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The Role of Reducing Energy Consumption in Sustainable Buildings

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Abstract: Undoubtedly,the energy issue is one of the current century's most critical challenges and controversial topics. In general, there are various methods to preserve energy resources. The most common method of saving is that it is possible through culture. The newest idea to save energy is to use new equipment and systems considered for this purpose.Building energy management systems are among these.An intelligent building is a building that includes a dynamic and cost-effective environment by integrating four main elements, namelysystems, structure, services and management and the relationship between them). An intelligent building provides these benefits through innovative control systems. While introducing energy management systems in buildings, this article examines its types, implementation methods, applications, and impact on energy consumption management and optimisation.

Keywords: Building-new technology-insulating materials-energy optimisation-heat exchange-technology-design

I. Introduction

Energy management, by definition, means the economic and efficient use of energy. Consumer devices are different depending on the type of consumption a building has. For example, office and commercial buildings most consume air conditioners and lighting systems. Of course, using HVAC systems has dramatically reduced energy consumption today. Facilities equipped with the help of advanced and complex controllers can reduce the amount of energy loss by reducing the number of equipment given[1].To put it simply, building controllers keep the desired level of a particular characteristic within the specified limit. This feature can be the lighting or heating and cooling system. Also, the use of insulation in the walls and the use of double-glazed windows can significantly reduce energy loss. The advantage of new energy-saving systems is their simple installation on computer networks (P.C.) and system control without the need for expensive cabling. Usingit is expensive equipment. Considering the amount of energy consumption and according to daylight and outside temperature, the system can choose a cheap consumption method and save energy[2].

Regarding the optimal temperature of the building based on the type of use, it is used will limit energy consumption to a great extent.This is done by considering the basic information thatThe employer gives the system and the data that the system has as a default, including daily and seasonal changes in terms of the planand how the equipment is selected. As a result, the process of exponential energy consumption and creating high costs for building maintenance is eliminated. In this way, building energy management systems (EMS) are defined. The procedure prevents it. To understand the economic importance of energy management systems, it is enough to mention that using EMS in a single-function building costs $100. At the same time, EMS control of the same building with traditional methods costs $1000[3].

II. Energy management

Although the implementation of the building management system increases the costs of building construction, the amount of savings in the current expenses of the building due to the performance of this system can compensate for the initial outlay in a short period and in addition, the levelbrings a higher level of comfort for the residents. Intelligent control systems have a high level of flexibility that can be easily adapted to different needs. Also, it is possible to easily change and optimise operations for better management and reduce energy and maintenance costs. Also, management systems of the building have high controllability, and by implementing the appropriate structure, it is possible to control its various components from all over the world. By defining different

access levels, the controllability of otherdetails can be levelled so that it is possible to make some changes only for authorised users and if the defined password is entered[4].

2-1 Integrated smart building

The intelligent building management system tries to manage the resources and resources of a building by using control technologies depending on its type of use (residential, office, commercial, etc.) Smartening causes the effect of factors such as human error, the rate of out-of-control incidents and accidents will decrease and increase the reliability of the correct operation of building facilities and equipment and improve the public safety of the building. Ability to operate various side systems or modern systems, such as condensing boilers, solar systems, and systems for the simultaneous production of electricity and heat (CHP), which have a separate control system through communication between the desired plan and the central management system exists and can be defined in the system[5].

III. BMS system

This system can include all electrical, mechanical, and building protection services. These services include heating, cooling, air conditioning, elevator, emergency power plant, escalator, lighting control, CCTV, announcement and extinguishing fire, traffic control, etc. Using the latest technologies, the intelligent building management system aims to create ideal conditions with optimal energy consumption in buildings.While controlling different departments in the building, these systems create suitable environmental conditions by providing simultaneous services, optimising energy consumption, efficiency level and productivity systems and facilities in the building. Control and access the system using relevant software from anywhere inside and outside the building through the internet[6]. Mainly, the cases of using this type of system are summarised as follows:

- Internal and external lighting system of the building
- Environmental thermal control and internal temperature regulation
- Ambient air conditioning
- Control of ventilation fans and exhaust suction
- Direct and reverse thermostats

3-1 The public benefits and results of using BMS include:

1. Creating a favourable environment for people in the building
2. Optimum use of the equipment and increasing their useful life
3. Providing a control system with the ability to schedule performance
4. Significant reduction in maintenance and repair costs
5. Optimising and saving energy consumption
6. No need for a permanent building contractor
7. The possibility of monitoring and controlling all points under control through a mobile phone or the internet.
8. Due to the integration of the management of various facilities and systems in the building, all theequipment works harmoniouslythe possibility of interference and problems caused by lack of coordination is eliminated.
9. The possibility of obtaining statistical reports of all equipment and their performance to optimise consumption and performance

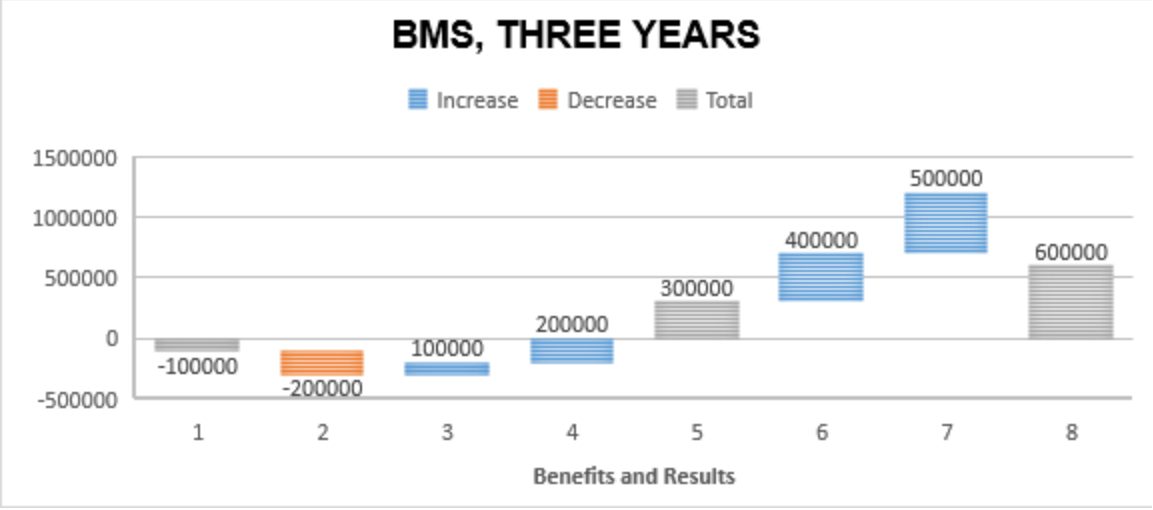

Chart 1 three years of BMS

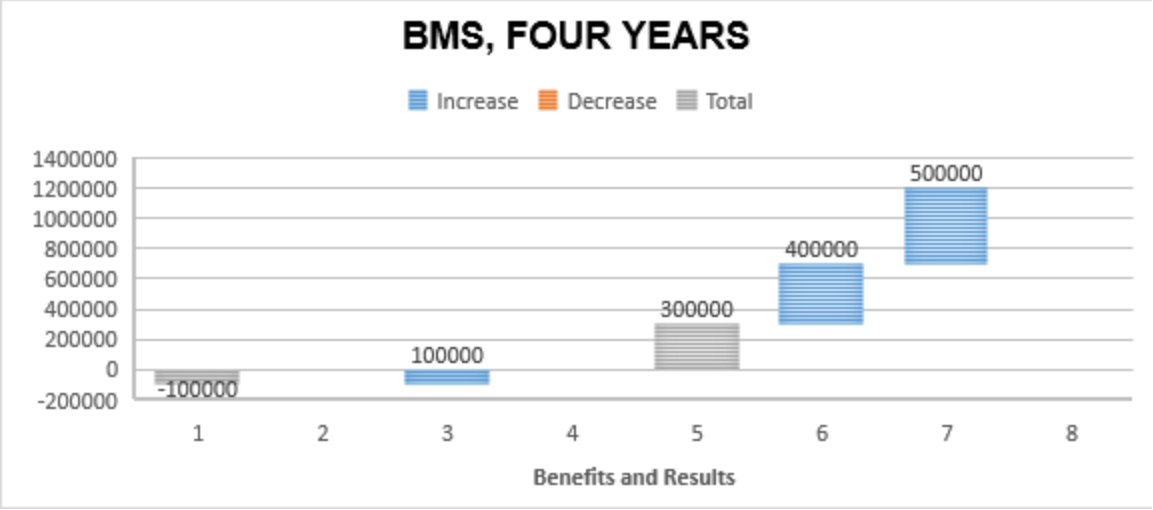

Chart 2four years of BMS

Chart 1 is for three years, and Chart 2 is for four years. As it can be seen, in the first nine months, we are facing a negative amount in cost reduction, which increases upward. This negative value continues until the 15th month and then goes on an upward path. In diagram 2, the process is the same. The presence of BMS increases the cost during installation and implementation. Still, with a closer examination, it becomes clear that after 3 to 5 years, the costs will be fully recovered, including energy savings and current prices. However, it seems like that at the beginning.

IV. The role of passive architecture in reducing energy consumption

Energy consumption in the building sector is as follows.
A- Brightness 25%
B - Heating and cooling 45%
C - Tools and equipment 15%
D - 15% energy loss

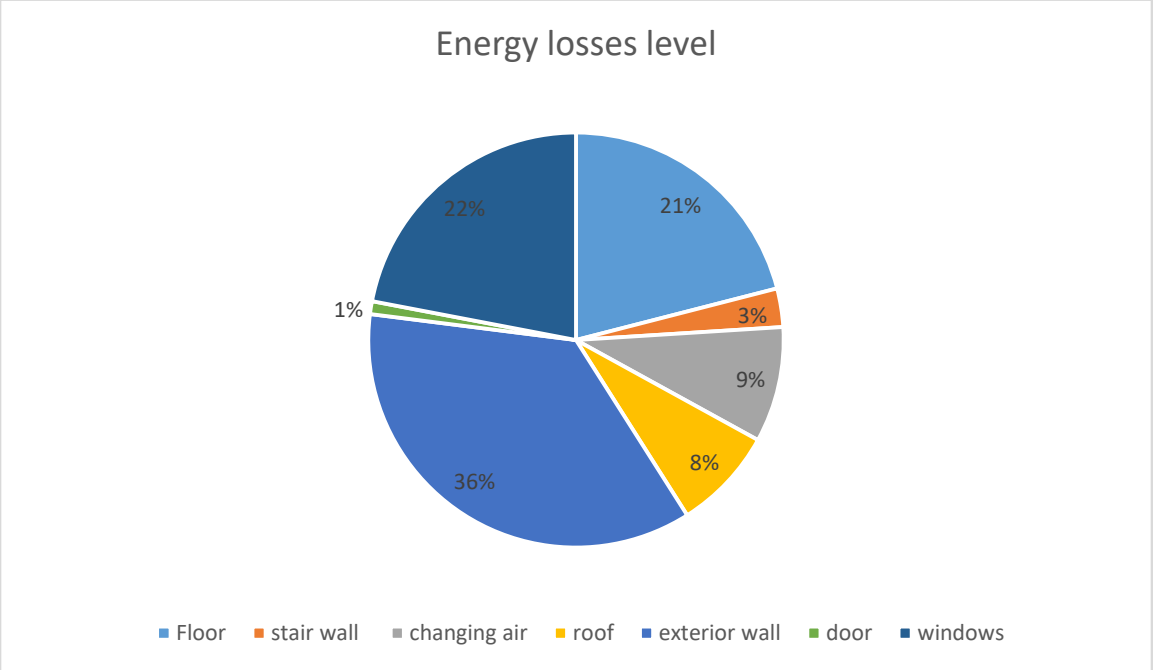

Chart 3 energy losses level

The building is one of the biggest energy-consuming sectors in most societies. The significant amount of 50% of the total energy consumption in the building, of which 15% is wasted, on the one hand, and the amount of 70% consumed in lighting, heating and cooling, on the other hand, are essential. Any savings in the above amounts will significantly affect the overall energy consumption. Paying attention toBuilding technologies to protect and optimise energy consumption can play a very influential role in this directionhave a manufacturer.It is worth noting that high energy consumption does not mean comfort in the building in any way. Dissatisfactions related to the lack of comfort are related to the cooling and heating equipment of the building.There is an air conditioner,which involves higher energy consumption, with far more dissatisfaction than buildings thatdon't have an air conditioner. It is in front. Therefore, in many cases, we use facilities that, despite the considerable amounts of energy,they do not provide multiple comforts[7]. Thus, this question raised the influential factors in the efficiency and optimisation of energy consumption which are?

The main factors in this connection are divided into three categories:

A- Architectural design of the building

B - Design of electrical and mechanical facilities

C - Residents' behaviour

At first glance, this may cause concern because the architect's role is tied to the position of facility engineers and residents. Two valid and acceptable reasons for the great importance of an architect's strategic decisions in advancing the designthere is a building. First, the factors related to the building are among the factors whose possibility of change is infrequent, only in TRenovation or significant repairs, when the building's facilities are completely replaced, this may happen. Better management can encourage residents to use energy efficiently[8].

Second, the three factors mentioned above do not act separately. Apart from the decisions that are made in the architectural design of the building to save energy consumption, the use of non-renewable energy from fossil fuels to (passive) renewable energy and saving more in energyis obtained, the use of passive systems by architectural projections and adaptation to environmental conditions of the objectives optimising energy consumption is considered to be a clear example of such a good and valuable use of the culture of using the passive method in Iran's traditional architecture, it can quickly help us in this direction. Indeed, the optimal energy consumption strategy in building design is also applied to the facility system, and it all depends on the behaviour of the building's residents[9].

V. How to optimise energy consumption in passive design

Studies show that in a typical house with four open sides, the amount of energy loss in the walls is 29%, the roof is 26%, the floor is related to the open air, 20%, the openings are 14%, and the holes are 11%. Regardless of the different parts of the building, factors such as how the building is placed and the form of the building also plays an influential role in the amount of energy loss. About the structure of the building, the most crucial factor is. It is the size of the building; medium-sized buildings and sets of office buildings or apartment buildings have less heat loss. The passive architecture design should be considered as one of the factors in the energy consumption optimisation strategy. The design of passive architecture, according to the amount of solar radiation and wind, can provide significant heating and cool for the building. At the same time, it will not involve more costs in building construction. Most of the people in the buildings the design method. They prefer passive architecture designed and made due to comfort and security in terms of pollution. To achieve Passive architecture design is enough to pay attention to its six principles[10].

1 - How to establish the building

- According to this principle, the angle of the building and the arrangement of different buildings on the site is such that lower buildings should be placed in the south and higher buildings in the north.

2-Using green spaces and trees

- The use of trees around the building should be such that it creates shade in hot and cold areas while not preventing sunlight on the structureand preventing the wind from blowing towards the building.

3 - The position and size of the openings

Window openings in the facade of the building should be appropriately distributed. The amount of windows on the east, south, and west sides is 15% of the room's floor area, and if double-glazed windows are used, the window area can be increased up to 30% of the room area. In cold regions, the amount of window surface on the north side of the building is suggested to be 5% of the floor of the room to use natural light, and in hot areas, this amount can be increased to the number of windows on other fronts[11].

4-How to arrange the interior space

Placement of the living room or the main space in the cold areas in the south and the hot regions in the north can increase comfort.

5 - Design

The architectural design of the building should be done so that it has the most miniature heat exchange and then creates the situation.It is better to pay attention to passive design considerations. This point is essential, as the compact plan without advancingthe coming and going reduces the heat loss, and the non-compressed program makes it possible to avoid radiation absorption[12].The sun should be used more. In hot areas, compact plans are preferable, and in cold regions, non-compressed projects, heat insulators should be designed to prevent heat loss, so they can also absorb the sun's heat.

6-Floor

As before, 20% of the energy comes from the floor connected to the open air. To reduce this, it was mentioned that the heat needed is 50 mm thick thermal insulation. In some existing conditions, thermal insulation with a thickness of 50 mm can be helpful in many ways. In such situations, it is necessary to implement a false ceiling to cover the insulation. Heat exchange through the floor connected to the ground depends on the size and shape of the floor, and relative to the conditions of the subfloor will be different. In the floor of the floors, the floor should be light, which plays a significant role in strengthening the building against earthquakes. The floor's thickness and details were considered so that the heat exchange was minimised. The use of different pipes on the floor has many disadvantages, the most important of which are the reduction of life Useful for the building, the weight of the roof and the weakening of the structure against the earthquake and the inability to create the conditions to reduce the heat inexchange[13].

7- The role of the architect and methods of reducing energy loss

Finally, consumers need to understand that their economic behaviour is in units of litres and kilowatts. In most common and ordinary buildings in Iran, using a thermal insulation layer with a thickness of 5 cm, more than per cent, will save fuel consumption. Still, in the language of money, the equation of saving and in the language of the environment, it means protecting the environment and reducing carbon dioxide and other pollutants[14].

8- Roof

Considering about 26% of heat from the roof, insulation of all roofs can be very effective in optimising energy consumption in the building, especially in the winter. Insulation of sloping roofs can be done both along the sloping roof and on the false roof.

6-1 Building design

The design of the building is of particular importance in minimising energy consumption because the designer must effectively communicate with the environment to achieve optimal energy consumption and design the building with an open mind, considering the space around the building. Sides and the occupied area of the building can be optimised for energy. On the other hand, according to the employer,be responsive to all these cases as much as possible and take a positive step in saving energy[15].

6-2 The side of the building

The important thing is that according to the statistics, northern buildings are the hottest during the day and night with 78% of the sunlight.It is the buildings that this article receives an average of the highest amount of the sun, and the least fuel is consumed in these houses compared to other places (east, west, south). For this reason, in the construction of buildings, the orientation of the buildings should be determined according to energy optimisation[16].

6-3 The direction of the windows

The side of the windows is essential for the optimal use of the light and heat of the sun .The heat of the sun can be checked in winter. Because of the appropriate level of windows in cold areas in different seasons and winter, they save fuel consumption to a certain extent; in this case, it should be avoided even if possible to be placed on the window side to the open environment[17].

6-4 Use of plants in building cover

In the facades of buildings, vegetation is an essential factor in thermal insulation of buildings[18]. But these plants must be indestructible, and the significant disadvantage is that if a strong wind blows, all these plants may be lost and destroyed, and for this reason,you should take special care of them because they are good sources of energy saving.

6-5 Use of false ceiling

Installing a false ceiling can reduce the heat transfer to some extent and can also use a part of the space for cooling and heating energy; it is essential to note that the false ceiling on the upper floors can reduce the heat

transfer between the interior and exterior of the building. Reducingfor this purpose is one of the ways to save energy[19].

6-6 Using double-glazed windows and standard frames

If the windows are entirely in standard sizes and the drinks are double-glazed, it will reduce energy consumption. In the industrialised countries of the world, most of the windows are small and double-glazed, but in third-world countries, we see that the dimensions of the windows are often large and have ordinary glass. It is essential here.Remember that the seams between the glasses and frames are completely blocked, and if not, it will cause more energy consumption and dust entering the building. But this factor seems simple and essential in saving fuel and preventing noise and dust from entering, and it is one of the crucial ways to save energy[20].

6-7 Using the space between the walls according to international standards

In this method, empty and economic spaces can be used between the primary and secondary walls of the buildings, according to the existing standards. More energy and dust enter the building. Economically used for optimal use of energy. This way, it causes a convection current between the wall, and the lower the thickness of the layer and the higher the conductivity in this part, the flow Convection is heat exchange remains constant; this space is like an insulator, causing heat and cold to disappear the walls do not pass and the energy in place of Moore[21].

VII. Energy storage

The system considers the room temperature based on the type of operation and its use according to the form's primary and secondary information .It briefly shows the daily or seasonal changes of the variables and how to choose the periods, and it also provides the consumption program according to the daylight and the temperature of the external plan, which is both low-cost and, on the other hand, takes into account the saving of energy consumption puts. Also, the system can report the employer's consumption costs and the amount of protection. Thus,Escalate, and the expensive energy consumption is eliminated[22].

VIII. Some goals of the intelligent management system

- Creating a favourable environment for people in the building.
- Optimum use of the equipment and increasing their useful life.
-Providing a control system with the ability to schedule performance.
- Significant reduction of costs related to maintenance and optimisation and energy saving.
- No need for a permanent building contractor.
- Or the Internet P.C., the possibility of monitoring and controlling all points under control through one according to the integration of the building, that all the equipment works in harmony, and the possibility of interference and problems caused by lack of coordination is eliminated.
- Obtaining statistical reports of all equipment and their performance to optimise consumption and performance. Integrating building services such as chiller, fire alarm system, access control system, and electrical panels provides a comprehensive solution directly related to energy consumption, which causes energy storage and regular operation. A machine is a construction tool. Since intelligent buildings are a new concept, the development of the use of such systems causes it saves more and more energy and has the following advantages. Communication has become a standard solution. The equipment should stand alone, and then they will find the ability to be integrated easily. A building management system should be able to "diagnose and report" and simultaneously "control and display". Enterprise resource planning systems of building management can automatically transfer all information to one system. Therefore, a building management system can provide the following facilities to owners and investors: "A system that can be controlled, displayed, managed and supported—building with a standard, flexible, integrated, intelligent and low-cost foundation[23].

IX. The role of intelligent buildings in reducing energy consumption

By paying more attention to the examination and estimation of the consumption cost in various applications, the following three categories can be achieved:

- Savings without cost: with the help of noticeable adjustmentsto control systems, significant and valuable changes can be made in the device's operation by directing the equipment's operation, which is almost free of cost.
-Saving with a meagre cost: this trend is in the parts used intermittently, including the following vending machine: lighting system controller, time switch in water heater system, toilet siphon controller or central heating controllers.
- High-scale economy: This process is used in plans that require making significant changes or changing the location on the map, andthey also need the use of very modern or sensitive equipment. For example, replacing the boiler and

thermal burner system with a hot gas conductor in the hot water unit or chiller systems, as well as where we have simultaneous electricity and heat consumption, what has been said so far was the result of a comprehensive energy management program, which is Ideal depending on how flexible it isIt includes 15 to 25% annual interest. Generally, 3% to 6% cost savings can be considered, or 4% for 3% of buildings with very high consumption. At the same time, we are facing annual savings in multi-purpose institutions[24].

X. Conclusion

This article has tried to open the chapter on the influence of architectural design in optimising energy consumption and the importance of what has been ignored so far;it has been done with only brief references, on the one hand, to the designers and architects who are not aware of the impact of their role in this direction.On the other hand, paying attention to the factors that directly relate to heating, cooling, and natural light use in the building forSimplicity has been proposed. Suppose the points raised by designers and architects, and residents of residential buildings are applied to non-residential. In that case, it is easy to reduce the pollution caused by the consumption of fossil fuels, and it has created a severe risk for the mental and physical health of the society; with less consumption of fossil fuels, more efficiency is achieved. And on the other hand,they benefited from the inexhaustible sources of natural energy.

This direction of practical attention to the following points can be effective in optimising energy consumption:

-Using the rich and straightforward experiences available in the traditional and native architecture of the country.

- Attention to the features required in design and construction as a strategy.

-Using optimal consumption management systems and intelligent buildings.

- Coordination of facility systems used with the design and environment in general.

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