

A comprehensive analysis of the problems in sustainable construction and mitigation strategies

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Abstract. The challenges arising due to the construction industry in balancing the development along with ecological concerns are being focussed upon in this paper. The detailed analysis of the materials that are being brought to use as a sustainable material in the constructions sectors is being focussed upon. Since the late 20th century, there have been significant developments in the building industry. Since the population is rising and the need for housing is increasing, all available resources must be employed to satisfy the demand as it stands. This will have a significant long-term effect on the situation since the resources at hand are insufficient to meet the demand. There are many data and trends about sustainable construction approaches that is being developed by the researchers across the world that form the basis of this review study. The work found that associated industries should be encouraged to take part in the seminars, workshops, and other training programs that are organized at various events in order to deepen and improve their comprehension of the concept of sustainable development. The comparison drawn-out in between the conventional and a smart building concludes the benefits of using sustainable methods in the construction industry.

Keyword. Conventional Building, Energy Efficiency, Green Material, LEED, Sustainability, Smart Buildings.

1 Introduction

An important factor in a country's social and economic growth is its building sector. Everyone working in the industry—clients, contractors, consultants, manufacturers, and end users of

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facilities—creates, develops, produces, designs, builds, alters, and maintains the built environment. But the sector has done a significant deal of damage to the environment. The traditional approach that the company has been using is based on the notion that investments and innovations drive economic growth while meeting consumer requests and preferences tends to provide it. However, it is critical to recognize that the practices and products of this business negatively impact the environment. Construction projects make extensive use of natural resources, water, and many forms of energy that is ultimately finishing the natural resources.

A subset of sustainable development is a sustainable construction as it helps in achieving the sustainable building industry. It's meaning is "The development and responsible management of a healthy built environment grounded in ecological and resource-efficient principles". Although concerns about the environment have long existed, attention has only lately turned to practical and workable remedies. The Agenda is an extensive plan of action which the system's governments, businesses, stakeholders, and the general public are all expected to implement at the global, national, regional, and local levels. The key principles of sustainable building include resource conservation, recycling and renewable material utilization, reducing resource use, and environmental protection.

1.1 Several studies on Sustainable construction

This study aims to provide an overview of the research concepts that have been investigated in the area of sustainable construction projects. To check the bibliography of the publications, two bibliographic analysis programs were used: BibExcel and Gephi. This allows author to examine the connections between documents as networks. Research Focused Parallel Network (RFPN) analysis and the Co-occurrence Network (KCON) text test were used to determine the research themes. RFPN Research has divided its research into three main areas: Organizational Project Management, Organizational Assessment and Sustainability Support. Even though every paper had a different topic, the KCON analysis revealed that project management, construction, and sustainability were the main concepts of each cluster. With an eigenvector centrality of higher than 0.94, it was found that "*Sustainability*" ranked initial in the very first cluster—that is, the overall assessment of sustainability—it rated second in the other two clusters. Moreover, this research discovered that sustainability is an idea that need to be included into building projects from the beginning of design and feasibility studies and that must to be continuously observed over the project's lifecycle. This study demonstrated how earlier investigations into sustainability in building projects were conducted using a range of statistical and mathematical techniques, including fuzzy decision-making techniques and structural equation modeling. By using an integrated method to identify the gaps in the literature, researchers may get insight into the most effective way to structure future investigations on sustainability in building projects [1].

One of the sectors that is crucial to economic growth, which is particularly in emerging nations, is the construction industry. This sector of the economy is distinct, dispersed, and complicated. The persistent issues include schedule cost overruns (75 percent of projects), cost overruns (about 14 percent of contract prices), and waste creation (around 10 percent of material expenses). It's ranked among the worst for environmental pollution. It appears that modern construction and project management techniques are unable to meet the difficulties posed by emerging issues like the carbon emission problem. These challenges highlight the need of operators reviewing and improving their technology and service methods. This shows that there is a big chance for the building industry to promote sustainable development by tackling economic, social, and environmental challenges.

Water-sensitive design may be used to lower flood risk, cut waste, preserve water resources, enhance water quality, lower emissions of pollutants into the air, water, and land, and lower light and noise pollution. With [2], everything is possible. It may cause renewable energy sources to operate less efficiently.

Table 1. Criteria for Sustainable Construction.

Publications	Dimensions	Code	Indicators	Number of items	Cronbach alpha	Methods	Findings
Sarpong and Bein (2021)	Environmental	EN1	Climate change	05	0.452	Several panel evaluation techniques, such as fixed impact panel estimation and gmm dynamic panels estimation, were employed for estimating the data.	Human welfare is enhanced by sustainability in sub-Saharan Africa.
		EN2	Ozone layer depletion				
		EN3	Human toxicity				
		EN4	Ecotoxicity				
		EN5	Acidification (acid deposit)				
	Social	SO1	Cultural heritage preservation	05	0.532	The 29-year panel data between 1990 to 2013 was analyzed by the author using panel estimate methods.	Environmental sustainability is negatively impacted by a rise in FDI inflows since it greatly exacerbates environmental deterioration.
Sekarlan git and Wardhani (2021)	Social	SO3	Choice and security of tenure	04	0.531	The generalized procedure of moments (gmm) estimation approach was employed by them. The Gini coefficient, Atkinson index, and Palma ratio were the three different indices of inequality that were utilized.	While rising mobile cellphone and internet saturation lowers the Palma ratio, growing internet usage and fixed-line broadband connections have a net effect of lowering the Atkinson index and the coefficient of Gini.
	Social	SO4	Housing for all	06	-		
	Social	SO5	Empowerment and participation	04	-		

						The penetration of mobile phones, the internet, and permanent broadband services are among the ict metrics.	
Huang, Shen and Miao (2021)	Economic	EC1	Initial cost	06	0.521	Sustainable development was quantified using the integration level model and the system connection model.	The benefits of the emission trading program (ETS) on sustainable development increase with a city's social and economic development.
	Economic	EC2	Maintenance cost	05	-		
Liu and Kong (2021)	Economic	EC3	Operational cost	05	0.515	Regression approach was applied. Examine if and how, from the perspective of green innovation, business strategies impact the sustainable growth of businesses.	Businesses that use prospector tactics are less likely than those that use defender strategies to adopt sustainable development practices.
Koiralaand Pradhan (2020)	Economic	EC4	Job creation	06	0.522	The random-effect panel regression model was used.	Income per capita and financial growth have a substantial and beneficial impact on sustainable development.
Singh, Issac and Narayanan (2019)	Economic	EC5	Long-term savings	06	0.525	SVM method	Sustainable material suggested economic growth and environmental benefits

Table 1 represents the impact of construction operations on the environment is a rising source of worry, and measures have been taken to mitigate it. Legal frameworks, as well as technological, management, and cultural behaviors, are examples of these measures. There is tremendous pressure on the construction industry to adopt eco-friendly methods, and being

environmentally conscious is becoming more and more valued as a competitive advantage [23] [24]. Nevertheless, there are certain difficulties in implementing environmental management systems within the building industry. As a result, maintaining sustainability in the building industry has proven to be extremely difficult.

The first findings of a larger research project on the application of sustainable construction are presented in this paper. The most significant challenges and opportunities that construction companies have while putting in place environmental management systems are outlined and examined in this study. A case study of a building project completed from the client's point of view was used to collect the data. To meet sustainability standards and capitalize on opportunities presented by implementing such practices, construction companies need to design robust and innovative environmental management plans [3].

Table 2. Benefits of Sustainable Construction.

Percentage	Benefits
2-12%	Construction cost premium
25-30%	Savings in Energy Consumption
20-30%	Savings in water consumption
50%	Less waste generation
35%	Reduced carbon emmision
1.9% to 2%	Rental Premium achieved in commercial buildings
30%	Reduction in building operating expense
40%	Increase in office space utilization

Studies have been done on the usage of building materials to reduce environmental effect and the design of green buildings (Table 2 Shows various benefits of sustainable construction). Many environmental problems have been linked to construction, including contamination of the environment and overuse of global resources during construction and operation. It is insufficient to solve the existing problem by relying just on project design to achieve sustainable development objectives or to reduce repercussions via proper site management. Beyond project design, a sustainability assessment aims to consider the project's sustainability from the outset, even before a choice is made to proceed with development or before a thorough design is created.

However, the importance of selecting more environmentally friendly designs has not been given much attention at the project evaluation stage, where environmental factors are most successfully integrated. The study aims at examining the evolution, application and limitations of existing methods for evaluating the sustainability of buildings in different countries. This brings up the concept of developing a sustainability model for multi-dimensional project evaluation, which will allow options to be ranked. This idea is covered in great length in the work [25-27].

This study looks at how construction affects society, the environment and human health while also taking the fallout into consideration [28]. The optimal building construction technique that complies with environmental control laws and reduces environmental impact is provided by the writers. Ecological and conventional materials differ significantly in a few

ways. The goal of this research is to develop a construction project grading system. The building alternatives for one-flat dwelling homes are the focus of this paper [29]. To assist you in selecting the perfect project, there are several options accessible. There is conversation on how building affects the environment. The analysis considers how the building life cycle affects the environment, society, and finances. The study examines the pollution caused by the production of building materials and the construction technologies used, taking into account the useful life, cost and energy consumption of the structure [30]. The selection is subject to a multi-criteria evaluation that considers human and environmental impacts. With the aid of the recently created SAW-G multi-criteria technique and environmental, financial, and quality criteria, it was found that the block home, which mostly consists of wood components, has a score of 0.303, which is 6.6% higher than the block house. Old brick homes had the lowest score of 0.280, indicating that wooden homes are 7.5% superior to brick homes. Wooden structures, on the other hand, scored 0.286 and are composed of wood and mineral resources. When choosing an event site, the AHP technique and the SAW-G method are helpful resources to help with decision-making [31-34].

Sustainability has become a major concern for the building sector in the twenty-first century. The goal of the study is to ascertain if industry participants think that using sustainable building practices would result in lower construction costs and carbon emissions, or if sustainability correlates to greater costs [35]. Following the literature research, a questionnaire survey was carried out to obtain opinions from those inside the industry. Furthermore, a case study has been carried out that contrasts the carbon emissions and operational expenses of a conventionally constructed structure—the current institution—with a sustainably planned structure—the facility that will eventually replace the original building [36]. The results show that although some in the industry believe that employing sustainable construction methods lowers a building's carbon footprint and operating expenses, others believe that doing so will increase costs and make creating a structure more difficult [37]. This work will be helpful to future academics since it shows how incorporating sustainability into new design may save a substantial amount of money on utilities and maintenance once the building is operational [38].

The principles of sustainable building, the advantages of sustainable construction, the difficulties of sustainable construction, and the constraints of life cycle costing are the four components of this research that examine the literature on sustainable construction [39]. The study's findings demonstrate that there have been financial gains, which are backed by a number of creative initiatives. Still, there are a number of obstacles standing in the way of the demand for and acceptance of sustainable building, including the false belief that it would cost more money and ignorance of its potential market. Thus, in order to convince stakeholders to embrace sustainable building practices, it is imperative to demonstrate the financial benefits of sustainable construction [40-42].

2 Sustainable Construction

The following techniques are commonly employed in the construction of ecologically friendly buildings and real estate:

2.1 Solar power

An increasing number of individuals are building their homes with solar energy. Solar energy and solar energy are the two types of green construction technology available [43]. Solar power uses solar panels to convert light energy into heat and electricity. Solar energy, on the

other hand, uses end-use materials and installed windows to heat homes. Because windows allow light in and absorb heat, it takes less energy to heat your home in the winter [44].

2.2 Green Resources

Using scarce resources to build development sites is environmentally friendly. This is because recycled materials create waste and harmful synthetic compounds that take a long time to break down [45]. Paints, bamboo, wood, plant structures (a type of trash) and old linoleum will disappear immediately and should not be in wet areas. Because it separates quickly and emits no pollutants, there are no unexpected ecological impacts. Insulation is one of the most crucial factors to take into account while constructing buildings and residences. With local level cores, costly or highly polished materials are not required [46]. Since waterproof insulation eliminates the need for premium finishes made of waterproof materials, it has become a priority in the development of building. Additionally, it functions by recycling items like denim and paper.

Cool Roofs Regional Unit, a type of sustainable architecture, mimics the process of removing heat and sunlight from a structure. It aids in keeping houses and buildings at the proper temperature by lowering heat absorption and release. Up to 50 degrees Celsius may be taken off summertime temperatures using cool roofs, which employ specific tiles and sophisticated coatings that absorb less heat and double power [47-49]. Cool roofs also reduce the need to cool and, as a result, energy use, which reduces the amount of substances that power plants release into the atmosphere that deplete the ozone layer.

2.3 Sustainable Resource Acquisition

Sustainable asset acquisition can be an important part of creative property development work, as it ensures the use of development materials designed from recycled resources and produced without harming the environment. Regional organizations dealing with agricultural waste and adverse effects regularly make changes to the collection of development material. Material per unit area must be recyclable, reusable and from sustainable ecosystem sources [50].

At the point when a couple of water-saving measures are established locally, that whole region turns into a piece of the innovative property improvement [51]. Viable water structures like double lines, greywater reuse, downpour gathering frameworks, and security establishments are essentially administered by the advances. Homes that gather water, for example, water that will be used for quite a while and store any extras. Water the board, reusing, and non-minimal purposes, for example, vehicle wash and bathroom flushing, are guaranteed by these strategies.

As building inhabitants' safety and well-being are crucial and should be guaranteed at least sometimes throughout the repair of any structure or house, area units are required for unpracticed development. Components that comply with unfeasible health requirements should have non-hazardous viewpoints including moisture resistance, minimal unstable discharges, and non-toxic components. Common materials that encircle units devoid of any hazardous, unnerving, or poisonous neoplastic illness fixes include wood, bamboo, and plugs. Low-VOC materials contribute to better indoor air quality and less exposure to harmful substances including vinyl, lead, and phenol-formaldehyde.

2.4 Passive House

Table 3. Sustainable Constructions.

Reference	Outcomes	Sustainable Construction
‘Kiani Mavi, Reza, Denise Gengatharen, Neda Kiani Mavi, Richard Hughes, Alistair Campbell, and Ross Yates’. "Sustainability in construction projects: A systematic literature review."	This review demonstrated how earlier academics examined sustainability in building projects using a range of statistical and mathematical tools, including fuzzy decision-making techniques and structural equation modeling.	Biodegradable Materials
‘Hussin, Jamilus Md, I. Abdul Rahman, and Aftab Hameed Memon’. "The way forward in sustainable construction: issues and challenges."	It has been found that traditional approaches to project management and construction cannot keep up with new challenges, such the issue of carbon emissions.	Green Insulation
‘Baloi, Daniel’. "Sustainable construction: challenges and opportunities."	This study presents the preliminary results of a wider research project on the implementation of sustainable building. The paper outlines and explores the most important difficulties and possibilities that construction firms face while establishing environmental management systems.	Solar Power
‘Ding, Grace KC’. "Sustainable construction—The role of environmental assessment tools."	This paper's primary goals are to investigate the evolution, function, and constraints of existing environmental building assessment techniques in determining the sustainability of buildings utilized in various nations.	Sustainable Resource Sourcing
‘Medineckiene, Milena, Zenonas Turskis, and Edmundas Kazimieras Zavadskas’. "Sustainable construction taking into account the building impact on the environment."	The SAW-G technique and the AHP methodology are helpful resources to use in choosing a conference venue.	Sustainable Indoor Environment Technologies
‘Dobson, David William, Amr Sourani, Begum Sertyesilisik, and Ashley Tunstall’. "Sustainable construction: analysis of its costs and benefits."	According to the findings, some people in the business think that using sustainable construction techniques reduces a building's carbon footprint and operational costs, while others think that using sustainable practices means paying more and having a harder time erecting a structure.	Passive House
‘Zhou, Lei, and D. J. Lowe’. "Economic challenges of sustainable construction."	The study's findings demonstrate that there have been financial gains, as evidenced by a number of ground-breaking initiatives.	Sustainable Indoor Environment Technologies

The passive house is the main low-tech type of natural development, with different advantages. It makes use of the field style rather than mechanical or electrical components. Using solar energy, every element of a building's design may regulate temperature, whether it's directly warming or cooling during the winter or getting rid of heat in the late spring. A loof buildings can save up to 90% of the energy required for cooling when compared to clear structural stock.

3 Difficulties of Sustainable Construction

Transitioning to supportable development is far from easy, despite its obvious advantages. Following the established protocols allots time and planning. It is necessary to invest time and money in preparation before beginning to use economical techniques. One such obstacle that many businesses may encounter is the actual necessary cost of a controllable course of events. The general belief is that decent structure is more expensive and costs more than what is actually required, regardless of evidence that appears out of the blue. In any event, more development organizations are shifting to sustainable development as public awareness of ecological concerns grows, and the use of green structures is increasing.

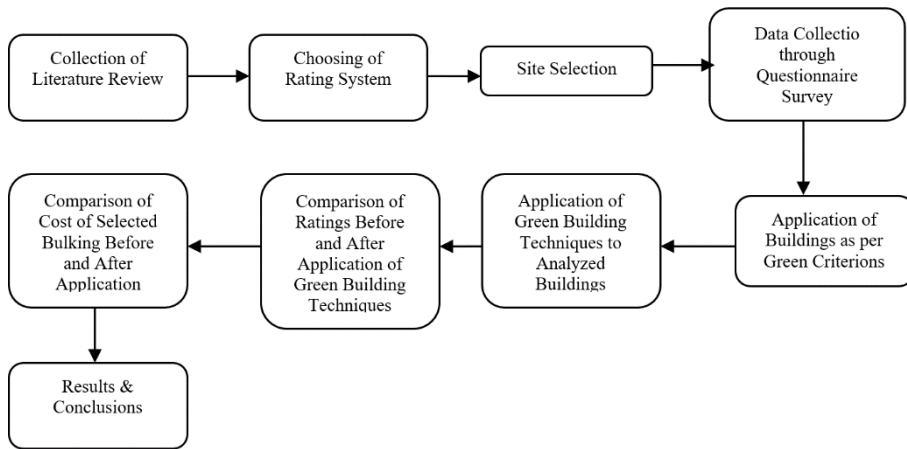


Fig. 1. Study of Process.

To enhance the adoption of sustainable building techniques, the subsequent actions have to be implemented:

1. The government should restructure the existing laws and regulations governing building practices in order to facilitate the successful implementation of the concept of sustainability.
2. The government may also use indirect incentives, like tax breaks, to entice developers to participate. Reducing the length of the approval procedure will motivate large, small, and medium-sized developers to create green buildings.
3. The study's findings showed that green buildings are not being implemented to a high degree. For future projects, the government and industry must take the initiative to implement sustainable building techniques. It is important to do research to help consultants and developers include sustainable problems right from the conceptual and planning stages.
4. Every industry player, including manufacturers, developers, contractors, authorities, marketers, and customers, is essential to the effective execution of a green construction project. It is important to do in-depth study to find out how each agent affects a sustainable project's success.

5. The government is essential to the accomplishment of a sustainable project. A review of the construction industry's current legislative laws should be conducted in order to determine any areas that would require revision in order to address the issue of "Absence of Enforcement."

6. The employment of sustainable building practices is growing in popularity as a means of reducing the damaging effects that construction-related activities have on the environment. It is necessary to conduct research to inform developers that development is motivated by profit. It is important to explain the possible social advantages of green buildings to developers in order to get their support for this type of architecture.

4 Conclusion & Recommendations

The study's findings are consistent with the motivations outlined in the literature on sustainable construction, which encourages industry participants to include sustainability into their projects and draw in new customers by promoting green as a growing trend. Government initiatives have created a situation where a growing number of developers are starting to embrace the idea of sustainable building and incorporate it into their upcoming or ongoing projects. However, a wider adoption of this idea has not yet occurred. Due to a lack of resources, expertise, and understanding, many small and medium-sized developers continue to use traditional building methods.

The findings showed that developers were more eager to include sustainable construction techniques into their projects. But it was discovered that the implementation status was poor. This might be the result of a lack of money, a servile culture, professional training, knowledge, skills, education, and related norms and regulations. The adoption and growth of sustainable construction practices have become more crucial due to the hindrances faced by traditional ways of development. In the long term, sustainable development is essential for human prosperity in addition to aiding in environmental protection. Reducing the obstacles to rational growth by providing additional incentives for those who create, build, and purchase economic structures that apply practical laws in their operations.

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