Effects of Construction Materials to Achieve Sustainable Buildings

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ABSTRACT

This paper pursues to study the challenges to applied sustainable building resources in building construction and to evaluate the factors influencing the choice of construction materials with respect to the concepts of sustainability. The research purpose was accomplished in two parts; in the first part, a conceptual study to establish the reasons why sustainable building resources are restricted usage in construction, and in the second part a conceptual study on sustainable building resources and their properties.

In order to encourage sustainability in design and construction, several countries have developed an understanding of sustainable development for buildings.

In order to decrease the negative environmental effects of buildings, the construction industry has created sustainable building approaches, where buildings play an important role in greenhouse gases, massive energy, and water use and large land use are important.

Ecological design involves designing houses, offices, or other facilities in a way that decreases the ecological impact, that means sustainable buildings, Where the careful equilibrium among economic, environmental, and social well-being of the currency and communities and therefore of the earth looks to sustainability at current. In order to evaluate the degree of sustainability practices, sustainability evaluation systems were established for effective performance at the top level of qualified systems. In sustainable buildings, accredited standards and checklists will be planned, built, and run.

Keywords— Construction Materials, Sustainable Building, Sustainability, Sustainable Management, Sustainable Materials

I. INTRODUCTION

Building designers and building users insist on developing healthy living and working environments to achieve a high degree of efficiency for the protection, health, and comfort of the residents and to satisfy SD commitments.

With the increasing growth in the industry of construction and ongoing required to make use of innovative technology in the industry of construction creative ways of choosing building materials are required to achieve the best use of resources present.

The industry of construction considered as one of the most resource consumers, Where the construction industry has been described as the most of the biggest users of resources.

It is acknowledged that this field is an important sector for the conservation of the environment and sustainable management of resources.

We should face the reality and seeking practical approaches, not token motions that have very small impacts, where the most pollution is produced from economic activities.

64% of global Carbon pollution is attributed to energy or activity (remaining is from forestry, agriculture, or destruction); 35% is from manufacturing, 31% from buildings, and 27% from transportation [1].

Manufacturing of construction materials consumes energy, and the building process also consumes heating, lighting, control and ventilation energy through the operation of buildings completed, In addition to energy use, the construction industry is seen as a significant contributor to environmental emissions and the largest use of raw materials, consuming 40% of global demand every year and producing an immense amount of waste [2].

II. MANAGEMENT OF SUSTAINABLE OF CONSTRUCTION ADVANTAGES AND SPECIFICATIONS

Sustainable construction involves a method of construction that contributes creatively, protects the natural environment and offers the user or built, the adequate returns.

Although these constructions can originally seem complex and boring to implementation, they give advantages defined as follows:

1. Quality of cost.
2. Friendly for the environment.
3. Dependent on renewable resources.
4. Feasible construction.
5. The residents' safe ecosystem.
6. Regulated resource use and decreased dependence.
7. Regulation of emissions.
8. Higher development/return.

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III. MANAGEMENT OF SUSTAINABLE CONSTRUCTION PROJECTS

Sustainable construction management highlighted the choice of sustainable material on every construction step, and engineering management plays an important function in the development of a successful sustainable building.

A professionally managed project is often preferable to a costly or architecturally great looking project in all fields such as quality, performance, and stability.

Classification of any construction project could be according to process, scale, location, and availability is possible.

But basically, for the construction of a sustainable building the basic steps are:

3.1. Objective and Site Evaluation

The first step in sustainable construction management involves defining the aim of meeting with sustainable development and ecological development, construction specifications and design setting, and selecting the relevant site.

However, the chosen site must be situated in an area with appropriate basic services including schools, a playground, a supermarket, libraries, transport, and communications services, according to the sustainable construction and rating framework.

3.2. Choice and Evaluation of Construction Materials

The main significant and the most challenging mission in sustainable building. the construction materials shall be approved by accredited organizations such as LEED, BREEAM and, ISO.

Life Cycle Assessment (LCA) is also a method, where a designer is chosen to find the best construction material to compatible with project tasks.

This is done in the following many stages as shown in the below figure (1).

The previous following steps can also be listed:

1. Describing the project aim
2. Describing the material necessary for the specific design.
3. Describing the low and high term characteristics of the material chosen,
4. Classify the material according to the requirement.
5. Examination of the isolated yield content.
6. Choice of material on the basis of the standards of yield, wellbeing, and sustainability and use for construction.

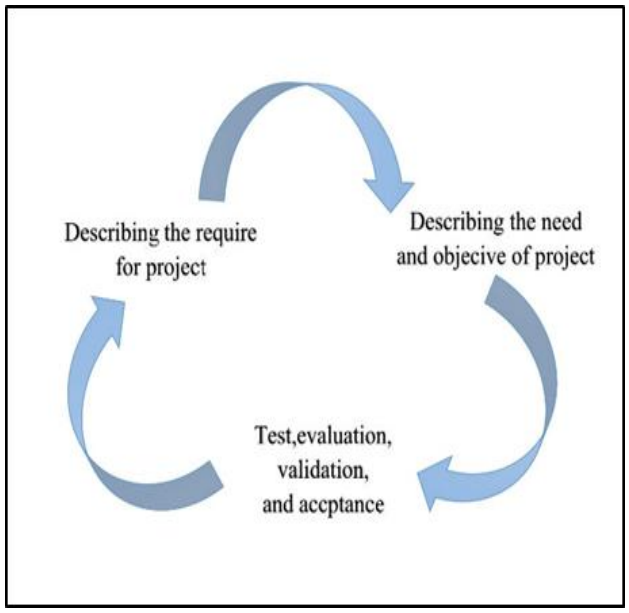

Figure 1: Simplified LCA approach for the selection of material

3.3. Design and Construction

A design study and site review are carried out before the start of any project. It includes feasibility studies, results of site selection analyses, the maintenance of design quality, and changes as needed to achieve the targeted and productive work performed by continuous monitoring, quality control, and ongoing inspection are considered.

3.4. Resource Management

Resource involves labor ability, equipment, tools, and other materials such as water. The equipment and instrument used often include consuming electricity, costs, and time, although their main objective is to decrease time, so, to getting out of this whole issue, well-managed timetables and the methods for effective construction should be strictly followed so as to attain the objective in the expected time and expense.

3.5. Energy

Sustainable management is the principle of on-site renewable energies or renewable for each residential building in order to get ahead of the challenges with restricted fuel supplies and energy.

Renewable energy supplies are necessary criteria for sustainability certifications such as LEED and BREEAM.

3.6. Project Management Team and Assessment

A professional with specialized knowledge of current procedures or improvements in construction development and management must be involved in the professional team appointed for a sustainable construction project. The team should also involve a person who is a

specialist or at least a trained specialist in sustainable building, attributing additional credit to the rating system to sustainable building qualified professionals for the project.

The principal objective of the stage is to guarantee that the project is carried out efficiently and that each step includes the idea of sustainability to optimize the performance of the project.

IV. COSTRUCTION MATERIALS AND SUSTAINABILITY

Construction materials have an important role to play in building sustainability, and they also engage in the development of the economy. The application of construction materials impacts on the environment by the several methods primarily because of the heavy use of nonrenewable energy and the quantity of dissipation and contaminants produced by the material life cycle [3].

In fact, stakeholders of the construction began while comprehending the importance of managing the environmental effects necessitated from the construction sector. Choosing building materials needs to be strengthened to take into account the sustainability properties of materials and considerations such as cost, availability, and appearance have been better chosen [4].

Sustainable construction resources are compliant with the limits of nonrenewable assets, operates according to life cycles and environment interactions, is nontoxic, is energy-friendly and water-efficient, is made of recycled materials, and can also be recycled by themselves [5].

The production of sustainable items is not inherently sustainable, the low-electric glass, for example, is called sustainable as the building heat consumption is minimized, however, floating glass is classified as a sustainable material, it is extremely recyclable compared to low-electric glass and not recyclable or weak [6].

Sustainability is a method that is not products or commodities and that does not consist of sustainable materials. We can produce excellent environmental materials, however if we do cannot use them to allow them to be used in accordance with the concepts of sustainable development, we will collapse [7].

V. SUSTAINABLE BUILDING MATERIALS PROPERTIES

Many properties differentiate sustainable building materials according to the life cycle of materials. If one or more of the following characteristics apply, materials may be called sustainable [8]:

1. Improving indoor air quality through the elimination of Volatile Organic Compounds (VOC) pollution.
2. Recycled contents generated in whole or in part out of post-industrial or post-consumer waste.
3. Low maintenance conditions and performance.
4. They are made from renewables.
5. The energy needed for the manufacturing and transporting of materials is minimal.
6. Ozone destruction free.
7. There is less toxicity.
8. They are materials from the local region.
9. They are capable of being reused.
10. They have capable of being recycled.
11. They are biologically degradable.
12. Through production or construction cycles, waste generation decreased.
13. They are energy-friendly and they help minimize operating energy when occupying the building.
14. They help to save water.

The properties of sustainable materials can differentiate by material nature.

Where, it's important to assess sustainable materials with the knowledge of environmental effects associated with various materials, knowledge of government policies and renewable materials requirement if they exist, knowledge of sustainable materials in regional markets, and how are their sustainable aspects [9].

VI. DVANTAGES OF APLLICATION THE SUSTAINABLE MATERIALS IN BUILDING

Choosing sustainable materials may be one of the hardest things to achieve in a construction project [6]:

1. A project consists of different items which had to be assessed.
2. Evaluation criteria can differ by material classification and by country of production.
3. In the production operations there is insufficient knowledge.
4. No approach is agreed on for the uniform evaluation of materials and products.

It can be beneficial to use sustainable materials for constructions for the triple main pillars as shown in figure (2), for several purposes [10].

Where we can descript these pillars as:

1. The environmental effects of the building industry can be minimized by the use of renewable materials.
2. Economically can minimize production costs by using sustainable materials.
3. Sustainable items will socially enhance the health of building users and protect the environment.

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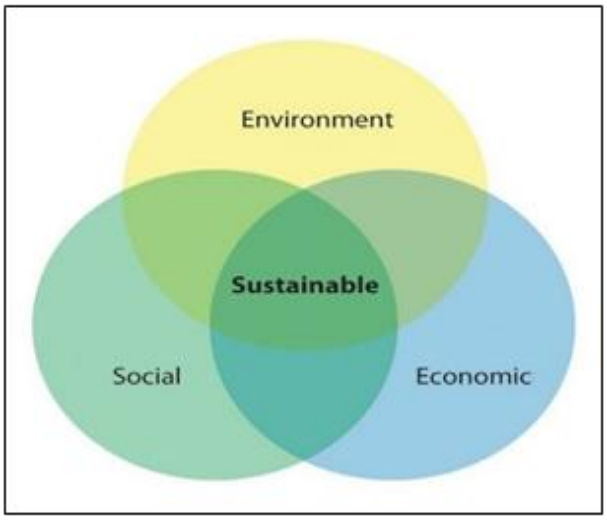

Figure 2: Triple Main Pillars

VII. OBSTACLES TO USE SUSTAIANBLE RESOURCES

Obstacles to the use of sustainable construction products and materials could be [11]:

1. Building professionals who are not conscious of the value of avoiding pollution in the environment from the waste produced by construction industries.
2. The shortage of enough sustainable building materials knowledge of for construction.
3. The shortage of enough environmental knowledge on construction materials to compare alternatives adequately.
4. The shortage of rules and standards which promote the use of sustainable buildings.

VIII. CONCEPTS OF CHOOSING THE SUSTAINABLE CONSTRUCTION MATERIALS

The selection of construction materials is generally based on the value of material costs. The definition of sustainable concept means that material selection should take place on

Every one of the main parameters contains a set of sub-parameters, the significance of which can depend on a variety of aspects, such as the kind of strategy of the organization, the kind of projects and their targets, such as water supplies, residential or commercial buildings, roads, and bridges.

A four-set of environmental, operational, economic, and social parameters.

8.1. Stages of Sustainable Materials Choice

The selection of the sustainable materials can typically be achieved by the following three steps:

8.1.1. Stage of Analysis

It includes gathering documentation on the product's technical efficiency and environmental effects to classify relevant information.

8.1.2. Stage of Assessment

It includes analyzing the information collected on the product and assessing it accordingly. When examining different materials for the same purpose, the assessment can be difficult.

8.1.3. Stage of Choosing

It includes using an evaluation tool such as an "assessment matrix" for collecting the values of each alternate environmental criteria. The high score alternative has the high importance to be chosen [12].

8.2. Process of Choosing a Construction Material

The proposed framework for the choice of construction materials in compliance with the sustainability parameters is shown in Figure (3).

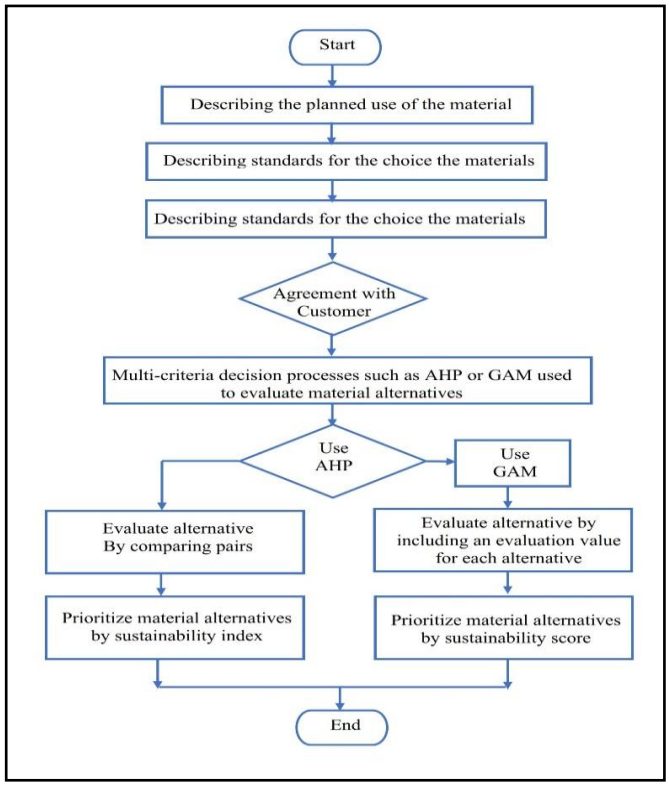

Figure 3: Proposed Framework for Choice of Construction Materials

where the proposed framework can be summarized in five steps:

1. Describing the planned use of the material as a first step.
2. Describing the standards for the choice of the materials.

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3. Describing the standards of chosen alternatives materials.
4. Multi-decision-making processes like AHP or GAM used to evaluate material alternatives.
5. Material alternatives were chosen based on sustainability after rearranged as per priority from the AHP or GAM analysis.

8.3. GAM

The goal achievement matrix (G.A.M.) aims at deciding whether alternatives are feasible in order to achieve specified goals and detailed objectives previously defined.

The extent to which the planner has accomplished expected goals in each of the proposals intended to solve a particular problem. The goal achievement matrix is based on several phases [13]:

1. Describing the comprehensive and general objectives.
2. Describing how all the targets are calculated in accordance with their design (economic, social, environmental).
3. Giving weight for targets is the basis for applying the matrix to the objectives.
4. Evaluate the accomplishment of each of the proposed alternative objectives.

a) Giving each alternative an evaluation value for the defined target.
b) Calculation of the alternative's matrix weights.
c) Calculating the total weight of each alternative (Sustainability Score).

5. Selecting the best alternative on the basis of total weight.
6. In some researches, the reliability of the findings is tested using a sensitivity analysis.

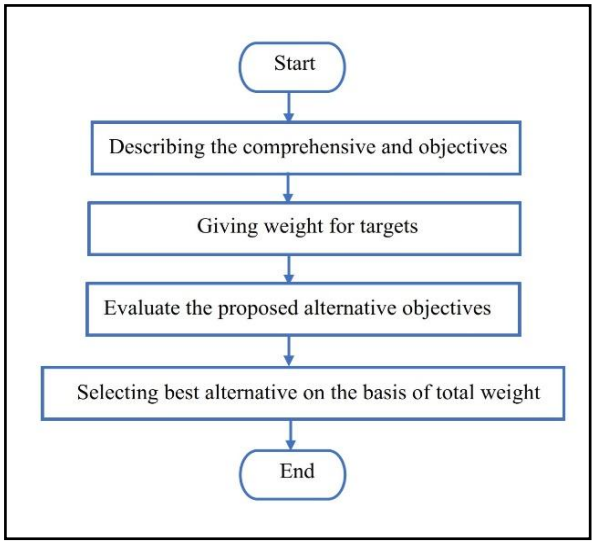

Figure 4: GAM

8.4. AHP

Analytical Hierarchy Process (A.H.P.) model provided a logical and descriptive way to organize and prioritize the decision issue.

The AHP model is centered on four fundamental principles [14]:

1. Stakeholders must be able to compare any two assessment elements in pairs.
2. Stakeholders must never consider that one measure is superior infinitely.
3. The assessment must be presented as a hierarchy.
4. The hierarchy must show all elements.

Figure (5) displays a flow chart for the selection of construction materials using the AHP process.

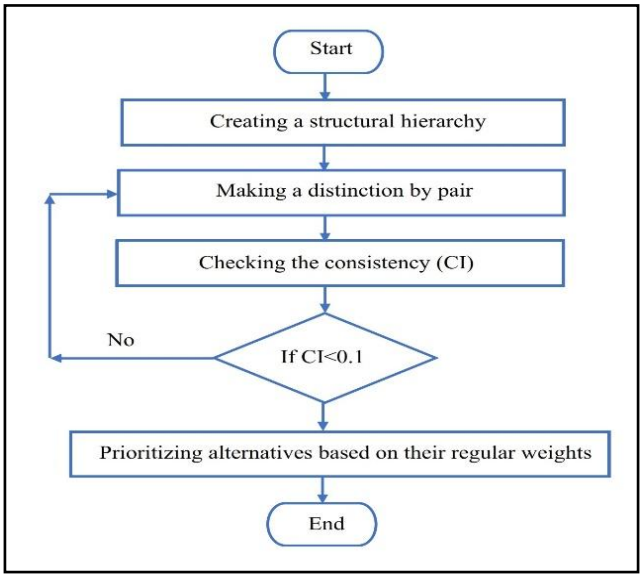

Figure 4: AHP

IX. CONCLUSIONS

Sustainability is important to the environment and living in the world, which must be the key slogan for every building in our time. This is possible through the suitable management of construction and material choice through, procurement, positioning, improvement, completion stages, painting, and subsequently effectiveness and maintenance of the structure and also until the processes after the structure has been demolished, such as recycling and landfill.

Building practices from conventional approaches are evolving towards a sustainable process. It's an effective indication and the time has come to use construction tools for every building infrastructure to revolutionize construction techniques.

The essential solution which is necessary to lead a sustainable and stable life is therefore to conserve the

environment and managed the earth resources secure from all the environmental dangers.

The construction material choice should be dependent on environmental and technological standards and the life cycle cost of materials and can be useful in choosing construction material in the scope of sustainable standards, also the using a multi-criteria decision-making approach such as GAM or AHP.

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