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SUSTAINABILITY PRACTICES IMPLEMENTED IN THE INDIAN CONSTRUCTION INDUSTRY: A FOCUS OF CONSTRUCTION PHASE

Nicola Thounaojam[1], Ganesh Devkar[2] and Boeing Laishram[3]

ABSTRACT

The construction industry is crucial to the global economy, significantly contributing to local economies and their overall productivity. This is evident in India also, where the construction sector has substantially driven economic growth and development. However, as this industry grows, it poses a significant risk to environmental degradation. While sustainability in construction industry is often investigated from the perspective of design and planning phases, there is also growing recognition of the importance of addressing sustainability during construction phase. A quantitative approach was utilised to investigate the degree to which sustainable practices during construction phase (SPCPs) are implemented in India. Data was gathered from clients, contractors, and consultants, and 40 responses were obtained from 147 respondents contacted. The level of implementation of SPCPs was ranked, and analysis of variance (ANOVA) was conducted to test the significant difference in perceptions among the three groups of respondents. The results indicated that five most frequently implemented SPCPs are: (i) health and safety inspection and auditing; (ii) health and safety training and education; (iii) preservation of archaeological sites, vegetation, and trees; (iv) construction equipment/machinery handling and utilisation strategy and (v) quality management systems. Some of the other fundamental sustainable practices that are under-implemented are: (i) construction noise/ vibration reduction measures; (ii) preassembly or off-site fabrication; (iii) sustainability assessment and recognition program and (iv) stormwater and greywater management plan. Findings of this study can provide guidance to construction industry practitioners in identifying areas that require enhancements, thereby fostering a collaborative approach towards advancing sustainable development goals.

Keywords: *Construction; Construction Phase; India; Sustainability; Sustainable Development.*

[1] Research Scholar, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, India, nicola@iitg.ac.in
[2] Associate Professor, Faculty of Technology, CEPT University, Ahmedabad, India, ganesh.devkar@cept.ac.in
[3] Professor, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, India, boeing@iitg.ac.in

1. INTRODUCTION

The construction industry's activities generate about one-third of the world's greenhouse gas (GHG) emissions (Adebowale & Agumba, 2023). GHG emissions are the primary environmental pollutants. In 2017, India was ranked as the world's fourth largest carbon emitter, with 19% of its emissions coming from the construction sector. In addition, it is estimated that construction and demolition (C&D) waste in India accounts for about 10-12 million tons annually. Furthermore, the industry consumes significant non-renewable resources (Banerjee et al., 2016). The industry not only has impacts that alter the natural environment, but they also impact the health and overall quality of life of humans. Therefore, given India's expected emergence as the world's third-largest construction market by 2025 (Saigal, 2020) and the rapid growth of urbanisation, adopting sustainable construction practices becomes crucial in achieving global sustainable development objectives.

Given the increasing body of evidence pointing to environmental degradation and the concerns for workers' health and safety in the construction industry, there has been a noticeable surge in the momentum behind sustainability in construction practices. Numerous research studies have focused on enhancing energy efficiency or reducing consumption in planning and design or reporting sustainability practices at the corporate level (Fernandez-Sanchez & Rodriguez-Lopez, 2010; Rooshdi et al., 2014; Yates, 2014). In India, some construction companies have begun promoting sustainability by reporting their efforts through the Global Reporting Initiative (GRI) and annual sustainability reports, but primarily at the corporate level, to facilitate sustainable development. The Indian construction industry, however, faces challenges in implementing sustainable tools and practices and is relatively low awareness of sustainability (Manzoor & Sharma, 2023).

Since the construction industry is the most resource-intensive industry, its role in attaining sustainable development goals is indispensable. Sustainability in construction is a multifaceted concept encompassing various phases, including planning, design, construction and operation. Traditionally, sustainability in construction has been primarily focused on planning and design, as these phases present opportunities to incorporate sustainable features such as energy-efficient designs, the use of renewable materials, and waste reduction strategies. However, it is true that the construction phase itself can also have significant sustainability implications, which are sometimes overlooked, primarily due to the complexity of analysis or the perception that the impacts are insignificant (Guggemos & Horvath, 2006; O'Connor et al., 2016). The construction phase involves on-site activities, such as material procurement, transportation, construction waste management, and energy use during construction, which can directly impact resource consumption, greenhouse gas emissions, and waste generation. While there is a growing awareness of the need for sustainable construction practices during the construction phase, comprehensive studies and reporting on this aspect may be relatively limited compared to the focus on design and planning (O'Connor et al., 2016; Omopariola et al., 2022; Yates, 2014). Therefore, this study aims to address this gap by examining the extent of sustainable practices implementation in India by clients, contractors, and consultants during the construction stage.

2. LITERATURE REVIEW

Sustainability emerged from the ‘‘sustainable development’’ concept, defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987, p. 37). Sustainability is a matter that pertains to all industries of the economy. The notion of it is a comprehensive concept that has the potential to impact, and be influenced by, every aspect of infrastructure development. Companies must ensure compliance with a wide range of requirements to follow the various directives and regulations regarding CO2 emissions, air, water and noise pollution, product safety, and product recycling (Shurrab et al., 2019).

Previous studies have comprehensively examined the environmental impacts associated with construction activities, which typically encompass energy consumption, dust and gas emission, noise pollution, waste generation, land misuse, and depletion of non-renewable natural resources. While multiple factors contribute to adopting sustainable construction practices, the environmental attribute has been extensively investigated. In recognition of the construction industry's significant impact on the environment, the industry is increasingly facing mounting legal and commercial demands to adopt eco-friendly practices and has been responding accordingly. Moreover, many nations that seek sustainable development have made it a priority to promote green construction practices.

The concept of "sustainable construction" and its guiding principles were initially introduced to define the construction industry's role in achieving sustainability (Kibert, 2008). In contrast to conventional design and construction, which prioritises cost, scope, time and quality; sustainable design and construction also take into account resource conservation, preventing environmental damage, and promoting human welfare and comfort (Sev, 2009). Several research studies have focused on sustainable construction at project design and operational stages, mainly by introducing energy-efficient strategies (Joseph & Mustaffa, 2023). In addition, sustainable design has been the subject of numerous studies in the construction industry for many years. Nevertheless, sustainable strategies during the construction stage are crucial as it involves several activities that may pose environmental, social, and health risks to workers. Moreover, the scarcity of information and practical guidance on sustainability during construction has intensified the demand for such guidance (O’Connor et al., 2016).

Shurrab et al. (2019) emphasised the significance of "green construction factors" that pertain to the implementation of energy-efficient measures during the construction phase. Yates (2014) highlighted integrating sustainable development practices into industrial construction projects, particularly in selecting reusable, recyclable, or resource-efficient materials. Other researchers have also underlined sustainability practices during the construction phase of such projects that reduce energy consumption during construction and operation and incorporate renewable energy technologies (Goh & Yang, 2014; Rooshdi et al., 2014; Shen et al., 2007). In addition, sustainability considerations in waste management involve reducing waste production and increasing recycling efforts (Krajangsri & Pongpeng, 2017; Ugwu & Haupt, 2007). Awareness and recognition of sustainable initiatives and incorporating sustainability clauses into contracts are crucial in achieving sustainable development in the construction industry (Ugwu & Haupt, 2007; Yates, 2014). Promotion of specialised expertise, skill and knowledge, and technical tools and techniques are some factors that can drive the implementation of sustainability practices (Omopariola et al., 2022). The summary of sustainability practices during the construction phase is summarised in table 1.

Table 1: Sustainability practices implemented during the construction phase

Sustainability practices	References											Frequency
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	
Preservation of archaeological site, vegetation, and trees	*	*	*	*	*	*	*	*			*	9
Sustainable temporary structures and labour camps						*	*					2
On-site power savings and energy efficiency		*	*	*	*	*	*	*	*	*	*	10
Eco-friendly dust and erosion control		*	*	*	*	*	*	*			*	8
Construction and demolition waste management	*	*	*		*	*	*				*	7
Interior air quality control	*	*	*		*	*	*	*	*			8
Stormwater and greywater management plan	*	*	*		*	*	*		*	*		8
Consideration of sustainable, local and regional materials/ services	*	*	*	*	*	*	*	*	*	*	*	11
Minimise generation of material waste			*	*		*	*	*	*	*	*	8
Construction equipment/ machinery handling and utilisation strategy		*	*	*	*	*	*	*		*	*	9
Reusable shoring, formwork, and scaffolding	*	*					*					3
Balanced earthwork and excavation operations		*		*	*		*					4
Preassembly or off-site fabrication		*					*			*	*	4
Construction noise/ vibration reduction measures	*	*	*	*	*	*	*	*	*			9
Site logistics and efficient route planning for project transport	*		*	*	*	*	*	*	*		*	9
Experts with knowledge in management of sustainable projects		*					*				*	3
Supporting local employment and skill development initiatives	*	*	*			*	*			*	*	7
Health and safety inspection and auditing	*	*	*			*		*	*		*	7
Health and safety training and education	*		*			*		*	*	*	*	7
Quality management system	*		*		*		*	*	*			6
Stakeholder engagement and community social responsibility plan	*	*	*			*	*	*	*		*	8
Sustainability-related provisions in project documentation and contracts	*					*	*					3
Sustainability risk management			*				*	*			*	4
Sustainability assessment and recognition program			*			*	*			*	*	5
Paperless site						*	*					2

[1] Ugwu and Haupt (2007); [2] Shen et al. (2007); [3] Fernandez-Sanchez and Rodriguez-Lopez (2010); [4] Goh and Yang (2014); [5] Rooshdi et al. (2014); [6] Yates (2014); [7] O'Connor et al. (2016); [8] Amiril et al. (2014); [9] Krajangsri and Pongpeng (2017); [10] (Shurrab et al., 2019); [11] (Omopariola et al., 2022)

3. RESEARCH METHODOLOGY

3.1 RESEARCH SURVEY DESIGN AND ADMINISTRATION

This study adopted a quantitative research methodology. First, a thorough examination of the literature and interaction with subject matter experts was conducted to identify the sustainability practices. As a result, 25 SPCPs (Table 1) were identified and utilised to design the questionnaire. Then, data were collected using the questionnaire survey with experts from the Indian construction industry. The questionnaire contained two sections. The first section requires respondents to give their background information. The second section asked the respondents, "*how frequently were these 25 SPCPs applied on your projects*" on a 5-point Likert scale, with 1= never, 2= rarely, 3= sometimes, 4= very often, and 5= always.

This study adopted purposive and snowballing sampling techniques. Potential respondents were identified through GRI and sustainability reports, web search and databases of construction firms, who (1) have worked for a minimum of three years in the Indian construction industry, and (2) have experience in managing construction projects or have acquired extensive knowledge of sustainable practices. Using the snowball sampling technique, the participants were requested to suggest additional respondents who were experts in the subject area. A total of 147 subject matter experts from various stakeholders, including clients, contractors and consultants, were identified, and questionnaires were sent out. Forty (40) respondents returned complete questionnaires representing a response rate of 27%. This response rate is consistent with previous research studies conducted with a focus on the Chinese (Ke et al., 2010) and Malaysian (Yap & Skitmore, 2018) construction industries.

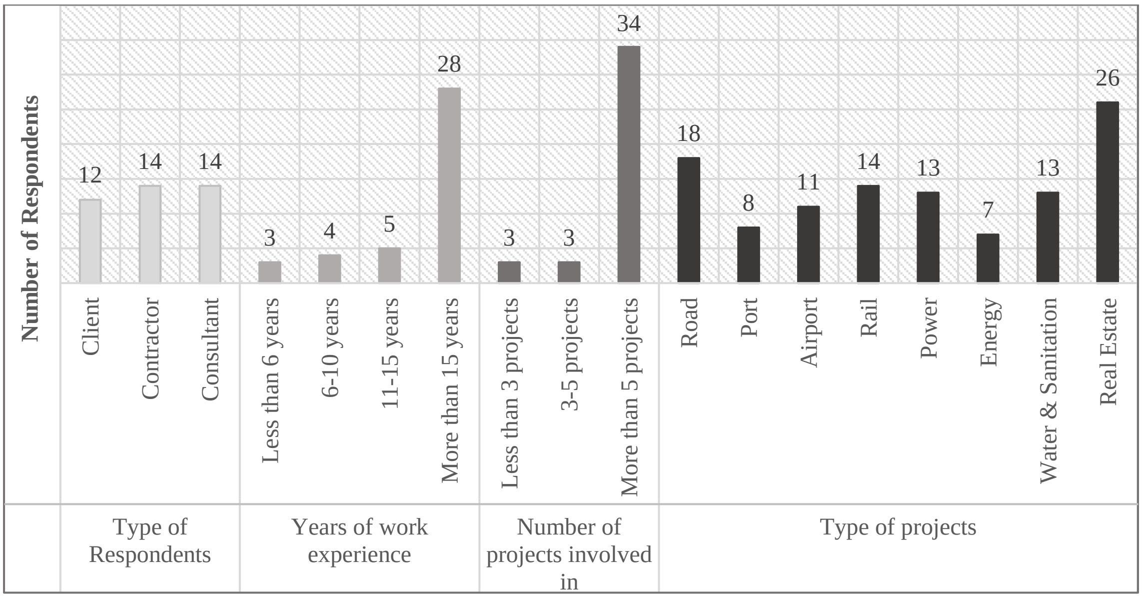

Figure 1: Respondents' Profile, N= 40

Figure 1 provides the demographic details of the respondents. 14 responses (35%) represent contractors, and an equal number of 14 responses (35%) represent consultants. The remaining 30% of respondents represent the client. Furthermore, 34 respondents (85%) had been involved in more than five projects. In addition, 28 respondents (70%) had worked for at least 15 years and were in senior positions. Their extensive experience ensured reliable responses. The respondents were involved in road, port, airport, rail, power, energy, water and sanitation, and real estate industries. Figure 1 provides the background information of these respondents.

3.2 TOOLS FOR DATA ANALYSIS

To assess the consistency of the rating scale utilized for the factors, Cronbach's alpha test was conducted to evaluate the data's reliability. Bonett and Wright (2015) stated that a score of 0.70 or greater suggests that the rating scale's internal consistency is satisfactory. The outcome of this test was a value of 0.91, demonstrating the reliability of the Likert scale utilised to rate the factors; thus, the data collected is deemed reliable. Furthermore, the frequency of application of the 25 SPCPs was analysed using the frequency index within different groups (clients, contractors and consultants). The frequency indexes are calculated by the formula adapted from the index formulated by Wang et al. (2000),

$$\text{Frequency Index (FI)} = \frac{1n^1+2n^2+3n^3+4n^4+5n^5}{5(n^1+n^2+n^3+n^4+n^5)}$$

where n^1, n^2, n^3, n^4 and n^5 are the number of respondents who responded ‘never, but applicable’, ‘rarely’, ‘sometimes’, ‘very often’ and ‘always’ respectively.

To further determine the statistical difference in perceptions between the clients, contractors and consultants, ANOVA test was conducted. The ratio of the F-statistics in ANOVA tells us about the variability between the group means compared to within the groups (Anderson, 2001, p. 34). If the F value is larger, it is less likely that the null hypothesis, which suggests no significant difference among the group means, will be true. The null hypothesis in this analysis is that clients, contractors and consultants equally consider the mean frequency index of the 25 SPCPs.

4. RESULTS AND DISCUSSION

Based on the five-point frequency of application scale, the frequency indexes are used to rank the level of implementation of 25 SPCPs. Ranked in descending order of frequency indexes, Table 2 provides the overall ranking of the SPCPs. Three different groups of respondents rated each SPCP. Consequently, Table 2 also provides ranking based on the three types of respondents. Overall, the findings indicated the most frequently implemented practices, based on frequency index, are *Health and safety inspection and auditing* (FI of 0.89), and *Health and safety training and education* (FI of 0.88). Ensuring the well-being of workers is crucial for their future availability in upcoming projects. One possible explanation for these findings is the current active efforts to promote health and safety through intensive campaigns and programs that aim to increase awareness of the health and safety of workers (Ugwu & Haupt, 2007). In contrast with the findings of this study, Omopariola et al. (2022) found absence of effort to govern workers' health and safety in the Nigerian construction industry. Furthermore, *Preservation of archaeological site, vegetation, and trees* ranked third most frequently implemented SPCP, with a combined frequency index of 0.85. This finding corroborates the finding of Omopariola et al. (2022). Infrastructure projects and their associated areas of influence are typically large, resulting in the disturbance, degradation, and destruction of significant natural habitats. Effectively addressing induced impacts can often be challenging and may involve cooperation between the parties accountable for constructing infrastructure projects and managing protected areas. Nonetheless, many significant conflicts between construction projects and biodiversity conservation can be prevented by meticulous project placement, with particular attention given to avoiding critical natural habitats or other extremely delicate zones, such as tropical forests, and the protection of archaeological sites.

Construction equipment/ machinery handling and utilisation strategy and *Quality management system* (both having FI of 0.83) are ranked fourth and fifth in their implementation frequency. The CO_2 emission levels are substantially influenced by construction machinery, transportation of materials, and travelling within site. By minimising equipment idling and using new techniques to improve equipment efficiency, it would be possible to reduce energy consumption and consequently decrease the amount of emissions released (O'Connor et al., 2016; Yates, 2014). To promote eco-friendly construction practices, the Ministry of Road Transport & Highways (MORTH) under the Government of India has introduced emission standards for construction equipment and vehicles and encouraged the use of dual fuel technology.

Furthermore, the majority of the sustainability indicators are centred on measuring environmental, social and economic performance of the construction project (Nguyen et al., 2018). Therefore, incorporating performance-based indicators into the Quality Management System (QMS) is crucial to keep track of construction activities at the site level (Ugwu & Haupt, 2007). In addition, sufficient quality control is necessary to guarantee that waste is minimised by preventing the need for rework. Rooshdi et al. (2014) also highlighted that quality management is a crucial factor, as it is essential to have well-designed and constructed methods to achieve and sustain a green highway. Nevertheless, the company's ability to grow sustainably and maintain its competitiveness is closely tied to the effective functioning of the QMS. Often, the construction sector shows a significant interest in implementing a QMS since the "presence of a QMS is a warranty mark" (Lukichev & Romanovich, 2016, p. 1719).

The next tier of frequently implemented practices is *Reusable shoring, formwork, scaffolding* (FI of 0.82), and *Sustainable temporary structures and labour camps* (FI of 0.81). Yates (2014) emphasised the significance of adopting eco-friendly temporary facilities (worker camps, construction site buildings, and storage structures) with lighting management systems that can decrease energy consumption at construction sites. Moreover, according to the study conducted by Ugwu and Haupt (2007), engineers place significant importance on the reuse of resources, including the reusability of formworks and moulds, as a key sustainability indicator. The next set of practices frequently implemented are C*onsidering sustainable, local and regional materials/ services* and *Site logistics and efficient route planning for project transport* (both having FI of 0.80). This finding is corroborated by National Highways Authority of India's (NHAI) promotion of using sustainable and locally available materials to construct roads cost-effectively. The strategy includes exploring new and alternative materials and technologies and optimising costs to meet higher targets while maintaining quality and sustainability. Likewise, to promote the sustainable and economical use of fly ash, the Ministry of Environment, Forest and Climate Change (MoEFCC) of Government of India, has mandated its use in road and flyover embankment construction within 300 km of thermal power plants. Moreover, as per the findings of the study conducted by Yates (2014), construction professionals have indicated that implementing pre-planned site logistics and traffic routes can effectively reduce the generation of pollution during construction activities.

Other frequently implemented practices are *Minimising material waste generation* (FI of 0.77), and *On-site power savings and energy efficiency* (FI of 0.77). On the contrary, Omopariola et al. (2022) found that contractors are hesitant to adopt innovative technologies, such as minimising energy consumption and reducing material waste, leading to predominant unsustainable practices at Nigerian construction sites. On the other hand, Shurrab et al. (2019) emphasized the significance of employing green technologies. These technologies not only minimize energy consumption but also provide economic benefits. Nevertheless, identifying appropriate operating strategies is crucial for construction decision-makers, especially when conflicting objectives arise between economic potential and emission reduction. Furthermore, Yates (2014) found that the industrial construction industry is now selling, reusing, and recycling more material by-products than before the introduction of sustainability practices on projects. Experts effectively managed construction by-products by segregating recyclable metal for resale, sending scraps to corporate inventory, sharing with other construction sites, and aggregating disposable waste to reduce energy use.

Table 2: Ranking of implementation of SPCPs

SPCPs	Clients		Contractors		Consultant		Combined		ANOVA test*	
	F.I.	Rank	F.I.	Rank	F.I.	Rank	F.I.	Rank	F#	p value
Health and safety inspection and auditing	0.87	3	0.91	2	0.87	1	0.89	1	0.287	0.752
Health and safety training and education	0.91	1	0.93	1	0.83	2	0.88	2	1.354	0.271
Preservation of archaeological site, vegetation, and trees	0.91	2	0.84	3	0.81	3	0.85	3	0.800	0.457
Construction equipment/ machinery handling and utilisation strategy	0.85	6	0.83	5	0.80	6	0.83	4	0.279	0.758
Quality management system	0.87	4	0.83	4	0.80	5	0.83	5	0.606	0.551
Reusable shoring, formwork, and scaffolding	0.84	9	0.81	9	0.81	4	0.82	6	0.055	0.947
Sustainable temporary structures and labour camps	0.85	7	0.83	6	0.76	7	0.81	7	0.918	0.409
Consideration of sustainable, local and regional materials/ services	0.85	8	0.83	8	0.73	10	0.80	8	2.251	0.120
Site logistics and efficient route	0.83	11	0.83	7	0.74	8	0.80	9	1.144	0.330

SPCPs	Clients		Contractors		Consultant		Combined		ANOVA test*	
	F.I.	Rank	F.I.	Rank	F.I.	Rank	F.I.	Rank	F[#]	p value
planning for project transport										
Minimise generation of material waste	0.84	10	0.77	13	0.74	9	0.78	10	0.949	0.397
On-site power savings and energy efficiency	0.87	5	0.74	15	0.71	14	0.77	11	1.784	0.182
Experts with knowledge in management of sustainable projects	0.80	12	0.79	11	0.73	11	0.77	12	0.523	0.597
Stakeholder engagement and community social responsibility plan	0.69	19	0.79	12	0.73	12	0.74	13	0.703	0.502
Sustainability risk management	0.65	21	0.81	10	0.64	20	0.71	14	2.990	0.063
Balanced earthwork and excavation operations	0.80	13	0.69	18	0.66	17	0.71	15	1.500	0.237
Eco-friendly dust and erosion control	0.78	14	0.71	17	0.64	21	0.71	16	1.056	0.358
Supporting local employment and skill	0.73	18	0.73	16	0.66	18	0.70	17	1.169	0.322
Construction and demolition waste management	0.75	15	0.63	22	0.73	13	0.70	18	1.254	0.297
Interior air quality control	0.75	16	0.64	21	0.69	16	0.69	19	0.548	0.583
Sustainability-related provisions in project documentation and contracts	0.62	23	0.76	14	0.66	19	0.68	20	1.264	0.295
Construction noise/ vibration reduction measures	0.75	17	0.66	20	0.61	23	0.67	21	1.176	0.320
Preassembly or off-site fabrication	0.64	22	0.63	23	0.70	15	0.66	22	0.648	0.529
Sustainability assessment and recognition program	0.67	20	0.69	19	0.60	24	0.65	23	0.501	0.610
Paperless site	0.53	25	0.61	24	0.63	22	0.59	24	0.654	0.526

SPCPs	Clients		Contractors		Consultant		Combined		ANOVA test*	
	F.I.	Rank	F.I.	Rank	F.I.	Rank	F.I.	Rank	F[#]	p value
Stormwater and greywater management plan	0.58	24	0.49	25	0.43	25	0.49	25	0.762	0.474

*H_0: There is no significant difference in ranking of present frequency implementation of SPCPs among different groups of respondents.
[#]Fcrit (critical) is 3.327 at 0.05 significance level. If F > Fcrit or $p < 0.05$, reject H_0

It is interesting to note that practices including Preassembly or off-site fabrication (FI of 0.66), Sustainability assessment and recognition program (FI of 0.65), Paperless site (FI of 0.59) and Stormwater and greywater management plan (FI of 0.49) were found to be not frequently implemented on site. However, many studies mentioned these practices as essential strategies to improve sustainable construction. Therefore, the implementation of these sustainable strategies ought to be considered by the construction industry in India to facilitate sustainable development in their construction projects. For instance, a Hong Kong construction industry study found that expanding the use of prefabrication techniques decreases the amount of waste generated during construction and helps reduce the difficulties associated with waste management (Jaillon et al., 2009). In addition, Killingsworth et al. (2021) found multiple benefits to utilising off-site structural framing systems, including reduced erection time, waste generation, project costs, safety risks, and on-site labor; at the same time, it improved logistics, quality, and collaboration among all parties involved in construction.

Furthermore, programs that include recognition system for innovative and effective practices is important to encourage the widespread adoption of green construction practices (O'Connor et al., 2016). In addition, introducing lessons learned and suggestions for future improvements, along with incentives that support and reinforce the vision of sustainable construction practices, would be crucial in enhancing sustainable construction (Omopariola et al., 2022; Yates, 2014). Shurrab et al. (2019) highlighted in their study that there is a rise in construction organisations showing their dedication to applying for sustainability standards and certifications. Furthermore, it is important to implement stormwater management practices, such as piping systems, retention ponds, or tanks, during construction to address the potential impact of runoff on construction sites. These strategies can also enable the treatment and reuse of water for various purposes, including sewage conveyance, vehicle washing, urinal and toilet flushing, and dust control (O'Connor et al., 2016).

In comparison to the findings of this study with existing literature, some similarities and notable differences are observed. Previous studies have shown successful implementation of practices such as local sourcing of materials, reuse of formwork systems, efficient construction equipment utilisation strategies, and optimisation of job site layouts in both developed (Yates, 2014) and developing countries (Oladokun et al., 2021). Certain techniques, such as air quality control, modularisation, and the promotion of local employment, have been implemented in other global contexts (Oladokun et al., 2021; Omopariola et al., 2022; Yates, 2014) but are not observed in this study. Existing literature has also highlighted areas that require further implementation and improvement. These areas include on-site power savings and energy efficiency, processes aimed at reducing waste generation, and the prequalification of vendors or suppliers based on their sustainability practices.

Furthermore, this study conducted ANOVA test to the statistical difference in perceptions between different groups of respondents. The result shows no significant difference in perception among the respondents (clients, contractors and consultants) on the ranking of the implementation of SPCPs. The high degree of agreement on ranking shows that the respondents have a common understanding of the SPCPs implementation in India, and their rankings' reliability is likely to be high.

5. CONCLUSIONS

Sustainability has become an important facet in the construction sector, and it is being more and more integrated into the phases of design, planning, construction, and operation. This study explores the implementation of sustainability practices during the construction phase in the Indian construction industry. This study found that major areas of SPCPs being adopted are *health and safety inspection and auditing, health and safety training and education, preservation of archaeological site, vegetation, and tree, construction equipment/ machinery handling and utilisation strategy* and *quality management system*. Other important sustainable practices such as *reusable shoring, formwork, and scaffolding, sustainable temporary structures and labour camps,* and *consideration of sustainable, local and regional materials/ services, site logistics and efficient route planning for project transport, minimise generation of material waste,* and *on-site power savings and energy efficiency* are also moderately implemented. Notwithstanding, evidence suggests that several crucial practices, including, but not limited to, *construction noise/ vibration reduction measures, preassembly or off-site fabrication, sustainability assessment and recognition program*, and *stormwater and greywater management plan*, are currently being under-implemented within the Indian construction industry. Including these critical practices in the construction strategy is essential to realise the goal of creating a sustainable environment. Overall, the findings of this study indicate that the results of this research suggest that the Indian construction industry is incorporating sustainable practices to a considerable degree. However, there are opportunities for increased awareness among construction experts and a need for further improvement.

It is important to acknowledge that this study has some limitations. Firstly, the sample size considered in this study was limited to n = 40, which may have implications for the generalisability of the results. Future studies should strive to include a larger sample size to increase the reliability of the findings. Secondly, this study is limited to the sustainable practices identified from the literature and analysed using a quantitative methodology. Future research should adopt a mixed-method research approach that incorporates the views and opinions of experts in the field to enhance the comprehensiveness of the findings. Thirdly, it should be noted that the findings of this study are within the Indian construction context and limited to generalising to other contexts.

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