

# Environmental Risk Assessment for Construction Project through CEMP

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*Abstract - The construction sectors are now a day's expanding rapidly with the different new sources, techniques but if it not planned with consideration of environmental aspects, it would give significant negative impact to the surrounding environment. Construction is considered as one of the main reason of pollution in the nature. So for the awareness and proper utilization of resources in the construction projects regards to environmental effect, needs to be enhanced. For this some management techniques are considered with environmental management. Construction Environment Management Plan (CEMP) is an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction on project environment are prevented. Also CEMP's provide an essential tool for ensuring that the assessment, mitigation of negative impacts and enhancement of positive impacts is carried out effectively during the project life-cycle. This is a plan or programmed that seeks to achieve a required end state and describes how activities that have or could have an adverse impact on the environment, will be assessed, controlled, monitored and mitigated. In developing the CEMP an Environmental Risk Assessment will be undertaken. The risk assessment identifies all aspects of construction that could have an environmental impact and assesses the potential risk and impact of that activity on the environment. Management controls are then devised to eliminate or minimize those identified impacts. In this paper CEMPs are developed. Also risk assessments of different construction projects are taken. It may identify some environmental impact factors by measuring environmental risk and finding their impact levels.*

*Index Terms: CEMP, Environmental Risk, Impact factors, Risk Assessment.*

## I. INTRODUCTION

The construction sectors expanded rapidly in the 80's because of demand for the large number of residential houses. With this the new concept forms township projects. Construction is considered as one of the main source of environment pollution in the nature. Building construction and operations have massive direct and indirect effect on environment [1]. So awareness and proper utilization of resources in the residential projects regarding environmental effect of construction needs to be enhanced. For this some management techniques are considered with environment that is referred as Environmental

Management. It is part of overall management system which consists of organized structure, planning, duties, practices, procedures and resources necessary for development, implementation, achievement and maintenance of the environmental policy. Construction Environment Management Plan (CEMP) is an environmental management tool used to ensure that undue or reasonably avoidable adverse consequences of the construction, function and ceasing of a project are prevented and that the positive benefits of the projects are increased. It is an essential tool for ensuring that the mitigation of negative impacts and enhancement of positive impacts are carried out effectively during the project life cycle [2]. It is therefore intended that this is used in the spirit of continuous improvement and development, to help out in motivating best practices in environmental management, in a manner that acceptable, efficient and cost effective.

A Construction Environment Management Plan (CEMP) can be defined as "an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced". EMPs are therefore important tools for ensuring that the management actions arising from Environmental Impact Assessment (EIA) processes are clearly defined and implemented through all phases of the project life-cycle.

Construction Environment Management Plan (CEMP) as well as providing an input to design and appraisal, environmental issues is incorporated into the implementation phase of the project cycle. A Construction Environment Management Plan (CEMP) should be prepared, which sets out the actions for monitoring and evaluation of the project during implementation or construction and operation. This should form a fundamental part of the project specifications. Its content will include:

- Measures to enhance environmental benefits
- Identified risks and uncertainties

- Mitigation measures to minimize adverse impacts
- Institutional support required for effective monitoring
- Monitoring and auditing programme details
- Environmental legislation and standards which apply resources, funds, contractual and management arrangements.

Risk assessments are an important component of effective environmental management systems. Environmental Risk Assessment (ERA) is a process that evaluates the likelihood or probability that adverse effects may occur to environmental values, as a result of human activities (i.e., a formal procedure for identifying and estimating the risk of environmental damage).

The ERA procedure is triggered prior to a significant decision affecting the environment. It can be broken into three broad stages:

- I. Preparation, involving collecting and examining relevant background information, and establishing the focus for the assessment;
- II. Conducting the assessment; and Interpreting, reporting and applying results of the assessment.

ERA is a support tool for policy evaluation, land use planning, and resource management decision making. It is systematic, and can be applied in a variety of situations, ranging from those with minimal available data and resources, to those with detailed inventories and complex systems modeling.

The CEMP plans are prepared by considering different aspects such as surrounding of projects, environmental conditions their probabilities and consequences.

In developing the CEMP, an Environmental Risk Assessment will be undertaken. It is an essential step in the development of solutions for pollution problem and new environmental regulations. Environmental Risk Assessment is the identification and characterization of the nature of existing and potential adverse effects to humans and the environment resulting from exposure to environmental hazard. Risk is function of the probability of an event occurring and the degree of damage that would result should it happen. Information from the environment assessment is required in order to conduct a risk assessment.

The risk assessment identifies all aspects of construction that could have an environmental impact and assesses the potential risk and impact of that activity on the environment.[3] Management controls are then devised to eliminate and/or minimize those identified impacts. Risk evaluating is the frequencies and consequences of risk occurrences of activity or exposure and generation of risks that arises from dangers, considering the adequacy of any existing controls, impacts and deciding whether or not the risk is acceptable.

The assessment is made at the site, local, area and regional level in Nashik. Special attention is paid to the site-wide and local levels when assessing impacts. In most assessments of environmental impact it is difficult to determine the quantitative value of the environmental change. So the semi-quantitative assessment considered which is based on scores.

With this the environmental risk assessment is identified with different environmental impacts or risks in construction by risk calculations. Then significance scoring is gives rating for each environmental aspect for finding risk rating.

## II. METHODOLOGY

The Construction Environmental Management Plan (CEMP) is studied with the different contents as shown above and identifying those construction activities that may have a detrimental impact on the environment and detailing the mitigation measures that will need to be taken and then procedures for their implementation also establishing the reporting system to be undertaken during the construction

The EMP also serves to highlight specific requirements that will be monitored during the development and should the environmental impacts not have been satisfactory prevented or mitigated, corrective action will have to be taken.

The Environmental Management section of the CEMP should include information regarding the policy statement, Environmental Management Systems, project personnel roles and responsibilities, Environment Health Safety (EHS) regulations and requirements, environmental awareness training, CEMP review and updates, and environmental commitments.

Firstly developing environmental policy that includes management and then develops programs and frameworks to assess environmental risks means undertake risk assessments of all work processes.

Then implement measures to manage environmental risks. Then monitor, audit and assess environmental outcomes and lastly report internally and externally and revise programs where necessary. This is complete structure of the CEMP. In this project the environmental risk assessment is identified with different environmental impacts or risks in construction by risk calculations. Then significance scoring is gives rating for each environmental aspect for finding risk rating.

Lists of potential issues that will need to be addressed in the plan are provided below based on information provided in the Environmental Statement with the investigation.

- Construction noise and vibration management
- Air quality including dust management
- Energy conservation management
- Land and Air management
- Management and protection of ecological resources (particularly relating to timing of certain works).The main aim of this work is to find out the important factors causing environmental impacts in the construction projects in context particularly for environment risk. For this interview was taken. The interview invited respondents to rate the Frequency and severity of the environmental impact factors or risks using the five-point Likert Scale [4].

Determining the rate of environmental impacts depends on the probability of a frequency of occurrence and its severity of impact on the environment. Probability or frequency is a likelihood of construction activities potential being realized and initiating a series of impacts that could result in damage to the environment. The severity of the consequences is the extent of damage that could result from an impact on the environment.

With the Likert Scale the questionnaire survey is taken of eight major construction firms in Nasik. The mega residential projects townships are ongoing of these firms. In this firm respondents were from different level of organization and scale is use to determine the scoring of the important factors causing environmental risk. The twenty one questionnaire interview was carried out among this construction companies. The majority of these firms are operating in Residential and Commercial projects. The interviews were carried out among top-level managers with different areas of the companies. Top-level managers were selected for the interviews because they were assumed to have sufficient

knowledge about the environmental management systems.

The factors considered in the study were identified from a literature review [1]. A total of 3 possible main factors and 21 sub factors, that were felt to have an effect on the environment of construction were determined. Similarly, the Sub-factors of these main factors were determined based on literature review and their impact rating were calculated according to the responses.

Respondents assign score from 0 to 5 for each main factors and sub factors according to their importance. A respondent refers Table 1 for assigning score to each main and sub factors at a time of questionnaire interview. Importance was decided on basis of expert talk opinion and discussion with the people who are actually in the field of management.

Table 1: Likert Scale Used To Determine the Level of Frequency and Severity

Score	Severity	Frequency	Description
1	Insignificant	Minimal impact	Never
2	Minor	Short-term impact	Unlikely
3	Moderate	Significant impact	Possible
4	Major	short-term impact	Major Likely
5	Catastrophic	Major long-term impact	Always

Risk can be assessed and offered using matrices by working out probabilities and consequences in a qualitative manner or with quantitative values a risk matrix has been used to rank various risks in order of importance. A risk matrix is a table that includes several categories of probability, frequency, or likelihood for its rows and several categories of severity, consequences, or impact [4]. It gives the values of total probabilities with consequences by multiplication and then the outcome matrix will gives discern probable environmental impact levels for each

common environmental impact in residential construction projects. The significant rating of a risk that is found in the literature is the product of the probability of occurrence and the consequence or net effect of that event shown, in Eq.1

$$R = F \times S \tag{1}$$

where R denotes the importance rating of an environmental impact level in a construction project; F is the frequency of occurrence, ranging from 1 to 5 which '1' is the least frequent and '5' is the extremely frequent; and S is the severity of impacts on the environment, ranging from 1 to 5 which '1' is the not sever and '5' is the extremely sever [1].

### III. DISSECTION AND RESULTS

A management panel was interviewed to rank the severity and frequency of some common environmental impacts in the different residential projects in Nashik. The responded gives scores to impact factors with five point Likert scale. By taking twenty one questionerrie surveys (n=21). They were having an experience of at list 2 years. The ranking of the level of severity and frequency is given by the calculations of scores. Then factors according to their average scores of impacts are calculated with frequency of occurrence and severity of impact by the respondents as shown in Table 2.

Table 2: Calculation For The Average of Common Environmental Impacts Assessments of Impact/Risk Factor (Natural Resources Impact).

Environmental Impact Factors		Frequency of Occurrence (F)	Severity of Impact (S)	Impact level/ Significant Rating (R=FxS)
Natural Resource Impact	Transportation fuel Resources	3.048	2.86	8.73
	Energy Consumption on Site	2.952	2.90	8.56
	Raw Materials Consumption on site	2.619	2.33	6.10

Electricity Consumption on site	2.952	2.62	7.74
<b>Total Impact Level</b>			38.86

Table 3: Calculation For The Average Of Common Environmental Impacts Assessments Of Impact/Risk Factor (ECOSYSTEM Impact).

Environmental Impact Factors	Frequency of Occurrence (F)	Severity of Impact (S)	Impact level/ Significant Rating (R=FxS)	
Ecosystem Impact	Noise pollution	2.67	3.14	8.38
	Dust Generation with Construction Machinery	2.57	2.71	6.96
	Land pollution	2.48	2.48	6.15
	Air pollution	2.52	2.67	6.72
	Operations with Vegetation Removal	3.19	3.00	9.57
	Toxic generation at site	1.86	1.90	3.53
	Green House Gas Emission	1.57	1.29	2.03
	Vibration Generation with Construction Machinery	2.24	2.48	5.56

Water pollution	1.86	2.67	4.96
Waste generation	2.90	2.76	8.00
Soil Erosion	3.62	3.86	13.97
Emission of Volatile organic compound (VOC)	2.95	2.52	7.43
<b>Total Impact Level</b>			83.26

Table 4: Calculation For The Average Of Common Environmental Impacts Assessments Of Impact/Risk Factor (PUBLIC Impact).

Environmental Impact Factors		Frequency of Occurrence (F)	Severity of Impact (S)	Impact level/Significant rating (R=FxS)
Public Impact	Site hygiene condition	3.33	3.67	12.22
	Labour facilities	2.33	2.62	6.10
	Public Health Impact	3.19	2.71	8.64
	Social Disruption	2.86	2.62	7.49
	Heritage and Archaeology	2.43	3.14	7.63
	<b>Total Impact level</b>			42.08

With the assessment of risk is carried out by calculated risk assessment table. Risk Assessment is major part

in the construction environment management plan and it will assess risk qualitatively or quantitatively also. It may conduct at every stage of construction. So that at every level of construction and at every aspect risk may measure and finding impact level with risk assessment and proper mitigation may use to reduce it.

The managerial approach may develop in the construction industry so that proper planning will enhances positive impact and reduces negative impact on environment. This may achieve by conducting Environmental Risk Assessment. These are aimed at ensuring that the contractor maintains adequate control over the project which helps to minimize the extent of impact during construction also ensure appropriate restoration of areas affected by construction and prevent long term environmental degradation. Also it having specification about Identifying those construction activities that have a detrimental impact on the environment with the risk assessment then detailing the mitigation measures that will need to be taken, and the procedures for their implementation and establishing the reporting system to be undertaken during the construction.

The Impact level/Significant ratings are calculated for three major and twenty one sub factors. After calculating impact level for all main and sub factors having a highest value of impact levels are the most important risk factor.

The first five highest significant ratings are there in which most effective impact factor is soil erosion that will affect environment. The degradation of soil is one of the major environmental risk factor.

Second is Site Hygiene Conditions it may directly impact on the surrounding humans with the hygiene on site and cleanness.

Third is Operation of Vegetation Removal with this the surrounding which may contains some green cover they may remove for the construction and it may harm the surrounding environment of construction projects.

Fourth is Transportation Resources are the resources that consume natural energy which will impact on environment.

Then fifth is Public Health Impact in construction project is one of the important aspects. The public health is major issue that will relate the health and life of people who are work at site and live along with that particular project. They may suffer some problems regarding construction and it will ultimately affect health environment.

IV. CONCLUSION

With the study of fundamentals of Construction Environmental management Plans (CEMP), the managerial approach may develop in the construction industry so that proper planning will enhances positive impact and reduces negative impact on environment. This may achieve by conducting Environmental Risk Assessment. The Environmental Risk Assessment is major part in environmental management plan (EMP). Due regard must be given to environmental protection during the entire project. In order to achieve this number of environmental specifications recommendations are made. These are aimed at ensuring that the contractor maintains adequate control over the project which helps to minimize the extent of impact during construction also ensure appropriate restoration of areas affected by construction and Prevent long term environmental degradation. The environmental risk assessment is identified with different environmental impacts or risks in construction by risk calculations. Then significance scoring is gives rating for each environmental aspect for finding risk rating by like rt scale. The environmental risk assessment is assessing the different impact factors. Those factors are responsible for affecting construction project. They may recommend for further mitigation.

Also this study investigated the environmental impacts due to construction processes in residential buildings in order of their impact levels. An interview with a panel group was conducted to determine the frequency and severity of the environmental impacts in the construction activities by giving rating or scoring them. With the percentage value of 51%, the ecosystem impact may hamper environment mostly than other two impacts.

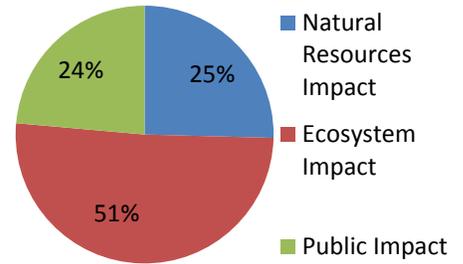


Fig 1: Total Impact Level

The significant rating or Impact Level is finding out for different risk factors. The results demonstrate that Operations with soil Erosion, Site Hygiene Condition, Operation of Vegetation Removal, Transportation Fuel Resources are the most risky environmental impacts on construction sites. The Major impact is not acceptable, further mitigation required for this impact level. Soil Erosion, Site Hygiene Condition, Operation of Vegetation Removal, Transportation Fuel Resources and Public Health Impact, for this impact factors continuous monitoring, further mitigation is required.

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