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A REVIEW ON MITIGATION PLANNING STARTEGIES FOR REDUCTION OF EMBODIED ENERGY IN CONSTRUCTION SYSTEMS BY CHANNELIZED ARCHITECTURAL

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ABSTRACT

When sustainability is the driving force in the creation of a building, specifiers and architects need additional knowledge to assist them in making decisions about the choice of building materials and the way in which they are used, this paper mainly focuses on the strategies implemented in reduction of embodied energy. Buildings account for at least 39% of energy-related global carbon emissions on an annual basis in the process of extraction, manufacturing and transportation of materials. The estimated result of cost and energy is compared between conventional construction materials and suggested alternatives. Energy consumed in the production of basic building materials such as (cement, bricks, etc.) and different types of materials used for construction has been discussed.

Keywords: Sustainability, Embodied Energy, Global Carbon Emission, Alternative Materials, Estimation.

I. INTRODUCTION

The embodied energy (Carbon) of a building material can be taken as the total primary energy consumed (carbon released) over its life cycle.

This would normal include:

- Extraction
- Manufacturing
- Transportation

Types of Embodied Energy:

1) Initial Embodied Energy:

The initial embodied energy in buildings represents the non-renewable energy consumed in acquisition of raw materials, their processing, manufacturing, transportation to site and construction.

It is further divided into 2 types:

⩾ Direct energy: The energy used to transport products to the site and then to construct the building.

⩾ Indirect energy: The energy used to acquire process and manufacture the building materials, including any transportation related to this activities.

2) Recurrent Embodied Energy:

The recurring embodied energy represents the non-renewable energy consumed to Maintain, Repair, Restore, Refurbish or Replace Materials, Components or systems during the life of the buildings.

Embodied energy is measured as the quantity of non-renewable energy per unit of material, component or systems.

It is expressed in Mega joules (MJ) or Giga joules (GJ) per unit weight (kg or Ton) or Area (m^2) but the process of calculating embodied energy in complex and involves numerous sources of data.

Units of Measurement:

- Standard unit for embodied energy: MJ / kg material (MJ / m^3).
- Standard unit for carbon emission: kg CO_2 (kg CO_2 / m^3).

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Reduction of Embodied Energy in the Architectural Planning Stage:

As architects, we have the ability and responsibility to provide solutions that minimize the climate impact of the structures we design. Creating an awareness on the embodied energy and take its measures from the initial stage of the planning and construction of the structure is a primary object of reducing embodied energy, which is possible through the usage of the alternative building materials which is as durable as the conventional building materials which are in regular practice of construction and the availability of the materials is as convenient as the regular materials. One of the methods to reduce the carbon emission is to replace the fossils with renewable energy and increasing energy efficiency. For example, replacing the vehicles used for the transportation of the materials to the replacing it with the Electrical vehicles or using any renewable source for the transportation.

II. LITERATURE REVIEW

- Weakness of embodied energy assessment on construction, ASCE 2016, Kailung Feng, Yaowu Lu:

Used professional searching tool Academic 2.0 for Data analysis for present embodied energy I/O based method has been used in this study and it is regarded as best method.0

- Embodied energy of common and alternative building materials and technologies, ELSEVIER 2001, B K Venkataraman Reddy, K S Jagadish:

This paper is mainly focused on the issues pertaining EE of buildings mainly in Indian context. Multi storeyed building, Load bearing building, Soil cement block building has been compared and is concluded that EE in Load bearing building can be reduced by 50% using ABM.

- Reducing Embodied carbon in buildings, RMI Energy transformed 2021 Rebecca Esau Matt, Jungclaus Victor Olgyay, Audrey Rempher:

The report comprises of comparison between mid-raised concrete and steel construction, midrise stick built construction, tilt up construction. This report demonstrate that midsized commercial project can reduce carbon by up to 46% at less than 1% cost premium using materials widely available today.

- Embodied energy and its impact on architectural decision, WIT Transactions on Ecology and the Environment, Vol 10 2007, H.J. Holatzhausen:

EE values in different building materials are brought together for adjusting decision made by architects in an order to increase the life and value of building. Designing the building for low maintenance and Flexibility in use and making the building climatically appropriate.

- Embodied energy and carbon in construction material, Proceedings of the Institution of Civil Engineers Energy 161 May 2008 Issue EN2 Pages 87–98, Geoffrey P. Hammond, Craig I. Jonas:

The development of an open access, reliable data base for EE and C associated with construction industry is described and it consists of study on more than 200 different building materials.

- Mitigation Strategies for Reduction of Embodied Energy and Carbon, in the Construction Systems of Contemporary Quality Architecture, Sustainability 2019 MDPI journal, Enrico Sicignano, Giacomo Di Ruocco and Roberta Melella:

Identifying the design strategies that can be reduced embodied energy and greenhouse gas emission of buildings.

- Life cycle embodied energy analysis of residential buildings: A review of literature to investigate embodied energy parameters, ELSEVIER 2017, Manish K Dixit:

The reported values of initial and life-cycle embodied energy are also presented to highlight variations due to differing parameters. The reported values of initial and life-cycle embodied energy are also presented to highlight variations due to differing parameters.

- Recurrent Embodied energy and its relationship with service life and life cycle energy, Emerald group publishing LTD 2014 Vol 22, Manish K Dixit, C. Culp:

Analyse the relationship of recurrent EE with service life and life cycle of Embodied energy and REE are determined and discussed. A review is performed on residential and commercial buildings to examine the relationship of REE with the building service life.

- The potential to reduce the embodied energy in construction through the use of renewable materials, Conference: ASA2012: The 46th Annual Conference of the Architectural Science Association, F. Myers , R. Fullera and R.H. Crawfordb:

The study has shown that most of the building materials can be replaced with renewable alternatives which could be beneficial from general resource perspective. This paper begins with a review of previous research on residential building EE and renewable building materials.

- Optimizing the Embodied Energy of building construction through Bioclimatic principles, Conference: 28th Annual ARCOM Conference September 2012, Sattar Sattary, David Thrope:

The climatic change is estimated around 30% of the base line CO_2 emission in buildings projected for 2020. To reduce the building energy use, replace fossil fuels with renewable energy.

III. CONCLUSION

As per the topics discussed above regarding reduction of the embodied energy in architectural planning process, there are many calculations, comparison and suggestion where we can expect an outcome of an effective reduction in the embodied energy as well as reduction in carbon emission. The construction industry alone stands responsible for more than 50% of greenhouse emissions which thereby have proven to lead to rising temperatures, rising sea levels, floods, droughts, and spread of infectious diseases among many others. By taking measures from the initial stage an effective amount of reduction in carbon emission and effective cost reduction can be noticed.

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