INTERNATIONAL JOURNAL OF SUSTAINABLE CONSTRUCTION ENGINEERING AND TECHNOLOGY
VOL. 12 NO. 5 (2021) 156-163

IJSCET

http://publisher.uthm.edu.my/ojs/index.php/ijscet

ISSN : 2180-3242 e-ISSN : 2600-7959

International Journal of Sustainable Construction Engineering and Technology

Assessing Site Waste Management Practices and Cost Between Conventional and Industrialised Building System (IBS) Projects in Malaysia

Ani Saifuza Abd Shukor[1], Nor Hanisah Idris[2], Anis Sazira Bakri[1]

[1]Faculty of Architecture, Planning and Surveying
Universiti Teknologi MARA, Shah Alam, 40450, MALAYSIA

[2]Archinteriors Engineering

*Corresponding Author

DOI: https://doi.org/10.30880/ijscet.2021.12.05.016
Received 19 October 2021; Accepted 31 December 2021; Available online 31 December 2021

Abstract: The Urban development and demands in the construction industry and the increasing population numbers have positively contributed to the rising waste generation. The growth and expansion of construction activities enhanced the problem of waste generation on construction sites. In the Malaysian construction industry, there is a pressing issue of minimising construction waste, which causes significant impacts on the environment. Malaysia is moving towards better construction waste management; however, there is still insufficient collection and improper construction waste disposal in projects site. Practices to reduce, reuse, or recycle waste have not yet achieved widespread implementation due to the cost incurred in handling and transporting the physical waste to thedumpsite. Thus, adopting an Industrialised Building System (IBS) has been one alternative to the conventional construction method to reduce construction waste. The research aim is to compare site waste management practices between conventional and IBS projects. The research examines the types of site waste generated from construction project activities, the types of site waste management practices, and the cost involved in managing site waste. The research methodology used qualitative research and used a case study approach. The data is gained from semi-structured interviews with conventional and IBS contractors in Malaysia. The analysis is based on cross-case analysis and pattern matching. Findings from semi-structured interviews based on six comparative case studies revealed that there are some differences between the types of site waste generate by the conventional and IBS projects due to some causes such as improper storage and wrong handling material. Adopting an IBS can greatly minimize construction waste, saving the cost of materials, and improve the environmental performance for overall site conditions. This research shows that the government should play an important role by encourage all the construction company to implement IBS as the new way in minimizing the construction waste.

Keywords: Waste management, construction waste, cost, Industrialised Building System

1. Introduction

Economic growth, increasing population, and demand for urban development have positively contributed to the growing construction activities and increase in waste generation. The construction industry generates a significant amount of construction waste because of the work being performed on-site. The growth and expansion of construction activities enhanced the problem of waste generation on construction sites (Arif et al., 2012). It is a significant contributor to generating waste, which can cause pollution that results in economic, environmental, and biological hazards and losses.

*Corresponding author: anisa278@uitm.edu.my

Site waste, also known as construction waste, referred to substances generated because ofconstruction work and abandoned whether it has been processed before being abandoned (Nitivattananon & Guilberto, 2007).

Furthermore, CIDB (2008) defined construction waste as unwanted or generated materials during construction or demolition activities, including improvement, preparatory, repair, or alteration works. Meanwhile, Hasmori et al., (2020), concluded that construction waste is the excess materials generates from construction activities. Mei (2016), who reported on data from Australia, noted that the construction industry produces 44% of the 14 million tonnes of waste put into landfills. In the European construction sector, about 820 million tons of construction and demolition waste are produced annually, around 46% of the total amount of total waste generated (Eurostat, 2017) (Martos et al., 2018). In the same vein, Saadi et al., (2016) reported that more than 25,000 tonnes of waste were also generated from the construction industry in Malaysian construction industry. The data show that environmental pollution contributed by construction can be expected to worsen over time. The construction industry consumes considerable amounts of natural resources and produces building waste that can rarely be recycled, as it may be highly polluted in the processes of production and assembly (Lachimpadi et al., 2012).

Introduction to and utilization of appropriate technologies and efficient facilities are essential in construction for the sake of environmental protection (Nagapan et al., 2012). The Malaysian Construction Industry Master Plan (CIMP 2006-2015) and the present Construction Industry Transformation Programme (CITP 2016-2020) aim to develop Malaysian construction into an environmentally sustainable industry. Moreover, the target of Sustainable Development Goals 12 (SDG 12), by 2030, there is significantly reduced waste generation through prevention, reduction, recycling, and reuse (Nor Faiza et al., 2019). Malaysians are moving towards better construction waste management; however, there are still insufficient collection and improper disposal methods for construction waste (Mei, 2016). According to Marzouk & Azab (2014), the lack of waste management practice on many construction and demolition wastes will have harmful effects on the environment. The government has developed various site waste management solutions; however, it has yet to achieve the level of effectiveness required to manage construction waste adequately. Thus, these inefficient waste management practices affect construction productivity and performance (Hasmori et al. 2020). Therefore, this research aims to examine the types of site waste generated from construction activities, the types of site waste management practices, and the cost involved in managing site waste between conventional and IBS projects. Thus, it is crucial to study site waste management to compare conventional and IBS approaches to investigate both construction projects on managing their site waste effectively. Thus, it could be possible to produce an output useful for the country's regulatory framework for future construction waste management.

2. Literature Review

Waste management is a crucial part of the construction industry. Management of waste includes monitoring activities, collection, transport, processing, and waste disposal. The focus on material waste and the low quality of waste management often causes rework schedule delays, increased time spent waiting for a decision, double material handling, and poor constructability (Saadi et al., 2016). Site waste has been criticized for producing a high quantity of waste. Current research proves that construction is the main contributor to generating waste, which can cause environmental pollution and other harmful effects. Additionally, Wahi & Joseph (2015) noted that there are two principal components of construction waste. The first is time waste, including waiting periods, varied information, delays in plan activities, and unusual wear of equipment, ineffective work, and required rework. The second is material waste, which includes ordering issues, incorrect storage and handling, manufacturing defects, and overproduction. Site waste has been criticized for producing a high quantity of waste.

Lachimpadi et al., (2012) compares site waste, generates between conventional construction methods and IBS; there are not many differences in terms of types, but the differences resulted from the amount of site waste generated between these types of the construction method. The research reveals that site waste generated from the conventional construction method is slightly higher than the site waste generated from the IBS projects. Saadi et al., (2016) stated that the types of site waste that usually generate in conventional projects were timber, concrete, bricks and blocks, soil and sand, tiles, glass, packaging waste. Meanwhile, types of site waste generated from the IBS projects mostly contribute to packaging waste and other materials such as tiles, timber, bricks, and blocks. By knowing the amount of wastage produced from the construction activity that can harm and cause destructive issues, the government for each country worldwide should implement site waste management to control and reduce the quantity of site waste.

Appropriate site waste management practices in the construction industry will create a significant priority to protect the environment. Conventional projects are being less likely to adopt effective strategies in waste management or waste minimization. Improper and unsystematic approaches to handling building materials and inventory on the site will increase waste generation. The site waste management approach commonly used in the Malaysian construction industry is to dump waste directly into landfills, legal or illegal dumping. The conventional construction method consists of extensive cast-in-situ activities in which all construction processes are carried out on-site; waste disposal at the landfill is how they manage their waste, but this practice is now under criticism. The conventional method is one approach that generates a vast amount of unwanted but useful surplus materials; however, disposal space is running low (Firmawan &

Othman, 2012). Thus, the conventional method is quite tricky and ineffective for controlling waste from building materials on a construction site.

Essentially, building materials are the main contributor to construction waste. However, the amount of that waste depends on the construction system used for the project and whether the company uses the conventional method or an industrialized building system (IBS). Urgent and immediate improvement to construction waste disposal practice is necessary to meet the current demands for improved construction waste management (Firmawan & Othman, 2012). However, there is very little relevant information on disposal practices for construction waste at the municipal level, including its composition and the disposal site's characteristics. Thus, a strategic practice is necessary to minimize and manage waste. Adopting an IBS is more familiar with their effectiveness to reduce waste and method to hoist and install very neat and safe, making the working environment safer in a construction site and shortening the construction period compared to the conventional method. This system's most important benefits are relatively high in reducing construction time, reducing total cost, reducing material waste, increasing buildings' quality, promoting safety, and providing a cleaner and neater site. This system also produces site waste, but in a minimal amount as compared to the conventional method.

An IBS will manage waste by using the 3-Rs concept, which refers to reducing, reusing, and recycling since this method generates less waste. Thus, waste minimization is an important area of concern in implementing construction waste management in the industry. As a result, government efforts have increased regarding promoting IBS usage as an alternative to the conventional, labor-intensive, and wasteful construction method (Saadi et al., 2016). Analysis of construction waste management cost is an issue that concerns worldwide researchers. The overall construction process, resources, materials, manpower, and equipment are first invested, and then construction waste is produced with time and cost accumulation. The process of collecting and sorting wastes take time and require a cost. The cost is generated when the storage site is required to collect waste but does not affect the time. Moreover, IBS projects' waste is lower and seems to demonstrate a 3-R concept as a tool to manage construction waste and reduce the effects on health, the environment, and aesthetics (Nitivattananon & Guilberto, 2007).

Therefore, the purpose of this research is to compare the site waste management between conventional and IBS projects is to investigate the way or method for both types of the construction project on managing their site waste effectively in order to produce an output that is useful for the country's regulatory framework for the construction waste management in the future.

3. Methodology

This section explained the process of the methodology adopted in this paper. The research methodology used qualitative research and used a case study approach to elaborate on waste management practice. To generalize the findings and provide an in-depth picture of the scenario, a qualitative approach using a case study design was appropriate for this study. The case study approach is a valuable research strategy when in-depth information is required (Yin, 2009). The multiple-case study design was selected for this research. A multiple-case study underlines the complexity and addresses a single case study's weakness through replication of cases. The choice is based on the robustness of the design.

Six cases were observed to obtain a comparison of the site waste management approaches practiced in the projects. Three conventional projects were chosen to compare against three IBS projects. This case study's primary purpose is to provide more knowledge, and the selected project in this study has applied a broader understanding of site waste management. The scope included the Johor Bahru area due to its notable development and the fact that it is a congested area that generates waste from its many construction projects. Residential buildings and shop houses are selected as a building for this research. Semi-structured interviews were conducted with contractors involved and have experienced in-site waste management to get through and more precise on the implementation of site waste management for the project they handle. The interviews were conducted in a face-to-face format. All individual interviews were audio-recorded, transcribed verbatim, and lasted approximately 45-60 minutes each.

The analysis is based on cross-case analysis and pattern matching. This process involves determining consistent patterns and summarizing the relevant details revealed in the investigation. Analyses for case studies require identifying and explaining the findings in detail based on the interviews' data. This approach allows the investigator to achieve the research objectives for each case study. Analysis of the cross-case study is the final stage of the research in which all data from each case study were compared to achieve the aims of this investigation.

4. Result and Discussion

4.1 Respondents Overview

In order to critically compare and review the case studies, six (6) cases, three (3) conventional projects compared against (3) IBS projects. All the data, information, and relevant idea are gained from the respondents involved and experience in the site waste management area.

Table 1 - Details of respondents

Case Studies	CONVENTIONAL PROJECT			IBS PROJECT		
	Project 1 (2 storey terrace houses, Skudai, Johor Bahru)	Project 2 (2 storey terrace houses, Saujana Jaya, Johor Bahru)	Project 3 (2 storey terrace houses, Pulai, Johor Bahru)	Project 1 (Medium cost terrace houses,Pulai, Johor Bahru)	Project 2 (4 storey quarters, Kulai Jaya, Johor Bahru)	Project 3 (shop houses, Pulai, Johor Bahru)
RESPONDENT	Respondent 1	Respondent 2	Respondent 3	Respondent 1	Respondent 2	Respondent 3
AGE	37 years	34 years	41 years	31 years	44 years	35 years
GENDER	Male	Male	Male	Male	Male	Male
POSITION	Contractor	Contractor	Contractor	Contractor	Contractor	Contractor
WORKING EXPERIENCE	11 years	7 years	11 years	9 years	12 years	10 years

Table 1 exhibits the cases, respondents' position, and experience. Initially, the respondents were asked about the basic background and brief description of their position in the company's organization. The majority of the respondents were very experienced with more than five years, which portrays their high management level and decision that indicates the data obtained are reliable and accurate.

4.2 Materials Waste Generated in Conventional and IBS Projects

This section will explain the types of waste generate between conventional and IBS projects. Material waste has been recognised as a significant problem in the construction industry, and there are no legal or economic instruments in Malaysia that can guide construction professionals' efforts in reducing the amount of waste generated. (Umar et al., 2020).

Table 2 - Types and quantity of site waste between conventional and IBS projects

Types of Site Waste	QUANTITY OF SITE WASTE (tonnes)							
	CONVENTIONAL PROJECTS				IBS PROJECTS			
	1	**2**	**3**	TOTAL	1	2	3	TOTAL
Concrete	431.00	206.80	211.30	849.10	-	-	12.28	12.28
Soil and Sand	337.50	-	-	337.50	-	-	-	-
Timber and Plywood	614.50	913.92	603.00	2,131.42	-	11.30	-	11.30
Bricks / Blocks	67.50	181.28	106.41	355.19	-	-	16.38	16.38
Tiles	14.50	13.50	17.58	45.58	11.30	16.81	8.54	36.65
Reinforcement	-	-	14.20	14.20	-	-	-	-
Packaging Product	22.50	21.30	-	43.80	25.92	22.72	31.36	80.00

As shown in Table 2, the waste material that obtained the highest reading was timber, 2,131.42 tonnes of which were generated from conventional projects compared to the 11.30 tonnes of timber in IBS projects. Timber is widely used in construction projects, especially in conventional construction methods. Timber has many functions that can be used in construction projects, such as formwork, strutting, use in landscaping, and other uses. However, improper storage and usage can lower timber quality and value, leading it to become waste (Lau, 2004). Concrete waste generated from conventional projects is high 849.10 tonnes compared to the concrete waste in IBS projects. The apparent issue is that concrete materials are widely used in conventional construction methods. The excess ordering of materials also is a problem for waste generation, mainly because of human error in calculating material quantities (Baldwin et al., 2016). Concrete waste is produced because of the other materials' defects, such as use the old formworks. Thus, it is evident that there are differences between the types of site waste generated by the conventional and IBS project approaches. Moreover, Umar et al. (2020) mentioned that much waste is generated without consideringthe impact it causes on the project and the entire environment.

Seven types of site waste were found in conventional projects and included concrete, soil/sand, timber, bricks,

tiles, reinforcements, and packaging waste. Timber waste was the dominant waste across all conventional projects, followed by concrete, bricks, soil/sand, tiles, and packaging products; the lowest quantity of waste generated was reinforcement waste. While the IBS projects only produced five types of site waste concrete, timber, bricks, tiles, and packaging waste, proving that this type of construction method generates less waste compared to the conventional method. Construction waste is generally produced due to causes such as improper storage, incorrect material handling, lack of skill by the workers (Manaf & Samah, 2009).

4.3 Waste Management Practices Between Conventional and IBS Projects

The cross-case analysis is aimed at identifying any similarities and differences within the findings of the types of site waste management in a project.

Table 3 - Amount of site waste to manage in conventional and IBS Projects

CATEGORY	PROJECTS	TOTAL CONSTRUCTION WASTE PROJECT	SEGREGATION OF CONSTRUCTION WASTE (tonnes)					
			REUSED AT SITE		RECYCLED		DISPOSED AT LANDFILLS	
		(tonnes)	(tonnes)	(%)	(tonnes)	(%)	(tonnes)	(%)
CONVENTIONAL COSNTRUCTION	1	1,487.5	22.50	1.51	1,113.00	74.82	352.00	23.66
	2	1,336.80	401.58	30.04	21.30	1.60	913.92	68.37
	3	952.50	335.30	35.20	14.20	1.49	603.00	63.31
Total		3776.80	759.38		1148.50		1868.92	
IBS	1	37.22	11.30	30.36	25.92	69.64	-	-
	2	50.83	16.81	33.07	34.02	66.93	-	-
	3	68.56	37.20	54.26	31.36	45.74	-	-
Total		156.61	65.31		91.30			

From the analysis (Table 3), the waste management systems that have been implemented in conventional projects include reusing, recycling, and disposing of waste at the landfill, whereas the waste management system executed in IBS projects is to reuse and recycle. As can be seen from Table 3, the reuse method obtained the highest reading with the total quantity of 759.38 tonnes as site waste management in the conventional project compared to the IBS projects, which only obtained 65.31 tonnes. The quantity of waste that has been selected to be recycled is 91.30 tonnes from the IBS projects, which is higher than conventional projects. The wastes that bring to be disposed of at landfills carried 1868.92 tonnes which come from conventional projects. Based on an experienced contractor's interview, the waste materials generated from IBS projects still have their quality and value to be recycled or reused, such as packaging waste, broken bricks, tiles, and others. Moreover, in IBS projects, the 3Rs concept to reduce, reuse, and recycle conceptbrings many advantages to the project and surrounding, such as saving in cost and reduce environmental pollution. In conventional methods, some of the respondents mentioned that the wastes disposed at landfills involved high cost; thus,most waste management systems in conventional projects tend to focus on managing waste through illegal dumping, primarily to reduce costs. Moreover, there are local charges for disposing of waste on landfill sites, increasing the cost of eliminating waste and transporting it to the landfill.

According to Rahim et al. (2017), the vast numbers of construction waste directly impact illegal dumping activities. Moreover, dispose waste directly to landfill sites is the most common approach in Malaysia (Hasmori et al. 2020). Thus, IBS could play an essential role in the 3Rs to overcome the construction industry waste (Azman et al., 2013), and recycling and reusing of construction waste in Malaysia significantly will also reduce the embodied energy (Umar et al., 2020). This research reveals that some contractors have been aware of and explore the importance and benefits of utilizing 3R's concept as tools or systems to manage waste in construction projects. The results reveal that recycling and reusing waste can save more money, create a market for recycled products, minimize waste quantity to the landfill, and reduce environmental issues (Begun and Satari, 2010; Kozlovska and Spisakova, 2013). The environmental impacts of the construction industry can be reduced through appropriate waste management practices. The vast amounts of construction waste generated yearly, only a portion is recycled, and the majority ends in landfills (Williams & Turner, 2011). Thus, efficient waste management practices such as IBS that can avoid and overcome the environment's negative impact are solutions (Hasmori et al. 2020).

4.4 Costs Involved in Managing Site Waste between Conventional and IBS Projects

The importance of material cost in waste management is very crucial in the construction industry. According to Jain(2012), material waste generation from construction activity is a massive effect on monetary terms and costly in projectbudgets (Surendra et al. 2016).

Table 4 - Cost involved in managing site waste between conventional and IBS projects

PROJECT	COVENTIONAL					
	1		2		3	
	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)
Total delivery cost (RM)	166,950.00	Purchased cost = RM 150.00/tons	2,896.80	Purchased cost = RM 136.00/tons	2,343.00	Purchased cost = RM 165.00/tons
Total labor cost (RM)	57,600.00	Labor cost = RM 60.00/labor	38,400.00	Labor cost = RM 60.00/labor	30,240.00	Labor cost = RM 60.00/labor
Total disposal trip cost (RM)	3,094.00	Cost per trip = RM 221.00	1,768.00	Cost per trip = RM 221.00	884.00	Cost per trip = RM 221.00
Land filling cost (RM)	75,152.00	Landfilling cost = RM 213.50/tons	195,121.92	Landfilling cost = RM 213.50/tons	128,740.50	Landfilling cost = RM 213.50/tons
TOTAL	**302,796.00**	-	**238,186.72**	-	**162,207.50**	-
PROJECT	INDUSTRIALISED BUILDING SYSTEM (IBS)					
	1		2		3	
	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)
Total delivery cost (RM)	4,043.52	Purchased cost = RM 156.00/tons	4,932.90	Purchased cost = RM 145.00/tons	3,825.90	Purchased cost = RM 122.00/tons
Total labor cost (RM)	33,600.00	Labour cost = RM 60.00/ labour	23,760.00	Labour cost = RM 60.00/labour	18,000.00	Labour cost = RM 60.00/labour
Total disposal trip cost (RM)	-	-	-	-	-	-
Land filling cost (RM)	-	-	-	-	-	-
TOTAL	**37,643.52**	-	**28,692.90**	-	**21,825.90**	-

Table 4 shows several costs associated with managing site waste, such as total delivery cost, total labour cost, total disposal cost, and landfill costs. Analysing costs involved in managing site waste is essential for knowing how much money has been adequate for the project cost. Based on the cost evaluation made, one can conclude that the third objective has been achieved; the costs involved in managing site waste from the IBS projects are lower than those involved in conventional projects. This is because the amount or quantities of waste generated from conventional projects are also higher than IBS projects, and another reason is the landfilling cost that is expensive, which can affect the overall cost of the projects. Reusing, recycling, and disposing at landfills are the site waste management systems that have been selected by the conventional projects, which involved a cost for delivery, labour, disposal trip, and landfilling. The cost of using a landfill in the management of waste has dramatically affected the project's cost since there are often local charges that have been imposed on this method. The costs involved in

managing site waste from IBS projects are lower since these projects practice the 3Rs concepts as a tool to manage the waste. This approach only involved two types of costs: delivery and labor, and did not include any landfilling methods. To conclude, proper site waste management reveals that it is economically viable to achieve significant cost savings from the process when the money would otherwise go into landfills in the form of waste (Tam, 2008) and reduction of construction waste will reduce waste transportation costs, disposal, and recycling (Hasmori et al. 2020).

5. Conclusion

Current research demonstrates that construction is a significant contributor to generating waste, which can cause pollution. Adopting an IBS can reduce enormous waste generation, and this study contributes IBS as the new way in minimizing the construction waste. This study suggests that government enforcement is utilizing an IBS for all projects can reduce waste. The government should play an essential role by enforcing and encouraging all construction companies to use IBS components as the primary material in the construction project. This is because the government sees IBS as a new way of minimizing construction waste. The utilization of an IBS in a construction project can produce less waste than the conventional method; it can also reduce the costs associated with site waste management. IBS elements are mainly produced in an off-site factory under a more controlled setting, thus, ensuring quality and minimizing waste on-site. Further, to reduce or adequately manage the site waste, awareness among various parties involved is essential and clear guidelines for all parties involved in construction projects.

Acknowledgement

The authors would like to thank the Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Shah Alam, MALAYSIA, for supporting this research works.

References

Arif, M., Bendi, D., Toma-Sabbagh, T. and Sutrisna, M. (2012), "Construction waste management in India: an exploratory study", Construction Innovation, Vol. 12 No. 2, pp. 133-155. https://doi.org/10.1108/14714171211215912

Azman,M.N.A.,Kamar,K.A.M., Nawi, M.N.M,(2013). Industrialised building system in reducing waste of construction industry. Journal of Science and Technical Education, 2(1),134-142.

Baldwin, A. K. (2016). Designing to encourage waste minimisation in the construction industry. Journal of Civil and Building Engineering.

Begun, R. A., & Siti Khadijah Satari, J. (2010). Waste generation and recycling: comparison of conventional and industrialised building systems. Journal of Environmental Sciences.

CIDB (2007). Construction industry master plan Malaysia 2006-2015: Construction Industry Development Board (CIDB) Malaysia, Kuala Lumpur

CIDB. (2008). Guidelines on construction waste management. Construction Industry Development Board (CIDB) Malaysia, Kuala Lumpur

CIDB. (2015). Construction industry transformation programme 2016-2020: Construction Industry Development Board (CIDB) Malaysia, Kuala Lumpur.

Firmawan, F., & Fadil Othman, K. (2012). Improving project performance and waste reduction in construction projects. Journal of Technology, 182-192.

Hasmori M.K , Md Zin A.F, Nagapan S, Deraman R, Abas N, Yunus R & Klufallah M. (2020). The on-site waste minimasation pracrices for construction waste. IOP Conf. Series: Maerials, Science and Engineering 713 (2020)012038.

Jain, M (2012). Economic aspects of construction waste materials in terms of cost savings- a case of Indian construction industry. International Journal of Scientific and Research Publication, Volume 2, Issue 10.

Kozlovska, M., & Marcela Spisakova. (2013). Construction waste generation across construction project life-cycle. Journal of Organization, Technology and Management in Construction.

Lau, V.L. 2004. Case study on the management of waste materials in Malaysia. Forum Geookol. 15(2).2004.

Lachimpadi S.K, Pereiraa J.J, Mohd Raihan Taha M.R.,Mokhtar M. (2012). Construction waste minimisation comparing conventional and precast construction (mixed system and IBS method) in high-rise buildings : A Malaysia case study. Journal of Resources, Conservation and Recycling.

Manaf, L.A., Samah, M.A.A,.(2009). Municipal solid waste management in Malaysia: practices and challenges . Waste Management. 29:2902-2906

Martous J.L.G., Styles D., Schoenberger H., & Lahl B Z. (2018). Construction and demolition waste best management practice in Europe. Resources, Conservation & Recycling. 0921-3449

Marzouk M.C & Azab S. (2014). Environmental and economic impact assessment of construction and demolition waste disposal using system dynamics. Resources, Conservation and Recycling, Volume 82, January 2014, Pages 41-49

Mei. (2016). A Survey of construction and demolition waste in Malaysia. Journal of the Faculty of Environmental Science and Technology, 1-42.

Nagapan S., I. A. Rahman, A. Asmi, A. H. Memon, and I. Latif,. (2012). Issues on construction waste: The need for sustainable waste management," 2012 IEEE Colloquim. Humanity. Sci. Eng., no. Chuser, pp. 325–330, Dec. 2012.

Nitivattananon, V., & Guilberto Borongan. (2007). Construction and demolition waste management : current practices in Asia. Journal on Sustainable Solid Waste Management.

Nor Faiza MT, Noor Artika H, Yusof MZ (2019). Health Care Waste Management and Sustainable Development Goals in Malaysia. Journal of Wastes and Biomass Management, 1(1) : 18-20

Rahim M.H.I.A, Kassim N, Mohamed I, Zainal R, Sarpin N, & Saikah M (2017). Construction waste generation in Malaysia construction industry: illegal dumping activities. IOP Conf. Series: Materials Science and Engineering 271 (2017) 012040

Saadi, N., Zulbahri Ismail, Z. & Zarina Alias (2016). A review of construction waste management and initiatives in Malaysia. Journal of Sustainability Science and Management, Vol 11, Number 2, December 2016: 101-114.

Surendra S.B, Manoj H & Madhav K. (2016). Impact of the construction waste on the cot of the project. International Journal of Engineering Research, Volume No 5, Issue Special 1, pp:126-128

Tam, V.W.Y. (2008). Economic comparison of concrete recycling : a case studyapproach. Journal of Resources, Conservation and Recycling,vol. 52, no. 5, pp

Umar U.A, Shafiq N. & Ahmad F. A.(2020). A case study on the effective implementation of the reuse and recycling of construction & demolition waste management practices in Malaysia, Ain Shams Engineering Journal

Yin, Robert K. (2009). Case study research: Design and methods (4th ed. Vol. 5): Sage Publications, Incorporated.

Wahi, N., & Corina Joseph, R. R. (2015). Critical review on construction waste control practices: legislative and waste management perspective. Journal of Science and Behavioral Sciences

Williams I.D, & Turner, D.A (2011).Waste management practices in the small-scale construction industry, Conference: Sardinia 2011, the Thirteenth International Waste Management and Landfill Symposium