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'Embedded Energy' of Dr. D. Y. Patil Institute Of Engineering, Management & Research, Akurdi, Pune

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Abstract – *Embedded energy is the energy required to produce any goods or services, considered as if that energy was incorporated or embodied in the product itself. The concept can be useful in determining the effectiveness of energy producing in any structural development or energy saving devices. One fundamental purpose for measuring this quantity is to compare the amount of energy produced or saved by the product in the amount of energy consumed in producing it, because energy inputs usually entails greenhouse gas emission in deciding whether a product contribute to or mitigate global warming. Embedded energy is an accounting method aims to find the total of energy necessary for an entire product life-cycle. Determining what constitutes this life cycle including assessing the relevance and extent of energy into raw material extraction, transport, manufacture, assembly, installation and usage. The purpose of this paper is to highlight the impact that embedded energy of construction materials could be a decision making point while developing a sustainable structure and ultimately on the environment.*

Key Words: ***Embedded Energy, Greenhouse Gas Emission, Global Warming, Product Life-Cycle, Sustainable Structure.***

1. INTRODUCTION

India is vast country with a fast growing population, the increase of population leads to adopt so keeping this in mind we have presented a new design methodology for sustainable structural development. The construction industry requires the extraction of vast quantities of material and equipments and this, in turn results in the consumption of energy resources and the release of deleterious pollutant emissions to the biosphere of environment. Each material has to be extracted, processed and finally transported to its place of use. The energy consumed during these activities is critically important for human development, but also puts at risk the quality and longer term viability of the biosphere as a result of unwanted or second order effects. Many of these side-effects of energy production and consumption give rise to resource uncertainties and potential environmental hazards on local, regional or national scales. Energy and pollutant emissions such as carbon dioxide (CO2) may be regarded as being embodied within materials. Thus, embodied energy can be viewed as the quantity of energy required to process, and supply to the construction site, the material under consideration.

1.1 What is an embedded carbon?

An 'embedded carbon' is a measure of the greenhouse gas emissions associated with an indirect activity, group of activities or a product. Nearly everything that we do produces greenhouse gas (GHG) emissions either directly or indirectly; whether it be getting to work, watching TV or buying our lunch. The most important greenhouse gas produced by human activities is carbon dioxide. Direct GHG emissions sources are often easy to identify – for example burning fossil fuels for electricity generation, heating and transport. It is sometimes less obvious that products and services also cause indirect emissions throughout their life-cycles. Energy is required for production and transport of products, and greenhouse gases are also released when products are disposed of at the end of their useful lives.

2. LITERATURE REVIEW

Jyoti Parikh a, Manoj Panda b , A. Ganesh-Kumar b , Vinay Singh they have studied that analyses of carbon dioxide (CO2) emissions of the Indian economy by producing sectors and due to household final consumption The analysis is based on an Input–Output and Social Accounting Matrix (SAM) for the year 2003–04 that distinguishes 25 sectors and 10 household classes According to them Total emissions of the Indian economy in 2003–04 are estimated to be 1217 million tons (MT) of CO2, of which 57% is due to the use of coal and lignite. The per capita emissions turn out to be about 1.14 tons. The highest direct emissions are due to electricity sector followed by manufacturing, steel and road transportation.[1]

Mary Lissy P N divide A Carbon footprint in two parts: the Primary footprint and the Secondary footprint. For found out total quantity of carbon emission he was following factors like, Human Factor, Transportation, Electricity, Solid Waste, Production and Consumption of Food, LPG, Natural Gas, Buildings. And multiply their emission constant like for Human factor- 1.14kg per person per day, Petrol 2.3 kg per liter, Solar based electricity 0.05kg per kwh, LPG 1.5kg per kg. [2]

Changhai Peng And Xiao Wu have studied that Using building information modeling (BIM) and ECOTECT, the estimated carbon emissions during an office building's life cycle. That building's life cycle CO2 emissions were divided into three parts: the construction, operation, and demolition stages. Among these, the statistics on the schedule of quantities were generated using BIM, and the energy consumption during the building's operational stage was obtained using ECOTECT simulation. Sensitivity analysis was performed by changing several alternative parameters, to identify which parameter has more impacts on building performance [3]

3. METHODOLOGY

Determination of carbon emission consists of two phases such as defining the carbon emission and quantifying the carbon emission. Development of carbon level in our college campus depends on the characteristics of vehicles and other factors considered in the project. Thus it is necessary to carry out certain test to determine the atmospheric characteristics in order to decide effective treatment process. Hence we have to analyse the sources of carbon emission through our campus. For this analysis we bifurcate the sources of carbon emission depending on their raw materials used for their processing of direct and indirect carbon emission.

In first phase of project we analysis direct carbon emission in our campus. In direct carbon emission, sources used for analysis were divided into 3 parts transport, electricity and canteen. After getting vehicular data and electricity uses, we compare the data with ISO standard coefficient to get CO_2 emission in KG.

In next phase of the project we are analyzing embedded energy in the form of carbon which is emitted in the environment in the life-cycle of the structural development of the campus. In that detail estimate of material used in structural development is compared with ISO standard coefficient to get total energy evolved in the form of carbon. But greenery and vegetation in campus absorbs some amount of carbon for photosynthesis, deducting these losses we are finding net carbon evolution in our campus area.

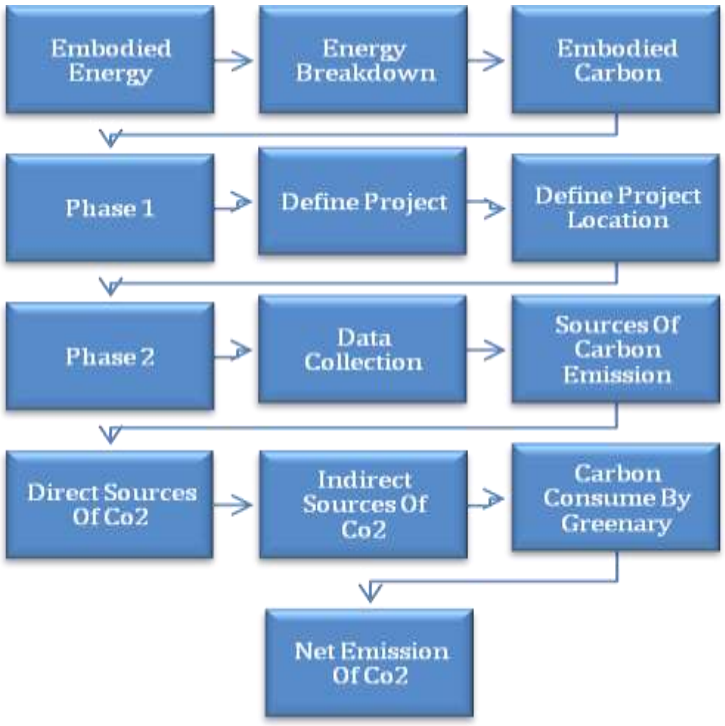


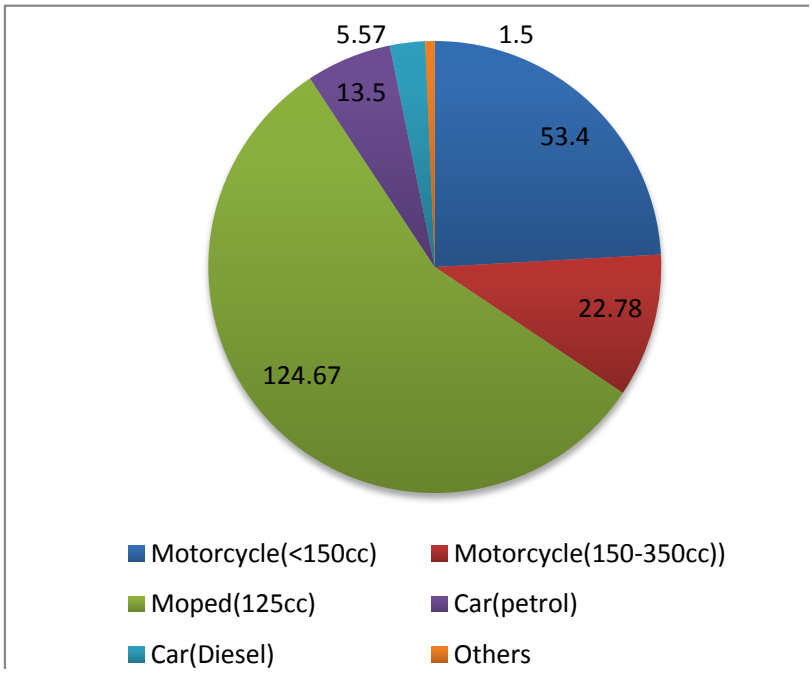
Fig No 1: Flow Chart of Methodology

4. EXPERIMENTAL STUDY

As per the requirement, project location confirm as the DYPIEMR campus. After that premises survey carried out and bifurcate the sources direct and indirect. In first phase of project direct sources of carbon emission are marked out and classification is done. As per the bifurcation the daily count of vehicle depending on Gear and Non-Gear, Cars, Trucks, Bus, JCB, and Tempo were collected and mention roughly to get idea about the variation in count according to peak days and hours. All these vehicles were categorized under PCU as it is difficult to analyze these vehicles separately. With the help of PUC (pollution under control) the percentage of carbon emission for specific passenger car unit were measured. This approximate percentage of specific car unit helped to find total carbon emission in Kg of CO_2 using carbon footprint calculators. Thus these reading of carbon emission compared with existing ISO standard for life cycle assessment (LCA) for greenhouse gas accounting ISO 14040/44, ISO14025 and ISO 14065 as it is most acknowledged existing ISO standards. As the electricity used in our campus is generated by hydropower station, results of carbon emission level due to electricity were null. Average data of CO_2 emission in Kg for three month is enlisted below-

Table no 1: Equivalent CO_2 emission per day

Equivalent CO2 emission per day						
	Category of vehicle	Average data	Frequency of vehicle	Average distance	Emission factors	CO2 emission
				KM	Kg CO2/km	Kg CO2/day
1	Motor-cycle(<125cc)	235	2	2.5	0.04543	53.4037
2	Motor-cycle(150-350cc)	135	1	2.5	0.06750	22.7812
3	Moped(125cc)	449	2	2.5	0.05553	124.6648
4	Car(Petrol)	54	1	1.5	0.16660	13.4946
5	Car(Diesel)	23	1	1.5	0.16160	5.5752
6	Bus	1	1	1	0.29080	0.2908
7	Tempo	2	1	1.5	0.20770	0.6231
8	JCB	1	1	1	0.48480	0.4848



Pie Chart 1: Equivalent CO_2 emission per day

5. CONCLUSION

The carbon levels are rising daily due to improper use of transport services, private vehicles, etc. the problems of global warming, improper weather is arising mostly seen in cities like Delhi, Mumbai, Pune, etc. In order to reduce these levels awareness should be spread among people to use more public transport avoiding single vehicle use. The goal of this project is to help people understand and shrink carbon emission which would be emitted by them. The carbon footprint has been utilized by commercialized to count themselves and their products carbon and adopt the preventive measures to reduce the carbon emission and achieve a sustainable development along with minimum effects on environment.

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