itself is the basic way to sustain the life of living organisms, then the air that these organisms breathe is not specifically related to themselves. Breathing air that contains many things has great health harm even to healthy people. The phenomenon of constructing aerated buildings has become more widespread with the increased use of building materials, modern synthetic finishes, synthetic chemicals, and various chemicals. All of these unnatural materials contribute to condensing the air and creating an unhealthy environment. In addition, the buildings are tightly sealed so as not to allow any air to drink in order to Controlling the heating or cooling processes and increasing their efficiency. Thus, these buildings become poorly ventilated and the rate of air change in them decreases to a point that reaches once every five or six hours, which helps to increase the concentration of pollutants inside this type of building. Good ventilation of the building is considered It is one of the most important factors to overcome the concentration of pollutants in it. Here, the importance of directing the building’s openings to the direction of the prevailing winds in each area appears, while ensuring that there is more than one opening in each room to create a suitable air current in it. In the case of rooms not facing the prevailing winds, air catchers can be used, as it should be noted. Here to use some porous materials Provided that they are used without covering or painting them with paints that clog their pores, it will have the greatest impact on controlling the humidity level inside the building, as these materials retain moisture in their pores at night, when humidity is higher (especially in dry areas), and this moisture is released from the pores of these materials during the hot times of the day. In the summer, which balances the humidity levels in this dry climate. Examples of these materials include bricks, natural stones, or wood that is not painted with paints that clog its pores.
5 Lighting and building

The sun is the primary source of natural light on Earth, and light spreads in the form of electromagnetic waves, and to recognize the importance of the amount of lighting for human life, Dr. Sheard emphasizes that the vision process consumes a quarter of the total energy needed for the body in the case of healthy lighting and sound vision, and Any deficiency in this lighting means draining energy from the body to compensate for this deficiency. Lighting can be provided inside buildings in two basic ways:

- The first is through natural lighting coming from the sun.
- The second is through artificial lighting

As for natural lighting inside buildings:

- A good building design must include the following:
  1. Each room should have two windows, as much as possible, distributed along two walls in order to avoid the phenomenon of clutter.
  2. Distribute the windows and choose their locations to obtain the greatest amount of natural light, especially reflected light, while trying to avoid direct light.
  3. Allocating some open spaces (such as courtyards, for example) in the building allows people to benefit from violet rays, while taking into account the privacy factor.
  4. In planning the site, the heights of buildings and the distances between them should be taken into account so that a building does not block natural light from another building close to it or facing it. Hence the importance of studying the different angles of the sun throughout the year to avoid this.

As for artificial lighting inside the building:

- It is used in two cases:
  - The first is when natural lighting is insufficient in parts far from windows.
  - The second is when the sun sets and darkness falls.

When choosing artificial lighting units, it should be taken into account that they provide a type of lighting that is as close as possible to natural light, and types that save on electrical energy consumption must also be chosen (fig.1).

Fig. 1. The Use energy inverters

6 Philosophy of using colours

Colors occupy an important place in all the various human life activities. In addition to the aesthetic effects of colors if they are used in thoughtful harmony and integration, colors also have psychological and physiological effects on the human body. In addition, choosing the colors of external facades has important environmental and climatic effects. Light colors or The color close to white has a great ability to reflect solar radiation. Studies have also shown
that the effect of choosing colors on ceilings is more influential, and the western and eastern facades of the building are more affected than the waterfront, while the southern facade represents a special case as it. Its reception of solar radiation in winter is greater than in summer, which is something required to benefit from the heat of the sun in winter. Colors have a psychological sense of heat or cold. Colors are divided into hot colors, such as red, orange, and yellow, and cold colors, such as blue, green, and those close to them. The psychological effect of colors is to deceive eyesight regarding surfaces and sizes (fig.2, 3).

Fig. 2. Philosophy of using colours

Fig. 3. Use white lighting

7 Acoustic design and noise avoidance

Sound, like light, has tangible effects on a person’s psychological and physical health. Acceptable or beautiful sounds have good psychological effects, and on the contrary, loud sounds or noise have harmful effects. There are three main sources for the creation and presence of noise inside buildings:

The first is the noise coming from outside the building and resulting from various means of transportation and cars or nearby workshops and factories, if any. This noise is carried by the air and enters the building through open windows and doors or even from some narrow cracks and openings.

The second source is the result of any object falling on the ground or as a result of the vibrations of some electrical appliances (such as refrigerators and washing machines, for example).

The third source results from the transmission of internal noise, whatever its cause, through the walls and floors of adjacent apartments and spaces. Therefore, the efficiency of walls in preventing the transmission of sounds or noise depends on their mass. Thicker walls and heavy constructions are better at preventing the transmission of noise. As for the effect
of floors on the transmission of noise, it does not depend on their mass, but rather on the
degree of absorption of the surfaces of these floors. Therefore, it is preferable to use Sound-
absorbing floors, finishes, or coverings (such as carpets, for example). The best defense
against noise and preventing it from reaching the interior of the building is to increase the
distance as much as possible between the source of the noise and the building to be protected,
or to place rooms that are not functionally affected by noise (such as service rooms, for
example). On the side of the building close to the source of the noise, which is often the
street, these rooms protect the important rooms and spaces that are affected by the noise. If
this is not possible, some simple design principles can be taken into account to reduce the
noise reaching the building. For example, planting trees in the direction of the source of the
noise (such as the street, for example), especially those with large leaves, can reduce the
degree of this noise by absorbing it, and planting shelterbelt planting belts next to it. A
building with a distance ranging from 6-15 m will have the best effect in reducing noise
reaching the building.

8 Architectural character compatible with the environment

One of the most important characteristics that must be present in an environmentally friendly
building is that its architectural character should be compatible with the environment from a
historical and social perspective, and even with the customs and traditions of the society that
uses this building, regardless of the function it performs. This is because the architectural
character reflects the image of human civilization at all times. It is a place that affects the
character of society and the individual’s balance in it from a health and psychological
standpoint.

The word “character” means the nature with which man is born, that is, spontaneity
without invention or dictation When assigning meaning to the architectural character,
spontaneity is the outgrowth of the environment, and this appears in the use of architectural
forms that have adapted to the conditions of this environment in a way that corresponds to
the nature with which man was born. Accordingly, the architectural character does not arise
suddenly and does not come from a vacuum, but rather it comes as a result. The art of
architecture has gone through several stages of development to respond to the requirements
of the environment and the society in which this character arose.

The factors that affect the architectural character can be summarized into two main
groups:

The first group: These are the natural environmental factors that determine the
characteristics of the place and have a direct impact on it over successive eras. Therefore,
they have a fixed effect in time and place on the architectural character, such as climatic and
geographical factors and local building materials.

The second group: These are the cultural factors that are the result of human interaction
with his natural environment. They include the religious, social, political and economic
factors, in addition to philosophical, scientific and artistic ideas.

Looking at contemporary architecture, we find that (the international style of
architecture), which was dictated by Western architects to the global community for the
purpose of unifying architectural thought. We find that planning in all parts of the world has
become dominant without taking into account the environmental, civilizational and cultural
differences of each society, and from here appears the importance of delving into the
architectural heritage of each region in order to benefit from the conditions that created this
heritage and then evaluate it with the aim of drawing inspiration from what is compatible
with it and suitable for application. In the environment and contemporary society, hence the
beginning is to find an architectural character for architecture and buildings that is compatible
with each environment, both natural and cultural.
9 Safe design of the building

The building must have a safety factor so that it can be called environmentally friendly. Given that human settlements and buildings can be affected by natural disasters in some areas, such as torrents, floods, earthquakes, hurricanes, etc., therefore, each area or site must be studied so that natural dangers are avoided. Which may exist.

In areas known for floods, care must be taken not to build in the paths and outlets of these floods, which the floods take as their path, or to take the necessary precautions either by changing the course of the flood itself or by benefiting from its water by directing it to ground tanks designed and studied to accommodate the expected quantities of water from these floods. As for earthquakes, the safety factors of the building’s structural elements must be taken into account during the design and implementation stages, while applying special design standards.

Risks that could threaten the safety of the building and its occupants must also be avoided. These risks can occur as a result of human negligence or poor implementation of some works and their non-compliance with technical specifications. The outbreak of fires in buildings comes at the top of these risks, which often lead to catastrophic tragedies. Large human and material losses, and there are many considerations that must be followed to avoid fire dangers, especially in tall buildings. Among these considerations are those related to the streets surrounding the building and the appropriate widths that ensure easy movement of fire engines and ambulances on the site, along with the provision of water sources to extinguish the fire. There are considerations related to the building itself using fire-resistant walls and structural elements along with providing appropriate stairs and in the appropriate number. With the number of building occupants, in addition to the use of advanced equipment to control fires, especially in public buildings such as early smoke and fire detection devices, mechanical means of ventilation and smoke extraction, automatic sprinklers, and fire-resistant doors. It is also important to search for alternatives to highly flammable materials and materials that are used in buildings (such as carpet flooring, for example), especially in places where it has dense clusters such as hotels and commercial centers.

10 The garden and the building

In general, any garden consists of the following main elements:

- Trees and plants: in order to create visual pleasure and provide shade in addition to the possibility of obtaining fruits and vegetables from them, or to use trees as fences that protect the garden from prying eyes and for protection as well, but care must be taken not to use trees and plants that cause allergies in some individuals. Care must also be taken to plant plants and flowers with pleasant scents, which will give the building a permanently pleasant smell.

- Water: It is used in the garden in various forms in the form of bodies of water shaded by trees or in the form of fountains that help move the water so that it does not act as a reflective surface for solar rays if they fall on the water, or in the form of waterfalls or overhead pipes from which water falls, making a sound and a beautiful purr, and all this diversity and creativity in using water in gardens is for the purpose of obtaining the greatest possible visual and audio enjoyment while using the least possible amount of water, in addition to its contribution to softening and humidifying the atmosphere.

- Shaded and open sitting areas: places shaded by trees, pergolas, or in the form of wooden gazebos are used during hot and sunny times. Some seats or sofas can also be provided in open areas for use at night or to enjoy the winter sun.

- Flooring: The flooring of the corridors in the gardens should be chosen from materials that do not require much maintenance and are easy to clean, in addition to that they do not
help reflect the solar rays falling on them, but rather absorb them, which contributes to reducing thermal radiation on the walls of the buildings next to them.

With the availability of the previous elements, such as trees, plants, and water, in various forms and shapes, along with the presence of shaded or exposed areas, the image of an earthly paradise or garden attached to an environmentally friendly and energy-saving building is complete.

References

7. Z. Huang et al., *Performance analysis of optimal designed hybrid energy systems for grid-connected nearly/net zero energy buildings*, Energy (2017)