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LIFE CYCLE ASSESSMENT OF EMBODIED ENERGY ON SUSTAINABILITY STRUCTURES OF REINFORCED CONCRETE BUILDINGS

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ABSTRACT
Rapid urbanization and population increase cause significant changes in the construction sector. Just the building sector is responsible for 40% of the carbon dioxide released into the atmosphere. Using sustainable design techniques and resources may lessen the effects of climate change. The built environment's carbon footprint can be reduced by reducing embodied energy, choosing building materials that adhere to ecological design principles such as cradle to cradle, cradle to grave, design for environment (DFE), design for deconstruction (DFD), and low impact development (LID) strategies. These strategies use locally available materials and design with the cardinal rules of deconstructable, disassessment, harmless, recycling, and less environmental impacts. When evaluating the sustainability of new construction, existing buildings, and the upkeep, renovation, and replacement of existing structures, life cycle assessment, or LCA, is a crucial tool. The quantity of carbon released and the energy needed to create a structure are known as embodied energy and carbon associated with building construction. Energy needed to extract raw materials, manufacture building components, transport them to the construction site, install them, and run them is known as embodied energy. The main sustainability tactics to use are biomimicry and design in accordance with how nature acts. The built environment suffers more when fossil fuels and traditional energy methods are used. Alternatives have gained attention; buildings are now more efficient because to the integration of hybrid systems and renewable energy sources. Major energy users in buildings have been identified as lighting, heating, and cooling services. Using local natural resources, district cooling and direct heating from geothermal energy (ground coupling) provide an ecologically friendly cooling option. Furthermore, Evaporative type cooling, downdraught cooling, earth tunnel air conditioning, chilled beam systems, and other passive cooling techniques enhance the energy efficiency of the whole structure. Possible sustainable parameter solutions and an integrated energy analysis of building services in mechanical, electrical, and plumbing systems are the topics of this article.
KEYWORDS: *Sustainability, Life-cycle Assessment, Ecological,buildings & Structures, Embodied energy, Lifecycle assessment, Carbon footprint, Low impact development*

1. INTRODUCTION

In India, urbanization, population growth, emerging economies are the most important factors that contribute to the built environment. Also, investment in housing and infrastructure doubles its long-term effects on resources and energy. While the European Union as a whole, Germany, in particular, has embraced resource efficiency as a key factor in its policy processes and is taking concrete steps in that direction. Similarly, it is also important for India to start a dialogue on resource use and find its areas of action. Like other emerging economic sectors, India is also experiencing an increase in urbanization, which is associated with a growing population. Indian cities are now home to about 300 million people in 2030, there will be an estimated 600 million people living in cities. Cities, accounting for about 58% of India's GDP in 2008, will account for about 70% of GDP by 2030.. In 2009, India became the third-largest consumer of world-class goods after China (with one billion tons) and the USA (about 6 billion tons). In the same year, India accounted for 7.1% of the world's excessive consumption while handling 17% of the global population. The use of the material in India over the last few decades reflects the general pattern of countries that make the transition from technological society to an industrial society, which refers to the consumption of non-renewable resources. The total use of biomass has almost dropped while the share of renewable resources has dropped from 79% in 1980 to 43% in 2009. If the current economic situation persists and the population grows according to the UN's average, India's material needs are expected to be around 15 billion tons by 2030 and more than 25 billion tons by 2050.

The construction sector has seen significant change in recent years due to the growing urbanization and population expansion. Large amounts of carbon dioxide and other greenhouse gases are released throughout the construction, operation, and maintenance phases of heavy structures, such as commercial, industrial, residential, and other types of buildings. Up to 40% of global emissions are attributed to the construction industry.30% of GHG emissions in India are attributed to the building industry, according to

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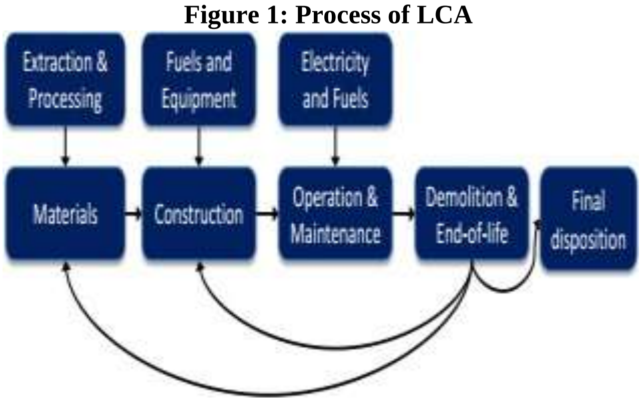
The Indian Climate Change Network Assessment report from 2007. Therefore, reducing techniques will lessen the effects on the environment and increase the efficiency of buildings. There are several ways to categorize these tactics. Carbon footprint, embodied energy, lifecycle assessment in the built environment, handling of waste from construction and demolition, recyclable potential of materials, design optimization, passive design strategies, use of renewable sources on site, hybrid energy system design, efficient use of building services (e.g., lighting, water usage, advanced controllers for heating and cooling), and low impact development methods. Energy use is equal to Fn (climate, population density, occupancy schedule, building orientation, and internal loads). Urbanism is defined by population density, which leads to multi-story complexes and huge structures. Origin to destination (O-D) research might use the phrase "embodied energy."

2. METHODOLOGY

The LCA methodology is based on ISO 14040. LCA is a strategy for examining the environmental elements and possible consequences of a product by creating an inventory of relevant inputs and outputs from the product system. And assessing the possible environmental implications of such inputs and outputs.analyzing the outcomes of the inventory analysis and impact assessment stages in reference to the study's purpose. Considerations in LCA framework in Global warming, energy usage, resource waste, clinical changes, and recycling. pollution and dangerous materials. Land use and conservation planning for the internal environment. more careful use of recycled materials in construction, as well as components that are reusable and recyclable.

Figure 1: Process of LCA



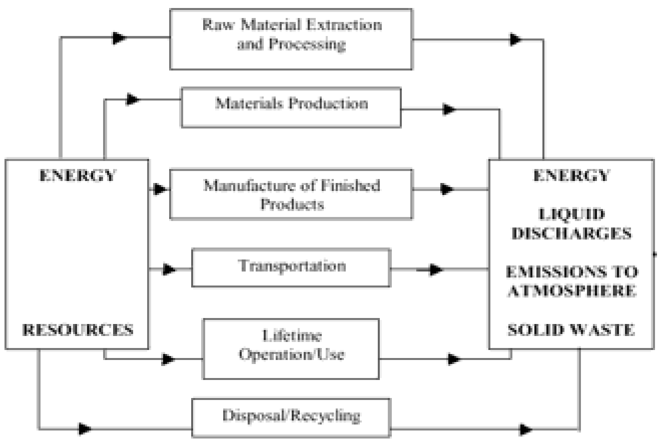


Figure 2: Graphical representation of the Inventory

3. ANALYSIS AND RESULT

3.1 Inventory analysis

In this step, the energy and raw materials used; the emissions to atmosphere, water, and soil; and different types of land use are quantified for each process then combined in the process flow chart and related to the functional basis.

As an example, the inputs may include water consumption and the outputs may include sulfur oxides (SOx). Thus, products and processes can be compared and evaluated using Life Cycle Inventory (LCI) results

3.2 Impact Assessment

The impact assessment translates the emissions from a given product or process into impacts on various human and terrestrial eco-systems. To aid in the understanding of impacts, the effects of the resource use and emissions generated are grouped and quantified into a limited number of impact categories, which may then be weighted for importance. Data from the inventory analysis is

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attributed to an appropriate impact category.

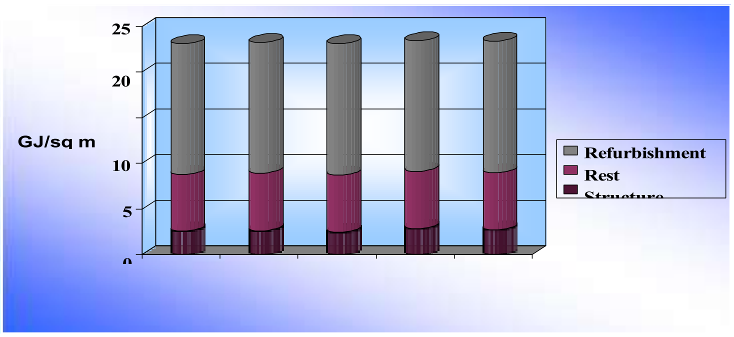

Figure 3: Life Cycle Embodied Energy

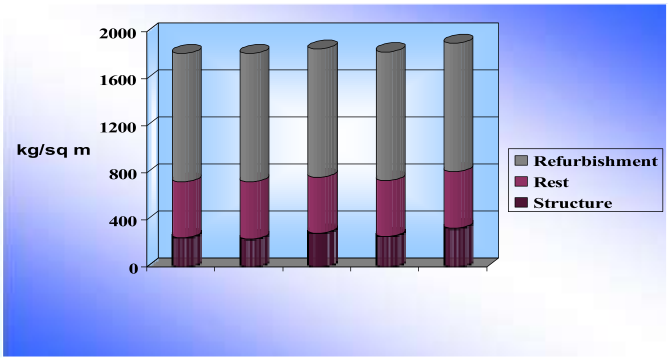

Figure 4: Life Cycle Embodied CO2

3.3 Interpretation

LCA results are reported in the most informative way possible and the need and opportunities to reduce the impact of the product(s) or service(s) on the environment are systematically evaluated. In this step, the results are often presented in the form of tables or graphs, which is especially helpful when comparing two competing design options or products. The outcome of this step is directly useful in making environmentally friendly decisions. Like any other design feedback tool, LCA can be an iterative process. The interpretation of the LCA can lead to changes in the proposed design

3.4 Global Warming Potential (GWP)

Global Warming Potential, or GWP, has been developed to characterize the change in the greenhouse effect due to emissions and absorptions attributable to humans. The unit fo measurement is grams equivalent of CO2 per functional unit of product, Buildings accounts for 39% CO2 emissions.

Table.1. GWP Potentials of few Common Gases

Gas	Global warming potential (GWP)
CO2	1
(CH4)	21
N2O	310
SF6	23900

The commercial and residential building sector accounts for 39% of carbon dioxide emissions in the India per year more than any sector.India buildings are more responsible for the more CO2 emissions than those of any other country except china. Most of these emissions come from the combustion of fossil fuels to provide heating, cooling and lighting and to power appliances and electrical equipment.by transforming the built environment to be more energy efficient and climate friendly. The building sector can play major role in reducing the threat of climate change.

Green buildings provide abundant opportunities for saving energy and mitigating CO2 emissions
Building Co2 emissions while improving the bottom line though energy and other savings. Examples of measures than can be taken to improve building performance.

- Incorporating the most efficient heating ventilation and air-conditioning system. Along with operations and maintenance and such systems to assure optimum performance.
- Using state of the art lighting optimizing day lighting.
- Using recycled content building and interior materials

- Reducing potable water usage.
- Using renewable energy.
- Implementing proper constructionswaste management.
- Siting the building near public transportation.
- Using locally produced building materials.

3.5 Low Carbon Refurbishment

Is done in four phases i.e. prepare, design, construct and use Building refurbishment' describes activities ranging from minor works to replacement of services and facades, which alter the interior and/or exterior of a building but fall short of demolition and rebuilding. As well as structural repairs and improvements to the external and internal appearance, refurbishments enhance the occupied space

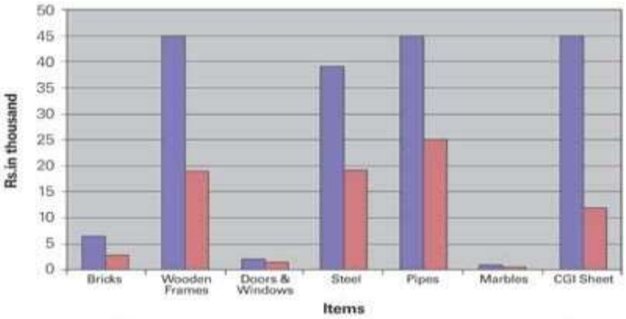

Fig.6.Cost comparison between new and old building materials

3.6 Recycling of C and D Waste

C and D waste management can be defined as the process related with the proper storage, collection and transportation, recovery and recycling, processing, reusing and disposal of C and D wastes in a manner that is in consensus with the principles of human wellbeing, economic, engineering and other environmental consideration.

Table.2: C& D Production in India

Constituent	Quantity generated In million tons p.a
Soil sand and gravel	4.20 - 1.54
Bricks and masonry	3.60 – 4.40
Concrete	2.4 – 3.67
Metals	0.60 – 0.73
Wood	0.25 – 0.30MT
Others	0.10 - 0.15MT

4. CONCLUSIONS

The problem of sustainable development is to manage resources and save the environment without sacrificing the goals of development and expansion. The purpose of this paper was to: When a system is developed using sustainable development, complexity is created, which guarantees that the environmental cost is minimized. Because of the significant environmental impact of the construction industry, using sustainable construction techniques may save costs by lowering a building's carbon emissions and operating expenses. Thus, the ideas of sustainable development are used to prevent environmental deterioration. Additionally, achieving sustainable growth comes with several difficulties. The paradigm shift from current methods to holistic thinking and strategic activities that connect short-term to long-term goals and priorities depends on the intellectual resources and effective implementations of these changes.

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