

# Sustainability Concerns in the Construction Sector: A Review

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Abstract As a significant industry, the construction sector is expanding at a considerably faster rate than anticipated. Construction's resource requirements place pressure on the environment. The present study uses a thorough literature review to understand sustainability concerns in the construction sector. The study analyzed high-quality journal publications by reviewing first-class databases. The fact was ascertained that the construction sector's environmental issues and resource problems are under-optimized. The sustainability concerns in the construction sector like overconsumption of non-renewable natural resources, mismanagement of building and demolition waste, and unsafe human life have made us think about better solutions to this problem. Hence, the study offers sustainable construction ideas like resource optimization, selection and recycling of materials, renewable resource regeneration, and inventive eco-building materials and techniques. The research study explores the future of sustainable construction in the construction sector and thrives on making it a national agenda.

Keywords — Sustainable Development Goals, Sustainability concerns, Construction sector, Environmental impacts, Sustainable construction

# I. INTRODUCTION

Based on the world's most favorable demographic dividend, India is counting on a remarkable economic development trajectory. It has been noted that the Indian construction sector has a detrimental effect on the environment. This scenario compels us to consider environmental concerns in more depth. We know the importance of construction to economic growth and development, but our environment must not be overlooked. Whatever businesses do, they must do so in a sustainable manner (Enshassi et al., 2016). Sustainable development means that growth must be accomplished with respect to nature and humankind. It is achieved with economic goals, social responsibility, and environmental protection. Past studies have proclaimed that sustainability involves three key aspects including environmental, social, and economic sustainability. Sustainable Development Goals (Global Goals) were formulated by the United Nations General Assembly in 2015 and are intended to be achieved by 2030. These goals must go hand in hand for the betterment of the environment and mankind. Exploring the environmental impact of the construction sector is important but side by side what the

sector can do to improve its environmental footprint is also of utmost importance.

The construction sector is a secondary sector as it includes all types of manufacturing and construction activity. It literally means to build or to construct. Construction activities include building new dwellings, renovating older ones, building roads, highways, etc. This sector has an enormous impact on the environment and procurable resources. It is one of the largest consumers of raw materials and also a major facilitator and contributor to the overall economy (Martinuzzi et al., 2011). The construction sector has to depend on a lot of resources for its needs hence making it truly a resource-intensive sector utilizing endless materials. With booming economies, more infrastructure and facilities are required to sustain economic development. As a result, more pressure is put on natural resources which may have a severe impact on the environment and all living organisms (Enshassi et al., 2016). Along with economic development, the environment is also worth noticing. Hence, it is the need of the hour to keep a constant vigil on the working of the construction sector to protect the environment in India from many of its adverse effects like excessive consumption of natural resources, environmental pollution



through generating greenhouse gasses, carbon emissions, and construction & demolition waste, misuse of land.

The government is also trying to cope with the unsustainability issues thus providing a number of policies and regulatory mechanisms to promote resource efficiency and environmental sustainability in the construction sector. National Building Code (NCB), Energy Conservation Building Code (ECBC), Environment Impact Assessment, building certifications like Green Rating for Integrated Housing Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), and National Mission on Sustainable Habitat (NMSH) are some of the flagship programmes initiated by the Government of India.

### II. RATIONALE

The purpose of this study is to investigate the potential for environmentally responsible building practices across the country. As a result of which, sustainability could be achieved by the judicious utilization of scarce resources and maximum utilization of resources that are present in abundance, with the minimal degradation of the environment. The impact on the environment could be significantly reduced by properly disposing of the waste generated by construction & demolition activities and decreasing pollution thus ensuring safe human life.

This paper offers measures that can be adopted for sustainable construction so that the impact on the environment is reduced and resource-efficient buildings having minimum load on the environment can be built. Green/sustainable public procurement should be enforced in order to facilitate the use of green products like bamboo, cork, recycled plastic, wood, etc. Green buildings are costeffective to construct and it uses less energy in their construction, operation, and disposal. They have a long lifespan and provide long-term benefits as compared to conventional buildings. Installation of solar panels on building rooftops and appropriate water conservation techniques can further make building more efficient and environmentally friendly. The adoption and promotion of environmentally responsible building practices is also a global priority.

### **III. OBJECTIVES**

The present study has the following objectives:

1. To identify sustainability concerns in the construction sector.

2. To explore various techniques for incorporating sustainability in construction activities.

### **IV. DISCUSSIONS**

4.1. SUSTAINABILITY CONCERNS IN THE CONSTRUCTION SECTOR

When it is about sustainability, three things come to our attention, environmental protection, social responsibility,

and economic growth. Sustainability is important for the well-being of our planet, the continued growth of a society, and human development. Sustainability means bequeathing the same resources to the future generation that has been inherited by us in the same or improved manner.

It is a well-accepted fact that the construction sector is a highly resource-intensive sector. Construction is a neverending process with various phases involving many stakeholders. The construction sector addresses builders, the production industry, as well as tenants, and consists of the built environment, which implies all human-built structures, including buildings, roads, and all other fixtures that form the physical characteristics of a city (Martinuzzi et al., 2011).

As demonstrated by Xie et al., (2020), construction activities lead to many problems such as disturbing biodiversity, generating greenhouse gasses and carbon emissions, and producing waste materials. The researcher has primarily focused on the environmental issues in the construction process like energy conservation and emission reduction and green construction (Xie et al., 2020). Sustainability factors that are associated with the environment are reduced waste, affluent generation, emissions into the environment, reduce impact on human health, use of renewable raw materials, and elimination of toxic substances. The following environmental issues raised by Enshassi et al. (2016) related to sustainable construction are:

To prevent environmental degradation.

To ensure a safe human life.

To check the exploitative technology and find alternative sources.

To check the over-exploitation and wastage of natural resources.

To regenerate renewable energy resources.

Eng The construction activities have various effects on the environment. The basic effects as pointed out by Enshassi et al. (2016) include energy consumption, dust and gas emission, noise pollution, and waste generation. In addition, water discharge, misuse of water resources, land misuse and pollution, and consumption of non-renewable natural resources.

Martinuzzi et al. (2011), emphasized that in addition to having some of the greatest direct effects on water, resources, land usage, and greenhouse gas emissions as well as indirect effects on the environment by altering transport networks, it also affects communities and even the public health of the country (Pinkse & Domisse, 2008); (Pitt et al., 2009) as cited in (Martinuzzi et al., 2011). These interventions in turn lead to impacts on the environment, directly or through a chain of environmental processes (Voet et al., 2009). This study further discusses some concerns which are related to environmental sustainability.

## 4.1.1 Overconsumption of natural resources

The construction industry is a burgeoning sector, which is dependent on natural resources. Deriving natural resources have direct environmental impacts that are most often seen during the extraction, processing, manufacturing, and transporting of raw materials.

As mentioned by Jain et al. (2019), due to population and economic growth, there is a huge demand for residential and commercial buildings in urban areas, thereby promoting construction activities. The Indian construction industry employs over 30 million people and creates assets worth over ₹ 200 billion. With this overview, one can relate the number of natural resources used by this sector. The statement is also justified by Xie et al. (2020), that the construction sector consumes a large number of building materials and emits a large amount of carbon dioxide during production activities. According to the United Kingdom Green Building Council, the construction industry consumes over 400 million tons of materials each year. Also stated by Xie et al. (2020) per capita consumption of construction minerals, such as sand and aggregates, increased by 300% since the 1980s with a growth rate equivalent to India's GDP. As a matter of concern, Jain et al. (2019) also raised the point that the consumption of construction materials in urban India will continue to increase for decades incurring numerous environmental and resource implications from, for example, excessive sand mining. Also, the construction sector is one of the major end-users of water. Water is used at every stage of construction, and also in the production of construction materials. The concept of sustainable water management aims at supporting economic, social, and educational development, in addition to protecting the environment (Lim & Loosemore, 2017). This concept can be materialized by following the finest management principle of using water more efficiently. During the construction of a building, water is used abundantly in each stage. Starting from the preconstruction phase to the operational phase, water is needed tremendously. It is required for the preparation of mortar, mixing of cement concrete, and for curing work, etc. during construction work. For every 1 sq Mt. of the constructed wall, an average of 350 litres of water gets consumed. The quality and quantity of water have much effect on the strength of mortar and cement concrete, curing of walls before and after plastering during the construction work. Hence, its usage cannot be curtailed but it could be used efficiently.

### 4.1.2 Disturbing biodiversity and natural habitat

Disturbance in ecology at times is a natural phenomenon like drought, volcanic eruptions, earthquakes, fire, flood, or outbreak of any disease. But what mankind is doing is unnatural and unacceptable. The human-environment relation must be in harmony with each other. The construction sector's over-dependence on resources somehow initiates disturbed biodiversity and natural habitat. When the mining companies extract the resources, they are directly or indirectly harming the natural habitat of many living species. Thus, it calls for the protection, conservation, and improved management of the natural resources of the earth. Land use causes loss of habitat for species (Voet et al., 2009). Many living organisms become homeless as a result of construction projects that disrupt their natural habitat. This overlooked damage is in some way upsetting the ecological balance. Deforestation, global warming, population growth and pollution are among the many contributors to biodiversity loss.

## 4.1.3 Unsustainable waste management practices

Increasing urbanization and population growth rate are significant contributors to the rise of landfills. With this, the need for dwellings also increases. As demand grows, so does the amount of solid waste produced through construction. In 2019, Jain et al. notified that India generated around 130 million tonnes of construction and demolition waste (C&DW) in 2012, which is expected to increase to more than 750 million tonnes a year by 2050. He also stated that a significant part of C&DW in typical Indian cities is dumped illegally or landfilled. It is bulky and occupies significant landfill space. Construction waste can be recycled easily. Most of the big cities have construction and demolition waste recycling units in India. Delhi-NCR generates about 5,000 tonnes of construction and demolition waste daily, however, the official recycling capacity is 6,500 tonnes per day. Hence the construction industry is losing a resourceful opportunity to utilize this waste for sustainable development.

The inefficient and ineffective management of C&DW results in several resource and environmental implications. According to Mathew (2021), landfills that are open and unclean can spread disease, infect people, and contaminate drinking water.

The construction sector tends to produce different sources of waste. These wastes could be non-hazardous as well as hazardous depending on their type. The challenge with waste management via burial, incineration, or discharge in water bodies and landfills is that the majority of waste is poisonous and may include toxic and health-threatening substances. This is very important to understand which waste needs to be disposed of in a special way and which can be dumped normally in the environment. This waste includes building materials like wirings, iron nails, scrap metal, plaster, wood, bricks, cement, etc. Most of this waste is recyclable and doesn't harm the environment. Another is hazardous waste which may be dangerous to people handling it and to the general public if not disposed of properly. Some of these wastes are paint thinners, aerosols, mercury, lead, etc. Demolition waste is another kind of waste that contains materials such as concrete, ceramics, glass, bricks, tiles, wood, plastic, etc. One of the most dangerous substances present in this waste is Asbestos. It is a naturally occurring fibrous silicate mineral which poses severe health risks like



lung diseases and cancer. It is used as heat resistant in cement, pressure pipes, sewerage pipes, etc, and as an insulation material during building construction in ceiling tiles, vinyl floor tiles, pipes insulation, etc. It is necessary to dispose of it in an appropriate manner in order to keep a close watch on public health.

# 4.1.4 Environmental pollution

It is a well-known fact that the construction industry is a major contributor to greenhouse gas emissions due to the extensive use of machinery, fossil fuel extraction, and the transportation of raw materials. During the construction and demolition phase of construction, Suspended Particulate Matter (SPM), i.e., dust, fumes, mist, and smoke is released in high amounts into the air. This causes respiratory disorders, heart problems, premature deaths, cancer and decreased visibility during winters. In addition, noise and vibration from construction sites contribute to environmental pollution (Enshassi et al., 2016).

With the rise in construction projects, using agricultural land for further construction activities is posing a threat to ecology. Agricultural land is fertile land used for cultivation. Emissions in soil due to construction may cause local pollution problems and contaminate groundwater and crops. It affects soil biodiversity, resulting in a reduction of soil organic matter. Some hazardous chemicals leach out into the soil during the construction phase of a building like petroleum hydrocarbons, solvents, pesticides, lead, and other heavy metals. These chemicals present in the soil make it infertile. This arrogance may lead to scarcity of food in near future. Similarly, water is also being polluted through various construction activities. Contaminant water poses a significant threat to the natural environment posing a serious threat to aquatic life and human using that water for their survival.

### **4.1.5 Effects of construction logistics**

Transportation of raw materials from godowns to construction sites requires a lot of logistics. The transport system is affected by the movements of huge commercial vehicles carrying raw materials for construction. Over half of construction logistics expenses, a fifth of energy use, and a tenth of greenhouse gas emissions can be ascribed to the transportation of construction materials. Effects of transportation on sustainability can be direct such as pollution, noise, traffic jams, etc. or indirect e.g., loss of ecosystems, health impacts, reduced quality of life, etc. (Dhawan et al., 2022)

# 4.2. INCORPORATING SUSTAINABILITY INTO THE CONSTRUCTION SECTOR

When the construction sector companies are working in harmony with sustainability aspects then their success is also in a way sustainable. It's important to make sure that development always remains within the limits of sustainability. If this sector is consuming more resources, then it must invest more in resource regeneration, which will make development sustainable. Sustainability can be managed in various ways throughout the delivery of the construction project. Hirpara et al. (2018) emphasized the fact that the early phases of the project are critical for defining the total value generated by the project and putting innovations in place. Enshassi et al. (2016) explained that 100 percent of waste streams should be recycled, energy must be conserved, and all sources of energy should be renewable and non-polluting. By applying advanced technologies or altering construction equipment, and imparting knowledge, the unsustainable environmental impacts can be avoided. Below are some of the ways through which sustainability can be incorporated into the construction sector.

# 4.2.1 Selection of materials

The selection of material is one of the most important factors in incorporating sustainability in the construction sector. Using locally sourced materials helps in avoiding environmental impacts as it reduces the shipping of these resources thus saving time, energy, and money. Construction companies should try to include readily available, durable and stronger materials so that they last longer. This will automatically reduce the repeated utilization of material. This sector should also make use of the materials that are present abundantly in nature as it replenishes fast making them available to use in a short time span. One of the best examples suits here is Bamboo. It is locally available in abundance, is durable, and replenishes rapidly. The dwellings made up of bamboo are aesthetically beautiful as well as eco-friendly. Being a resource-intensive sector, construction companies need to optimize on use of resources as sustainable construction practices have no bearing on the environment.

Some of the good practices to adopt for the selection of sustainable materials are also discussed. Using sustainable concrete is one of the sustainable practices. Concrete is a mixture of cement, gravel, sand, water, and a range of aggregates. Concrete is one of the most widely used construction materials in the world. However, the manufacturing of cement, an essential constituent of concrete, releases significant amounts of Carbon dioxide, a greenhouse gas (Duchesne, 2020). The production of one ton of cement produces about one ton of Carbon dioxide and other GHGs. The environmental issues associated with GHGs are getting too much attention and hence researchers are focused on the manufacturing of an alternate way of ecofriendly concrete. This will ensure that the total environmental impact during its life cycle will be minimal. Concrete is ever using component in construction; therefore, it must keep evolving to satisfy the demands of its users. The production of sustainable concrete has a low energy cost, is made up of abundantly available resources on earth, is



durable, and is recyclable (Calkins, 2002). Some of the sustainable concrete materials in use nowadays are silica fume, fly ash, blast furnace slag, etc.

The foremost objective of humanity is to protect the environment and self. In this regard, asbestos is one of the dangerous materials used in construction. The health-related concerns due to asbestos have been discussed above. Its extensive use in construction materials is very shocking. Despite knowing the fact that it can prove fatal, companies are still using it. To avoid this problem, cellulose fibre is one of the most common and widely used alternatives to asbestos. Cellulose is available easily and can be used during construction efficiently as it acts the same way asbestos does.

# 4.2.2 Recycling resources

Products can either be recycled, burned, or thrown away as leftover waste after their useful life has ended. The more we recycle and the fewer things we throw away, the less material is extracted, which is better for the environment. Waste can be reduced and recycled. This eco-efficiency brings both environmental and economic benefits by reducing energy consumption, implementing cost-neutral new building maintenance methods, and reducing typical workplace costs. Recycled plastic, concrete, bricks, steel and untreated timber, etc. are a few materials that could be reused in construction activities (Enshassi et al., 2016). A circular flow of resources can minimize the need for mining non-renewable resources and the severe environmental impacts that come with it. Materials are collected, categorized, reprocessed, and prepared for the next life cycle. This assists in resource management before any "waste" is generated. Water is a resource taken for granted. Its use is not optimized as at many construction sites water is wasted with leaking tanks, faulty taps, broken pipes and unnoticed running taps. One of the important points to consider is using greywater. Greywater is the relatively clean waste water from baths, sinks, washing machines, and other kitchen appliances. One of the best practices suggested by M et al. (2019) and Peche et al. (2014) is that the treated grey water could be used in the making of concrete during construction activities. The grey water used for making cement was found to be suitable for use as per IS provision. The setting time of cement paste using greywater was found within the Indian Standard limits. The strength of concrete was found to be increased by using secondary treated water for concreting purposes. In 2019, M et al. suggested that onsite water treatment plants minimizing waste is also a good option. Agricultural waste could also be utilized for sustainable construction practices. A few of the agro waste materials that can prove useful in construction are rice husk ash, sugarcane bagasse ash, straw, groundnut shells, bamboo leaves, etc. The agro-waste products have the potential to replace conventional construction materials and thereby achieve economic. and long-term environmental, social sustainability. The findings of Maraveas (2020) showed that

incorporating agro-waste in the development of construction materials helps address the sustainability challenge while minimizing pollution and unfavourable environmental impacts.

### 4.2.3 Integration of energy efficiency in buildings

According to Tong Z (2017), the use of environmentally friendly energy-saving technology in buildings should run throughout the entire process of building design, construction and use. This will enable green energy-saving technologies to achieve their maximum level of effectiveness in the construction sector.

Orientation of buildings plays a very important role to minimize energy waste through heat gain or loss. Orientation of a building refers to the position of building faces relative to the sun's path and the wind patterns. If the building is constructed keeping this in mind, then it will contribute in energy efficiency. Maintaining airflow is crucial for a number of reasons, including limiting energy waste, preventing moisture damage, and ensuring occupant comfort and safety. Constructing a ventilated building reduces energy loss by a significant amount.

Controlling heat in houses from the atmosphere is very important. We want our homes to be cooler during summers and warmer during winters. Accordingly, the construction sector is required to use materials or techniques that are practical. This could be hastened by installing solar panels and minimizing the need for forced air-conditioners. Natural or organic building insulations like cellulose, cork, wood wool, hemp, flax, and sheep wool make great home insulators when used in ceilings, walls, etc in cold regions.

# 4.2.4 Proper disposal of Construction & Demolition waste

As ascertained by Enshassi et al. (2016), factors affecting sustainable construction during the demolition phase are environment-friendly demolition methods, special waste treatment, waste recycling, and reuse. Jain et al. (2019), also pointed out that there are only three C&DW recycling units in India: two in New Delhi and one in Ahmedabad. In India, city-level data on construction and demolition activities and official estimates on total annual construction are limited. Hence, more C&DW recycling units are required to be set up in metro cities, where there are a lot many concrete buildings. The cement and construction industries should be incentivized to utilize recycled construction and demolition waste.

### 4.2.5 National agenda for sustainable construction

Changing the attitude of all the personnel related to the construction sector through imparting knowledge will help in following sustainable construction practices. It needs to instil a genuine environment respecting moral values in the young budding engineers and other specialized area students who, in their professional careers as planners, designers,



builders and decision-makers, will bear considerable responsibility for mankind's impact on nature and the natural environment (Mondal, 2018).

Lack of awareness about the possible green construction ways needs to be tackled. This could be done through various ways like public forums, workshops, presentations, demonstrations, showing photos and videos, etc. A construction worker's importance is further underscored by the fact that the business relies on their talent and their ability to efficiently combine various types of abilities. (Pathirage., et al., 2007)

Enshassi et al. (2016) stated that training courses conducted for employees to improve the quality of human resources prove beneficial for themselves as well as the environment.

Various governments, as well as private organizations, are working hard to achieve environmentally friendly buildings. India's comprehensive building code, the National Building Code (NBC), is a national tool for enforcing construction regulations across the country to ensure public safety. In order for a structure to be constructed, it must adhere to specific rules. All required materials must also be ecofriendly. NBC was initially a voluntary code. Building standards in most states have now made it mandatory and enforceable, making it an essential aspect of building regulations (BIS, 2021). One of the latest government achievements is Light House Projects (LHPs) commenced by the Ministry of Housing and Urban Affairs (MoHUA) and built as part of the Global Housing Technology Challenge-India (GHTC- India) initiative. Six states namely Madhya Pradesh, Tamil Nadu, Gujrat, Jharkhand, Tripura, and Uttar Pradesh are chosen for showcasing six distinct technologies for LHPs. These projects are demonstrating the construction of ready-to-live houses with maximum speed and with better quality of construction in a sustainable manner (MoHUA, 2019).

Similarly, Laury Baker, a British-born architect has built over 2000 buildings in Kerala alone. He lived in Kerala for more than 40 years and served as Director of COSTFORD (Centre for Science and Technology for Rural Development), an organization promoting low-cost housing. He was named 'Brick Master of Kerela' as he re-used all sorts of bricks for his eco-friendly creations. He has also pioneered earthquake and tsunami-proof housing. The Government of India awarded him the Padma Shri in 1990 for his meritorious services in the field of architecture. He was known for sustainable as well as organic architecture. He also incorporated concepts such as rainwater harvesting, minimizing the use of energy-inefficient building materials, and minimizing damage to the construction site thus integrating his creations into the environment.

# V. CONCLUSION

The environmental impact of a construction project is evident at every stage of the process. The unsustainable

practices discussed above followed by the construction sector are overconsumption of natural resources, disturbing bio diversity and natural habitat, poor waste management, pollution, and unsustainable construction logistics. Companies from the construction sector should be doing their business in an environmentally safe manner. Environmental violations must be thoroughly investigated. The residents of environmentally friendly buildings can be healthier, happier and more productive at work. Furthermore, innovative and alternative construction technologies have entered the market in India, and their acceptance, as well as adoption, must be improved. Usage of durable and recyclable materials contribute to sustainable construction. Sustainable buildings allow us to use resources more efficiently, increase end-user health and wellbeing, and reduce overall environmental impact. We need to protect Earth for the sake of future generations well-being. By conserving trees, natural flora & fauna, natural resources, power, etc., we can protect the planet. To effectively reduce environmental pollution and global warming, we must closely adhere to every possible measure of green construction promoting sustainable consumption and production. This transformation will soon contribute to achieving the UN Sustainable Development Goals (SDGs).

# VI. LIMITATIONS AND FUTURE WORK

The present study is done on the basis of available online data in the form of research papers. Hence, the researcher feels that the study could have been done in a physical environment to understand the real sustainability concerns in the construction sector. Secondly, despite the awareness of existence of evidence pertaining to additional the repercussions of the construction sector, this study has focused solely environmental on ones. As a result, future research is needed to explore other consequences of the construction sector. Additionally, future research is also required to increase knowledge of how environmental schemes may be utilized not just to reduce the environmental effect, but also to reduce construction disruptions to society by utilizing low-cost sustainable raw materials for construction activities and corporate engagement in sustainable development. When the construction sector companies are working in harmony with these aspects then their success is also in a way sustainable. It's important to make sure that development always remains within the limits of sustainability. Sustainability can be managed in various ways throughout the delivery of the construction project. The early phases of the project are critical for defining the total value generated by the project and putting innovations in place (Hirpara et al., 2018). If this sector is consuming more resources, then it must invest more in resource regeneration, which will make development sustainable.



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