INTERNATIONAL JOURNAL OF MANAGEMENT STUDIES
https://e-journal.uum.edu.my/index.php/ijms

How to cite this article:
Khoo, T. J., Mohd Shafiei, M. W., Ha, C. Y., & Ismail, R. (2024). Green site management practices in the Malaysian construction sites. *International Journal of Management Studies*, *31*(2), 605-630. https://doi.org/10.32890/ijms2024.31.2.8

GREEN SITE MANAGEMENT PRACTICES IN THE MALAYSIAN CONSTRUCTION SITES

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Received: 14/7/2022 Revised: 5/7/2023 Accepted: 27/4/2024 Published: 30/7/2024

ABSTRACT

This study intends to explore the available green site management practices for construction stakeholders. Green site management practices have been introduced to the construction industry to mitigate the negative impacts of construction activities if construction stakeholders start to implement them. Therefore, green site management practices such as land control, construction site waste management, dust, noise, and vibration control, and a green and conducive environment shall be explored to promote green development in the construction industry. A qualitative method was employed since this study focused on the views of construction stakeholders on green site management practices. Five contractors were randomly selected from the construction sites in Malaysia based on the convenience sampling method. All respondents were qualified to give opinions

as they hold management posts. The process collecting of opinions from the respondents stopped when no new issues were found in their feedback. The results reveal that land control, construction site waste management, dust, noise, and vibration control, and a green and conducive environment were considered green development in the construction industry. However, these practices were not systematically practised as there were no clear guidelines to lead the practitioners. The results also showed that the government has the power to enforce green practices on construction sites. Green site management practices will bring another new era to the construction industry, which is intended to protect the environment while ensuring that the practitioners can be financially sustainable. The results will shed light on green construction development, whereby these green practices can be promoted to construction sites.

Keywords: Green site management practices, construction site, green development, Malaysia, sustainable.

INTRODUCTION

Rapid development is occurring in Malaysia in line with government development plans to become a developed country by 2050. However, some of these developments are causing a negative impact on the environment, as construction activities have resulted in pollution, deforestation, and wastage. Furthermore, the waste created from construction activities, which is not treated properly, has further aggravated the situation. Therefore, several policies and approaches such as Green Building Index (GBI), Energy Efficient (EE), and Building Sector Energy Efficiency Program (BSEEP) have been introduced in recent years by the Malaysian government to reduce the negative impacts caused by the construction industry. Furthermore, the Construction Industry Development Board (CIDB) and the Public Works Department are working together to explore the best approach to promote green site management practices which can effectively handle sustainable issues. In addition, the willingness of the younger generation to reduce environmental issues has helped to promote the importance of green site management practices and encouraged designs and methods that emphasize green development. There has been a 60 percent decrease in water and energy consumption, a 1

percent to 25 percent output increase, and at least a 14 percent increase in profit margins after the implementation of green site management practices (Chang et al., 2018).

However, green site management practices require comprehensive guidelines to reduce the difficulties of implementation (Chevallier & Goutte, 2017). Normally, construction stakeholders implement conventional site management practices based on their experiences. So, there will be various styles of site management, which indicates that current site management styles are quite unstandardized. Unstandardized green site management practices will cause difficulties in reducing negative environmental impacts. However, some green concepts are found implemented within these unstandardized site management styles. The implementation of green site management practices is important as it will bring benefits to the practitioners in three main dimensions: environmental, economic, and social performances. The outcomes are more significant when the construction sites do not receive complaints from their neighbors and fines from the authorities, which indicate improvement in the sustainability aspects (Karimi et al., 2018). Thus, green site management practices need to be applied to construction sites to improve sustainable corporate performance (Jing et al., 2019). Therefore, this study intends to investigate the available green site management practices for construction stakeholders to promote green development in the Malaysian construction industry.

LITERATURE REVIEW

The construction industry is developing rapidly today and Malaysia is relying on this to construct a massive amount of shelters and infrastructures in urban areas to satisfy the increasing population (Onubi et al., 2020c). However, the rapid development has brought about various environmental problems, whereby the construction industry has consumed a massive volume of resources such as energy and water (Chevallier & Goutte, 2017). It is undeniable that the construction industry has brought several negative consequences to the environmental aspects, but Malaysia needs to continue developing to become a developed country (Government of Chile, 2013; Yusof et al., 2020). Thus, immediate action should be taken to mitigate these problems before they reach uncontrollable levels (Building and Construction Authority, 2010; Yusof et al., 2020).

Green site management practices are effective in reducing the negative impacts brought about by construction activities, wherein they can reduce the consumption of energy and water, and construction wastages. To start implementing green site management practices, the environmental consciousness and professionalism of the construction stakeholders are the two most important aspects to be emphasized (Chang et al., 2018; Department of Environment, 2010). The top management team has a crucial role in assuring that green site management practices can be implemented successfully (Qian et al., 2015; Teoh, 2011). Besides that, the government and private sectors can encourage the adoption of green site management practices by introducing appropriate policies (Martín-de Castro et al., 2016). However, there are multiple challenges in the adoption of green site management practices (Building and Construction Authority, 2010). Although there are obstructions, green site management practices can bring enhancement in terms of accessibility, public safety, reduction of noise and vibration, and improved communication and workforce management in construction sites, making it a worthwhile investment (Construction Industry Development Board, 2015; Yusof et al., 2017).

Currently, the environment is contaminated due to rapid development, where green site management practices are urgently needed. Thus, the government as the key stakeholder, should enforce strict laws to ensure all construction stakeholders follow the necessary regulations (Martín-de Castro et al., 2016). Besides enforcing the regulations, the government should promote several policies to prevent low self-awareness of construction stakeholders who neglect the negative impacts of construction activities on the environment (Liao et al., 2021). Awareness raising programs for these construction stakeholders are important, through regular seminars and training. The leaders in the construction industry should start adopting green site management practices as they can apply normative, and mimetic pressures on the construction industry, while the government exerts coercive pressure on the construction stakeholders.

Overview of Green Practices at Construction Sites

Construction site management is considered situational theory management and contingency theory management, where site

management teams manage their construction sites with various kinds of management styles based on their experiences. Thus, site management is a tough task as it has no clear guidelines, but experts from the industry and academia have encouraged green site management practices for construction stakeholders, whereby several green approaches have been introduced (Onubi et al., 2019).

Land Control (Erosion, Sediment, and Flood Control)

Most excavation works do not have proper protection on the surface of excavated soil and these works have caused problems like erosion, sediment, and flash floods due to the excavated soil surface being directly exposed to the weather. These problems are much more significant in hilly areas, as the lack of land control in these areas will cause sediment and mudflow to nearby rivers, leading to the shallowing of riverbeds. Eventually, flash floods will occur easily, especially during heavy rains. Furthermore, nearby water sources might be contaminated due to silt flowing out from construction sites. Thus, silt fences, silt traps, and detention ponds or retention ponds should be installed to effectively stop silt, mud, and sediment from flowing out from construction sites (Kumari et al., 2014). These protective approaches can be further enhanced by supplementing protection on exposed excavated surfaces with damp-proof membranes, which can be laid on the exposed areas to help prevent surfaces from being directly exposed to the weather.

On the other hand, a construction site that demonstrates good land control level will provide a positive image to the public, which helps to build public confidence in the construction industry's efforts to protect the environment (Yusof et al., 2017). Employers have started to emphasize green and conducive construction sites to construction workers by planting trees surrounding construction sites or conserving existing tree plantations to help preserve the environment and provide shade and greenery to construction workers, especially during hot weather (Eger et al., 2017; World Green Building Council, 2012). Moreover, these preserved plantations can help protect soil surfaces from erosion and sediment flow to nearby rivers. This further emphasizes the importance of preserving plantations, especially in hilly areas.

Construction Site Waste Management

To assist construction stakeholders in understanding the concepts of integrated waste management and waste minimization (Huang et al., 2017; Papargyropoulou et al., 2011) and identifying the measures that can be adopted in their projects to minimize waste and move towards green site management practices (Construction Industry Development Board, 2013), the site management team should develop a construction waste management plan to handle construction waste effectively (Jing et al., 2019). The waste management plan should include scheduled waste and non-scheduled waste. Scheduled waste refers to waste generated by constant construction activities, such as metal scrap, which needs to be cleared frequently, while non-scheduled waste refers to rubbish and biomass produced by construction workers. These wastes need to be handled properly. Besides the waste management plan, adopting new technology such as Industrial Building System (IBS) will also help. IBS is a construction technique where building components are manufactured in a controlled environment, either in a factory or off-site, and later transported, positioned, and assembled into a completed work on the construction site to reduce the possibility of error and rework (Construction Industry Development Board, 2013). On the other hand, the adoption of Building Information Modelling (BIM) can help the site management team to reduce construction waste and plan the clearance of construction waste.

The number of construction workers on the construction site is massive as there are plenty of construction parties. Thus, workforce management is important in ensuring that waste management can be carried out successfully (Building and Construction Authority, 2013). To ensure that all parties understand their roles, training should be conducted through briefings and demonstrations of the correct approach to implementing green site management practices (Building and Construction Authority, 2010; Onubi et al., 2020b). Since construction workers' conditions will affect the quality of the building, a good working environment must be provided for them to ensure their productivity (International Trade Centre, 2012). Adequate rewards can be used to encourage construction workers to perform housekeeping regularly (Choo, 2010; Tan et al., 2015). Besides housekeeping, a tidy storage area can ensure that construction materials and equipment are stored properly, as this action will improve the productivity of construction workers by allowing them to save time looking for tools

and materials that they need (Building and Construction Authority, 2010; Gulghane & Khandve, 2015). Since all these actions rely on manpower, supervision from the site personnel plays a vital role in organizing these works to ensure that waste management plan can be implemented successfully (International Trade Centre, 2012).

The 3R concept consists of reducing, reusing, and recycling construction materials and waste (Environment Transport and Works Bereau, 2003; Onubi et al., 2019). The site management team must segregate waste that can be recycled and reused, such as plastic packaging and wood pallets, into specific areas for future usage (Ismail, 2013). Furthermore, this effort can be extended to office waste (Ajayi et al., 2016; Papargyropoulou et al., 2011). In addition, tracking the waste management plan is important, as this can increase its effectiveness. This can be easily achieved through scheduled observations and daily records (Onubi et al., 2019; Papargyropoulou et al., 2011). Onubi et al. (2020a) have emphasized the importance of reducing as it leads to sustainability. The reducing concept could be further utilized by adopting technologies in formwork and systematic platform systems where these technologies can significantly reduce the usage of plywood formwork. Furthermore, a support system like a climbing platform can reduce the usage of scaffolding, which can eventually reduce construction costs.

Since tracking waste management is essential, scheduled observations and daily records should focus on several key indicators, such as concrete and steel reinforcement bars' wastage percentage (Nandhinipriya et al., 2016). Moreover, the site management team will be able to plan and arrange ahead of the construction progress through schedules and records to obtain the best outcome on waste management (Onubi et al., 2020a). Some of the recyclable construction waste can be used as sustainable materials for non-structural building works, such as road curbs and drainage. This is considered one of the green site management practices as it reduces embodied energy in manufacturing these materials (Bhardwaj, 2016; Isnin et al., 2012; Karakhan & Gambatese, 2017).

Dust, Noise, and Vibration Control

Dust control is important as it determines the air quality nearby. To achieve this, the contractor will spray water on the main road to

prevent dust from flying around (Land Transport Authority, 2009). This needs to be done using water from the nearest river or drainage as the main water source to reduce the consumption of treated water. Besides, noises and vibrations from construction activities cause a nuisance to neighbors and buildings, where their rest time is highly affected and building structures develop cracks (Andrew et al., 2010; Onubi et al., 2020a). These problems need to be mitigated by adopting the correct approaches for construction activities, such as arranging noisy construction activities during the daytime when most neighbors go out to work (Onubi et al., 2020a). Noise sources must be covered up by using effective noise barriers that can filter noise (Onubi et al., 2020b). However, using noise barriers can cause an increase in construction costs, but movable noise barriers can solve this problem as they are portable and convenient to be moved around (Building and Construction Authority, 2010).

Machinery can always create huge sounds if it lacks maintenance. Thus, regular maintenance must be carried out on machinery to mitigate the sounds created during operation. In addition, the correct way to operate machinery can reduce rumbling, thus, regular training needs to be given to operators (Building and Construction Authority, 2010; Onubi et al., 2020b). Furthermore, there are alternative methods such as adopting low-noise generators and non-percussion piling methods which produce less noise. Previously, huge noise and vibration could be created in the earthwork stage, but now the silent jack-in-pile approach has been adopted to solve the problems. Hence, the right construction method can decrease dust, noise, and vibration caused by construction activities (Building and Construction Authority, 2010). On the other hand, the use of newly introduced technologies such as engineered formwork made from steel, which is highly durable and recyclable compared to conventional plywood formwork. In addition, steel formwork requires lesser manpower to be installed and dismantled due to its repetitive specifications. As its specifications ensure convenience and time-saving in installing and dismantling formwork, it reduces noise pollution (Building and Construction Authority, 2010; Zarei et al., 2018).

Green and Conducive Site Environment

It is important to include green site management practices in company policies (Onubi et al., 2019). Furthermore, company policies are

useful in raising the awareness of site staff by guiding everyone (Tekchandani, 2015). Moreover, company policies need to be continuously improved, whereby feedback from participants should be collected and assessed (Building and Construction Authority, 2010; Qian et al., 2015). The government has played its role through CIDB, where standards and guidelines have been developed for the construction industry's reference; thus, top management can refer to these available sources to implement the best green site management practices (Construction Industry Development Board, 2013).

The site office can be utilized as one of the green site management aspects where energy consumption in the site office can be greatly reduced to decrease construction project administrative costs (Collins et al., 2017). To ensure the energy-efficiency of the site office, the location and orientation of the site office are important (Abu Bakar et al., 2015; Ofori-Boadu et al., 2012). The site office should be oriented in the north-south direction where more windows can be made facing north-south. This orientation will ensure the site office absorbs the least heat, indirectly reducing the usage of air-conditioning systems in the site office (Collins et al., 2017). Moreover, the roof and facades of the site office can be fully utilized by applying heat-shielding coating on the walls, which can reduce heat intake from the sun (Building and Construction Authority, 2010; Onubi et al., 2020b). The roof can be utilized by constructing a small roof garden above the site office, which can help to cool down the site office (Building and Construction Authority, 2010; Onubi et al., 2020b).

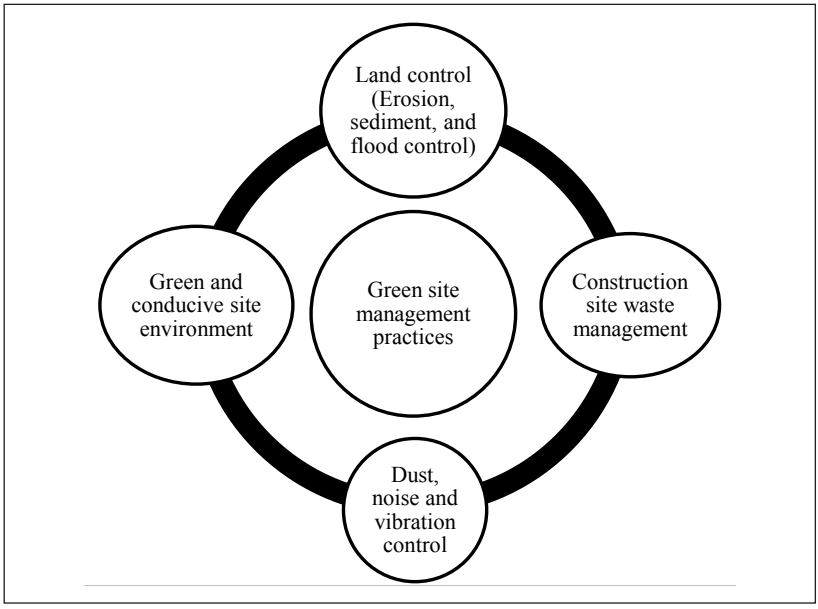
METHODOLOGY

This study aims to identify available green site management practices in construction sites, as various green practices can be implemented. The study adopted a phenomenological qualitative method, which consisted of observations and interviews. A research phenomenon can arise from any problem, issue, or topic chosen from the practical world of affairs as the subject of investigation (Van de Ven, 2016). Since this research intended to explore available green site management practices in construction sites, an exploratory research method was used. Contractors are the most important contributors as they hire various employees to assist them in managing their construction projects and

resolving issues on construction sites. These are skilled workers with sufficient management abilities. Therefore, this study interviewed site supervisors, construction managers, and project managers to obtain detailed information on available green site management practices. These individuals were chosen as research respondents because of their positions, which directly impact the implementation of green practices. The interviewees discussed available and implemented green site management practices in their construction sites and the factors that drove them. As the population of this study was too large to gauge, convenience sampling was used. Convenience sampling is a non-probability sampling approach that collects available data from the available population, reachable, and willing to be involved in the data collection process. This is a viable sampling design approach to collect exploratory information. Therefore, this study engaged five respondents who were willing to participate and with vast experience in managing construction projects from different locations in Malaysia. Figure 1 shows the available green site management practices in construction sites, which are the focus of this study.

Figure 1

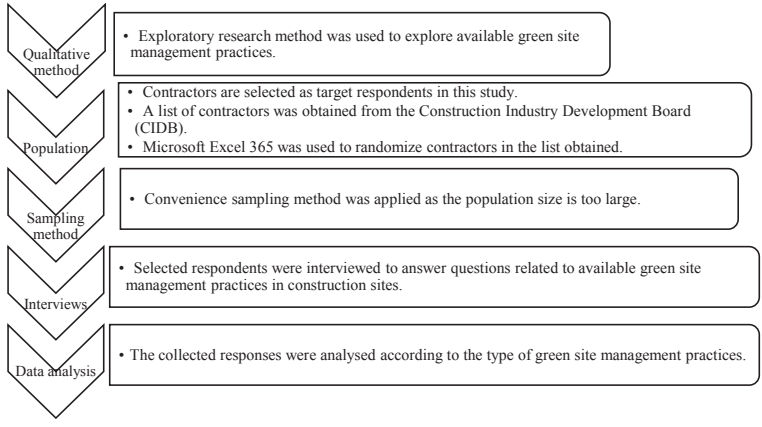
Available Green Site Management Practices in Construction Sites



A list of contractors was obtained from the Construction Industry Development Board (CIDB), and several contractors were randomly selected from the list to gather diverse data from various construction sites. Microsoft Excel 365 was used to perform the randomization. As the accuracy of the data is critical in assessing the actual conditions of the construction site, all respondents for the research were chosen randomly to verify that there was no bias on any construction site. To ensure no bias, these respondents were randomly selected based on regions, sizes, scales, and experiences to obtain the most accurate statistics. This supports the statement of Onubi et al. (2019) that green site management practices should not only be implemented by large-scale construction projects, as every construction project will have significant impacts on the environment (Onubi et al., 2019). Firstly, the respondents were randomly selected from a list of contractors obtained from CIDB, and permission was obtained from their headquarters to interview the targeted respondents. After permission was obtained from the respondents' headquarters, online interview sessions were conducted due to Covid-19 pandemic restrictions, with selected respondents asking questions pertinent to the available green site management practices in their respective construction sites. As this study employed a convenience sampling method, the data collection process stopped when no new issues were found from the feedback received. Figure 2 illustrates the research flow applied in this study.

Figure 2

Flowchart of Methodology



RESULTS

Respondents' Background

Table 1 shows a summary of the respondents' demographic profiles. It is evident that the respondents hold various positions and are located in different areas, with diverse working experiences in the construction industry. Most of the respondents occupy influential positions within their respective companies, all of whom are part of the management team. The majority of the respondents have over five years of experience in managing construction sites, validating the quality of their opinions as they are actively involved in daily site management tasks. This ensures that the feedback from the respondents is both valid and reliable. The respondents indicated that various green site management practices can be implemented. The collected responses confirmed that green site management practices were adopted in every construction site; however, the level of implementation varied due to differences in understanding the green concept. Moreover, the respondents emphasized that the implementation of green site management practices requires a detailed and comprehensive design plan, incorporating all green practices required by the construction project. This plan should be prepared meticulously for all staff involved in executing site management tasks to ensure the successful implementation of green site management practices.

Table 1

Demographic Profiles of the Respondents

Respondent	Location	Position	Years of experience
A	Pulau Pinang	Project Manager	10–15 years
B	Pulau Pinang	Construction Manager	10–15 years
C	Kuala Lumpur	Senior Site Supervisor	5–9 years
D	Kuala Lumpur	Senior Site Supervisor	5–9 years
E	Johor Bharu	Site Supervisor	1–4 years

Table 2 shows the summary of green site management practices which includes land control, construction site waste management, orderliness of construction sites, dust, noise, and vibration control, and green and conducive site environment implemented by the respondents which will be discussed further in this study.

Table 2

Green Site Management Practices Implemented by Contractors

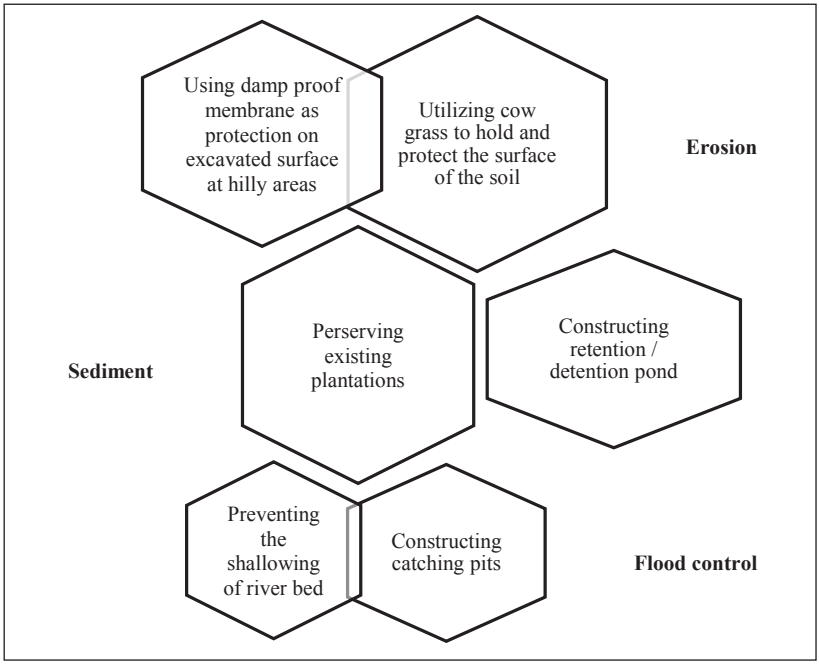
Green Site Management Practices	Land Control (Erosion, Sediment, & Flood Control)	Construction Waste Management	Orderliness of Construction Site	Dust, Noise, and Vibration Control	Green and Conducive Site Environment
A	/	/	/	/	/
B	/	/	/	/	/
C		/	/	/	/
D	/	/	/	/	/
E	/	/	/	/	/

Land Control (Erosion, sediment, and flood control)

The results show that most of the respondents implement land control as one of the green site management practices to avoid silt, sediment, and mud from causing problems to the environment. Respondent A stated, *"We must prevent the environment from being polluted by construction activities or there will be complaints and fines by the local authorities.*" Those who do not adopt green site management practices in the land control aspect are mainly working in the middle of urban areas where their construction sites are not near hilly areas. Respondent C, who is working in the middle of the city, said, "*We can skip the land control works, but we have more things to consider. Other considerations are the vibration and sound distortion that might cause dissatisfaction among adjacent residents. Besides that, the construction activities might cause cracks in other buildings. We must prevent this and fix it if it happens*." The results show that green site management practices in the land control aspect will be implemented if deemed necessary. Figure 3 illustrates the land control practices, including erosion prevention, sediment control, and flood control on construction sites.

Figure 3

Land Control Practices in Construction Sites



Construction Site Waste Management

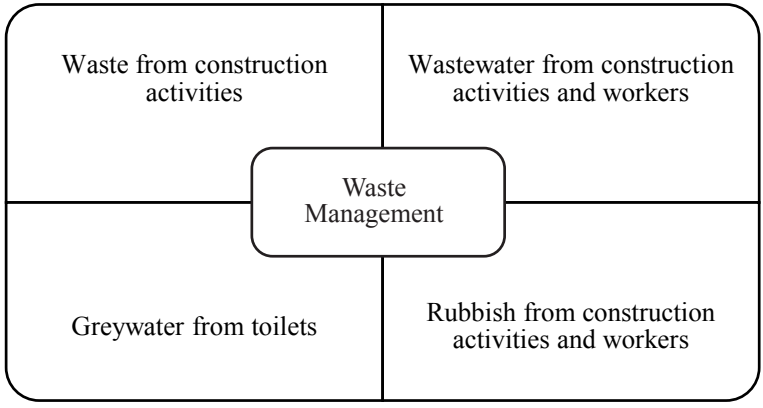
The results indicate that the government has successfully played its role in waste management aspects, as most respondents stated that they have no choice but to adopt this practice. Respondents expressed concerns about potential fines from the government if their waste management plan does not meet the standards stated in government regulations. The site management team conducts monthly checks around the construction site to ensure proper execution of the waste management plan (Huang et al., 2017). While government regulations have been crucial in ensuring waste management practices, some respondents mentioned that certain waste management practices are implemented voluntarily due to financial benefits, indirectly reducing construction costs (Karimi et al., 2018). Respondent A stated, "*No contractor will commit to green practices if there is no benefit for*

them, especially in the financial aspect." However, respondent D had a different opinion, stating, "*We must protect the environment to ensure the next generation is not affected.*" Respondent D thinks that it is everyone's responsibility to keep the environment free from pollution, countering respondent A's opinion.

Waste management practices should emphasize three types of waste: materials waste, wastewater, and rubbish generated by construction workers (Gulghane & Khandve, 2015). Greywater from toilets must be filtered and discharged to installed septic tanks to prevent direct discharge into nearby water sources, which will cause severe pollution. Regular clearing of rubbish is necessary to prevent unpleasant smells, flies and mosquitoes, and the spread of bacteria which can lead to health problems for construction workers. Respondent E stated, "*The unpleasant smell of site toilets and rubbish always causes nuisance to the workers; this should be handled wisely as it might lead to disease among the workers, resulting in the construction site being shut down for several weeks if the authorities penalize us."* This is also supported by Kontogianni and Moussiopoulos (2017). Respondents D and C shared similar concerns as their construction sites were once instructed to shut down by the authorities due to the spread of dengue fever, ultimately causing delays in construction progress.

Figure 4

Waste Management Practices in Construction Sites



In addition, the waste management plan should emphasize the reuse of construction materials, such as using crushed concrete as crusher run to distribute over the foundation, as this can save construction costs (Nandhinipriya et al., 2016). Respondents D and E said that "*We use the extra and shorter parts of steel reinforcement bars, which are cut after being used on columns and beams of the building structure, as lintel's steel reinforcement bars, are usually shorter in length. This practice helps to maximise the use of steel reinforcement bars.*" Dumping useful construction materials not only causes wastage but also increases construction costs, as contractors need to call for rubbish trucks to remove waste to the dumping area. Respondents B and C explained that "*To dispose the excavated soil, we must arrange for lorries to transport it to the dumping area, which will cost us based on the total number of trips required. Therefore, it is better to transfer unwanted excavated soil to other sites which need filling to increase ground level.*" This shows how respondents utilize materials on their construction sites. Figure 4 summarizes waste management practices in construction sites.

Orderliness of Construction Site

The image of the construction site is important to portray a high level of green site management practices. Moreover, a messy construction site can cause problems for construction workers. Often, construction workers struggle to find the necessary tools, materials, and equipment if the site is disorganized. Therefore, all respondents strongly emphasized the importance of cleanliness and orderliness at the construction site to ensure that site conditions do not hinder construction progress. Respondents C and E highlighted that, "*the image of the construction site is important, as the first impression is critical to ensure that potential house buyers are willing to make bookings based on the appearance of the construction project.*" Thus, construction workers are instructed to maintain the orderliness of the construction site.

Furthermore, the orderliness of the construction site enhances its aesthetic aspect. Respondents A and D noted that "*the aesthetic view surrounding the construction site significantly improves the working efficiency of construction workers.*" To achieve this, landscaping of the construction site can be enhanced with existing and newly planted plants. Respondents A, B, and C said, "*there will be plantations surrounding the site office, showroom, and other open areas to create*

a positive image on visitors, ensuring they and the construction workers have a conductive environment." As a result, environmental and social performances can be improved as this action to greening the environment, reducing temperature, and decreasing air pollution and improving satisfaction among construction workers in their working environment.

Dust, Noise, and Vibration Control

Dust is often a problem for adjacent residents; thus, contractors typically spray water on the road to mitigate it. All respondents agreed that this is an effective approach, especially during hot seasons when there is little rainfall. Respondents A and B also emphasized the use of pavement sweepers on construction sites, noting that "The pavement sweeper can be used to clean up the construction site if there is no available natural water resource found nearby for spraying purposes." This practice aligns with recommendations by the Building and Construction Authority (2010). In efforts to be green and sustainable, Respondents C and D advocated for the use of movable noise barriers. they said that "portable barriers should be used to filter noises caused by machinery as it is more convenient compared to immovable noise barriers." This method is also endorsed by the Building and Construction Authority (2010). Furthermore, Respondents A and E mentioned that they use noise reduction machinery for construction activities, "We use the silent jack-in-piles for piling works which greatly reduce noise and vibration levels". This aligns with recommendations by the Building and Construction Authority (2010) which emphasizes that adopting appropriate construction methods can significantly reduce dust, noise, and vibration,. Moreover, to enhance noise and vibration control, Respondent E suggested, "a device should be installed to monitor noise and vibration levels to ensure that immediate action can be taken." This recommendations aligns with the guidelines by the Building and Construction Authority (2010) as installing monitoring meters ensure prompt corrective action can be taken when noise and vibration levels exceed stipulated limits. Figure 5 shows the dust, noise, and vibration control practices in construction sites.

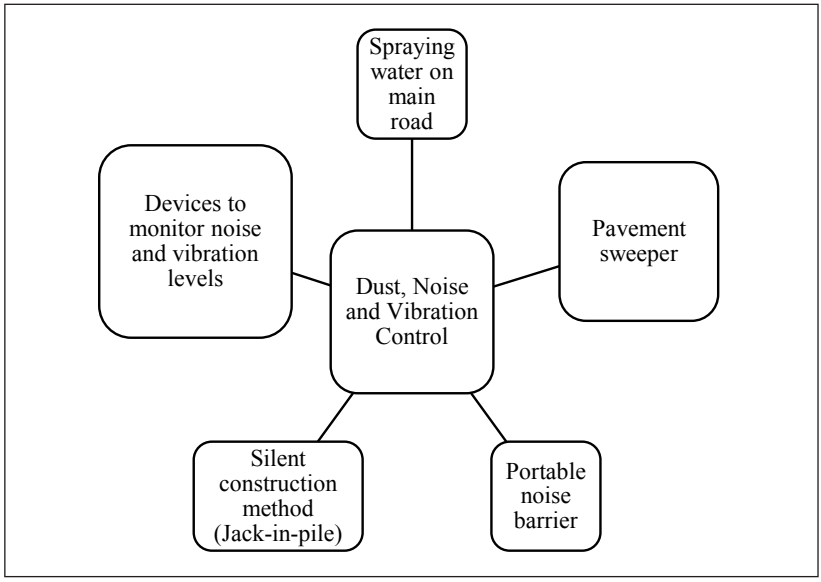
Green and Conducive Site Environment

All respondents emphasized that water quality management is essential to prevent water pollution and the shallowing of river beds,

crucial for fostering green and conducive site environments. Effective site management practices are integral to reducing pollution levels. Therefore, precautionary measures such as constructing retention ponds or detention ponds are vital (Kumari et al., 2014). Siltation, is a common issue arising from soil excavation, exposes excavated areas directly to the weather, potentially leading to problems like flash floods (Huisingh et al., 2015). To mitigate this, many construction projects cover excavated areas with cow grass turfing. This approach, utilizing available resources without significantly increasing construction costs is considered a green site management practice (Bhardwaj, 2016).

Figure 5

Dust, Noise, and Vibration Control Practices in Construction Sites



Respondents C, D, and E said "*water usage is normally consumed in large amounts in construction projects. The washing bay, located at the construction site exit is used to clean the tires of departing lorries, preventing mud from polluting roads. Normally, this process requires a lot of water but water consumption can be reduced by using nearby water sources like rivers and drainages. Moreover, reusing water from the washing bay can further reduce usage. However, the water in*

the washing bay will be contaminated by lorry oil. Hence, this water should be filtered before being discharged out to the nearby sewers." Thus, equipping the site boundary with drainage and catching pits is essential to prevent contaminated water from flowing out without proper filtration. Regular maintenance of drainage systems is crucial to prevent silt accumulation and ensure proper water flow. Additionally, directing surface run-off to wastewater treatment facilities helps prevent water pollution.

DISCUSSIONS

Several green site management practices are available in construction sites, including land control (erosion, sediment, and flood control), construction site waste management, orderliness of the construction site, dust, noise, and vibration control, and creating a green and conducive site environment. The results indicate that the majority of contractors implement land control measures, except those operating in urban areas. However, construction projects in urban areas must address vibration and noise issues to avoid disturbing nearby residents, thus necessitating additional green site management practices. Furthermore, the implementation of a waste management plan is compulsory due to government regulations. This not only helps contractors improve their economic performance by adopting the reuse, recycle and reduce concept to minimize construction expenses but also reduces environmental impact. Moreover, maintaining the orderliness of the construction site is crucial in portraying a high level of green site management practices. A well-maintained construction site contributes to efficiency by reducing the time spent to search for tools, materials, and equipment. Efforts to control dust, noise, and vibration are essential in construction sites. Contractors take various measures such as watering roads to prevent dust, using pavement sweepers for cleaning, installing noise barriers, and adopting appropriate construction methods to reduce vibration. Lastly, creating a green and conducive site environment is important for enhancing corporate sustainability performance. This involves drainage systems and landscaping by planting more vegetation within the construction site area to prevent soil erosion and improve environmental performance. The implementation of green site management practices can mitigate the negative impacts of construction activities, as evidenced by the respondents' feedback.

By integrating practices such as land control, waste management, site organization, and environmental maintenance, both economic and environmental performance can be significantly improved. Table 3 summarizes the feedback obtained from the respondents through interviews.

Table 2

Summary of Results from Respondents

Respondent	Land control (Erosion, sediment and flood control)	Construction site waste management	Orderliness of construction site	Dust, noise, and vibration control	Green and conductive site environment
A	Prevent environmental pollution to avoid penalties from the authorities.	Metal scraps are sold to reduce construction costs.	The aesthetic view will improve the working efficiency of construction workers. The good aesthetic view gives a positive image to visitors which can improve the company's reputation.	Pavement sweepers are used to clean up dust within the construction site. Alternative construction methods such as jack-in-pile are used to reduce noise and vibration levels.	The orientation of the construction site is critical. We should plan the orientation of the site office, store room, construction workers' accommodation, and canteen, properly.
B	Land control must start at the beginning of the construction project, especially substructure works.	Excavated soil can be utilized by removing the soil to other construction sites to raise ground level.	Surrounding vegetation increases buying rate among house buyers.	Pavement sweepers are used to clean up dust to reduce water consumption.	A small garden can be allocated near the site office to encourage green development. Training should be given to construction stakeholders to raise awareness of the importance of green development.
C	Land control can be skipped in the city but there are other concerns such as vibration and noise levels which can cause disturbance to the surrounding environment.	Rubbish from workers' accommodation must be cleared weekly to avoid the spread of diseases. Excavated soil must be utilized to reduce dumping costs.	Orderliness of the construction site can increase the purchasing intention among house buyers.	Noise barriers including non-portable and portable types should be used to reduce noise levels.	The washing bay can use water from nearby river or drainage to clean lorry tires before exiting the construction site.

(continued)

Respondent	Land control (Erosion, sediment and flood control)	Construction site waste management	Orderliness of construction site	Dust, noise, and vibration control	Green and conductive site environment
D	Cow grass and damp-proof membrane should be used to protect the surface of excavated areas, especially hilly areas.	A waste management plan is important to avoid the spread of dengue fever due to stagnant water in rubbish allocated areas. Used steel reinforcement bars are utilized as trimmer bars around concrete slabs and wall openings.	The appearance of the construction site is vital in maintaining the company's reputation and to prevent penalties from the authorities.	We should learn from Singapore which uses noise barriers to prevent construction activities such as hacking and hammering from causing a nuisance.	A washing bay with a detention pond or retention pond is essential to reduce the consumption of treated water.
E	A detention pond or retention pond must be constructed to capture sediment. The water in the detention pond or retention pond can be used to clean lorry tires.	The site toilet must be washed regularly to keep it clean. Used steel reinforcement bars are utilized as lintel steel reinforcement bars.	Construction sites that are in order can increase productivity. The orderliness of construction sites lend confidence to potential house buyers.	Alternative construction methods should be adopted to prevent dust, noise, and vibration. A device should be installed in the construction site to monitor noise and vibration levels.	Store rainwater for use as water source to wash lorry tires at the washing bay.

CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS

The results show many green site management practices are available for implementation in construction sites. These practices can be categorized into several categories, such as land control, construction site waste management, orderliness of construction sites, dust, noise, and vibration control, and creating a green and conducive site environment (Abu Bakar et al., 2015; Onubi et al., 2020c). The results show that most of the construction stakeholders have adopted green site management practices due to pressure from the authorities leading to a successful reduction in water consumption and pollution levels in nearby rivers. Land control measures have prevented soil erosion and siltation, as mud cannot flow out from the construction site. Additionally, slope protection is applied to excavated surfaces near hilly areas to prevent landslides that may endanger construction workers. Inadequate site management practices can have severe

environmental consequences, prompting increasing attention from the authorities and private sector on green site management practices. Air quality management is also important as the site management team attempts to reduce dust and greenhouse gas emissions from daily construction activities.

This study is limited to only five willing respondents. Future research is suggested to expand the size of the respondent pool. Other recommendations for better green site management practices include training, integrating green concepts into company policies, and enforcing legislation, whereby the authorities conduct more frequent checks on construction sites. Construction courses at the tertiary level have begun integrating green concepts into their syllabi, raising awareness of the importance of environmental problem-solving in the construction industry. Furthermore, the government has stepped up efforts to integrate green concepts into legislation and conduct regular checks on construction sites to prevent irresponsible contractors from flouting their responsibilities. Monthly checks should be conducted on construction sites, especially mega projects that significantly impact the environment. Adequate penalties should be imposed on contractors who flout the law to serve as a lesson and a deterrent. Therefore, future studies could evaluate the effectiveness of relevant legislation enforced by the authorities and the integration of green concepts into tertiary education syllabi.

ACKNOWLEDGEMENT

This research did not receive any specific grants from public, commercial, or not-for profit funding agencies.

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