Sustainable Environment in Interior Design: Design by Choosing Sustainable Materials

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Abstract. The process of designing interior environments has witnessed in recent years a shift in design strategies that have adopted the provision of healthy and sustainable environments, relying on choosing eco-friendly building materials and appropriate design solutions in interior spaces, creating environmentally responsible architecture and interior design. Many studies showed that despite the development of the concept of sustainability, many architects, designers, and even users do not adopt sustainable design strategies, especially concerning the choice of sustainable materials in the processes of design, construction and even furnishing. The most important criteria in the choice of such materials and products are the low footprint and environmental impact, the high and easy maintenance, as well as durability, budget, comfort, safety, and flexibility. The present paper aims to explore the role of the interior designers and the users in promoting the concepts of sustainability in interior spaces, by the proper choice of materials and design solutions to preserve the environment and achieve the users' optimal interaction with their surrounding spaces. The results show that the process of promoting and enhancing the interior environments with sustainable materials is a shared responsibility of both interior designers and users. Interior designers should develop solutions to raise the aesthetic and performance level of sustainable materials, as well as encouraging the concerned parties (users) to provide materials and furniture that comply with the concepts of reuse and recycling, to finally raise the level of environmental sustainability of interior spaces, and achieve the health and wellbeing of occupants, building a better and more sustainable future.

1- Introduction
In spite of the development in the concepts of sustainability and environmental preservation, the decisions of architects and interior designers are still limited in this direction[1], It is a shared social responsibility of all members of society, as each side bears part of it according to its specialization. Environmental responsibility can be represented in the interior design through these issues:
1- Effectiveness of design topics concerning reducing the negative impact on the natural environment.
2- Reducing the economic consequences and the performance effects of internal spaces within the building.
3- Achieving considerations related to measures of the quality of the inner spaces and their effect on psychological and physical comfort. [2]
The criteria for achieving sustainable interior design are multiple and have several directions, all of which are necessary for finding ways to reach and achieve a sustainable interior environment. This paper will focus on studying aspects related to sustainable materials and their characteristics. The range of environmental solutions for interior space design depends mainly on the characteristics and specifications relevant to its operational life cycle for materials, products, equipment, and devices. [3] On the other hand, there are societal and demographic developments that take place in cities and communities, recent years have witnessed a significant increase in population growth, accompanied by
a trend of housing and living in city centers, which led to an increase in the need for housing units in large numbers, this fact means an increase in demand for materials that go into the processes of manufacturing and constructing buildings and housing units. Threats increased dramatically due to the excessive increase in demand for natural resources without taking into account their limitations, so the situation has become a negative future for our environmental resources, hence the need for sustainability solutions [2] figure (1).

![Figure 1. The Demand for Sustainable Solutions](image)

The material passes during its life cycle in several stages that start from the production processes and end with disposal, where the raw materials are extracted from nature and then inserted into the production of goods that perform specific functions, and after the need is not removed for them, when the damage or when their operational life ends, they are disposed of, and in. In fact, sustainability is concerned with all these stages. [4] Sustainability when extracting operations takes into account the issue of abundance of raw materials and takes care not to deplete them, and in manufacturing processes, it cares about quality and the issue of reducing toxic emissions and pollution, and in the operation, stage takes into account that the use of these products is done correctly and appropriate operation.

Moreover, there are constraints and barriers in the use of sustainable materials, such as a lack of experience and knowledge of information related to these materials and the role of suppliers in providing them, the second factor is the high costs of sustainable solutions in general and sustainable materials in particular when compared to traditional treatments, another factor is that customers prioritize the aesthetic aspects of sustainable materials over sustainability issues. [5], [6]

From the above, interior designers require standards and foundations for the selection of materials and products, in addition to the criteria for sustainable interior design solutions. The solutions that result from sustainable interior design differ from the solutions for conventional interior design, especially concerning environmental conservation and rationalization of resource consumption.[7]

This paper seeks to explore the importance of sustainable materials in creating sustainable environments, as well as explore how sustainable materials can be evaluated and selected. This study addresses the following question; How to create an acceptable sustainable interior environment by selecting sustainable materials? The purpose is to tackle the current problem of Find out the role of interior designers and their customers in promoting the values and concepts of sustainable architectural and interior environments.

The importance of this study can be observed by understanding the relationship and contribution of architectural and interior designers in preserving the environment and natural resources, in addition to contributing significantly to reducing energy consumption, toxic emissions and environmental pollution resulting from the production and transformation of materials, also, the role of interior designers in establishing the concept of customer desire for sustainable interior designs, and making them involved in making sustainable design decisions.
2- Literature review

Many studies have focused on the topic of sustainability in interior design and interior architecture, and these studies dealt with topics related mainly to the concepts of sustainability and the societal role and ways to achieve them, as well as addressed topics related to the demand for environmentally sustainable products and materials, and how to use and make those materials the main component of interior environment elements.

Aylap, N. (2012) studied and examined the dimensions and levels of the need for a sustainable interior environment, the adoption of concepts of sustainability in the process of building the interior environment, and the possibilities of achieving sustainability through the elements of interior design, as well as research and investigation of natural resources that could be included in the manufacture of the components of the interior environment and the strategies that would reduce energy consumption by using natural light.[8]

The Hayles, C. (2015) study highlighted the current supply and demand mechanism for environmentally sustainable materials, the role of commercial outlets in providing these materials, educating and encouraging consumers through the promotion of these products, in addition to highlighting recent information about sustainable materials and how they are used, where the research finds that everything that has been provided will play a critical role in promoting sustainable practice.[9]

Rashdan, W. (2017) study presented a suggestion of having a set of functional and effective standards to ensure sustainable interior design solutions, as these criteria are important in assisting interior designers in their choice of sustainable interior design solutions, these criteria focused on mechanisms for selecting sustainable materials by identifying and evaluating the producing companies and evaluating those materials based on sustainable product certificates, assessing the life cycle of a sustainable product and the suitability of these materials to health standards.[10]

The study of Ismail, O., and Abdel-Bari, S. (2009) discussed the role of architectural and interior design in achieving a balance between the requirements of the economy and the environment on the one hand and the requirements of the user on the other hand. The study also addressed the problem of high prices for sustainable solutions compared to traditional solutions, and the study reviewed some ecological economic solutions to reach systems that make the building connected and integrate positively with the surrounding environment.

In the Ali, M., and Shamayel, A. (2018) study, the elements of sustainability in the interior design of the Arab Islamic house were explored, through reviewing environmental solutions and using locally available materials, taking into account social and cultural dimensions, and studying the dependence of traditional homes on natural energies, and the study concluded by presenting criteria for sustainable interior design based on solutions found in traditional houses.

Based on the literature reviewed, it is obvious that there is enough room for further research focusing on exploring the role of the interior designers and the users in promoting the concepts of sustainability in interior spaces, by the proper choice of materials and design solutions to preserve the environment and achieve the users' optimal interaction with their surrounding spaces, also studying the importance of the design process in making sustainable materials a major part of the internal environment components, by introducing them into the design system to achieve performance and aesthetic requirements. Table (1)

In conclusion, there is a gap in the literature Related to the topic of understanding and developing a concept for the role of the interior designer in raising the aesthetic values of sustainable materials, in addition to clarifying the criteria upon which the basis for choosing the type of sustainable materials is made and thus making the customer willing and accepting those materials.

| Authors       | Signification                                                                 |
|---------------|-------------------------------------------------------------------------------|
| Aylap,        | Studied the sustainable interior environment, elements                        | Sustainable interior environment                           |
|               |                                                                                | Performi... character                                      |
|               |                                                                                | Element of Design... Interior designer                     |
|               |                                                                                | Sustainable Materials                                       |
3rd International Conference on Sustainable Engineering Techniques (ICSET 2020)       IOP Publishing
IOP Conf. Series: Materials Science and Engineering 881 (2020) 012035   doi:10.1088/1757-899X/881/1/012035

N.(2012) of interior design and natural resources of sustainable materials.

Hayles C. (2015) Highlighted on environmentally sustainable materials, the role of commercial outlets in providing these materials and the recent information about sustainable materials and how they are used.

Rashdan W. (2017) a suggestion of having a set of functional and effective standards to ensure sustainable interior design solutions, selecting sustainable materials by identifying and evaluating the producing company certificates.

Ismail,O. &Abdel-Bari.S. (2009) Studied the role of architectural and interior design in achieving a balance between the requirements of the economy and the environment, the high cost of sustainable solutions and reviewed some ecological economic solutions.

Ali, M. & Shamayel, A. (2018) study the elements of sustainability in the interior design, reviewed environmental solutions by using locally available materials and presented criteria for sustainable interior design based on solutions found in traditional houses.

The present study Studying the sustainable interior environment through introducing performance characteristics and aesthetic characteristics of sustainable materials, and what is the role of the interior designer in creating that environment and filling on the research gap founded in the previous Literature.

3- Methodology
The study aimed to shed light on the role of interior design in contributing to the creation of sustainable interior spaces and to contribute to the cognitive awareness of sustainability options by setting a perception of mechanisms for using sustainable materials, identifying their characteristics and developing design approaches in making the components of the design elements. Although the study of sustainable materials may not represent a state of integration in finding buildings with sustainable interior spaces, however, its applied criteria may be considered as a solution to part of the problem. To achieve this, a two-stage strategy will be adopted, the first stage is to conduct a research study of the literature on topics related to concepts of sustainable environment, definitions, and classifications of sustainable materials and elements of sustainable interior design, subsequently coming up with criteria for the foundations of creating an interior environment that is classified as sustainable through its design components. The second stage includes a review and analysis of regional and local examples and models, which relied on strategies for sustainability concepts in the process of designing and creating them and applying the criteria extracted from the study of the literature in analyzing its elements and components.

3-1 Theoretical framework
3-1-1 Sustainable environment
The environment that this paper is studying is the (built environment), the term built environment, refers to the human-made environment that provides the setting for human activity, ranging in scale from buildings to cities and beyond. It has been defined as "the human-made space in which people live, work and recreate on a day-to-day basis".[11] So all encompasses places and spaces created or modified by people to serve their needs of accommodation, organization, and representation, considered as-built environment.
Sustainability is generally defined as "development that addresses current needs while remaining adaptable enough to ensure that the needs of the future can be met". [12] From the practical side was defined as a technical term for facing environmental problems, and it has three dimensions economic development, social development, and environmental protection. These dimensions work together and can be mutually reinforcing, the goal of sustainability is to meet the needs of the present without affecting the ability of future generations to meeting their needs.[13]

The sustainable environment is a "product of both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition". [14] From this perspective, sustainable environments are every building and space built according to the sustainability criteria, which give environmental solutions and efficient use of materials. Figure (2)

![Figure 2. Sustainable Environment, by Author.](image)

Therefore, sustainable environments are less environmental impact, "sustainable environment will contribute more than it consumes"[15] , It is the product of sustainable solutions within design and material selection processes.

3.1-2 Sustainable materials
There are a large number of concepts that defined sustainable materials, as these concepts depend on the values of energy consumption and pollutant emissions of production processes, abundance, and renewability of resources, the durability, and permanence of materials and economic impacts. Therefore it can be defined as "materials with a relatively positive impact on communities and the environment that are used to build products, deliver services and develop environment such as buildings". [16]

In the field of architecture and interior design, a large number of materials are used in large quantities. Building and construction operations in the world each year consume approximately 3 billion tons of raw materials, which represents 40% of the total resource consumption. [17]

3.1-3 Source of Materials
Building construction and finishing materials can be classified according to their sources:
Natural Materials: It refers to materials that remain in their natural condition with the possibility of conducting some treatments on their surfaces, such as stone and wood.
Converted Materials: It refers to materials that result from converting natural materials into converted materials, such as tiles and bricks.
Artificial Materials: It refers to materials that result from manufacturing processes and these materials are not present in nature, such as plastic, pigments, and glass. [18]

As it becomes evident that industrial materials have greater impacts on the environment in the processes that accompany the production stages, followed by converted materials, while natural materials are the least impacts, and in disposal operations, industrial materials record the highest rates of negative environmental impact, in terms of pollution and energy consumption, converted materials whose environmental effects in disposal operations are less than those accompanying their production processes, and the natural materials remain are the lowest in the environmental impact rates. Figure (3)
3-1-4 Selection of sustainable materials

The selection of materials is a very important issue in the interior design process, as materials are the main component of the elements of interior spaces. The materials can be considered an independent design element since through the way they are used, their quantity and distribution within the inner space can give multiple design ideas. [19]

The materials are an important element because the interior design does not seek to achieve the Functionality and the performance aspects alone, but rather seeks to create a mental image consisting of the materials used in the inner space and affects the process of users’ perception of the inner space. [22] Therefore for the importance of the materials that make up the elements of interior design, as it contributes greatly to the formation of the image and the shape of the interior spaces, as well as its role in the process of integration and linking users with the functional aspects of the interior space.

The sustainable materials in interior design are selected according to certain characteristics, which are determined by the criteria of the factors of reducing the negative impacts on the environment, the characteristics of these materials can be determined:

- Local materials; The choice of the interior designer for homemade materials would achieve harmony with the surrounding environment, which means increasing the operating life of these materials, in addition to supporting the local product and enhancing the design identity. [20]
- Durable materials; Selection and identification of durable materials that will contribute effectively to the efforts exerted to achieve the sustainability of interior spaces. [21]
- Reused materials; "the action or practice of using an item, whether for its original purpose (conventional reuse) or to fulfill a different function (creative reuse or repurposing)”. So reuse – by taking, but not reprocessing, previously used items helps save time, money, energy and resources. [22]
- Upcycled materials; it is using a certain material again, but in a manner different than what it was originally intended for. The original product is left mostly intact, utilizing its shape, form, and material for a different purpose. [23]
- Recycled materials; Use of materials from a process of recovering material from waste and turning it into new products. The original product is destroyed in this process, usually through a melting process, but it used to form new products. [24] The use of such materials can reduce the excessive consumption of natural resources.

Through the characteristics of sustainable materials that are used in interior design, interior design becomes part of environmental sustainability systems, as it contributes to preserving natural resources, reducing pollutant emissions and reducing energy consumption, in addition to that, the sustainable interior design contributes to reformulating the cycle of using natural resources. Figure (4)
3.1-5 Sustainable Interior Design

The holistic concept of environmentally Sustainable design (also called environmentally conscious design, eco-design) "is the philosophy of designing physical objects, the built environment, and services to comply with the principles of ecological sustainability".[25]

Sustainable interior design is defined as "interior design in which all systems and materials are designed with an emphasis on integration into a whole to minimize negative impacts on the environment and occupants and maximize positive impacts on environmental, economic and social systems over the life cycle of a building".[21] Sustainable interior design aim to rationalizing the use of materials in an innovative way that enables the conservation of natural resources in a way that does not lead to environmental degradation.[26]

Therefore, in comparison with traditional design practices, "where designers are primarily focussed on meeting the clients' aesthetic and functional needs, the sustainable interior design focuses on the materials' intended application, aesthetic qualities, environmental and health impacts, availability, ease of installation and maintenance, and initial and life cycle costs".[1]

As for the above, sustainable interior design does not only take into account the characteristics of sustainable materials and solutions related to their environmental impacts during their production and disposal operations but also takes into account their effects on the environment and the health of individuals during their operation.

3.1-6 Sustainable design elements

3.1-6-1 Creative design ideas

Sustainable interior design is based on the sustainable design principles and strategies common to the built environment as a whole, namely providing physiologically and psychologically healthy indoor environments.[26] Creative ideas require interior designers to have a new vision in designing elements of interior spaces, by adopting modern methods that connect them with elastic fabric, through which these elements can be linked together with future development possibilities.

There are three dimensions to achieving sustainable interior design: design plans, the quality of the interior environment, and interior materials.[27] Design solutions take into account all the variables related to developing concepts for design production, improving the quality of interior spaces in terms of performance and aesthetics and determining the type and suitability of the materials that make up the elements of interior space.

The challenges faced by interior space designers to achieve sustainable internal environments are multiple, and here comes a role in developing smart strategies for the distribution of spaces within the inner space. "Through the interior design process, sustainable interior environments can be obtained, such as when creating flexible, designed spaces that can adapt to space events".[28] Consequently, the results of reducing material consumption are achieved through the multiple use of elements, flexibility and development and growth capabilities.
3-1-6-2 Interior Space components

Surface finishing: The surfaces are the inner shell of the structural elements that surround the interior spaces, and they are floors, walls, and ceilings. The sum of the surface areas of the interior space is more than three times the area of space, which means that it requires finishing materials in large quantities. The surfaces reflect the nature of the material and express the spaces and their areas, in the sense that the materials that go into covering the interior spaces are an expressive and performance element, finishing materials have a major impact on improving the internal environment and human health. [7] "Selecting sustainable products makes a vast improvement on the effective surface materials have on the environment". [20] Therefore, in terms of environmental protection, the choice of surfaces finishing materials must take into account sustainability criteria by choosing durable materials that do not cause the consumption of natural resources and are not considered human health.

Furniture: Furniture is a key element in determining the type, function, and use of interior spaces, according to the sustainability requirements, the materials that make up the furniture must be durable and of long-term use, and at the same time that these materials are not harmful to the environment during the processes of obtaining them from their sources and during their manufacture they produce the minimum of polluting emissions, in addition to the possibility of recycling or reuse, as mentioned previously when talking about sustainable materials. Sustainable furniture is defined as furniture that, when designing and manufacturing, takes into account the use of recycled or recyclable materials, taking into account the possibility of dismantling and recycling parts after their useful life.[1]

In sustainable interior design, designers go to reduce the number of furniture units by choosing smart furniture units that are versatile and that serves more than one purpose, and instead of relying on production processes to obtain new furniture, there are possibilities to reuse old furniture after its renovation, or making some adjustments to it, this type of reuse is often considered unaesthetic, and here comes the role of cooperation between designers and agencies that renew furniture.

Lighting systems: The considerations of sustainability in lighting in interior design come through reducing the number of lighting units and reducing the period of their use to reduce energy consumption, making the most of daylight by properly directing windows and using reflective surfaces, that daylight is the main lighting source that can be used by "bringing" Natural lighting inside the building's spaces and distribute it efficiently".[27]

Equipment and electrical devices: Interior environments are among the largest consumers of energy resources, especially concerning electrical devices, for example, air conditioners, washing machines, dishwashers, computers, etc. It is possible to solve through the process of reducing the need for these devices, for example, a good isolation system that reduces the consumption of air-conditioners for energy, in addition to choosing electrical devices with less energy consumption, taking into account the durability and convenience of these devices.[28]

3-1-6-3 Clients desires

The design must satisfy customers' desires, They have functional requirements and aesthetic preferences, as well as setting financial budgets. therefore, the role of the designer in convincing them of the importance of sustainable solutions comes through the development of detailed designs and plans that explain to the clients the minute details of the components of sustainable design, knowing its environmental importance and comparing it with conventional design solutions.

Another aspect of the designer's role in making the customer a contributor to achieving sustainable interior design is to make him aware that despite the initial costs of sustainable solutions, it will reduce expenses in the future. designers also have a role in explaining the role of clients in how to deal with their sustainable interior environments, by educating and encouraging them to adopt sustainable behavior.[29]

From the foregoing, we find that there are three; factors that share and complement each other to achieve sustainable buildings and spaces; the designer and what sets out innovative design solutions, the idea of design and the desire to create a sustainable environment and the desires of customers to
obtain sustainable buildings and spaces in addition to their acceptance of additional expenses. When these three factors meet, it is possible to reach the goals of sustainability in the interior design, namely: preserving the environment, spreading a culture of sustainability among members of society and reducing future expenses. Figure (5)
Through the derived criteria from the theoretical framework, these three factors will be studied through the thematic analysis of four main topics which are: the status of the building and the construction method, once the designer and the goal of the design, the role of the customer and the use of sustainable materials.

![Figure 5. Cycle of Sustainable Materials, by Author.](image)

3-2 Practical studies
3-2-1 Case study (selective projects)
To achieve the purpose of this research, it's been selected several case studies for a project that attempted to produce sustainable internal environments, especially concerning standards for selecting materials, these selected models were characterized by being public places that can be accessed and observed.

Sample (1) Assaha Restaurant / Beirut
Designed by the architect Jamal Mecca, the first stage was created in 2014, and in the year 2017 the second stage was completed, the designer tried to apply the theory of rotational architecture, which is based on taking advantage of the waste of old and destroyed buildings, through the reuse of old tools and collectibles and building elements in them, and using them again in architecture and interior design.\(^1\&^2\)

Sample (2) Assaha Restaurant / Baghdad
Designed by Al-Mammal Jamal Makkah, construction began in 2014, the designer tried to apply the theory of rotational architecture, which is based on taking advantage of the waste of old and destroyed buildings, through the reuse of old tools and collectibles and building elements in them, and using them again in architecture and interior design. and was completed in 2018, in addition to restoring the heritage architecture.

Sample (3) Darbuna Restaurant / Baghdad

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1 Interview conducted by the author with Mr. Hussein Shubeih, director of Assaha Village Beirut, on Thursday 8/8/2019.
2 Correspondence with the architect Jamal Mecca and a visit to the website assahavillage.com
3 Interview conducted by the author with Mr. Muhsen Debek, director of Assaha Restaurant/Baghdad, on Saturday 14/9/2019.
The restaurant building is an old house that was built in 1931, the building was restored and converted into a restaurant and the interior design of the restaurant owner himself, Mr. Mahdi Laith, works as an environmental activist. The restaurant was opened in 2019, the restaurant owner wanted by design to reflect the integration and belonging of a person with nature, homemade made of natural elements brought from the marshes of Iraq in the southern region was used, the main goal was to achieve environmental sustainability by bringing the community members closer to nature So that they know its importance.

Sample (4) Al-Shah Bandar Café / Baghdad
The building of the Shah Bandar Café was built in 1907, and at the beginning there was a printing press, and it was transformed into a café in the early 1960s. After the explosion of the building as a result of terrorist acts in 2007, the idea of its restoration was based on returning the building as it was before the explosion, using local materials and reusing elements of old buildings.

Sample (5) Al-Mahatta (Station) / Baghdad
The terminal building was built in 2017, and the purpose is to create a sustainable social environment based on the development of human resources. The building was designed by Mr. Mujahid Al-Wisi, who is a specialist in the field of media. The idea of design is to create an office environment (shared workspace), and the building is a simulation of the station that transports community members and startups to social sustainability practices and behaviors. The designer tried to reflect these ideas through simplicity of design, using recyclable industrial materials, and reducing the use of termination materials.

3-2-2 Analysis and description
Sample (1):
The restaurant building was constructed using reinforced concrete and solid concrete block, and it was covered with natural stone.

The materials used for finishing the floors are old mosaic tiles that were used in demolished buildings. Figure(6)

Figure 6. Sample 1,Floors Finishing , Photos taken by Author.

Architectural elements have been reused in interior wall facade finishes, such as stone walls and some mosaic works. Figure(7)

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4 Interview conducted by the author with Mr. Mahdi laith, owner of Darbuna Restaurant, on Sunday 5/1/2020.
5 Interview conducted by the author with Mr. Muhammed Al-Khashali, owner of Al-Shah Bandar Café, owner since 1963, on Saturday 24/8/2019.
6 Interview conducted by the author with Mr. Ali Sameer, Operation manager, on Saturday 20/7/2019.
Figure 7. Sample 1, Walls Finishing, Photos taken by Author.

Roof finishing materials consisted of architectural elements brought in from the remains of buildings that were demolished. Figure(8)

Figure 8. Sample 1, Ceilings Finishing, Photos taken by Author.

Interior spaces are furnished with reused and antique furniture. Figure(9)

Figure 9. Sample 1, Furniture, Photos taken by Author.

Sample (2):
The restaurant building was constructed using reinforced concrete and Bricks, and it was covered with natural stone.
In some parts, floor finishing works were used as old mosaic tiles brought from old buildings that were removed in Lebanon, and in other parts marble tiles were used. Figure(10)

Figure 10. Sample 2, Floors Finishing, Photos taken by Author.

Gypsum plastering was used in the finishing of the walls, and some parts were covered with ancient carved stone walls, brought from Lebanon, belonging to the old buildings that were removed.
The ceilings were covered with wood panels, and some old tools for decorating were added to it, in addition to making some sky light units to bring in daylight.

Antique furniture units were reused, part of which was brought in from Lebanon, the rest from Baghdad, and old, refurbished furniture was reused.

Sample (3):
The building is an old house, which has been restored and redesigned its internal spaces, and transforms it into a restaurant using local materials brought from the southern region, particularly from the marshes.

Floor finishing materials, the existing old tiles were restored, and proud clay tiles (farshi) were added to compensate for the damaged parts.
The walls were plastered with clay mixed with straw, which is an ancient technique that was previously used, in addition to using a mats made of reeds and papyrus. Figure(15)

![Figure 15. Sample 3, Walls Finishing, Photos taken by Author.](image1)

The ceilings were covered with mats made of reeds and papyrus, In addition to using stacked natural wood pegs, which is an old building technique that was previously used. Figure(16)

![Figure 16. Sample 3, Ceilings Finishing, Photos taken by Author.](image2)

Old furniture units were reused and homemade furniture was produced using traditional manufacturing techniques. Figure(17)

![Figure 17. Sample 3, Furniture, Photos taken by Author.](image3)

Sample (4):
The building was constructed using a dismountable steel structure, the parts of which can be reused to construct other buildings when the building is removed, and industrial iron elements such as cargo transport containers, re-use of iron sections and iron meshes were used.

Porcelain tiles have been used in floor finishing works, as it is a durable material with long operating life, and does not need constant maintenance in addition to the ease of cleaning. Figure(18)

![Figure 18. Sample 4, Floors Finishing, Photos taken by Author.](image4)

The walls are built with homemade red bricks, no wall finishing materials have been used, some of the walls have been painted to reduce the use of materials, in addition to using interlocked iron sections as partitions. Figure(19)
The ceilings are made of I-section steel structure bridges, and corrugated iron panels, no false ceilings nor finishing materials were used to reduce material use. Figure(20)

Furniture units made inside a workshop were used in the building, using wood and iron, and these units are designed by workers in the building and contain electrical sockets, and chairs with non-local origin were used. Figure(21)

Sample (5):
The building was constructed more than a hundred years ago at the beginning of the last century, Local materials and conventional building techniques were used in its construction. The building was restored in 2008 using the same materials if available, and the same construction techniques.

When restoring the structure, Terrazzo tiles were used in floor finishing work, as there was no manufacturing of the previous tiles. Figure(22)

The walls of the building are built with Iraqi traditional bricks (chaff Qeem) and no material has been used for the wall finishing works. Figure(22)

The ceilings are built with knotted bricks, and no false ceilings nor finish materials have been used. Figure(22)
Renovated furniture units were used as part of the building restoration work, in addition to using old furniture and antiques for decorating purposes. Figure (23)

Table 2. Analysis of case Study

|                     | Sample (1) | Sample (2) | Sample (3) | Sample (4) | Sample (5) |
|---------------------|------------|------------|------------|------------|------------|
| building            |            |            |            |            |            |
| New Constructed     | ●          | ●          | •          |            |            |
| Renovated           | ●          | •          |            |            |            |
| Rehabilitated       |            |            |            |            |            |
| Design              |            |            |            |            |            |
| Architect           | ●          | ●          |            |            |            |
| Interior Designer   |            |            |            |            |            |
| Other               | ●          | ●          | ●          |            |            |
| The desire to achieve sustainability |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          |            |            |
| Partial Achieved    | ●          | ●          | ●          |            |            |
| Unachieved          |            |            |            |            |            |
| Use of Sustainable Materials |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          |            |            |
| Partially Achieved  | ●          | ●          | ●          |            |            |
| Unachieved          |            |            |            |            |            |
| Surface Finishing   |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          |            |            |
| Partially Achieved  | ●          | ●          | ●          |            |            |
| Unachieved          |            |            |            |            |            |
| Windows             |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          |            |            |
| Partially Achieved  | ●          | ●          | ●          |            |            |
| Unachieved          |            |            |            |            |            |
| Furniture           |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          |            |            |
| Partially Achieved  | ●          | ●          | ●          |            |            |
| Unachieved          |            |            |            |            |            |
| Lighting            |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          | ●          | ●          |
| Partially Achieved  | ●          | ●          | ●          | ●          | ●          |
| Unachieved          |            |            |            |            |            |
| Equipment and electrical devises |            |            |            |            |            |
| Achieved            | ●          | ●          | ●          | ●          | ●          |
| Partially Achieved  | ●          | ●          | ●          | ●          | ●          |
| Unachieved          |            |            |            |            |            |
4- Results

- Three of the selected models were the first, second, and fifth are newly constructed buildings, while the third model was an old heritage building that was renovated, while the fourth model was a restored and rehabilitated building.
- The buildings of the first and second samples is designed by an architect, the third sample the designer was the owner himself, as for the fourth and fifth models the designers are individuals who are not specialized in the field of architecture and interior design.
- The aim of designing the first, second and third models was to achieve sustainable building design and interior spaces using sustainable materials and elements. In the fifth model, the use of sustainable intent was to restore and rehabilitate the building, in the fifth model, the goal of achieving sustainability was not primarily based on the foundations of the use of sustainable materials.
- In the first and third samples, sustainable materials were used more than the rest of the case study samples, as for the rest of the case study samples, the use of sustainable materials was used at lower rates.
- The third model achieved the highest percentage of using sustainable materials for interior space surface finishing and plastering.
- In the third and fourth samples, reused windows were used, and in the first, second and fifth models, the windows used were newly manufactured.
- In the first and second samples, most of the furniture used is reused furniture, and in the third and fourth samples, part of the furniture was reused, in the fifth sample, the furniture used is new manufactured.
- In the first, second, third, and fourth samples, there were some sustainable solutions in bringing daylight to the sample spaces, and in the fifth sample, there were no serious solutions to mention where the greatest reliance was on artificial lighting.
- In the third sample, there were limited attempts to reduce the number of electrical devices, and there were no solutions that could be mentioned in the rest of the samples.
- The sources of the materials used in the first samples, the third and the fourth were local, and in the second sample, some were local and the other regional, while the fifth model was most of the materials used are imported from outside the country.

5- Conclusions

- There are possibilities for converting the interior spaces of existing buildings into sustainable internal environments, by redesigning them using sustainable materials instead of materials that cause environmental damage and economic loss.
- Although there is a desire among some individuals to create sustainable internal environments, the study did not record the existence of interior designs for local architects and interior designers. Most of the attempts were subjective efforts of non-specialized individuals.
- Interior designers should develop solutions to raise the aesthetic and performance level of sustainable materials, as well as encouraging the concerned parties (users) to provide materials and furniture that comply with the concepts of reuse and recycling, to finally raise the level of environmental sustainability of interior spaces, and achieve the health and wellbeing of occupants, building a better and more sustainable future.
- The process of promoting and enhancing the interior environments with sustainable materials is a shared responsibility of both interior designers and users.
• One of the sustainable solutions is the process of using natural materials that were previously used in traditional building methods, that is, reviving the use of traditional building materials and techniques that would contribute to reducing the negative impacts on the environment and reducing costs.
• There is a long list of available local materials, which can be used to produce alternative structural elements, and all that is required is to use these materials creatively and include them in the design of interior space components.
• The provision of sustainable materials in the local market where there is no such material, and the collection of materials resulting from the demolitions of old buildings and their marketing after some treatments have been made on them, would provide materials that are not harmful to the environment, as alternatives for interior designers and customers in their choices of materials.

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