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IMPACT OF CONSTRUCTION ACTIVITIES ON ENVIRONMENT

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ABSTRACT

Construction processes and related activities have significantly aided in environmental pollution and degradation of environment, deforestation, and other environmental issues. Construction operations have a negative influence on the environment because of waste creation, consumption of resources, noise pollution, air pollution from construction dust, and foul odors from huge diesel-powered construction equipment and vehicles used for transporting materials. This study's objective is to evaluate how construction affects the environment in order to provide solutions for mitigation and strategies for enforcement. To acquire information from primary sources, a literature review was conducted. Although all these effects cannot be eliminated, but various mitigation strategies, such as Environmental Management System (EMS), Environmental Impact Assessment (EIA), Quantitative Risk Assessment (QRA), Green Building (sustainable construction), and Environmental Protection Agency (EPA) can be used. As a result, the government and construction stakeholders should make a conscious effort to effectively integrate and start enforcing the present approaches/initiatives during the construction processes. These measures should be monitored from start to finish and legislative laws should be formulated in order to spell out punishment for the scenarios of violations. It is also advised that construction stakeholders become more aware of, and learn about, the environmental implications of building construction operations.

Keywords: Construction, Impact on Environment

1. INTRODUCTION

Environmental degradation is one of the most frequently discussed topics locally, internationally, and globally. Bentivegna et al. (2002). The expansion of the population and the pursuit of progress, including the improvement of the built environment, have all contributed to the depletion of global warming, resource depletion, ecological damage, and the ozone layer (ibid). Due to the significant environmental impact of their operations, this has highlighted constructed environment and construction industry. Construction operations influence the environment during the development cycle. These consequences have an impact on

all stages of a building's life cycle, from the beginning of construction site activities to the end, use, and demolition.

Even though it lasts only a short time compared to other phases of a building's life, the construction phase has a number of significant environmental effects. Additionally, the effect that building operations have on both human and environmental health is worrisome. Even if the development of construction projects helps to support economic and social development while also raising living standards and quality of life, it also substantially degrades the environment at various stages. Azqueta (1992). Construction is a useful industry that provides infrastructure and facilities, but it also has certain negative effects on humankind. Environmental worries concerning construction projects have been raised on a global scale, with a focus on air pollutants, the natural resource depletion, and energy-related problems.

The methods utilized to obtain construction materials and the materials themselves provide a serious environmental danger. In order to reduce waste production, the usage of virgin resources, and the subsequent loss of energy utilized in the production of new materials, it is crucial to reduce consumption of these materials through recycling and reuse of waste.

Ecological integrity is at danger as a result of construction activities' significant and long-lasting harmful effects on the environment. Uher (1999). Buildings are a significant contributor to environmental deterioration, claims Levin (1997). It is apparent that actions must be done to increase the environmental friendliness of construction activities and the built environment Hill and Bowen, (1997), Barret et al., (1999), Cole, (1999), Holmes andHudson, (2000), Morel et al. (2001), Scheuer et al., (2003).

2. CONSUMPTION OF RESOURCES

Both renewable and non-renewable natural resources are heavily utilized in the construction industry. Uher (1999), Curwell and Cooper (1998), Spence and Mulligan (1995). The availability of raw materials for the construction process, such as lumber, sand, and aggregates, is significantly influenced by the natural environment. According to the World Watch Institute, 40% of those resources are used in building construction each year, along with 25% of the world's virgin wood, raw stone, gravel, and sand (2003). Additionally, it consumes 16% of the nation's water and 40% of its energy on an annual basis.

Table 1

Table 1 Estimate of Global Resources Used in Buildings

Resource	(%)
Energy	45–50
Water	50
Materials for buildings and roads (by bulk)	60
Agricultural land loss to buildings	80
Timber products for construction	60 (90% of hardwoods)
Coral reef destruction	50 (indirect)
Rainforest destruction	25 (indirect)

Source Hawken, et al. (1999), Natural, Capitalism – Creating the next Industrial Revolution, Little Brown and Co., 1999, 369.

3. EFFECTS OF CONSTRUCTION ON ENVIRONMENT

The environmental effects of construction activities are severe and must be avoided, according to numerous studies. The construction industry contributes significantly to the advancement of civilization. This is acknowledged, but it is also mentioned as a key factor contributing to the degradation of the ecosystem. Land depletion, energy demand and consumption, solid waste generation, gas and dust emissions, noise pollution, and the use of natural resources, particularly non-renewable resources, are all negative consequences on society.

According to Chen et al. (2000), there are seven main categories of pollutants and dangers related to building activities: Sound, solid and liquid waste, noxious fumes, dust, dropped objects, and additional movements on the ground Chen et al. considered the contaminating effects of subsurface water, dust, toxic pollutants, noise, vibration, and building and demolition debris, effects on animals and natural features, and archaeological consequences (2005). Cole (2000) claims that the construction process has environmental effects on resource use, ecological burdens, and problems with human health. According to Shen and Tam (2002), the effects of construction on the environment include the extraction of natural resources such as fossil fuels and minerals, the expansion of the use of basic resources such as land, water, air, and energy, the production of waste that necessitates the use of land for disposal, and the degradation of life through the release of pollutants such as solid and sanitary waste, as well as noise, smells, dust, vibrations, and chemical emissions.

Buildings and construction were responsible for 37% of all worldwide energy-related emissions in 2020, down from 38% in 2019. This minor drop is due to developments in other industries, such as industrial emissions, which happened more quickly than in the building sector. GABC Buildings-GSR, UNEP (2021)

Figure 1

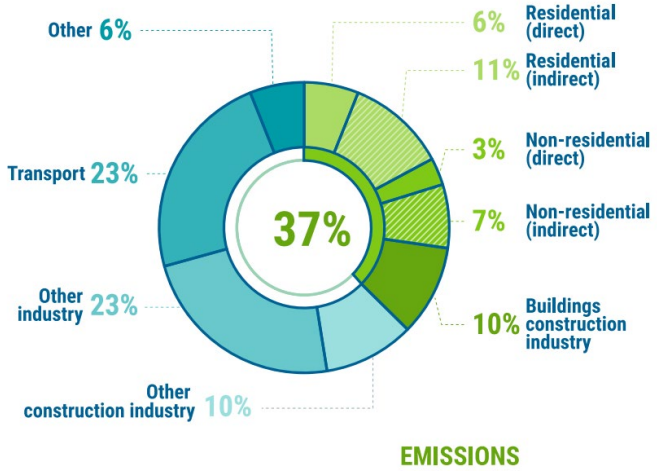

Figure 1 Buildings and Construction's Share of Global Energy-Related CO2 Emissions, 2020
Source IEA 2021a. All Rights Reserved. Adapted From "Tracking Clean Energy Progress"

Trash, muck, dust, pollution of the soil and water, damage to public drainage systems, plant mortality, aesthetic impact, noise, increased traffic and a scarcity of parking places, and deterioration of public space are some of the negative impacts of construction operations, according to Cardoso (2005).

According to another IEA report, Paris (2022), the built environment accounts for 40% of annual global CO2 emissions. Building operations account for 27% of total emissions, while building and infrastructure materials and construction (commonly referred to as embodied carbon) account for an additional 13%.

Figure 2

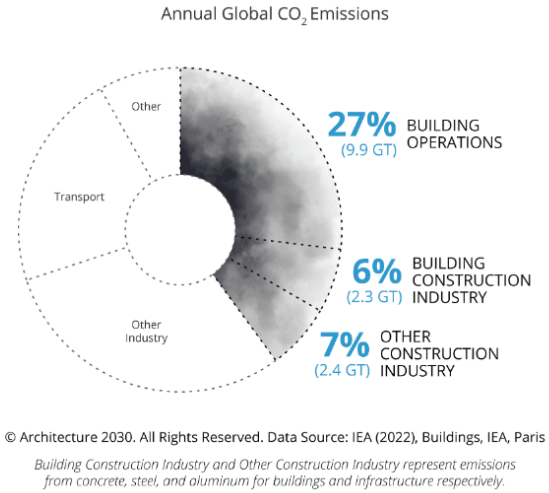

Figure 2

Levin claims that in the US, buildings are responsible for 40% of air pollutants, 20% of water effluents, and 13% of other wastes (1997). Dust and other pollutants contain certain dangerous compounds, such as nitrogen and Sulphur oxides. They constitute a serious hazard to the environment and are released during the production, shipping, and on-site activities of goods. Spence and Mulligan (1995), Ofori and Chan (1998), Rohracher (2001). Chlorofluorocarbons (CFCs), a class of harmful substances used in insulation, air conditioning, refrigeration equipment, and fire-fighting systems, have significantly damaged the ozone layer. Langford et al., (1999), Clough (1994). There have also been significant spills of hazardous materials into subterranean aquatic systems and reservoirs as a result of the discharge of pollutants into the biosphere, which has led to significant land and water contamination. Sometimes this has happened as a result of on-site negligence. Keinet al. (1999). According to Langford et al. (1999), roughly one-third of the world's land is degraded, and pollutants lower the quality of the environment, preventing it from naturally developing a balanced ecosystem. There is an enormous quantity of waste produced during resource production, transportation, and usage. Ofori and Chan (1998), Kein et al. (1999). Construction activities generate roughly 29% of the garbage in the US, compared to over 50% in the UK and 20–30% in Australia. 2001 (Teo & Loosemore). Construction generates 25% of the solid waste produced in the US, according to Levin (1997). The building sector generates between 40 and 50 percent of the waste imported into the European Union annually. Sterner (2002), Sjostrom and Bakens (1999). Most of the building waste is wasteful Sterner (2002). He said that there is considerable potential for recycling and reusing many construction and demolition materials. But recycling building waste requires time-consuming screening, inspecting, and processing, and the lack of environmental literacy among construction workers may seriously limit recycling's usefulness. Langston and Ding (1997). Given that the bulk of recyclable waste generated by the construction sector is disposed of in landfills, the depletion

of natural resources is a serious issue. According to Sterner (2002), incorporating a waste management plan into the planning and design phases can reduce waste generation on site by 15% and reduce trash handling costs by up to 50%.

Building operations permanently convert arable land into tangible assets like structures, roads, dams, and other civil engineering projects in addition to producing waste. Spence and Mulligan, (1995), Langford et al. (1999), Uher (1999). According to Langford et al., between 1980 and 1990, there was a loss of more than 7% of global agricultural productivity. (1999). Arable land is lost during the quarrying and mining processes used to get the raw materials for construction. Using wood in construction and the use of energy to produce building materials, construction also contributes to the destruction of forests. Deforestation and the usage of fossil fuels both directly contribute to air pollution and global warming. Furthermore, the building sector consumes a lot of energy, and using limited fossil fuel resources as a result has greatly increased carbon dioxide emissions. Langford et al., Uher, (1999), Clough (1994), Spence and Mulligan (1995), Ofori and Chan, 1998). Nearly 40% of the energy produced in Europe has been used for construction. Rohracher (2001), Sterner (2002), Sjostrom and Bakens (1999).

In India, the marble industry generates about 6 MT of waste per year because of various operations like cutting, processing, polishing, and grinding marbles. About 95% of the marble produced in India is generated in Rajasthan, which is also thought to have one of the greatest marble reserves in the world with over 4000 marble mines. According to a 2017 IIT Kanpur study, the largest source of urban pollution is road dust, which accounts for 38% of harmful and respirable PM 2.5 subatomic particles and 56% of all PM10 particles.

Brick and concrete, as illustrated in Figure 1 Hammond and Jones (2008), are the greatest contributions to carbon footprint when compared to other construction materials. The average carbon footprint of brick production is estimated to be 195g CO2/kg, including fuel and transportation Kulkarni and Rao (2016).

Figure 3

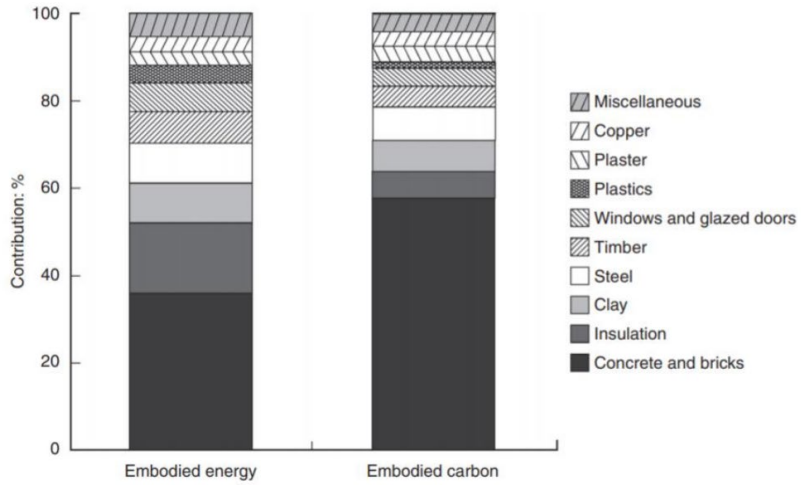

Figure 3 Constituent Raw Materials for Building

Several sustainable alternatives are presently employed in the building industry. Fly ash, recycled concrete, foam concrete, agro-based panel boards, recycled materials boards, silica fumes, recycled tyres, and so on are some of the most common Meyer (2009).

4. STRATEGIES TO MINIMIZE THE IMPACT

Construction causes environmental damage both locally and worldwide. Understanding the consequences of building on the environment is crucial for minimizing harm. Here are a few strategies for reducing the environmental impact of a construction project:

4.1. ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) is a collection of procedures or practises that allow a company to lower its total environmental impact while boosting its operational efficiency. It is a framework that allows a firm to meet its environmental objectives in a consistent manner. ISO 14001 is the most widely used international standard for evaluating environmental management systems. ISO 14001 provides guidance for businesses and other organisations to build and execute an EMS. I. Petrosillo, A. De Marco, S. Botta, and C. Comoglio, ―EMAS in local authorities: Suitable indicators in adopting environmental management systems, ‖ Ecol. Indic., vol. 13, no. 1, pp. 263–274, 2012.

4.2. ENVIRONMENT IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment (EIA) is the process of detecting, forecasting, assessing, and mitigating the biophysical, social, and other relevant consequences of development proposals prior to large commitment Barlett and Prior (1991). The goal of EIA, according to the International Association for Impact Assessment Act IAIA (2000), is to guarantee that decision makers evaluate all possible impacts and their respective effects when deciding on a project.

Environmental Impact Assessment (EIA) is a tool to properly anticipate and evaluate the likely impacts of a proposed construction project or development activity and propose measures and strategies to mitigate the adverse impacts. It also takes into consideration, both the negative and positive impacts due to interdependent socio-economic, cultural, and human-health aspects due to these construction projects.

4.3. USE OF BIOMATERIALS

In construction industry, biomaterials can be proved to resolve numerous issues faced in conventional materials. The major benefit of the all the new engineered materials is that they are energy efficient and are capable of reducing carbon emissions to a large extent. Many companies are also accelerating their technology platforms to enable broader applications in various different biologically engineered construction materials.

4.4. LEAN PRINCIPLES BEFORE AND DURING CONSTRUCTION

The Lean Construction approach helps the building project by decreasing resource waste while also increasing productivity and ensuring a healthier and safer atmosphere. The primary idea of lean manufacturing is to promote the flow of useful activities while eliminating non-value stages.

4.5. LIMIT FUEL USAGE

The environmental impact of construction enterprises using fossil fuels like gas and diesel is quite detrimental. Every building activity generates these methane, carbon dioxide, and other air pollution-causing gas emissions. It is believed that these emissions contribute to global warming. To save gasoline, minimise vehicle idling time, cut haul lengths, switch to cleaner alternative fuels, and employ hybrid equipment. Your efforts to minimise fuel use and enhance air quality can help the building project.

4.6. REDUCE NOISE

Construction noise considerably worsens already existing noise pollution. The machinery required for site preparation, demolition, and landscaping produces the majority of this noise. Because many construction sites are located near homes and businesses, noise complaints may be common. Before starting a project, make careful to demonstrate consideration for others and adhere to any municipal construction time constraints. Many folks may not appreciate the sound of heavy construction and work starting at six a.m. on a Saturday.

4.7. PROPERLY WASTE DISPOSAL

In 2014, the United States generated over 534 million tonnes of waste building materials. Demolition trash accounts for 90% of all debris, and the majority of it is disposed of in landfills or by incineration. Environmental harm results from these two techniques. Reduce the quantity of waste that is hurting our priceless environment by recovering, reusing, and recycling the materials already in your possession. Hardware, fixtures, and appliances can all be recycled or put to use once more. These can be utilized for upcoming projects or donated to people in need. Metals, wood, masonry, and concrete are significant recyclable materials that can be recovered and used as fill or driveway bedding.

4.8. UTILIZE REUSABLE TECHNOLOGY

To lessen these environmental effects, a range of green construction techniques can be used. For instance, inflated water dams lessen erosion, runoff, and sedimentation. In contrast to costly and time-consuming sandbags and other traditional dewatering methods, inflatable water dams are reusable and take up little space. They are easier to install and less harmful to the environment because they utilise water that is already accessible on every project.

4.9. EXPEDITE YOUR PROJECT

By finishing a construction project faster, you may reduce traffic congestion, related emissions, and fuel expenses. Use these methods to keep on track and set certain completion deadlines. By reducing the amount of time that traffic is moving and accelerating construction, safety zones are improved, and noise pollution is lowered.

5. CONCLUSION

The ecology suffers as a result of construction activities. Although all of these problems cannot be eliminated, there are a variety of approaches/initiatives in place to minimize and mitigate these negative environmental impacts. However, implementing these measures has proven to be a significant difficulty. Because of the movement of vehicles and construction equipment, construction activities result in waste production, resource consumption, noise and air pollution, ecosystem deterioration, and greenhouse gas emissions. Two modern strategies/initiatives used to address these issues are responsible construction and environmental impact assessment (EIA). The construction process must be closely monitored from beginning to end, legislative laws outlining penalties for violations must be passed, strict punitive actions of representatives by various professional organizations must be put into place, contract management must be open and transparent, and ongoing professional advancement should be encouraged. It should be tried to integrate the strategies/initiatives into construction projects right away. To ensure that all of these strategies are used effectively and in compliance with standards, extra care should be used.

CONFLICT OF INTERESTS

None.

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None.

REFERENCES

Aghimien, D., Oke, A., and Aigbavboa, C. (2019). Environmental Sustainability : Impact of Construction Activities.

Ametepey, S. O., and Ansah, S. K. (2015). Impacts of Construction Activities on Theenvironment : The Case of Ghana. Journal of Environment and Earth Scienc, 5(3), 201.

Anigbogu, N. (2005). Impact of Construction Activities on The Environment.

Hawken, P., Lovins, E., and Lovins, H., (1999). Natural, Capitalism – Creating The Next Industrial Revolution, Little Brown and Co., 369.

How To Decrease The Environmental Impact of Construction. (N.D.).

Sandanayake, M. S. (2022). Environmental Impacts of Construction In Buildingindustry—A Review of Knowledge Advances, Gaps and Future Directions. Knowledge, 2(1), 139-156. https://doi.org/10.3390/knowledge2010008.

Hill and Bowen, (1997), Barret et al., (1999), Cole, (1999), Holmes and Hudson, (2000), Morel et al.,(2001), Scheuer et al., (2003).