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ENVIRONMENTAL IMPACT ASSESSMENT STUDY AND MITIGATION MEASURES FOR BUILDING CONSTRUCTION ACTIVITIES

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ABSTRACT

Indian villagers are migrating towards cities from villages due to the industrialization and population growth, hence human settlement in cities becomes crowded. This generates several issues with regard to the environment. Environmental Impact Assessment (EIA) provides systematic environmental management plan, probable impacts on environment and its mitigation measures. The growth rate of Indian construction sector is very high as compared to the other countries. Providing EIA for construction activity will reduces probable environmental impacts. It is necessary to prepare a detailed account of environmental impact due to the proposed activity so that appropriate precautions or mitigation measures could be taken. This paper is to study environmental impact of building construction project and its mitigation measures. The study covers various parameters like location, parking system, rainwater harvesting system, sewage treatment plant, water quality, solid waste management, source of water, ground water quality of study area, nearest sensitive areas and overall socioeconomics. Aim is to define the project in a systematic manner and suggest possible mitigation measures for development. The primary purpose of this study is to establish Eco-friendly management of the construction activities

KEYWORDS: Environmental Impact Assessment, EIA, Building Construction, Assessment Methodology.

I. INTRODUCTION

The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction activities and use of buildings and related activities with a view to define an Environmental Management Plan (EMP) to minimize adverse environmental impacts.

Many cities in developing Asian countries have been facing serious problems originated due to increase of environmental pollution. Republic of India also experiencing environmental degradation due to rapid growth in economic, Population, Urbanization and industrialization. The country has a long history of unplanned developments in many sectors without safeguarding natural resources, social and environmental concerns [1]. In India the concept of environmental protection can be seriously started in eighties after a gas leak tragedy in Bhopal in which more than 1 lakh persons were injured and around 15,000 died. An government was stunned and then set up the Environmental Protection Act (EPA) 1986 under which a notification was passed in 1994 to make EIA mandatory for certain projects.

In a span of one decade, between 2001 and 2011, the number of million plus cities in India has increased from 35 to 53, while the number of towns and cities has increased from 5161 to 7935, leading to an overall increase in the proportion of urban population from 27.8% to 31.2 % [3]. Such a massive growth on urban population as well as rural-urban migration would create huge challenges for urban local bodies mainly in maintaining the environmental quality without any compromising the human safeguard. It is beyond doubt that urban planning, infrastructural development and the resource consumption patterns of the emerging urban space will impact ecosystems both within cities boundary as well as outside, with implications for the quality of life for people across the country. Problems in the levels of amenities as well as natural resources endowments may arise where building construction projects inadequately deal with environmental impacts.

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A. Environmental Impact Assessment

The term EIA refers to the process of identifying, predicting, evaluating and mitigating the environmental consequences of any development projects and to decrease the possible adverse impacts. It is also one of the most popular decision-making tools and has been integrated in the regulatory system of many countries.

Based on the project types and severity of impact, the EIA can be conducted by two types. They are,

Rapid EIA

- This is carried out for projects having limited (or) less adverse impacts.
- Baseline data (or) information is collected for only one season (other than monsoon)
- Time frame for Rapid EIA is Shorter (3 months)

Comprehensive EIA

- This is carried out for projects having series of adverse impacts.
- Baseline data (or) other related information for three seasons (other than monsoons)
- Time frame for Comprehensive EIA is more than a year

Note

As per the EIA notification, the appropriate authority is empowered to decide whether the project proponent has to conduct a rapid or comprehensive EIA.

B. Need of EIA for Building construction projects

A high standard of environmental quality and sustainability requires for building construction is characterized by clean environment and ecofriendly building with safe and health comfort, energy efficiency, water efficiency, ambient air quality, parking area and green cover area including open spaces. EIA of building construction projects focuses on the prediction of environmental impact of the different components of the construction activity, ways and means to reduce adverse impacts by shaping the project to suit local environmental conditions, and presents the predictions and options to the decision-makers. Some important components of quality of life in urban neighborhoods are summarized as follows [3]:-

- **Environment**: important component of quality of life
- **Physical**: air quality, water quality, derelict land, open space, noise
- **Built**: building type, condition, appearance
- **Social**: education, community participation, services, crime, health, mental health.
- **Economic**: employment and income

C. EIA procedure for Building construction projects

EIA procedure systematically examines both positive and negative impacts of the proposed project and ensures that these impacts are taken into account during the project design. The building construction project falls under 8(a) category of EIA notification 2006 (as amended) by Ministry of Environment and Forests (MoEF). It is required to prepare EIA report on the basis of guidance manual and then submitted to the appropriate authority. The EIA is therefore based on predictions. These impacts can include all relevant aspects of the natural, social, economic, and human environment. The study, therefore, requires a multi-disciplinary approach and should be done very early at the feasibility stage of a project [3].

II. RELATED WORKS- LITERATURE REVIEW

A secondary investigation was carried out on the previous researches done on EIA across the globe. Also, these literatures were referred for the selected methodologies applied to issues regarding in the analysis of data or information in the EIA process. As a part of the study text book related to EIA and the government guidance manuals for various projects in India was reviewed.

A. Findings from literature survey

Review of the traditional methodology followed on EIA and upcoming new tools and techniques to analyze the process can be identified. A comprehensive review is carried out on the adequacy and qualities of EIA report with respect to one of the major issues are report does not address the Term of Reference (ToR) [1].

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B. Problem identification

The effects of alternative spatial plan policies were assessed in GIS are against a set of environmental performance indicators, including deforestation, loss of agricultural land, encroachment of flood-prone areas and wetlands and access to water sources. Critical environmental effects were restricted to policies, not development projects [7].

III. STUDY AREA

The entire study was conducted at Village: Ghodbunder, Tal: Thane, Dist: Thane, Maharashtra. Today it is an important educational, industrial hub. The intricate network of creek, tanks and groundwater forms the city's essential blue-green infrastructure, providing water, drainage and sanitation for domestic, agricultural and industrial use. This will lead to further pressures on infrastructure, housing and basic services.

A. Study Area-Background

The area split up and space utilization details for the existing and proposed developments are given in the following sections.

TABLE 1. Land area breakup- Total activity area

Class Name	Area Sq. km	Area %
Beach	680700	0.22
Saltpan	9623575	3.06
Open Land	68768750	21.88
Hilly Region	58634075	18.66
Vegetation	80139350	25.50
Water body	28960125	9.22
Mangroves	28460625	9.06
Built up area	38984600	12.41
Total	**314251800**	**100**

The study area details are listed in the Table 2.

TABLE 2. Details of Study area

S.No.	Parameters	Details of study area
1	Study Location	Village Ghodbunder
2	Nearest railway station	Mira road rail way station
3	Source of supply water	Municipal Water Supply
4	Nearest city/town	Dahisar
5	Nearest water bodies.	Ulhas River/Vasai Creek
6	Nearest highway	NH-8
7	Nearest sensitive zone	Schools and Temples
8	Nearest airport	Mumbai airport(19 KM)
9	Nearest forests	Sanjay Gandhi National Park, Borivali

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TABLE 3. Pollutant Sources and Characteristics

Sr. No.	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
CONSTRUCTION PHASE				
1.	Construction Site Preparation	Air emissions – SPM, PM_{10}, CO, NO_x, SO_2	Dust from construction activities and excavation. Particulates, NO_x and CO from vehicle exhaust	Temporary during construction phase only- bulk of the emissions are expected from ground working and levelling activities.
		Earth / solid waste	Solid waste from construction activity and excavation.	Periodic.
		Noise	Noise generated from construction equipment and machinery	Temporary during initial construction phase.
2.	Labour Camps	Sewage	Sewage generated from temporary labour camps	Temporary – during the initial construction phase
		Solid Waste	Solid Waste generated from temporary labour camps	Temporary – during the initial construction phase
FUNCTIONAL PHASE				
1.	Vehicular movement	Air emissions and Noise	Vehicle exhaust emissions	Continuous / Periodic
2.	Diesel generators	Air emissions	SO_2, NOx, SPM, CO from fuel burning	Periodic during power failure
		Noise	Noise due to running of equipment	Periodic during power failure

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Sr. No.	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
		Hazardous waste	Used Oil Generation	Periodic, during oil changes
3.	Sewage treatment Plant	Solid waste	Settled and stabilized sludge	Continuous
		Treated water	Treated sewage used for horticulture	Continuous
4.	Diesel Storage	Solid waste	Settled sludge during tank cleaning	Occasional
		Oil	Oil spillage – Accidental large spills due to pipe rupture Oil Spillage - Small quantities due to small pipe leaks	Accidental / Only due to poor housekeeping
5.	LPG Cylinders	Thermal /Blast Effect	Accidental Explosion due to LPG leaks and fire	Accidental
6.	Maintenance/ housekeeping	Wastewater	Floor washing	Continuous
		Solid waste	Used equipment parts and garden wastes	Continuous
7.	Air conditioners	Air emission	Ozone Depleting Substance release	Continuous
8.	Vehicle Parking Area	Oil Spills	Minor oil leaks in parking lot	Continuous– small quantities
9.	Storm water drains	Wastewater	Contamination discharge from site – Mainly suspended solids	During rainy season

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TABLE 4. Environmental Aspects of Construction activities and Use

Sr. No.	Area	Aspect
I.	Energy conservation	Solar Heat Gains Solar Heating Day lighting Design Natural Ventilation Thermal Transfer Value of Building Material Energy Efficient Building Services and Equipment Public Area Lighting Exterior Lighting
II.	Water Conservation	Water Metering Reuse of recycled Water Gardening Water Source Bathroom Fittings Rainwater Harvesting
III.	Internal Roads and Accesses	Pedestrian Access Ramps for Disabled Persons Road Painting and Signage Speed Breakers
IV.	Material Use	Construction Materials Selection Paint Selection Use of Recycled Materials Use of Ozone Depleting Substances Use of Permanent Timber for Permanent Works Use of Timber for Temporary Works
V.	Aesthetics During Functional Use	Stilt parking Visitors Parking Vehicle Washing Arrangements Playground for children Service Roads for Walking Air Conditioning Arrangements Standby Power Supply Provision for Garden and Complex Maintenance Staff
V.	Facilities for Building Complex Servants	Servant Quarters Rest Rooms with toilets for Security Persons Rest Rooms and Eating Places for Drivers
VI.	Location with respect to Potential Hazards	Contaminated Land Industrial Area Solid Waste Disposal Area Municipal Wastewater Treatment Plant Hazardous Waste Disposal Facilities Sea coast

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B. Study area-Environmental Survey

Based upon the EIA notification 2006, any new project or Expansion/Modernization of existing projects requires submitting a Form-1(Details of the project) consists of Name, Location, nearest places, project facilities etc mention in the above table I & II and Form-1A (Information Checklist) consist of primary and secondary impact of the project. Information checklist consists of series of questions based upon the environmental parameters. It can be evaluated by extensive field checks and questionnaire surveys. The selected study area can be surveyed under visual and behavioral observation to gather the required information for the questionnaires.

C. Baseline Data of Study area

Baseline environmental status forms the basis for evaluation of the construction activities on the existing conditions. This can be broadly grouped into physical, social, aesthetic and economic environment. Physical environment includes air, water, land, aquatic and terrestrial flora & fauna, civic infrastructure, public services, etc. Social environment includes demography, community facilities and services, community characteristics, employment centers, commercial facilities servicing the area, etc. Aesthetic environment includes historical monuments, archaeological or architectural sites at and in the vicinity of the construction activities. Economic environment covers employment levels, sources and levels of income, economic base of the area, land values, land ownership etc.

Scope of Baseline Studies

For the present Environmental Impact Assessment study, the attributes of environment considered are:

- Air environment (Meteorology, ambient air quality, noise levels, traffic pattern and traffic density);
- Water environment ;
- Land environment (Geology, Geo-hydrology, land use, solid waste disposal etc.);
- Biological environment (Flora, fauna, vegetation, ecosystem); and
- Socio-economic environment (Demography, occupational structure, educational, medical facilities, literacy etc.)

It is important to define the study area for conducting the Environmental Impact Assessment Study which could reflect the changes due to the construction activities. The present study is carried out in 10 km radius of the construction activities. The environmental parameters are studied to establish an existing environmental scenario of an area covering 10-km radius, which is considered as an impact zone.

i. Noise level study

Noise is a prominent feature of the environment including noise from transport, industry and neighbors. An important part of noise assessment is the actual measurement of the noise levels. Traffic noise produced by vehicles operating on highways has been the source of concern all over the world. The traffic noise of motor vehicles, construction activities such as movement of heavy vehicles, operation of construction equipment and transportation of materials in urban areas may lead to the environmental problems which might affect adversely human health, poor working efficiency and productivity in the study area. Mostly in the institutional buildings the laboratories and parking area causes much noise.

TABLE 5. Ambient Noise Quality Standards

Area Code	Category of Area/Zone	Limits in dB(A) Leq	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

ii. Water quality study

Water is an essential thing for basic utilities and day to day domestic purposes. As well as water is need for construction activities. Therefore, the study of water quality is important for EIA to find the various parameters of ground water in the study area are tabulated below.

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Both surface and ground water resources were identified within the study area. Ulhas River/creek forms the major water body in the study area of 5 km radius. However the upcoming developments will not affect these water bodies directly or indirectly.

The drinking water is provided through municipal water supply pipelines in study area. Tanker water is seldom used in case of unavailability of municipal water supply.

Water analysis of physico-chemical and parameters related to health were carried out as per the Standard IS 10500 to assess baseline water quality. The results of the water quality along with the parameters which were monitored are given in Table.

Table 6. Water Quality standards

Sr. No.	Parameters	Unit	Permissible limits
1.	Colour	Hazen	25
2.	Odour	-	Unobjectionable
3.	pH	-	6.5 - 8.5
4.	Temperature	°C	NS
5.	Suspended Solids	mg/lit	NS
6.	Oil & Grease	mg/lit	0.03
7.	Total Residual Chlorine	mg/lit	--
8.	Total kjeldahl Nitrogen (TKN)	mg/lit	--
9.	Chlorides	mg/lit	NS
10.	Bio-Chemical Oxygen Demand (5 days at 20°C)	mg/lit	NS
11.	DO	mg/lit	NS
12.	Lead	mg/lit	0.05
13.	Chromium as Cr+6	mg/lit	NS
14.	Total Chromium	mg/lit	0.05
15.	Copper as Cu	mg/lit	1.5
16.	Zinc as Zn	mg/lit	15
17.	Cadmium	mg/lit	0.01
18.	PO4	mg/lit	--
19.	Sulphide	mg/lit	--
20.	Phenol	mg/lit	0.002
21.	Manganese as Mn	mg/lit	NS
22.	Iron as Fe	mg/lit	1.0
23.	NO3	mg/lit	--

Note: N.D:- Not Detected, N.S:- NOT Specified

iii. Air Quality Monitoring

Air quality was monitored at study area location for peak hour (10.30am to 4.30pm). Air pollution is the addition of gases, chemicals and particulate matter into the atmosphere. Large quantities of dust become wind borne and were carried away depending on the wind velocity and wind direction [8].

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Table 7. National Ambient Air Quality Standards (NAAQS)

Sr. No.	Pollutants	Time Weighted Average	Concentration in Ambient Air (in µg/m^3 except indicated)	
			Industrial Residential, Rural and Other Areas	Sensitive Area
1	Sulphur dioxide (SO_2)	Annual Average*	50	20
		24 Hours**	80	80
2	Nitrogen Dioxide (NO_2)	Annual Average *	40	30
		24 Hours**	80	80
3	Particular Matter (Size less than 10 µg) or PM_{10}	Annual Average *	60	60
		24 Hours**	100	100
4	Particular Matter (Size less than 2.5 µg) or $PM_{2.5}$	Annual Average *	40	40
		24 Hours**	60	60
5	Lead (Pb)	Annual Average *	0.50	0.50
		24 Hours**	1.0	1.0
6	Carbon monoxide (CO)	8 Hour Average	02 mg/m^3	02 mg/ m^3
		1 Hour Average	04 mg/ m^3	04 mg/ m^3
7	Ammonia (NH_3)	Annual Average *	100	100
		24 Hours**	400	400
8	Benzene (C_6H_6)	Annual Average *	05	05
9	Benzo (a) Pyrene (BaP)- particulate phase only	Annual Average *	01	01
10	Arsenic (As)	Annual Average *	06	06
11	Nickel (Ni)	Annual Average *	20	20
12	Ozone (O_3)	8 Hour Average	100	100
		1 Hour Average	180	180

IV. MITIGATION MEASURES

The main aim of the mitigation measures to protect and enhance the existing environment of the study area. The measures should have positive effects on environment. Environmental mitigations are essential and shall be undertaken in various phase of project cycle viz. preconstruction, construction and operation stage of the any project [9].

As per the noise quality, water quality and air quality records of study area, the noise quality in some of the places that can be exceed the standards level. The water quality parameters are under permissible limits. The another main components of ambient air quality results within limits, namely suspended particulate matter as per the standards of National ambient air quality standards (NAAQS). Hence our study area does not affect by air pollution but we need mitigation measures required to prevent noisy environment. So we suggest some mitigation measures to control the noise pollution by installation of barriers, strong leafy trees, limitation of vehicle speed and provide sound proof doors and windows are proposed in our study area. The environmental monitoring can be done periodically once in three month of frequency of sampling and analysis of ambient air quality, stack emission from DG set, ambient noise level and treated sewage to maintain the ecofriendly environment as well as to reach as sustainable campus in future.

V. EIA SYSTEM

Step 1- Screening

Upon a project application, a decision needs to be made whether the development requires an EIA. For any work that will alter the physical nature of the land, the person proposing the development must submit an EIA screening application.

An Approving authority is any public authority or person authorized under a written law to approve a development proposal. Examples of approving authorities include:

- Ministry of Environment and forest (under Environmental protection act,1986)
- Directorate of Town and Country Planning (under Town and Country Planning Act, 1971)
- Pollution control board (under Prevention and Control of Pollution Act,1981).

According to the EIA notification 2006, proposals that come under category-A and category-B will require EIA. Under category-B, any proposal that could come in general condition and special condition it can be treated as category-A. The category can be divided on the basis of threshold limit mentioned in the notifications amendments.

Step 2- Scoping

The scoping step involves activities like formal and informal meeting with all affected people, physical site inspection, public participation, and writing up a Terms of Reference [TOR] for the conduct of the EIA study. However, the data collected from site inspection and information collated from face-to-face meeting can be provided as input into the system for further processing and subsequent TOR Report and EIA decision [2].

Step-3 Data collection

The baseline data collection also cannot be computerized. Due to changes in site variations, climatic factor, local peoples and environmental conditions the computerized process is not suit but the data collected from site inspection and information collated from face-to-face meeting can be provided as input into the system for further processing and subsequent TOR Report and EIA decision [2].

Step- 4 Public participation

Another activity is public participation during this step. The public should be able to view the Application and its related information online. All the data and information collected so far in the process of the application is available online for public knowledge. The EIA process becomes transparent and accountable. The public can air their concerns about the proposed development via online submissions or attend public scoping meetings to be heard. The applicant and the processing authority are present to answer questions [2].

Step-5 Impact analysis

The purpose of the EIA study is to assess potential significant environmental issues associated with a project,

and to develop appropriate methods to resolve those issues. Considerable amounts of fieldwork are usually performed in an EIA study so that accurate measurements of environmental values can be used in making impact predictions.

Step-6 Mitigation & Environmental Management Plan (EMP)
The implementation of an EMP, mitigation measures are some of the weaknesses of Indian EIA system. This component can check for regulatory compliance of climate change regulations and other pollution levels. This will be the focus of a future research paper looking at Automated Regulatory Compliance of the EIA process.

Step 7- Appraisal
In India the online submission of TOR and EIA report are available on e-Government Portal of MOEF and State Environmental impact Assessment Authority (SEIAA) website. An applicant who is not happy with the rejection of his EIA may appeal the decision using the online system. A resubmission appeal needs to contain strategies for mitigating those environmental impacts [2].

Step 8- Post monitoring
Monitoring and EMP are part of the same process. These shortfalls are due to the lack of enforcement machinery and environmental authorities. Development projects are monitored to check whether it is complying or not with the required regulations. A monitoring component can be added into the system. However, the monitoring and compliance will be the focus of a future research paper looking at Automated Regulatory Compliance of the EIA process [7].

VI. RESULTS AND DISCUSSIONS

Developing nations like India and China needs developmental projects for social and economic development. In many case, poor EIA for developmental projects leads to permanent environmental damage such as climate change, environmental degradation, natural resources depletion, loss of biodiversity and also affect human beings. So developing nations need solution for EIA enforcement. Information and Communication and Technology (ICT) can provide flexible cost, effective solution for EIA automation, monitoring and enforcement. A detailed EIA study is a contribution for Effective impact assessment process, Environmental monitoring, Ecofriendly building and Sustainable development.

VII. CONCLUSION

Planned approach is essential for integration between urban development, environmental conservation and overall wellbeing of people. Thus creation and maintenance of ecofriendly and sustainability is a future consideration of environment to save the resources, environmental quality and human health also. So every developmental projects need an effective EIA preparation as well as existing projects also must need to maintenance the environmental quality by properly doing of environmental monitoring program and also good environmental management plan (EMP) is needed to ensure the mitigation measures specified in the EIA report. This paper shows to suggest that EIA documentation process and environmental monitoring can be recommended to done as systematic to solve the problems and issues in the current manual EIA process.

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