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Impact of construction activities on the environment: Narrative review

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Abstract- Nowadays the construction industry is progressing very fast. The way buildings are designed and constructed creates a harmful environmental hazard. According to research, the construction industry is the third largest energy-consuming industry. The objective of this paper is to highlight the impact of construction activities on the environment, assess current evidence and experience, identify the linkages between different construction activities and the environment and draw from these implications for reorientation in the design and implementation of construction projects. The literature was collected through different electronic databases, like NCBI, PubMed, SpringerLink, GoogleScholar, and research gate. The collected literature was synthesized according to the narrative review method. Available literature shows that the increasing urbanization by this industry is also increasing the temperature of the earth. Apart from this, the materials used in this industry are also responsible for polluting the environment. The main environmental problem related to building materials is air, water, and noise pollution.

Key words: Construction activities, environment, construction pollution, construction impact

INTRODUCTION

As a result of human manipulation of nature, some serious destructive processes such as tsunamis, forest fires, floods, droughts due to global warming, sea level rise, depletion of the ozone layer which cause cancer, take birth. Apart from this, soil damage also occurs due to soil contamination. Construction industries make a huge contribution to these environmental problems.¹ Excessive use of building materials leads to extensive wastage of resources. Worldwide, building materials generate one million tons of waste material a year. The production of building materials requires more energy.² As a result, a large amount of carbon dioxide is emitted and the production energy of steel and cement is 32 and 7,8 MJ/Kg respectively. Most of the carbon dioxide is emitted in

the processing and transportation of building materials. If the consumption of building materials continues in the same way, then by the year 2050 the production of carbon dioxide will reach 3-5 billion metric tons, but the annual production and consumption of building materials are increasing simultaneously.³ The annual production of cement will reach above 5 billion metric tons. Due to this about 4 billion tonnes of carbon dioxide will be emitted. Due to the abundant use of cement in building materials, it has a greater impact on the environment than other sources. The average life of buildings is decreasing due to changes in human lifestyle as a result of which buildings are demolished and brought back in good condition.⁴

Thus the construction industry is one of the main sources of pollution. Which is responsible for complaints of particulate emissions, carbon dioxide emissions, water pollution, and much noise pollution all around. Although

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construction processes also pollute the soil, the main areas related to it are air, water, and noise pollution.⁵ This article shows the environmental crisis caused by the uncontrolled consumption of construction materials.

OBJECTIVE AND METHOD OF LITERATURE SEARCH AND SYNTHESIS

The objective of this study is to evaluate the impact of construction activities on the environment by reviewing available literature in the field. In this research, results have been obtained from the literature collected traditionally. Research papers have been collected from various databases in which Dada Base NCBI, PubMed, Springer Link, Google Scholar, & Publon is available online.

MATERIALS USED IN CONSTRUCTION

The main building materials by volume are broken rock, sand, cement, cement concrete, asphalt concrete, timber production, bricks, concrete blocks, roofing materials, steel, aluminum, copper and other metals, plastic paper, paint, glue, and many more chemical products natural aggregates (grated rock, gravel, sand), portland cement concrete and asphalt concrete are most commonly used in group construction.^{6,7} In recent years the combustion products of coal (fly ash, bottom ash, and evaporated sewage), blast furnace sludge, and foundry sand have replaced natural aggregates.

A. Concrete: Concrete is an essential product used in construction and industrial applications. Concrete was first used in construction by the Egyptians in 3000 BC. Ready-mixed concrete was first made in 1913 AD in Baltimore Maryland USA. Concrete is made by mixing Portland cement, water, retail stone, fine aggregates, and certain chemicals (which control the properties of solidification). The mixture hardens by the reaction of cement and water. Concrete accounts for 9-13 percent of the weight. Supplementary cement material is used to displace some parts of the cement.⁸ The supplementary cement material consists of fly ash sludge, blast furnace sludge, and fine silica.

The following toxic substances are released in the process of production of concrete, which contaminates the environment.⁹ Particulate matter (PM-10); sulfur oxide (SOx); nitrogen oxides (NOx); Volatile organic compounds (VOCs); and surface level ozone (O₃ is formed by the reaction of NOx and VOCs). The following are other

contaminants related to this industry, total particulate matter (TPM); carbon dioxide (CO₂); carbon monoxide (CO); methane (CH₄); and nitrous oxide (NOx). The graph below shows the comparison between the concrete production industry and the total national industrial emissions as per the data taken in the year 2000.¹⁰

B. Cement: Portland and Masonry types of cement are hydraulic types of cement that harden when reacted with water.¹¹ The air pollutants related to the production of cement are as follows:

- Particulate matter (TPM, PM-10, PM-2.5) Nitrogen Oxides, Sulfur Oxides, Carbon Monoxide, Volatile Organic Compounds - (Benzene, Toluene, Ethyl Benzene, Xylene) and Ammonia Green House Gases (Carbon Dioxide, Methane and Nitrous Oxide)).
- Acidic compounds: hydrogen chloride, hydrogen fluoride, sulfuric acid.
- Heavy metals: arsenic, cadmium, chromium, lead, mercury, and nickel.

C. Organic matter: Asphalt is made by mixing polychloride dye benzo p dioxin polychloride, biphenyl, hexachlorobenzene, and polycyclic aromatic hydrogen with aggregates such as stone, sand, and gravel.

D. Asphalt: Asphalt cement is mixed with aggregates such as stone, sand, and gravel to form asphalt. Asphalt is the oldest building material in the world. Asphalt is used in driving paths, parking spaces, running paths, tennis courts, and other applications (where smooth, stable driving surfaces are required). The air pollutants released in the production of asphalt are particulate matter (TPM, PM-10, PM-2.5), nitrogen oxides, sulfur oxides, carbon monoxide, carbon dioxide, heavy metals, polyaromatic hydrocarbons, and volatile organic compounds.¹²

E. Iron and Steel: Iron and steel are used in roofing materials, pipes, road building materials, etc. Iron and steel production plants generate 80 percent of TPM, NOx, Sox, CO, VOCs, and greenhouse gases.¹³

F. Use of Industrial Energy: Energy is required for various tasks in the construction industry. A combustion system is a component of industrial energy. This emission smoke contributes to the formation of acid rain, particulate matter, and carbon dioxide and causes climate change.¹⁴

G. Timber and composite wood products: Timber and composite wood production come under a wide range of physical features as per Standard Industrial

Classification (SIC&25) industry. Organizations that use wood as a raw material for making wood products are sawmill factories, plywood factories, panel board factories, particle board factories, and medium-density fiberboard factories. A large proportion of timber and composite timbers are used in residential and industrial construction. The process used to make the emissions from wood products factories depends on the type of wood. Emissions from wood product factories include volatile organic compounds, particulate matter, nitrous oxide, carbon monoxide, methyl alcohol, formaldehyde, acrolein, and acids.^{15,16}

H. Asbestos: Asbestos is used abundantly in the buildings and construction industry. It is a rust-free component of the silicate family, which is why it is resistant to electricity, fire, and chemicals. Asbestos is the only substance that has all these characteristics, that is why it is so popular. Although asbestos can be very dangerous for those who are constantly exposed to it. It is made up of a group of microscopic animals.¹⁷ When asbestos is damaged, its fibers break apart and the harmful substances spread into the air from where they are inhaled and affect the organs and lungs. Asbestos cancer is one of the most common diseases among people working in the construction sector.¹⁸ It destroys the digestive organs. Thus it affects the process of digestion. This type of cancer is more in those people, who are in contact with it for a long time, that is why such cases are found more in the workers associated with the construction industry. The use of asbestos is so widespread that without it no construction industry is reducing its use.

IMPACT OF BUILDING MATERIALS ON THE ENVIRONMENT

According to reviewed literature, by construction blog Bimhow, the construction sector contributes to 23% of air pollution, 50% of the climatic change, 40% of drinking water pollution, and 50% of landfill wastes. In separate research by the U.S. Green Building Council (USGBC), the construction industry accounts for 40% of worldwide energy usage, with estimations that by 2030 emissions from commercial buildings will grow by 1.8%.¹⁹

The pollution caused during building construction works is called building construction pollution. The collapsed condition of buildings also generates this type of pollution. Road construction pollution: Where road construction work takes place.²⁰ The pollution generated

in those areas is called road construction pollution. The construction materials used in road and building works mainly generate air, water, and noise pollution.

Various types of construction processes such as excavation, running of diesel engines, building demolition, combustion, etc. are the factors of air pollution. The use of various building materials such as concrete, cement, silica stone, etc. produces very small dust particles PM-10 which enter the lungs in the process of breathing and cause many types of health problems like respiratory diseases, asthma, bronchitis, cancer, etc. The main sources of noise pollution are the movement of vehicles, heavy machinery, and other equipment in the construction areas. Noise pollution causes hearing loss, high blood pressure, insomnia, and stress.²¹ Noise pollution also affects the natural processes of animals. In this way, construction materials are very harmful to the environment, but industrialization is also necessary for the development of the country, so it is necessary to keep in mind that all these natural resources should not be tampered with to such an extent that human There should be a danger to his existence.²²

A. Air Pollution: The air that we breathe in can become polluted due to construction works. Construction processes that contribute to air pollution are: clearing land, running diesel engines, demolishing buildings, lighting fires, and working with toxic materials. All construction areas generate high levels of dust (from concrete, cement, wood, stone, silica, etc.). Construction-related dust is classified as PM-10 (PM-10 particulate matter less than 10 µm in diameter), which cannot be seen with the naked eye. The main construction polluting elements that are spread into the atmosphere by the wind are volatile organic compounds bound with particulate matter, asbestos, and gases such as carbon monoxide, carbon dioxide, and nitrogen oxides.²³ These polluting elements are spread by the wind over long distances in the atmosphere and they affect the areas more in the direction in which the wind blows.

According to research, PM-10 causes many health problems such as respiratory diseases, asthma, bronchitis, cancer, etc. by entering the lungs through respiration. A major source of PM-10 in construction areas is smoke from diesel engines of vehicles and equipment. It is called diesel particulate matter.²⁴ They contain soot, sulfate, and silicates, which together with other toxic substances in

the environment, cause many health problems when inhaled. Types of diesel are also responsible for the emission of carbon monoxide, hydrogen oxide, and carbon dioxide. All these pollutants are of different types and differ in their chemical composition, action, properties, emission sources, stability in the environment, their ability to travel long and short distances, and their ultimate effect.

B. Water Pollution: Groundwater and surface running water in and near construction areas are Contaminated by construction materials used in construction work such as organic compounds, paints, glues, diesel, oil, other toxic chemicals, and cement These pollutants pollute running water and cause surface and underground water pollution.²⁵ They also affect the water (because the running water gets filtered on the surfaces and mixes with the underground water). Groundwater and surface runoff can reduce the source of pollution from construction areas. Domestic and domestic animals drink this contaminated water, which is fatal for them and it also contaminates the soil there.²⁶ Apart from this, due to contamination of groundwater, the climate around us is also affected directly and indirectly. (Volatile pollutants released from the water spread to the surrounding air). Overall, water pollution arising from construction sectors cannot be underestimated but has the potential to cause serious environmental problems.

Sources related to water pollution: The details of sources related to water pollution are as follows:

- (I) The cement, lubricants, and plastics used in the construction industry contaminate our water resources. Heavy siltation and foothills along with water flowing from construction areas also pollute rivers and lakes.
- (II) The main sources of water pollution in construction areas are diesel and oil, paints, solvents, cleaners and other harmful chemicals, construction debris, and dust. In construction areas, when land is cleared, it causes soil erosion, which leads to siltation of running water and soil pollution. The silt and soil mixed with the running water turbid the natural resources of water. Dirty water blocks the filtration of sunlight, which leads to the destruction of aquatic life.
- (III) Pollution elements of construction areas are absorbed by groundwater which is the source of drinking water for human beings. Once

groundwater is contaminated, it is more difficult to treat than surface water.

C. Noise pollution: Noise made by construction equipment is the main source of noise pollution. Other sources that affect hearing are various processes in construction areas such as construction alterations, demolition of buildings, and other related activities such as clearing of land, preparing their sites, digging and beautifying the area, etc. They are used because construction equipment is run outside in open places.²⁷ Therefore, they affect people other than the workers working in the construction sector. Noise pollution causes hearing loss, high blood pressure, insomnia, and stress. It has also been known from research that noise pollution also affects the nature of animals.

D. Soil pollution: The soil around the construction areas can become contaminated due to airflow because the contaminants emitted from the construction materials present in the air get deposited in the surrounding soil. Similarly, the soil gets polluted due to the flow of contaminated water.²⁸ The contaminants present in the soil persist for a long time such as polyaromatic hydrocarbons.

MEASURES TO PREVENT POLLUTION

Managing how much pollution you create as a company and as an individual is incredibly important. As well as controlling the negative impacts on on-site workers, residents, and the environment, enforcing pollution prevention strategies can have a significant positive impact on your business. By working sustainably and considering how you can limit the impact of your construction activities, the perception of your company is going to be positive and you can establish yourself as a forerunner in comparison to your competitors.²⁹

Under the Environmental Damage (Prevention and Remediation) (England) Regulations 2015, businesses are made financially liable for any damage they cause to land, air, water, and biodiversity in England. The regulations reinforce what is known as the 'polluter pays principle'. This is in place to hold businesses responsible for the pollution they create by encouraging them to limit their environmental impact with financial incentives.³⁰ Companies also risk being fined for breaking environmental laws. Some of these so-called 'enforcement undertakings' are an alternative to prosecutions, with the money going towards projects helping wildlife. Therefore, if your construction activities do create a lot of pollution,

especially when it is avoidable or manageable, you risk being given a significant fine. To try and reduce your pollution contribution we have created a list of suggestions that you could put in place:

- To prevent soil erosion and water flow, more trees should be planted.
- Water sprinkling and fine mesh should be laid on construction materials such as sand placed in construction areas.
- Toxic paints, solvents, and other hazardous materials should not be used as much as possible.
- The material should not be burnt in the construction areas.
- Engines of all vehicles and equipment should use low-sulfur oil and particulate filtration with the latest specifications.
- Toxic substances should be kept separately and properly covered and
- Construction materials like cement, sand, etc. should be kept covered and they should be kept in such a place where they cannot flow with water.

CONCLUSION

The construction industry is the third largest energy-consuming industry. Due to the urbanization caused by this industry, the temperature of the earth is also increasing. Apart from this, the construction materials used in this industry are responsible for environmental pollution. Air, water, and noise pollution are among the main environmental problems related to building materials. Various building materials like concrete, cement, silica stone, wood, etc. produce very small particulate matter which causes diseases like respiratory diseases, asthma, bronchitis, cancer, etc. In addition, during the production and use of these materials, nitrogen oxides, sulfur oxides, carbon monoxide, volatile organic compounds, ammonia, and greenhouse gases are emitted, which have a bad effect on the environment. Heavy equipment and vehicles operating in construction areas cause noise pollution. Noise pollution causes hearing loss, high blood pressure, insomnia, and stress. The environment can be protected from contamination by safe measures.

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