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A Theoretical Proposed Frameworks to Satisfied Sustainability in Iraq's Building Industry

Mohanad Ibrahim Altuma[1] , Azhar Abed mohisen Alrikabi [2]

[1,2] Southern Technical University, Iraq

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*Correspondence: Mohanad Ibrahim Altuma
Email: mohanad.altuma@stu.edu.iq

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Abstract: *The current research introduces a theoretical framework developed to integrate sustainability ideas into the construction sector. The suggested framework, established on the sustainable triple-bottom paragraph concept, encompasses resource preservation, expensive reduction, and planning that emphasizes the well-being. After conducting a comprehensive literature assessment, each concept related to strategies and methodologies applicable throughout the life cycle of construction projects is elucidated, accompanied by many case examples to illustrate the approaches. The framework will enable designers to achieve a suitable equilibrium among economic, cultural, and environmental considerations, transforming the mindset of construction practitioners regarding the information utilized in evaluating building projects, thus promoting the sustainability of the Iraqi construction industry.*

Keywords: Sustainable Building, Project Management, Construction Industry, Sustainable Development, Environmental Performance

Introduction

An integral part of every economy is the construction sector, although it considerably affects the environment. Due to its scale, the buildings industry is among the primary consumers of energy, supplies of materials, and water, and it is a significant source of pollution. In light of these implications, there is an increasing consensus between organizations dedicated to environmental performance objectives that effective methods and actions are essential for enhancing the sustainability of construction operations. Given the substantial impact of the construction sector, the sustainable building paradigm possesses considerable potential to contribute meaningfully to sustainable advancement. Sustainability is a multifaceted and intricate notion that has emerged as a significant concern in the construction sector .

Sustainability entails the enhancement of living quality, enabling individuals to reside in a healthy environment characterized by enhanced social, monetary, and environmental situations. A sustainable project is conceived, constructed, refurbished, managed, or repurposed in an environmentally friendly and resource-efficient way.

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It must fulfill many specific targets: resource and energy conservation; decreasing CO2 and greenhouse gas pollution; reducing pollution; noise minimization; enhancement of indoor air conditioning; and environmental compatibility. An optimal project should be cost-effective to construct, endure indefinitely with minimal upkeep, and fully decompose upon abandonment .

Professionals in the construction operations have started to focus on mitigating and rectifying the environmental harm caused by their operations. Architects, developers, engineers, and other stakeholders in the construction process possess a distinctive potential to mitigate environmental effects by integrating sustainability objectives into the planning and development stages of a construction activities.

Present sustainability programs, strategies, and activities emphasize broader global targets and strategic principles but are significantly deficient in addressing incorporated decision-making at the individual (project-specific level). Ironically, it is at the individual levels where sustainability objectives must be converted into tangible actions using an integrated strategy to enhance decision-making.

Despite the continuous development and enhancement of innovative methods such as the "Building Research Establishment Environmental Assessment Method (BREEAM)", "Building for Environmental and Economic Sustainability (BEES)", and "Leadership in Energy and Environmental Design (LEED)", the overarching goal remains the design of buildings that minimize the general effect of the constructed environment on individuals and the typical ecosystem .

This study enhances current research in sustainability by presenting a theoretical framework for the implementation of sustainability targets at the level particular to the project within the Iraqi building projects, viewed through a span of time viewpoint. The framework improves sustainability and industrial research by showing how big the problems are; it all starts with an assessment of the environmental issues that building sites face, and also proposes ideas and ways to alleviate the environmental consequences of construction operations, hence promoting the sustainability of the Iraqi building developments.

Methodology

This study adopts a qualitative research approach to develop a theoretical framework for enhancing sustainability in Iraq's building industry. The methodology encompasses a comprehensive literature review to identify key concepts, strategies, and methodologies integral to sustainable construction. Scholarly articles, industry reports, and case studies from reputable sources were analyzed to understand best practices and innovative approaches within global and local contexts.

The research prioritizes the sustainable triple-bottom-line concept, focusing on environmental preservation, economic effectiveness, and human-centric planning. Key sustainability indicators were assessed across project life cycles, from design and construction to operation and decommissioning. Data was thematically categorized to construct a framework adaptable to the Iraqi construction sector.

Validation of the proposed framework was conducted through expert consultations with architects, engineers, and sustainability practitioners. Their insights refined the framework, ensuring its relevance and applicability to the regional context. The iterative process emphasizes actionable recommendations and alignment with global sustainability goals while addressing Iraq's unique challenges, such as resource constraints and environmental degradation.This systematic approach integrates theory and practice, aiming to promote environmental resilience, economic growth, and social well-being in construction projects.

Result and Discussion

Concepts of Sustainable Construction

The construction business is undoubtedly one of the most demanding resource sectors worldwide. In contrast to other sectors, the construction industry's swift escalation in global energy consumption and reliance on finite supplies of fossil fuels has already elicited apprehensions regarding supply challenges, resource depletion, and significant environmental repercussions—ozone layer degradation, carbon dioxide pollution, warming temperatures, and the effects of climate change. By 2056, it is projected that worldwide economic activity would quintuple, the global population will increase by more than 50%, the consumption of energy on a global scale will nearly triple, and global industrial operation will at least triple. The manufacturing of building materials, the construction process, and the operation of a completed building all require energy for A/C, illumination, power, and ventilation. Besides energy consumption, the construction sector is a significant contribution to environmental degradation, accounting for the use of 3 billion tons of natural resources yearly, or 40% of world usage, and generates a substantial volume of waste products.

The primary challenges related to the essential sustainable construction topics have been delineated and compiled in Figure 1.

Fig. (1). The Seven Elements of Sustainable Construction

The sustainable construction strategy is seen as a method for the construction industry to progress towards sustainable development, addressing environmental, social, and economic concerns; it also serves as a means to illustrate the industry's obligation to safeguard the environment .

Sustainable building practices encompass diverse methodologies in executing construction projects that minimize environmental impact, such as waste reduction, enhanced recycling of waste in material for construction production, effective waste management, societal benefits, and profitability for the company.

The sustainable building process starts at the design phase and persists throughout its lifecycle, culminating in the dismantling and recycling of materials to mitigate the waste generated by destruction.

Application Strategies and Methodologies for Sustainable Construction

To attain a sustainable vision in the construction sector, it is essential to take a multi-disciplinary strategy that encompasses several aspects, including energy conservation, enhanced material utilization, waste reduction, pollution mitigation, and emissions management. The existing form of construction may be regulated and enhanced to mitigate environmental harm without diminishing the beneficial outcomes of building operations. To establish a competitive advantage through sustainable construction techniques, the entire lifespan of buildings should serve as the framework for implementing these principles.

A literature analysis has delineated three overarching aims that should inform the framework for executing sustainable building planning and implementation, as shown in Figure 2 while considering the previously recognized concepts of sustainability challenges.

These aims are:

- Preservation of resources
- Economic effectiveness

- Design for Individual Compatibility

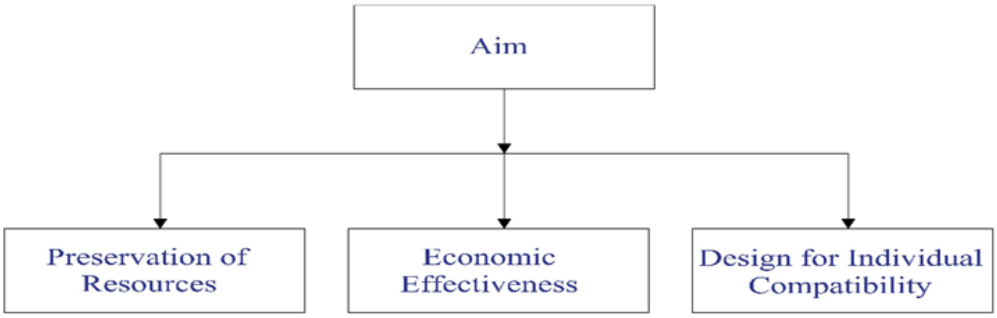


Fig. (2). Framework for the implementation of sustainability in construction practices.

Preservation of Resources

The preservation of resources involves achieving superior results with few resources; it is the management of human use of natural resources to maximize advantages for current generations while ensuring the capacity to meet the needs of future generations as well. The concept has arisen as a crucial subject in dialogues on sustainable development, as certain resources have grown exceedingly scarce, necessitating prudent management of existing supplies, where the researcher advocated for replacing rare resources with less scarce or renewable alternatives. The policy arenas have acknowledged assertive declarations regarding the necessity of significant improvements in the utilization of energy and natural elements. The presumption is that to reduce the impact on the ability of ecosystems to process refuse elements and energy, it is imperative to enhance efficacy .

As per, the construction sector is a significant consumer of natural resources; hence, several programs aimed at developing environmentally sustainable structures concentrate on enhancing resource use efficiency. He asserted that the methods employed to pursue these efficiencies are diverse. He provided examples including the concepts of solar passive construction, which seeks to minimize the use of resources that are not renewable, energy use in manufacturing, life cycle design, and construction-oriented design.

Strategies for reducing material waste in the construction process and facilitating the recycling and repurposing of building materials enhance resource consumption effectiveness. Advocacy for resource efficiency has emerged from apprehension around the escalating degradation of non-renewable environmental resources.

The preservation of items that are not renewable, such as energy, water, materials, and land, is crucial for ensuring a sustainable future in building projects. Preservation of resources produces distinct design steps and methodologies, as seen in below Figure 3.

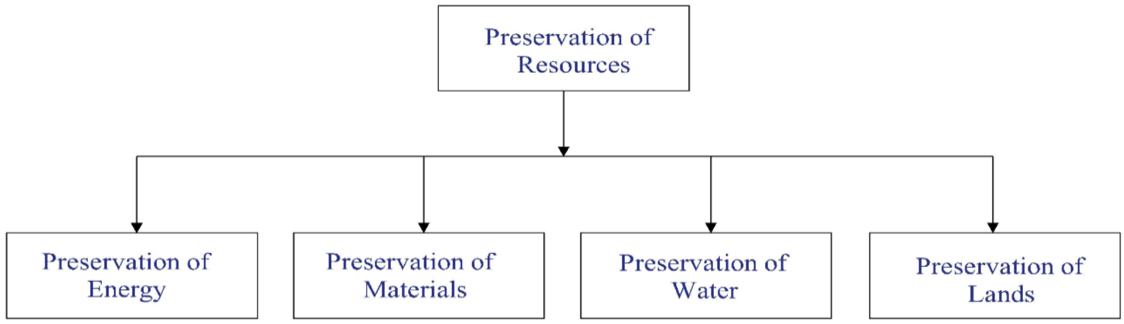


Fig. (3). Strategies and methodologies to satisfied preservation of resources

Preservation of Energy

The application of energy is a critical environmental challenge and its management is essential in any effective modern society. Structures are the primary users of energy. Buildings utilize energy and materials during all phases of a constructing responsibility involving design, service, and eventual destruction .

The nature and quantity of energy consumption throughout the life lifespan of a building component, from manufacture to post-consumer management, may influence the release of greenhouse gases into the environment in several ways throughout distinct timeframes.

Reducing their use may be significantly achieved by enhancing efficiency, which effectively mitigates greenhouse gas pollution and decelerates the decline of not renewable energy supplies. This awareness has led to heightened emphasis on enhancing energy conservation in the construction industry, due to its significant possibility of primary energy savings and emission reductions that adversely affect the environment.

Life cycle investigation into buildings indicates that efficient energy constitutes (85–95%) of the average demand for energy and releasing CO_2 pollution, mostly resulting from occupancy-related activities such as air conditioning, ventilation, and hot water consumption. This encompasses energy derived from power, gas, and the combustion of fuels like oil or charcoal.

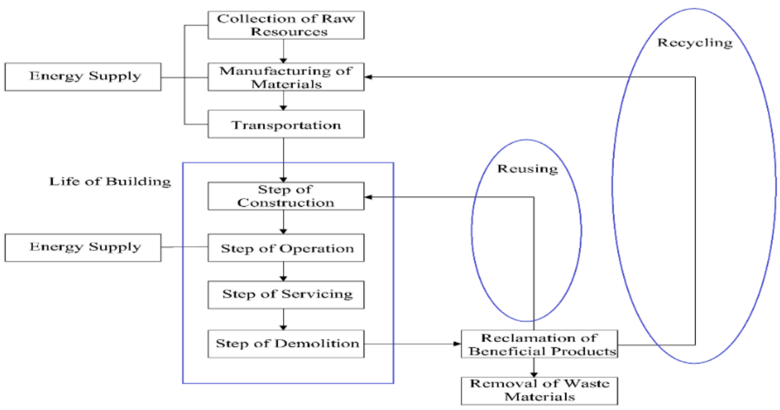


Fig. (4). The steps of energy consumption over a building's lifecycle

As operational energy requirements diminish, greater emphasis must be placed on the energy consumption associated with material manufacture, referred known as stored energy. The stored energy of a structure encompasses the overall energy necessary for its development, comprising both the direct energy utilized during construction and installation, as well as the indirect energy needed for the production of its materials and elements.

This inadvertent energy encompasses all energy necessary for raw material extraction, preparation, and manufacturing, in addition to the energy consumed in transportation during this process and the pertinent energy components that are embedded in the infrastructure of factories and apparatus that are associated with production, building, and transportation [18]. As shown in Figure 4, a building's energy applications include different operating and stored energy inputs throughout its lifetime.

The primary objective of energy preservation is to decrease the burning of fossil fuels while augmenting the utilization of renewable energy sources. This might be accomplished by considering the following techniques as shown in Figure 5.

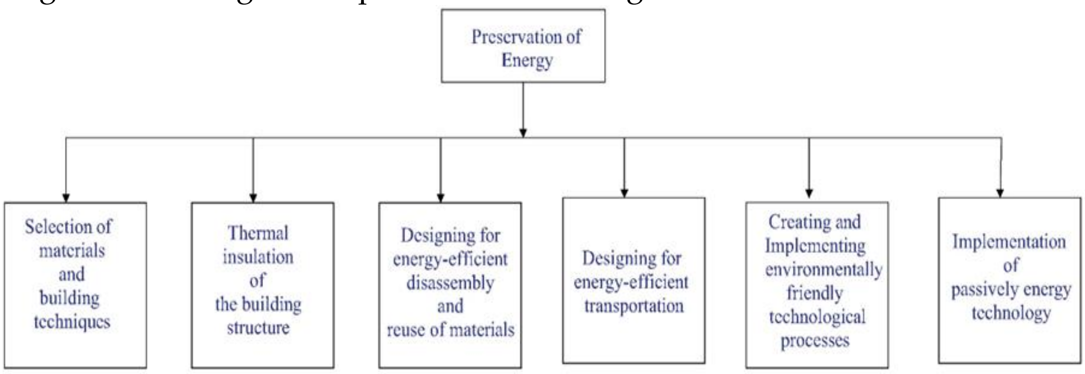


Fig. (5). Methodologies to achieve Preservation of Energy

Preservation of Materials

The mining and utilization of natural materials for constructing components, as well as the production of these materials during construction operations, directly affect natural biodiversity by fragmenting ecosystems and natural habitats. A significant quantity of mineral resources is utilized in the building environment, the majority of which are non-renewable. Consequently, it is imperative to diminish the utilization of non-renewable elements .

Incorporating this into the project's assessment criteria during the planning and implementation phases is essential, where material selection is crucial and should be informed by the environmental consequences of the resources. During the building and dismantling stages, several approaches can be employed to mitigate the environmental implications of material consumption.

This sub-section examines several approaches for attaining material efficiency in buildings as shown in Figure 6.

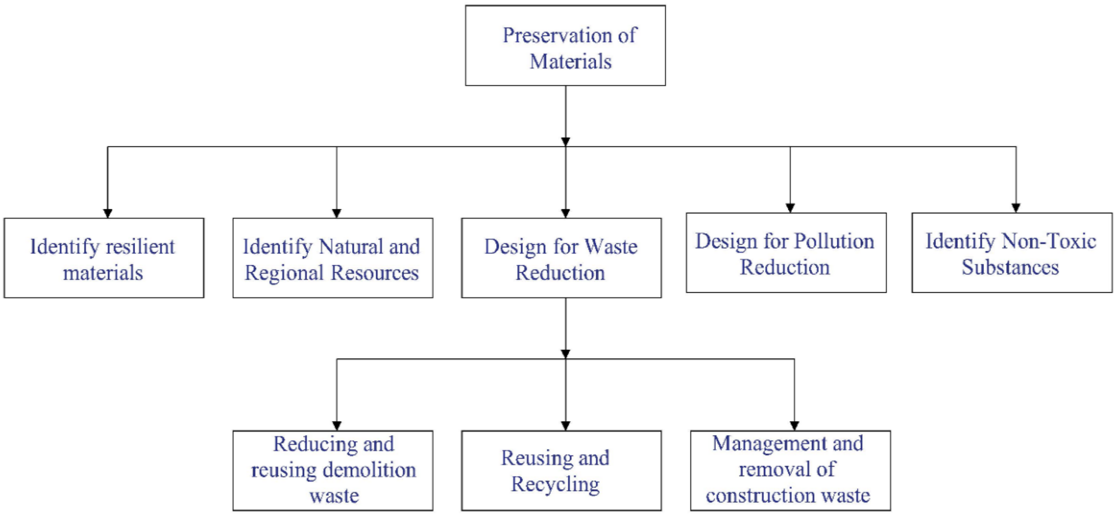


Fig. (6). Methodologies to achieve Preservation of Materials

Preservation of Water

The rapid advancement of the industrial economy is rendering the depletion of water supplies a key environmental worry globally. The "UNWDR" warns that water for all purposes is becoming limited, resulting in a water shortage. The environmental impacts of a sector are most evident in the construction field. Building and its services significantly rely on water sourced from the environment. The increase in municipal water use has led to a substantial decline in water tables of values, necessitating extensive projects that divert resources from agriculture.

Water utilized for building activities accounts for a significant amount of the total water used in the country. Yet, this is by no means the only water type that a structure will use over its lifetime. There are several local and distant processes that rely on water, including mining, processing, manufacturing, transporting supplies and products to the site, and construction itself. Water preservation methodologies and tactics are frequently the most neglected components of a comprehensive construction design approach. Nonetheless, the strategizing for diverse water applications inside a structure is progressively gaining prominence, partly due to the growing acknowledgment of the water conservation achievable via the adoption of water-saving measures.

According to the research that has been conducted, there are a variety of approaches that may be utilized to lessen the quantity of water that is used over every stage of life of a building. These approaches, in general terms, include the following:

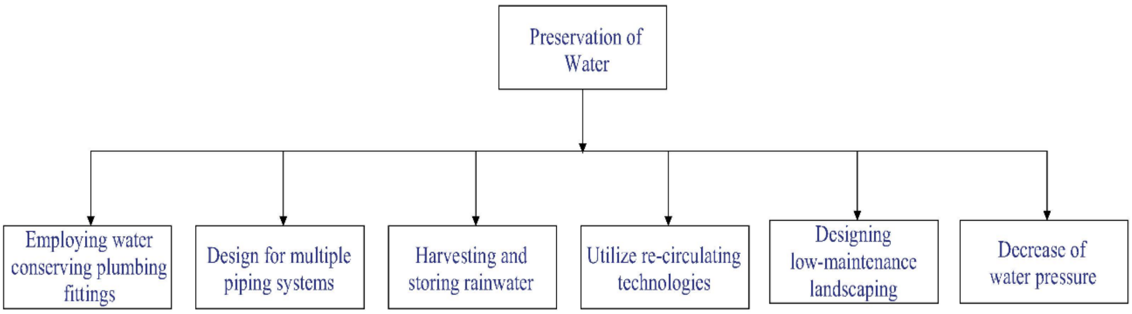


Fig. (7). Methodologies to achieve Preservation of Water

Preservation of Land

One of the most important resources that the construction industry depends on is land. An increasingly pressing concern in both developed and developing countries is urbanization, which affects land usage. Reclaiming more land from the water is possible, but it is not a good idea to do it all at once since it can have a major impact on ecosystems.

Soil deterioration, groundwater pollution, chemical rain, and other pollutants from industry are compromising the health of plant populations, hence exacerbating the imperative to repair ecosystems. Sustainable design must cultivate an appreciation for the landscape and invest greater effort in comprehending the interconnections of the ground, water, plant populations, associations, and ecosystems, along with the effects of human activities on these elements.

Because of the building sector's impact on pollution and city expansion, land is an important sustainability indicator that can prove to be an indicator of environmentally friendly design. One way to preserve land is to limit the growth of existing cities as much as possible.

This can be accomplished by the appropriate repurposing of an existing structure, thus obviating the necessity for NC. Furthermore, situating sustainable construction projects in proximity to public transit, healthcare facilities, commercial zones, and recreational amenities will mitigate the encroachment of the built environment on agricultural and ecologically sensitive regions.

These strategies would enhance urban land utilization by increasing population density, hence optimizing infrastructure services and transportation networks. The creation of agricultural land for building purposes, which would be connected to one another by a mass transit system that is efficient in terms of energy consumption, is still another possible subsidiary.

Economic Effectiveness

Construction customers want guarantees on the long-term economic viability and expenses of their structures. Moreover, the supply chain of buildings involving developers, providers, producers, and design and construction organizations faces escalating pressure from clients to reduce overall project costs while evaluating the life cycle expenses of a building and its capacity to fulfill occupiers' needs effectively.

Structures constitute a significant and enduring commitment in both financial and other capabilities. Enhancements in the cost-effectiveness of buildings are, thus, of mutual interest to the owner, the individual, and society at large. The principle of sustainability in the building process aims to enhance efficiency and minimize financial expenditures. Significant data demonstrates that many firms, in both the private and governmental sectors, largely focus their choices on building-related expenditures on original construction cost estimations, frequently overlooking operations and maintenance costs during the building's existence.

This research has highlighted three primary life cycle costs to be addressed at the commencement of a building project. The original expenses, operational expenses, and recovery expenses are shown in Figure 8.

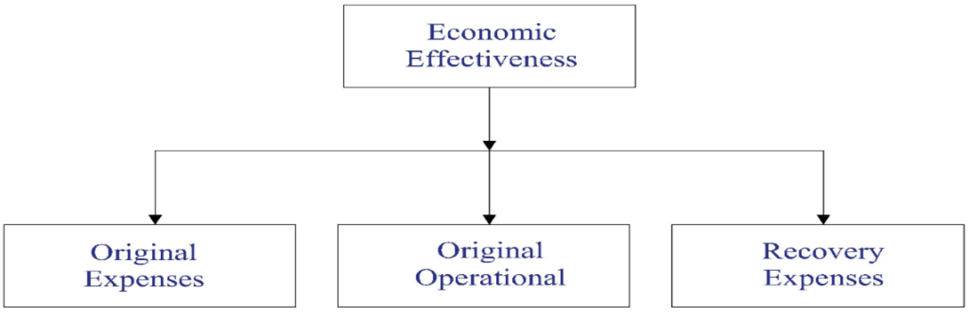


Fig. (8). Methodologies to achieve Economic Effectiveness

Design considerations necessitate the selection of construction frameworks, building resources, and installation tasks, frequently resulting in investment mistakes due to insufficient economic oversight of these choices. Increasing energy expenses have underscored the potential for substantial savings throughout a building's lifespan through earlier investments in more energy-efficient technologies. Consideration may also be given to savings on alternative running and maintenance expenses, such as employing building finishes that require seldom refinishing.

The economic functioning of a building must be evaluated throughout the construction phase and in relation to its maintenance and preservation throughout its lifespan. To ensure the achievement of these targets, life-cycle cost assessment (LCCA) will be pivotal in the economics of a construction project. Life cycle cost assessment (LCCA) is an economic evaluation method that forecasts the expenses associated with a structure throughout its operation, service, and renewal until the conclusion of its lifespan [34].

The successful use of life-cycle expense necessitates the use of a deliberate, thorough design in addition to building methods that incorporate specific environmental factors. The life cycles cost (LCC) is a crucial instrument for attaining cost efficiency in building projects.

Original Expenses

The original expenses, also known as acquisition expenses or development expenses, encompass all expenses associated with the creation or renovation of a building, including land or building acquisition expenses, qualified consultants' fees, resources required for the completed structure, and assembly expenses.

Organizations expend significant time and resources in conducting an economic assessment of the original expense when contemplating the acquisition of a big asset. For numerous consumers, this is their principal and sometimes exclusive worry. Expense savings may be achievable by opting for more economical building materials and minimizing on-site assembly time, contingent upon the identification of these expenses. Additional strategies related to the decreasing of initial construction costs encompass the following:

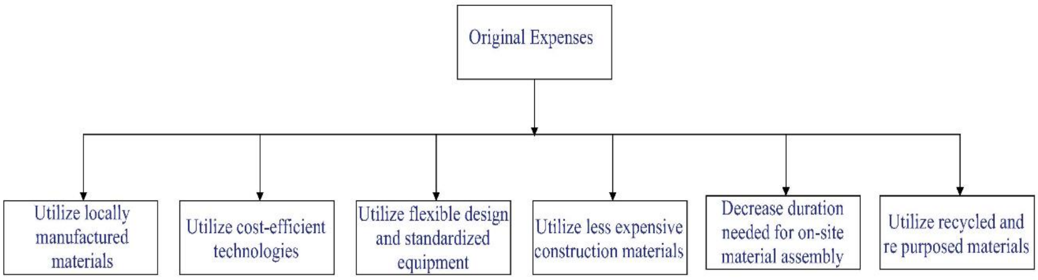


Fig. (9). Methodologies to achieve Original Expenses

Original Operational

The expense in use, sometimes referred to as the operating cost or operational cost, is determined by judgments made during the overview step and eventually choices made throughout the design and construction steps. It entails routine changes and inspections to safeguard a structure, ensuring it continues to provide consistent comfort and resources, as well as the expense of components necessary for maintenance. Additionally, interior design, building materials (such as roofing and external walls), and services (including heating and conditioning) were also addressed at this stage.

For several years, operational expenses received only cursory consideration during the design phase; however, this has evolved with the implementation of life cycle estimation methodologies that elucidate the connection between design choices and operational costs.

Resources and components with extended service lifetimes are more expensive than those with shorter predicted lifespans, and planning for reduced maintenance and operational costs may lead to higher starting expenses. Nonetheless, over an extended period, such as 15 years, it may be less expensive for the building individuals than the one with a lower original expense. Expense decrease in building utilize may be achieved by considering the following considerations:

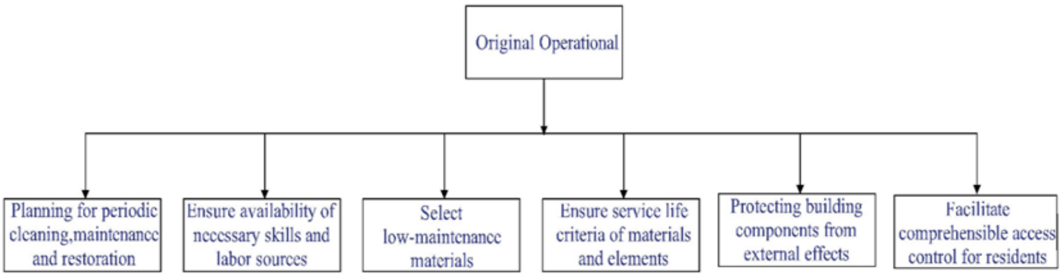


Fig. (10). Methodologies to achieve Original Operational

Resources and components with extended service lifetimes are more expensive than those with shorter predicted lifespans, and planning for reduced maintenance and operational costs may lead to higher starting expenses. Nonetheless, over an extended period, such as 15 years, it may be less expensive for the building individuals than the one with a lower original expense. Expense decrease in building utilize may be achieved by considering the following considerations:

Recovery Expenses

Additionally, the cost of component destruction and recovery is a third expense that is seldom considered. The customer may have already sold the building a significant amount of time before it is utilized, which is one reason for this. Another reason is that expenditures of this nature are typically associated with the original cost of the development that will occur in the future.

Furthermore, this might not be of much concern to the existing customer, who is searching for opportunities to make a profit in the near term with a small investment. On the other hand, if we are serious about treating environmental concerns, then we ought to put into practice the following strategies in order to cut down on or completely eliminate the expenses of recovery.

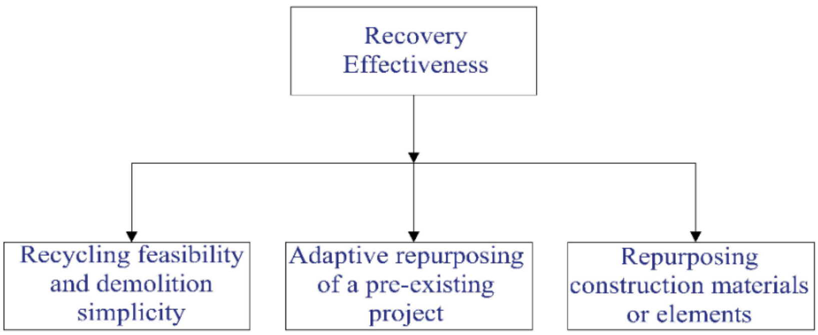


Fig. (11). Methodologies to achieve Recovery Expenses

Design for Individual Compatibility

The primary objective of a sustainable building is to create an environment that is conducive to human endeavors and is both healthful and suitable. A structure must be able to accommodate its intended activities by providing sufficient surface area, room volume, accommodation, illumination, and facilities for work, residence, education, healthcare, and processing.

Additionally, it is imperative that the building supply its inhabitants with an interior environment that is both wholesome and appropriate. The building must adhere to basic standards to prevent harm to its inhabitants or the environment. This includes being structurally sound and fire-resistant.

In order to achieve sustainable development, it is essential that construction does not pose a disproportionate burden or hazard to the environment, particularly in terms of energy utilization.

As illustrated in Figure 12, the subsequent two design methodologies should be taken into account in order to enhance and facilitate human adaptation.

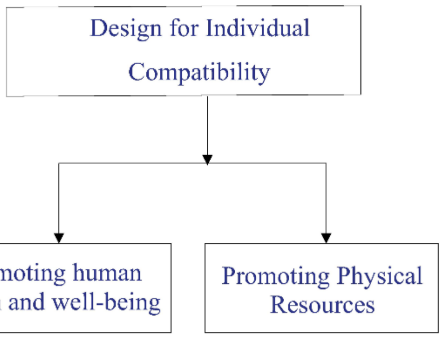


Fig. (12). Methodologies to achieve Design for Individual Compatibility

Promoting human well-being

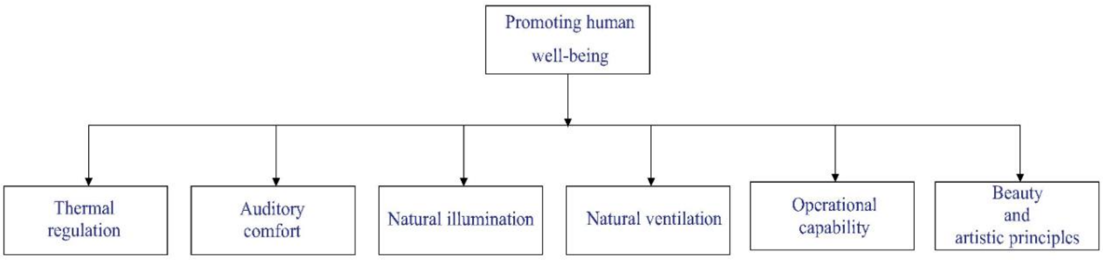
Well-being, encompassing health and comfort, is a crucial factor influencing an occupant's quality of life. In contemporary culture, when individuals allocate over 90% of their time indoors more than 70% of which is spent at home the fundamental duty of architecture is to ensure occupants' health, physiological comfort, happiness, and performance.

The principle of health is indispensable for the establishment of the principle of a "sustainable building" in relation to building efficiency metrics, including acoustics, temperature regulation, interior air quality, and illumination effectiveness.

A sustainable enterprise must balance the capacity to sustain human needs with the ability to perpetuate the environment and culture. A building that is healthy is free of hazardous materials (such as lead and the mineral asbestos) and enhances the health and comfort of its occupants throughout its lifespan, thereby addressing societal needs and increasing productivity.

A healthy building acknowledges that human health requirements and comfort are paramount. Numerous designers of buildings have focused on aesthetics and form, neglecting the sustainability and human contentment within and surrounding the constructed environment. In order to improve the cohabitation between the environment, buildings, and the people who live in them, the research has identified the following strategies as essential, as shown in Figure 13.

Fig. (13). Strategies to achieve promoting human well-being



Promoting Physical Resources

Promoting physical resources is a fundamental element of sustainable design and implementation. Designs must account for resilience against natural and human calamities, including fire accidents, earthquakes, storms, and criminal assaults [51].

Hazard reduction planning involves identifying strategies to minimize or eradicate loss of life and financial harm, with the following approaches outlined as shown in Figure 14.

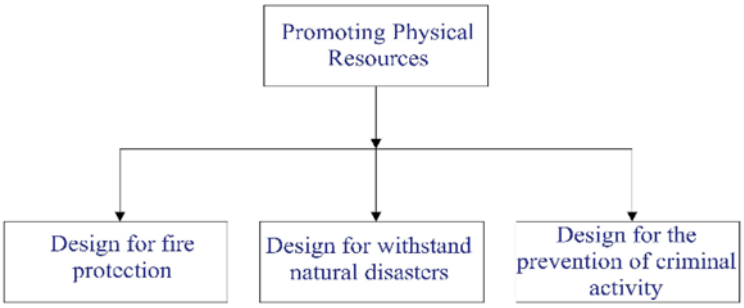


Fig. (14). Strategies to achieve promoting physical resources

Conclusion

Sustainable construction is regarded as a means for the building sector to advance environmental protection, where the encouragement of sustainable building methods aims to achieve a balance between economic, social, and environmental sustainability in the execution of construction projects. Accepting this establishes a clear connection between sustainable advancement and building; the latter has substantial economic importance and exerts significant environmental and social effects.

The increasing understanding of environmental preservation has garnered greater attention from building professionals globally. Advocating for sustainable development techniques is proposed as a means to promote economic growth in the construction sector while reducing environmental effects. To mitigate the adverse effects of building on the environment and attain sustainability within the industry, three concepts arise: resource efficiency, expense effectiveness, and design to promote human adaptation.

The research project presents a theoretical framework designed to incorporate sustainability concepts into the building sector. The proposed framework, based on the sustainable triple-bottom-line idea, includes resource conservation, cost minimization, and human-centric planning. They establish the foundation for incorporating sustainability principles into construction projects from the design phase, where the framework significantly enhances the comprehension and execution of sustainability in building endeavors.

- The research offers a concise summary of sustainability concepts, strategies, and methodologies, highlighting the necessity for a comprehensive and cohesive approach to adopting sustainability in construction projects.
- The objective of the research is to establish a comprehensive framework for enhancing the quality and comparability of methodologies used to evaluate the environmental effectiveness of buildings.
- The research defines and delineates considerations pertinent to the evaluation of environmental sustainability for new or existing buildings during the design, construction, implementation, refurbishment, and dismantling phases.
- The research clarifies obstacle for designers is to integrate these diverse sustainability needs innovatively.
- The research explains that new design methodology must acknowledge the effects of each design decision on both cultural and social assets at individual, community, and global levels.
- The sustainability considerations will be relevant at all phases of the building life cycle, encompassing design, operational usage, and waste management after destruction.
- This framework establishes the foundation for creating a decision assistance tool aimed at enhancing the decision-making approach in the implementation of sustainability in construction projects.
- The comprehensive decision assistance tool will be detailed in the model presently under development for application in the Iraqi construction sector.
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