

Performance of Environmental Critical Factors in Building Construction Projects

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Abstract

Construction industry of India has shown a significant growth in recent years. However, as the construction industry grows its effects on the environment have also increased. The main focus of this paper is to study the impact of the building construction on the environment during the construction process. The critical factors of the environment have been determined & impact of the construction process on these factors has been analyzed. We have presented the impact analysis in this report by taking a survey of different construction projects. We have calculated the weighted average of the necessary scores obtained by these projects during impact analysis & determined the sustainability of each factor. This paper will be a guideline for the decision maker of building construction.

Keywords

Building Construction, Critical Environmental Factors, Impact Analysis, Weighted Average

I. Introduction

The construction industry has always been a major force behind India's economic growth. Its contribution to the nation's GDP is about 8 percent. However, construction sector is also responsible for a significant contribution in waste production [1]. The sources of environmental pollution from construction activities are ground movement, noises, solid waste, liquid waste, unsafe gases, dusts and many more [2]. The environment is immensely affected by the ill effects of such waste productions. Sustainable development is a crucial factor for environment protection in construction process [3]. Environmental Management System is a necessity for every construction firm [4]. The building construction firms in India should adhere to environmental building standards set by various institutions such as Indian Green Building Council's LEED rating system, TERI's GRIHA rating system & Bureau of Energy Efficiency's rating system. Environmental Impact Assessment (EIA) plays a major role in predicting the consequences on environment due to any project.

In India, The Ministry of Environment and Forests (MoEF) does a significant work in Environmental Impact Assessment. In order to increase the environmental performance of any building construction project, the critical factors of environment such as land, air, water, noise, waste control, energy resources & human factor affected by construction process need to be identified. The goal of this paper is to find out the impact on these critical aspects during construction process by different building construction projects.

The structure of the paper is as follows: Section II states the different literatures studied in interest of the paper. Section III describes the methodology used. Section IV contains the analysis of the results. Section V gives conclusion & future aspect of the work.

II. Literature Review

Building construction firms in India give less attention to environmental problems arising due to construction process. Increasing cost & time act as the major barriers for construction firm in implementing environment friendly techniques [5]. The important environmental factors affected by the ongoing construction process should be recognized & necessary mitigation measures should be implemented.

Several literatures regarding assessment of the impact on the environment during construction process have been studied & the key findings have been presented.

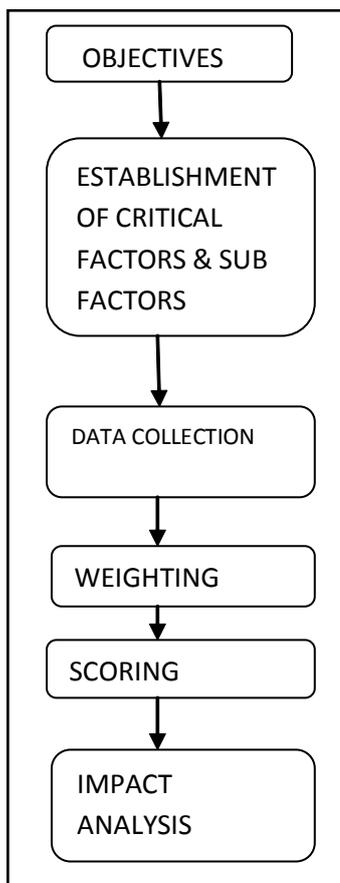
Table 1: Key Finding From Literature Study

Author	Key Finding
D. J. Harris(1999)	Impact of the building materials on environment depends on material properties, building's location & application on the building
Vivian WY Tam, Khoa N Le (2007)	Input factors for assessment of environmental performance in construction industry are Site Planning, Energy Consumption, Pollution Control of air, noise, water & waste
Çiğdem Belgin Ddkmen, Arzuhan Burcu Gulteknd (2011)	Building sector should take necessary measures to reduce use of non-renewable & create building design to force the use of renewable resources in order to check the environmental problems. Potential of solar energy should be considered.
Namala AmugaKeftin (2013)	Building construction can have serious impact on land use, human health, noise, public services, plant life and surrounding aesthetics.
Samaneh Zolfagharian, Mehdi Nourbakhsh, Javier Irizary, Aziruddin Ressay, Masoud Gheisari (2012)	Environmental impacts due to construction process consists of ecosystems impact(noise, vegetation, air, water etc.), natural resources impact and Public impact(site hygiene, public health ,social disruption)
Cui, H. Z ., Sham, F. C., Lo, T. Y. and Lum, H. T. (2011)	For reduction of carbon dioxide emission , cement and steel are to be replaced by alternative building materials which are environmental friendly
Edoka Augustine Ijigah, Richard Ajayi Jimoh, Bamidele O. Aruleba. & Abduiquadri Bilau Ade. (2013)	Major environmental impacts due to building construction are pollution, resource utilization and habitat destruction caused by vegetation destruction, desertification, waste disposal & soil erosion.

III. Methodology

For the research objectives, we have taken five building construction projects across the state. The construction projects were having a total of 31 buildings under them. The process followed for the research is based on Systematic Evaluation and Assessment of Building Environmental Performance (SEABEP) [6]. A check list was made comprising of the factors & sub-factors presented in Table 3. Weighting of different sub-factors was made in reference to the Leadership in Energy and Environmental Design (LEED) & Green Rating for Integrated Habitat Assessment (GRIHA) rating systems. Each project had appointed a supervisor for environment friendly process during the building construction. Relevant data were collected by frequent interaction with the supervisor as well as engineers & workers associated with the projects.

Process Chart



The final scoring was done in accordance with the implementation of sub-factors & weights associated with them. Each building construction project was given a score, which was the average of the scores obtained by different buildings built under the project.

Table 2: Scoring System

1	Least significant
2	Fairly significant
3	Significant
4	Very significant
5	Extremely significant

Table 3: Critical Factors & Sub- Factors

FACTORS	SUB- FACTORS
1.Land (EF1)	Site selection, Erosion control, Decreasing Site disturbance, Natural drainage system conservation, Soil conservation
2.Water (EF2)	Efficient water use, Water recycling & reuse, Rain water harvesting, Ground water maintenance
3.Air (EF3)	Low usage of equipment emitting ozone depleting substances, Usage of low volatile organic paints, Tobacco & smoke control, Dust settlement techniques, CO2 emission control
4.Noise (EF4)	Noise barriers installation, Low usage of machineries, Noise level control
5.Energy (EF5)	Usage of renewable energy, Efficient usage of energy, Design permitting maximum renewable energy usage
6.Waste Control (EF6)	Solid waste management(storage & disposal), Wastewater treatment & reuse
7.Human factor (EF7)	Sanitation & safety of workers, Health & hygiene check, Lesser disturbance to surrounding population

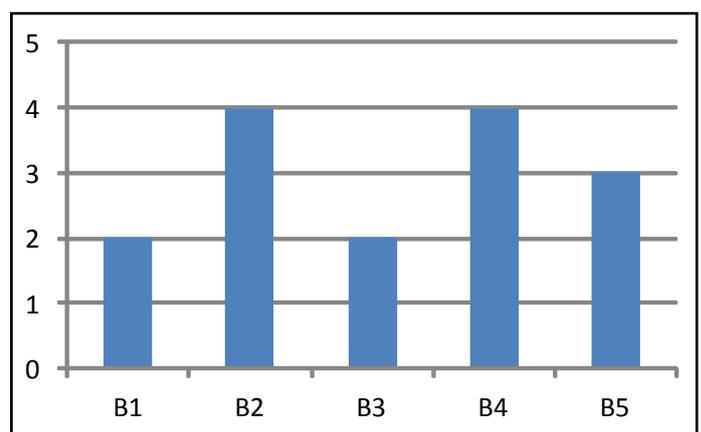
IV. Results Analysis

After the scoring process, the results found were presented in form of charts for impact assessment.

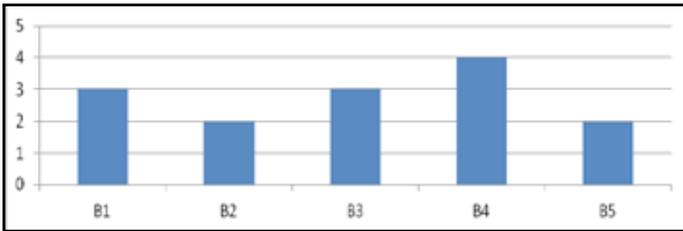
Notations used are as follows:

B1, B2, B3, B4 & B5 are the five building construction projects with 5, 10, 6, 2 & 8 numbers of buildings under them respectively. EF1, EF2, EF3, EF4, EF5, EF6, EF7 are the different critical factors of the environment.

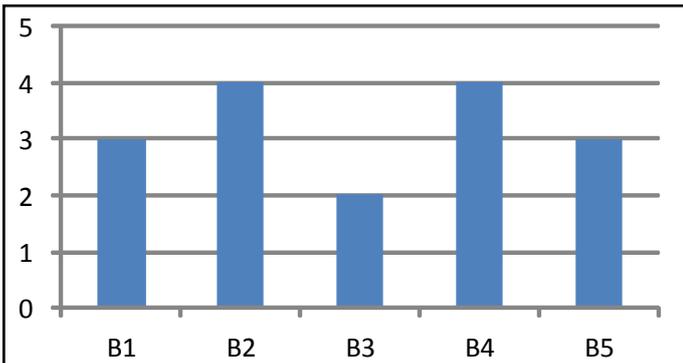
A. Impact on Land Environment Due to Building Construction Projects:



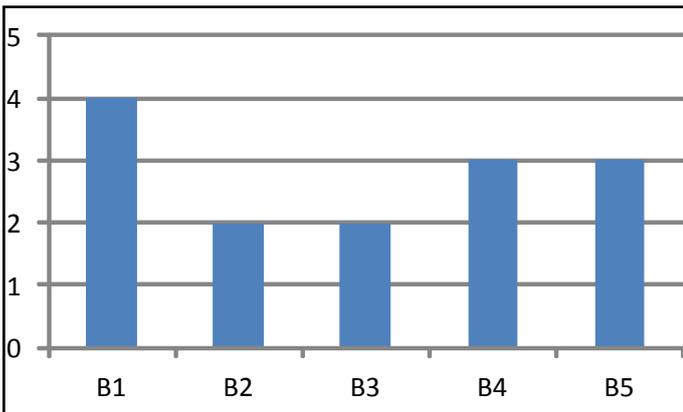
B. Impact on Water Environment Due to Building Construction Projects:



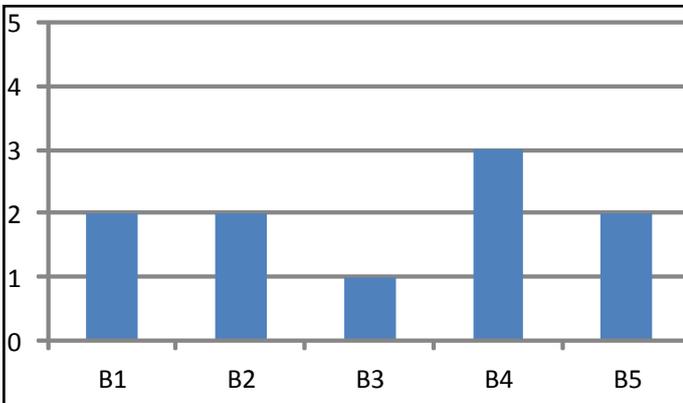
C. Impact on Air Environment Due to Building Construction Projects



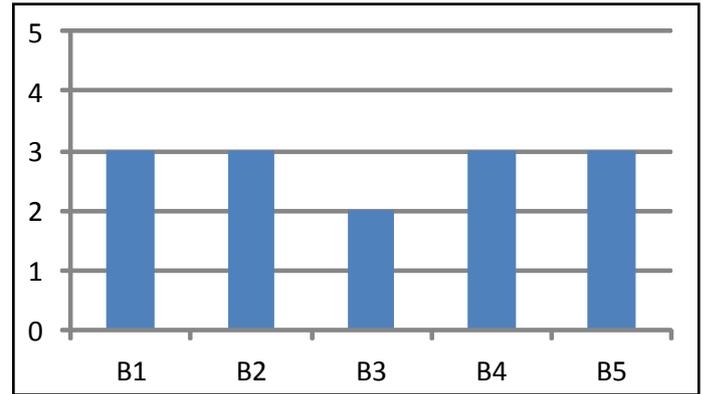
D. Role of Building Construction Projects in Noise Control



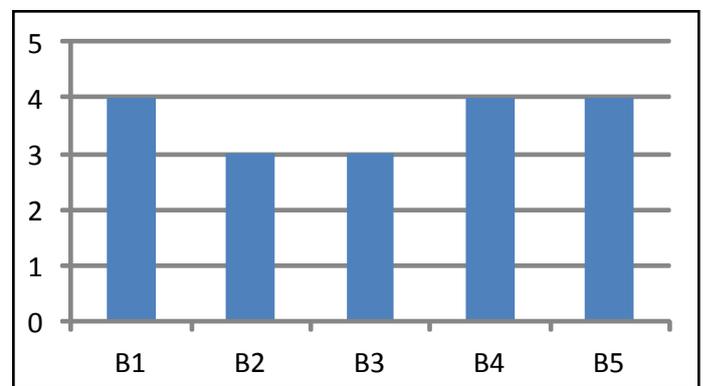
E. Impact of Building Construction Projects on Energy Resources



F. Role of Building Construction Projects in Waste Control:



G. Impact on Human Factor Due to Building Construction Projects:



Calculation of Weighted Average of the Critical Environmental Factors

Weighted average of individual critical environmental factor is calculated by dividing the summation of the values found by multiplying the score obtained by each building construction project with respective number of buildings under them by the total number of buildings inspected.

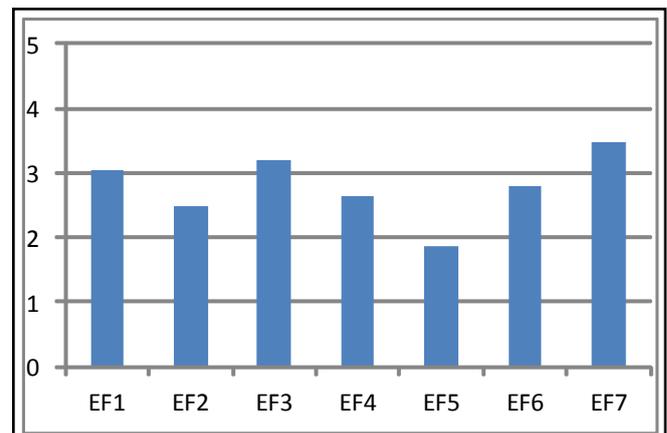
Weighted average for

$$EF1 = (5 \times 2 + 10 \times 4 + 6 \times 2 + 2 \times 4 + 8 \times 3) / 31$$

$$= 94 / 31 = 3.0322$$

Similarly the weighted average for

EF2= 2.484, EF3= 3.194, EF4= 2.645, EF5= 1.871, EF6= 2.806 & EF7=3.484



V. Conclusion

Environment protection should be considered as an important aspect in any construction project. Significant reduction in use of natural resources, increment in usage of renewable resources & application of recycling process are the major areas to be treated with utmost importance in construction process. This paper underlines the impact of the building construction projects on the critical environmental factors during the construction process. From the result analysis, energy consumption is found to be given minimum significance in the building construction projects & needs to be checked in order to enhance the environmental performance of the construction process. Stringent government regulations & environment awareness programs can provide a necessary boost regarding environmental sustainability in construction industry. Further research on finding a trade-off between cost, time, quality & environmental protection measures in construction industry should be emphasized.

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