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# Technologies of Sustainability in Large Banks Buildings

Maab Hisham Ayead and Osamah Al-Tameemi



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**Maab Hisham Ayead [1]*, Osamah Abdulmunem Al-Tameemi[1]**

[1] Department of Architecture, University of Baghdad, Baghdad, Iraq.

m.h.ayad1104@coeng.uobaghdad.edu.iq

osamah.al-tameemi@coeng.uobaghdad.edu.iq

**Abstract.** Achieving energy efficiency is a very important step of applying the concepts of sustainability, this will reduce the financial costs that coming from energy consumption for the purposes of operating HVAC system so this concept will give a great effect on the environment and the economic aspects. Bank buildings are represented of the financial strength of the country, as they have a strong and direct impact on the reality of society and urban reality, and these buildings often consume a large amount of energy for cooling and heating purposes in the hot and dry climate of Iraq, so the research problem is focus on the knowledge deficiency of the importance of the role of techniques of sustainability in advancing the banking work at the design and performance level. Therefore, the purpose of research was to find the knowledge aspects of designing the external envelope of the banking building in a sustainable manner that contributes to achieving energy efficiency and reducing the negative impact of banking buildings on the environment, as a result technique of sustainability and technological developments have led to the change and innovation in designing an advanced environment in banking buildings, such as achieving communication in the work environment in addition to providing comfort to the occupants in it, and this will lead to improved performance and production.
**Keywords:** Techniques of sustainability, banking building, energy efficiency, indoor environment.

## 1. Introduction

Sustainability concept is considered as one of the most important topics used within many development sectors today which is ruled by technological, economical, political challenges. This concept of sustainability can be applied in architecture according to environmental, social, economical and functional considerations as the applications of this architecture contribute to improving the quality of the internal and external environments of buildings and urban communities up to the whole city; Therefore, it is the preservation of the environmental, economical and social systems that make up the urban environment, so that sustainable architecture is a process that includes dealing with resources and technical direction for development in a way that is consistent and compatible with the current and future needs of humanity.

In large banks buildings sustainability techniques have offer high efficiency within the framework of a suitable natural environment and organized to increase the speed of user understanding, communication, productivity and performance efficiency through entry of many variables, sustainable and technological concepts. Therefore, this banks are designed as a dynamic and adaptable building according to the internal and external changes in it, from its external changes it can be applied by the selection of materials that have low emissions, sustainable development of site and all building systems are centrally

controlled which increases the efficiency of the building's operation and the efficiency of energy conservation, and then its internal space can be designed with flexibility and fulfilling the client's needs through provide appropriate lighting, thermal conditions, protection and security needs such as protection from fire and theft.

## 2. Sustainability in architecture

Sustainability in architecture is a comprehensive term which means to planning design and construction for future, referring to the meet of the present generation needs the without compromising or sacrificing the future generations ability to meet their needs so its integrating two objectives include technology and human objectives [1] so that the sustainable architecture is an architecture that reacting with the local and environmental situations which is attempting to apply themes of ecological abilities to produce attractive environmental situation; therefore, it is balance of ecological situation that means it has lower damages on ecology and the changes for flexibility, adaptability and continuity [2] in that term a sustainable building is a building that has maximum flexibility with natural and artificial environment and it is consist of the building, environment surrounded, local and global environments [3] that means achieving more with less, also it is the management of using the natural resources to supply maximum of benefits to the current generations while protect the ability to meet the future generation's needs. [4] As a result, sustainability objectives in buildings are classified to four groups of social, economical, technical, and environmental issues. In 'Figure 1' some of these main issues in sustainability.

- Minimizing the effect and increasing.
- Rising the social beneficial.
- Rising the asset and economic.
- Rising the optimization and quality. [5]

In each group of these objectives there is some of general points are shown as principles of sustainability and goals and they are efficient in fulfilling.

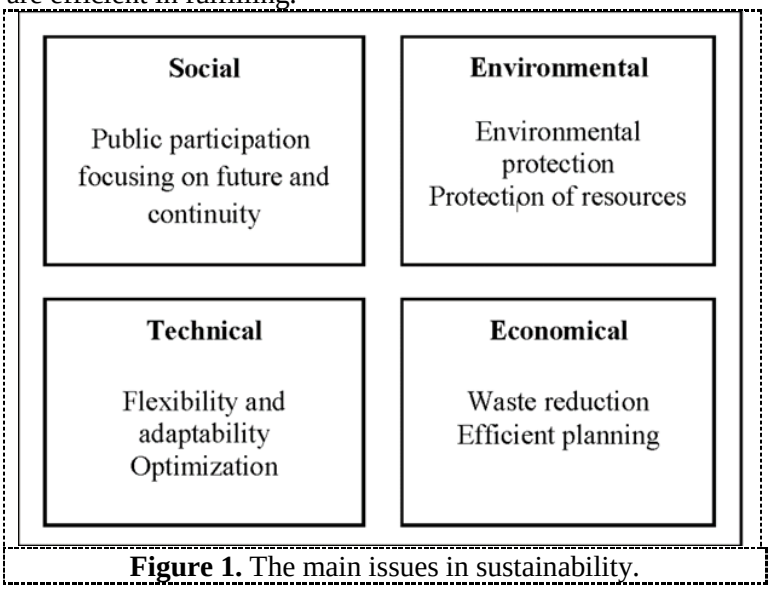


**Figure 1.** The main issues in sustainability.

## 3. Sustainability effect on architecture production and its benefits

Architecture is one of the most unifying arts with technology, the performance of the building is determined with its aesthetic value, the symbolic connotations with the constructing system, and the meanings with the function process, thus favouring two types of technological tasks in architecture, the first is [Technical] its includes structural principles which is the service systems and the means of energy supply this modern technical aspects have provided broad prospects for implementing the concept of sustainability in architecture within several levels to raise the level of architectural works and make them continuous over time, and then prevent their negative impact on humans and environment, and the second is [ Aesthetic] its includes form, scale, function and others that represent the expressive field of

architecture. [6] In the procedure of design the building, sustainability concept is an aim of the design of architecture needs to follow, it terms to the designing of function and safety of the needs of building and the trend of development of function, as a result, designing at the level of architecture ecology this can actually meet needs of the occupants construction. In the contexts of sustainability, it should be to replace unacceptable material construction, recycle non-renewable energy, recycle and encourage the sustainable development of modern buildings. [7]

In order to design sustainable ecology buildings we must concentrated on increasing the resource use efficiency from the solar passive design principles which lead to reduce of non-renewable resources consumption, the energy production consumption, life cycle design and the design of construction, these methods for reducing the wastage of materials during the process of construction building and supplying chances for recycling, reuse of building material and to improving efficiency of resource consumption [8] and using passive energy technologies in design process like a natural ventilation, landscaping by vegetation, use of water spaces for evaporation and cooling, building orientation, etc. all these technologies contributing to achieve visual and thermal comfort inside the building, so that there is a considerable minimizing in energy consumption by conventional air conditioning and artificial lightning in a building and applying solar-passive and bioclimatic design feature and taking advantage of the natural resources of the site. On the other hand the consumption of natural resources such as materials of building as raw materials for materials production [9].

Therefore; the benefits of sustainability on buildings are identified by the OECD[1] project which noticed five objectives:

- Efficiency of resource.
- Protection of pollution (including noise abatement and indoor air quality)
- Efficiency of energy (including Greenhouse Gas emissions reduction)
- Harmonization with environment conditions (including environmental assessment)
- Integration of building systems approaches (including environmental management system) [10]

**4. The importance of bank buildings in modern cities**

Bank buildings are always represented the country's financial strength, prosperity of the community, the prestige of the owner and financial security so that they have a strong and direct impact on the reality of society and the urban reality as well, as a result banking buildings are distinguished by luxury, whether in terms of finishing materials or finishes, or even at the level of interior design to give an impression of strength and luxury for the purpose of enhancing their role in the country in addition to their role to attract customers while providing services in an accurate manner, so it is natural that banking buildings are distinguished from other types of buildings with an attractive design elements to attract the largest number of customers, the use of technical and technological developments have led to the pursuit of change and innovation in designing an advanced environment in banking buildings, such as achieving communication in the work environment in addition to providing comfort to the occupants in it, this will lead to improving productivity of banking work. [11]

The concept of a contemporary historical bank is not new. However, suddenly in the mid-20th century, an industry steeped in tradition quickly transformed its architectural icons from classic to modernist. In fact, banks adopted a new, unconventional vocabulary more readily than some of the less conservative types of buildings. New materials, technologies, and designs were used to symbolize seemingly disparate expressions of stability and progressiveness. Banks on main street have been modernized or built in new suburbs to make exciting contemporary statements.

The first architectural reflection of the bank's new procedural openness appeared from the inside where the ATMs were downsized or removed entirely; floor plans are becoming increasingly open; cabinets have been moved to display. The interior was open-minded and the new approach should include more courtesy in customer service, new efficiency in trading accounts, a new public mind-set for executives, and more responsibility new loan accounts. [12]

[1] Organization for Economic cooperation and Development

## 5. The most important technologies of sustainability used in banks buildings

The banking building is the financial interface of the city, which reflects the country's ability to use the latest sustainable technologies in order to achieve a sustainable modern bank building there is a technologies of sustainability can be applied to control and improve the building activities and prevented the damage of environment, without the reduction of the beneficial output of building activities.

### *5.1. Material used technology*

The use of smart environmentally friendly materials in an attempt to obtain materials with little impact on the surrounding environment such as Green House Gass (GHG) emissions and CO2 footprint is minimal; light and economical materials which have hardness, durability, and a high ability to resist sudden security breaches as shown in 'Figure 2', and sustainability sourced products that cause pollution prevention and minimizing polluting emissions. [13] To reduce construction costs and emissions during the process of producing building materials as well as to shorten time and effort and reduce the loads imposed on the foundations as a result of light weight and flexibility in formation during the building implementation process.

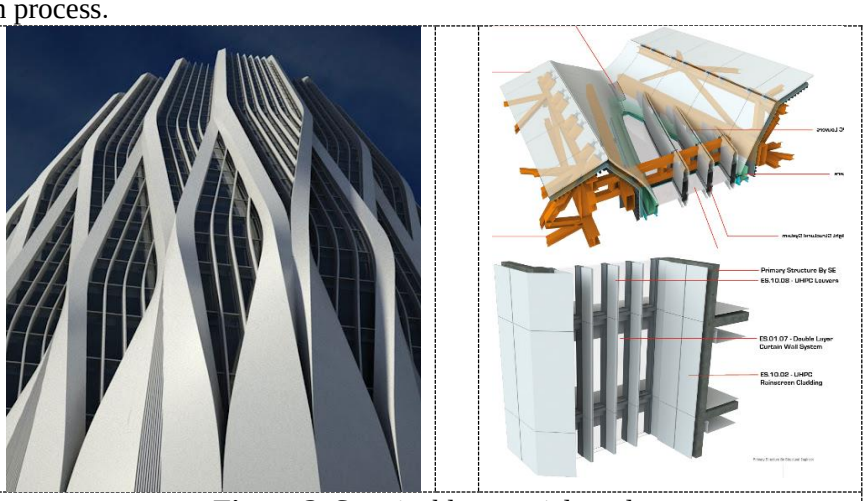


**Figure 2.** Sustainable material used.

### *5.2. Energy efficiency technology*

In general natural, smart ventilation, daylighting, high quality insulation and thermal energy strategy have become an important technologies in building design; these technologies such as replacing the air of building spaces to provide high indoor air quality without using mechanical methods, that means ventilation condition inside a space have a direct influence and these technologies produce a comfort ,health and well-being of the occupants. [14] As shown in 'Figure 3' conservation energy techniques lead to saved energy by the use of double glassing, smart windows with solar panels to manage energy and elevation design solar control building envelope colour hanging gardens that energy saved and natural ventilation. [15]

### *5.3. Indoor environment quality technology*

Healthy working environment and natural technologies at design process by using nature for ecological considerations reduction of noise to improve harmonic indoor air quality with the environment to improved productivity; employee satisfaction; client satisfaction; this will provide best value to clients and focus on improving client business safety, health and working environment; maintaining employee satisfaction. [16] In order that, the use of green surfaces for a healthy and comfortable atmosphere and an opening for sunlight and to achieve the largest view to exterior environment and green roof for comfortable healthy environment by providing a sky-light for sun rays 'Figure 4'.

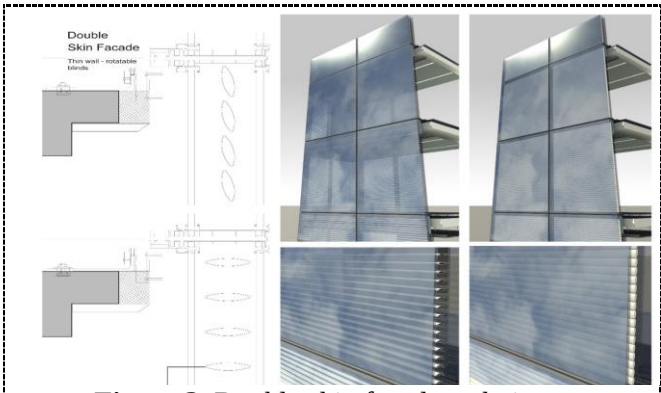


**Figure 3.** Double skin façade technique.

**Figure 4.** In door environment quality.

*5.4. Well-being technology*

The integration of smart building systems at building management system (BMS) to control lighting, monitoring, protection, safety, maintenance, cleaning and fire detection systems, as a result; plan for resistance from fire protection risks and crime prevention by access control uses, fences, gates, doors shrubs, and other physical design elements to prevent access to the building except its intended users. Controlled is achieved by placing the locations of windows that allow the users to see or be seen and ensured that the strangers will be observed. [17] Protection of sensitive ecosystems through good construction practices and supervision; water efficient landscape and digital design technology and parametric design (BIM) by using computer programs, which provides ease of work and modification of organic forms and obtaining an analysis of the initial building systems during the design phase .

## 6. Theoretical framework

Theoretical framework as shown in 'Table 1' was associated with the previously mentioned knowledge, so that it was based on main aspects related to technologies of sustainability associated with bank buildings while the sub aspects were associated with the applied aspects of those technologies in order to get out with possible values that represent the extents of the impact of these technologies on the environmental performance of those buildings.

**Table 1.** Theoretical framework.

| Main aspects | Sub aspects | Possible values | Notes |
|---|---|---|---|
| 1. Material used technology | The use of light and economical materials which have hardness, durability, and a high ability to resist sudden security breaches. | Achieve material used technology | Use of glass fibre reinforced concrete(GRC) and ultra-high performance concrete (UHPC) materials which are the best solution for construction in Iraq due to their availability, low cost and no need for high experiences. |
| 2. Energy efficiency technology | Provide passive ventilation, heat and sound isolation and natural day light. | Partially achieve energy efficiency technology | Using smart solar louvers for cladding the building with solar panels to obtain an energy resource and use double facades, two layers of glass, mediated by a ventilated vacuum insulation which connected to the central cooling system. |

| | | | | |
|---|---|---|---|---|
| 3. | Indoor environment quality technology | The use of green surfaces for a healthy and comfortable atmosphere and an opening for sunlight to enter and to achieve the largest view of the Tigris River. | Partially achieve indoor environment quality technology | Using green roof for comfortable healthy environment by providing a sky-light for sun rays and wide view for Tigris river. |
| 4. | Well-being technology | Building management, building energies management, fire detection systems, security protection systems, maintenance, self-cleaning and optimal use of service sites. | Achieve well-being technology | By modeling the building with BIM technology and thermal analysis of the building to achieve environmental sustainability and the organic curved form of the building. |

## 7. Case study

The new headquarters of the Central Bank of Iraq (CBI) located in Baghdad, Al-jadriah, designed by Zaha Hadid Architects in 2011 and under construction at now, comprises a podium and tower of 170 meters' height and a gross internal area of 90,000 $m^2$. [18] The building of headquarters of the Central Bank of Iraq (CBI) rises from the bank of the Tigris River in Baghdad which has shaped the city, the design transfer values at the heart of the institution: solidity, stability and sustainability, also an important of national institution, perform its necessary functions and it's the role of stability serving, economic growth and development in Iraq. [19]

**Figure 5.** General exterior perspective for central bank of Iraq.

The (CBI) building composition design is a very specific constraints of the site, so that the form at base is narrow, and in the middle the tower widens to improvement the layout and rise efficiencies, and then tapers insides towards the top, the concept of the form stems from the function of the building and is inspired by the elements of the contemporary economy and has nothing to do with the site or the Iraqi civilization. The façade frame which is itself composed of a pattern which is open and closed elements that visually and conceptually imitative to the reflection of light from waves in the river below. The design dynamism is reinforced by provide a practical purpose of the areas variety of light and shade inside and at its base solid and purposeful.

The podium is hardly waved but its soft landscaped; also the scale of building is gradually formed by a series of gardens and landscaped terraces that is directly related with surrounding neighbourhood which is manage the access to the building, the towers façade is vertically so its transformed to the horizontal platform and rise within the landscape, the bank building atrium brings natural light to the building heart, and opens the building to the river.

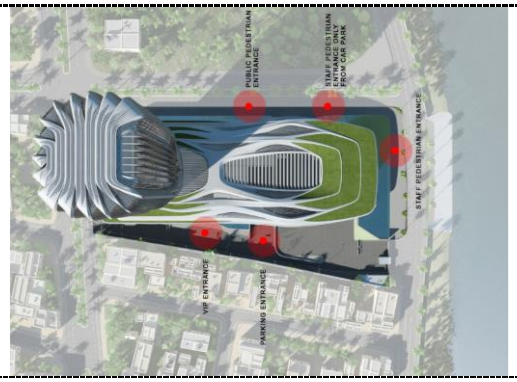


**Figure 6.** Bank building entrances.

Sustainable technologies at the building of central bank of Iraq are achieved in the use of smart materials such as smart glass and pollution-resistant cement in an attempt to obtain materials that have little impact on the environment also using Glass fibre reinforced concrete (GRC) panels in the tower and the use of Ultra high performance concrete (UHPC) in the entire structure of the building due to the high strength and durability of these panels due to that the building needs to support security defences and external penetrations ‘Figures 7,8’. [19]

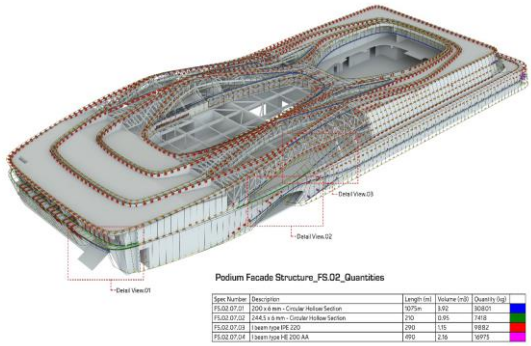


**Figure 7.** The use of hinged elements to connect the UHPC plates with the structures of the skin shell.

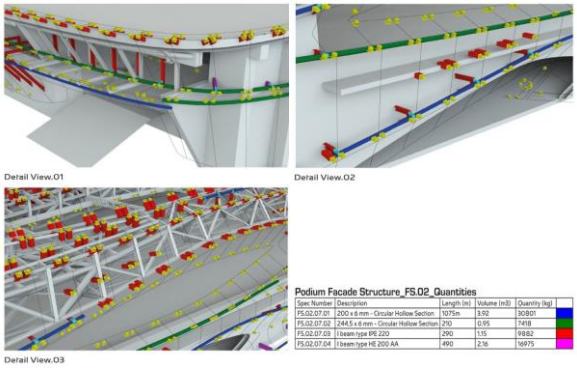


**Figure 8.** Details of the elements connecting with the structures of the skin shell of the building.

Using smart systems in building management (BMS), energy, fire detection systems, security protection systems, maintenance and self-cleaning to achieve a sustainable building and cleaning systems for building facades and smart techniques like double facades as shown in ‘Figure 9’ by create two layers of double glazed layers between them to achieve air insulation and isolate the external conditions from the internal spaces as well smart windows with louvers on the south and west facades for energy management. [18]

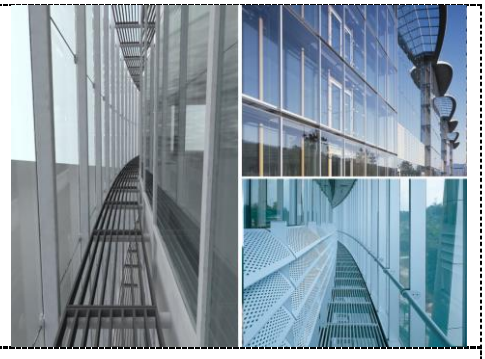

**Figure 9.** Double skin facade.

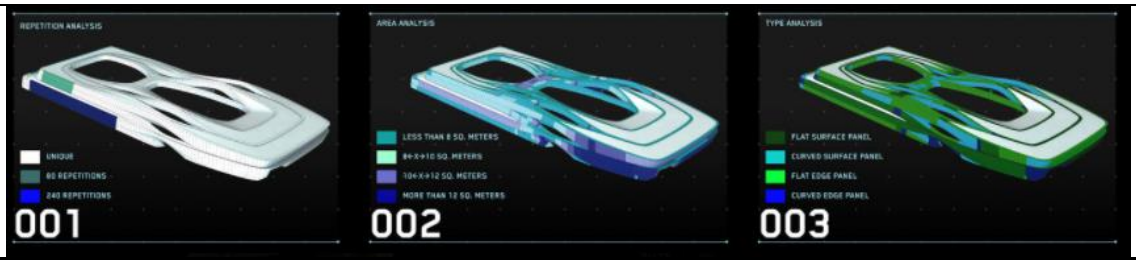


**Figure 10.** Thermal analysis of the building facade-engineering .

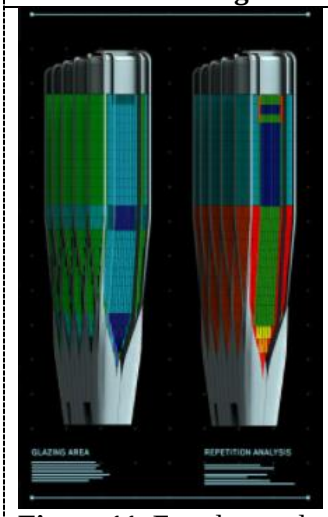


**Figure 11.** Façade panels analysis.

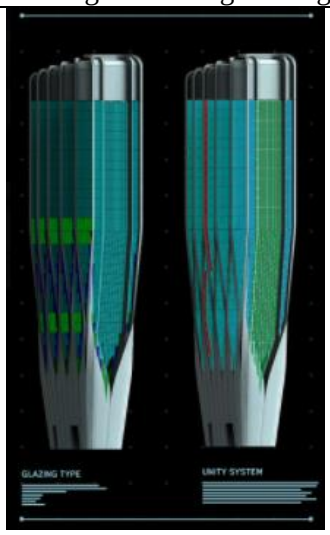


**Figure 12.** Façade panels analysis.

Using smart technology of feeding and draining the green roofs located above the base of the building with surplus water and rain water in a smart manner according to the needs of the roof.
Intelligent systems in the design process give flexibility in designing the form and achieving different shapes due to the use of parametric design technique (BIM) this technique of design create blades in the facades to provide the largest view of the Tigris River that digital design using Revit and Rhino programs to obtain 3D modelling with the use of the parametric design method for creative form design.

**Figure 13.** BIM system modelling.

## 8. Analysis

**Table 2.** SWOT analysis for techniques of sustainability in Central bank of Iraq (CBI).

| | POSITIVE | NEGATIVE |
|---|---|---|
| | Strengths | Weaknesses |
| Internal | 1. Use BIM system, which provides easy modification to the organic forms and obtaining an analysis of the initial building systems during the design phase.<br>2. The building is more comfortable, economical and less wasteful of energy due to the use of building management systems, smart activities, natural resources.<br>3. The use of ultra high performance concrete, which is preferred to be used in the Iraqi case, because its surface is smooth, and this interface will not be exposed to the problem of dust accumulation on it. | 4. Although The general form of the project achieves aspects of sustainability, stems from its function and is inspired by the elements of the contemporary economy but it is not related to the surrounding site.<br>5. In spite of using energy efficiency techniques, the building functions and activities need a continuous artificial energy source. |
| | Opportunities | Threats |
| External | 6. The use of glass fiber reinforce concrete systems (GRC), which is the best solution for construction in the Iraqi case due to the availability of materials and less need for great expertise and its low cost. | 7. Lack of societal awareness about the importance of sustainable development in bank buildings.<br>8. The absence of an economic vision in the sustainable planning of large projects.<br>9. Weakness in the local technical capabilities at the level of implementation and production of such advanced technologies. |

## 9. Conclusion

- The use of environmental design strategies contributes to improving the thermal performance of building envelope, which is one of the necessary things that the architect must take it as a consideration at contributes to achieving energy efficiency.
- Banking buildings contribute to the consumption of depleted energy and environmental resources, due to the banking building's work during the day and the requirements of the occupants, especially in the hot, dry climate that characterizes Iraq.
- It is possible to improve energy levels in buildings and reduce the consumption of it by treating the building's envelope (the roof and facades) by raising their thermal performance.
- Due to the various activities in banking building and the long operating period of the building, this contributed significantly to the increase in energy consumption rates, especially for cooling purposes in hot climates such as Iraq.
- Sustainable banking buildings are a major solution in reducing energy consumption, by dependence on particularly passive design methods to achieve energy efficiency, in addition to raising the quality of the internal environment by adjusting the levels of thermal comfort.

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