

Theoretical Framework for Sustainable in Construction Waste Management Toward 3R Practice in Penang

Ng Lee Shan, Seow Ta Wee, Goh Kai Chen

Faculty of Technology Management and Business

Universiti Tun Hussein Onn Malaysia

86400 Parit Raja Batu Pahat Johor

Malaysia

leeshan3122@gmail.com, tawee@uthm.edu.my, kaichen@uthm.edu.my

Abstract

Development of construction industry has led increase in generated construction waste and it also cause increase amount of waste in landfills. Weaknesses in implementation of the policy of solid waste reduction through 3R among contractor will cause unsustainable in construction waste management which increase the generation of construction waste in landfills especially in islands. Land on the island is limited where the disposal activities very limited compared to the amount of waste entered. Solid waste reduction through 3R are the thrust 1 in National Solid Waste Management Policy. The objective of this paper is to discuss the implementation and constraints of the policy of solid waste reduction through 3R and the element to close gaps between the implementation of the policy of solid waste reduction through 3R with contractors in construction industry in Penang. The theoretical framework in this paper also describes the concepts and approach that explain the currently phenomenon of implementation and constraints of policy of solid waste reduction through 3R in construction industry and also the element to achieve sustainability in construction waste management. Therefore, the element to close gaps should be emphasised in order to reduce the construction waste through 3R to reach sustainable in construction waste management.

Keywords: *policy implementation, constraint, element close gaps.*

Introduction

Solid waste reduction through 3R are the thrust 1 in National Solid Waste Management Policy where the 3R are Reduce, Reuse and Recycle (National Solid Waste Management Department, 2012). Landfill require a large piece of land. Shortage of land to manage construction waste are the major problem of waste disposal in Penang. According Muin Sapidin (2011), the process of waste disposal in Penang almost paralyzed when the waste disposal center in Ampang Jajar has faced technical problem that can not accommodate the hundreds tonnes of garbage and solid waste from Penang Island and Seberang Perai.

Weakness in the implementation of the policy of solid waste reduction through 3R among contractors will cause unsustainable construction waste management where increase the generation of construction waste in landfills especially in islands. According Wei & Rotter (2008), acts and legislation is not mandatory, the sector generated waste will fail to implement the policy. In addition, Act 672 was not enforced in Penang are the gaps that weakness in implementation of the policy of solid waste reduction through 3R. According Seow & Mohamad (2007), the municipal council did not interfere in the process of construction waste management because the task of managing construction waste is the responsibility of contractor. According William (2010), the shortage of land in island lead soaring high for land prices and the land supply was not sufficient for the large demand of land.

The scope area of this paper will focus in Penang because the operating landfills only 2 and average daily waste disposed are 1706.59 tonnes. It was very critical compared with other states have more landfill and the waste disposed were less than Penang as shown in Figure 1 and Figure 2 based on the statistical report until September 2012 (Ministry of Housing and Local Ministry, 2012).

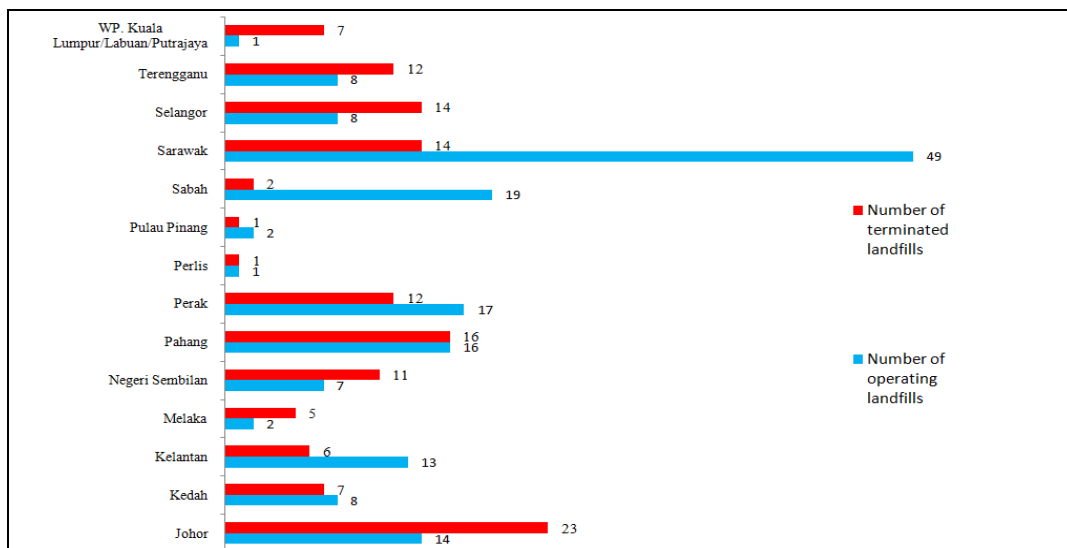


Figure 1: Number of operating solid waste lanfills and terminated for each states in Malaysia (Ministry of Housing and Local Ministry, 2012)

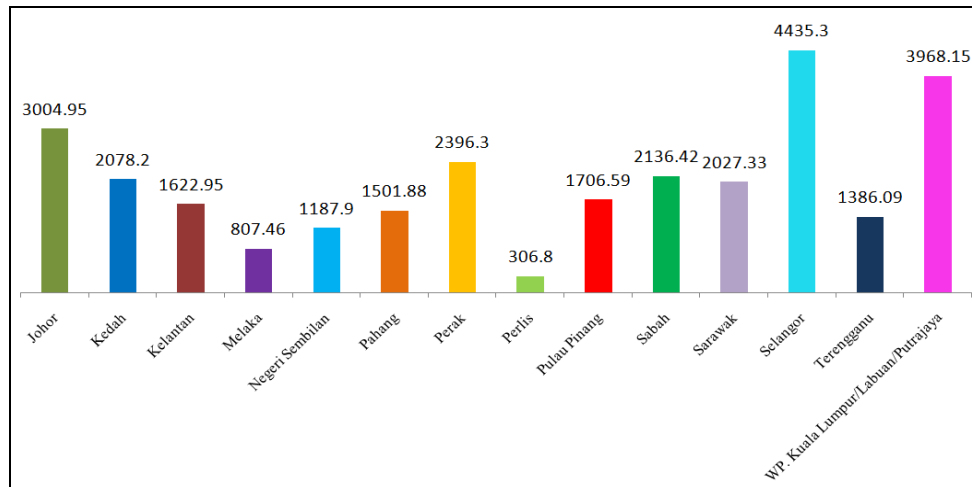


Figure 2: Average daily waste disposal per tonne for each states in Malaysia (Ministry of Housing and Local Ministry, 2012)

Objective of this paper is to discuss the implementation and constraints of the policy of solid waste reduction through 3R and the element to close gaps between the implementation of the policy of solid waste reduction through 3R with contractors in construction industry in Penang.

Definition and Act

Construction and demolition waste was defined as waste that is produced from the construction industry with construction activities, building renovation, civil construction and building, construction site cleaning, road construction and demolition activities, include soil excavation (Shen *et al.*, 2004). The Solid Waste Management and Public Cleansing Act 2007 (Act 672) passed by Parliament on July 17, 2007 and been gazetted on August 30, 2007. The Act gives the executive power to Federal Government to undertake the responsibility of solid waste management and public cleansing (National Solid Waste Management Department, 2013a). In this Act, Section 101: Reduction, Reuse and Recycling of Solid Waste Regulated very important for the reduction of solid waste through the 3Rs (National Solid Waste Management Department, 2013b)

Theoretical framework

The theoretical framework as a concept and guideline for this paper. The theoretical framework of this paper shown in Figure 3 as below describes the concepts and approach to explain the current phenomenon of implementation of policy of solid waste reduction through 3R in construction industry in Penang.

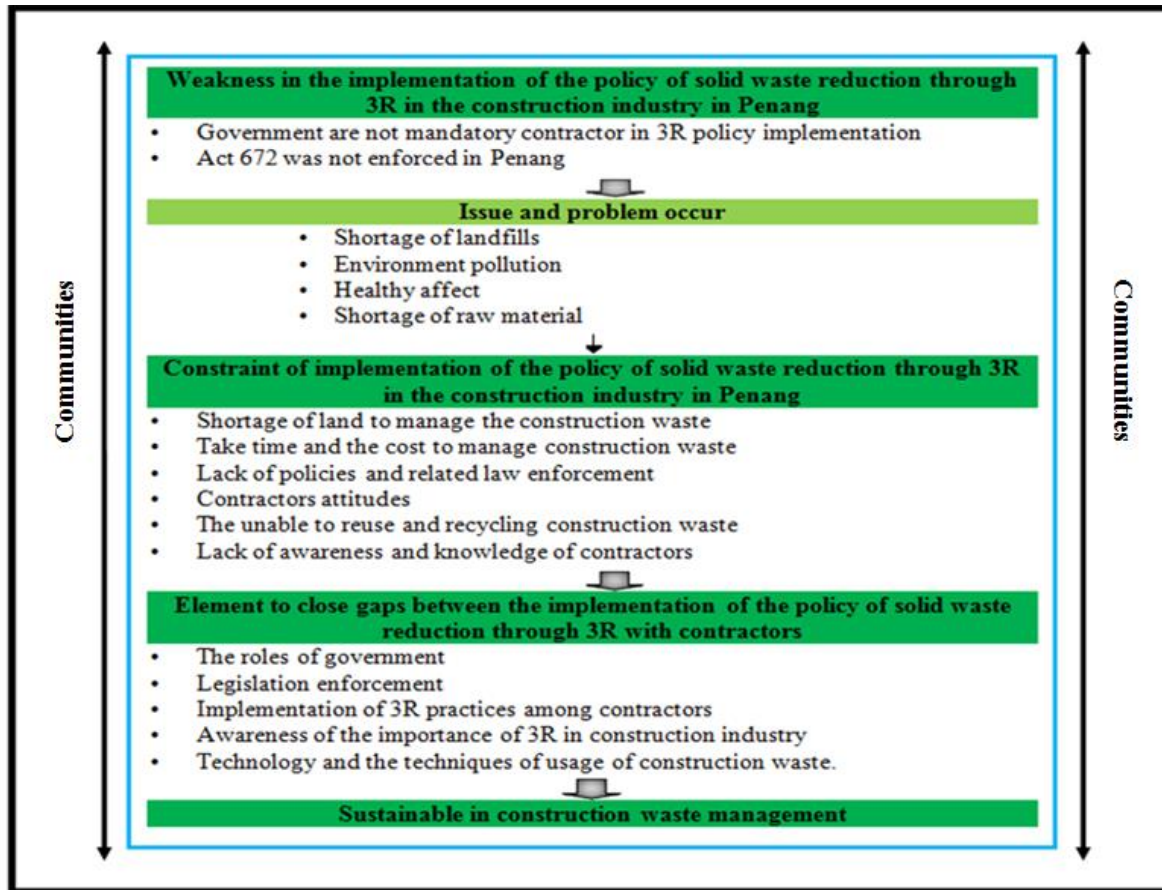


Figure 3: Theoretical framework

Weakness in the implementation of the policy of solid waste reduction through 3R in the construction industry in Penang

3R was limit practiced in construction sector because there were not mandatory construction companies to pratice 3R. According Wei & Rotter (2008), if the law and act not mandatory, the persons generate waste will fail to implement that policy. Refer to Seow & Mohamad (2007), the municipal council did not interfere in process of managing construction waste because the task of managing construction waste was the responsibility of contractor. Besides that, the implementation and enforcement of 3R practices and concept has been list in Part X: Reduction and Recovery Controlled Solid Waste where the persons generate solid waste generators are required to reduce through 3R (Agamuthu *et al.*, 2009). However, the policy of reduction solid waste through 3R weak implemented because the Act 672 is not enforced in Penang. According National Solid Waste Management Department (2013c), Akt 672 enforced on 1 September 2011 in Penisula Malaysia and Wilayah Persekutuan except Labuan, Penang, Perak, Selangor, Terengganu and Kelantan.

Issue and problem occur

Waste disposal process in Penang almost paralyzed when the waste disposal center in Ampang Jajar faced technical problem that can not accommodate hundreds tonnes of garbage and solid waste from Penang Island and Seberang Perai (Min Sapidin, 2011). The increase in quantity of generated solid waste will be affect to environmental especially if the landfills are not managed properly(Omran, 2008). Traditional disposal methods must use a large area of land. Disposal method currently also affect in healthy and ecology risk (Chuen & Jamal, 2011). Contractor thought purchase the new material are cheaper than practice recycling method. With this, Malaysia will face shortage of raw material from natural resources. According Corporation of Solid Waste Management and Public Cleansing (2013), 3R approach will maintain natural resources for future generations.

Constraint of implementation of the policy of solid waste reduction through 3R in the construction industry in Penang

Shortage of land to manage the construction waste

The shortage of land in island lead soaring high for land prices and the land supply is not sufficient for the large demand of land (William, 2010). So, the site for manage the construction waste was not enough to overcome their needs. This problem also occur when the area of construction site is very small and limited. This problem was more complicated when the construction waste generated in large quantities and it also very hard to separate the construction waste by types (Kadis, 2007).

Take time and the cost to manage construction waste

Construction waste generated at construction site will be collected and separated by types of wastes. Then, the separated construction waste will be kept in an area that given by own contractor in the construction site. However, this also is a raising problem where the contractors have to find time and pay cost for the construction waste management of waste separation by types when quantity of construction waste generated too much (Pilus, 2005).

Lack of policies and related law enforcement

Lack of law enforcement related construction waste is also an important constraint (Ngoc & Schnitzer, 2009). Construction and demolition waste always ignored in effort to reduce waste sent to landfills due the focuses only in reuse and recycling domestic waste. There are no legislation exist directly to solve the issue of construction and demolition waste management in many Asian country. Besides that, lack of practice and strategy of construction waste management related 3R also the constraint to implement the policy of solid waste reduction through 3R in among contractors (Nitivattananon & Borongan, 2008).

Contractor's attitudes

Attitude of contractors are necessarily important in construction waste management. It is because contractor have important role and responsible to transfer construction waste to landfills at the final stage. According Kadis (2007), contractor usually will also dispose construction waste that can be recycled at landfills. Contractors will assume disposal method is easier to manage the construction waste.

The unable to reuse and recycling construction waste

Construction waste consists of various types of building materials. Majority of contractors agree that many types of construction waste in construction site unable to recycle and contractors will assume purchase new material will cheaper than practice recycling waste (Shareh Musa *et al.*, 2009).

Lack of awareness and knowledge of contractors

Lack of awareness of sustainable waste management among contractors also the constraint to implement the policy of solid waste reduction through 3R. There are still lack of knowledge and awareness of sustainable practice in construction waste management among contractor (Papargyropoulou *et al.*, 2011). In addition, unskilled workers also generated a large amount of construction and demolition waste (Yuan *et al.*, 2011).

Element to close gaps between the implementation of the policy of solid waste reduction through 3R with contractors

The roles of government

Financial incentives will attract interest of contractors to practice separate and recycling construction waste before dispose to landfills. In addition, local authority also can provide financial incentive in term of subsidies or loans on credit to contractors for buy equipment or machine used for the recycling process (Chen, 2005). In effort to promote reduce, reuse and recycle waste, Hong Kong government has implemented the Construction Waste Disposal Charging Scheme (CWDCS) in December 2005 to provide financial incentives for organization that reduce construction and demolition waste and promote reuse and recycling (Poon *et al.*, 2013) and charging of construction and demolition waste to landfills. Construction Waste Disposal Charging Scheme implemented as one of the policies that most influence government in controlling the generation of construction waste (Yu *et al.*, 2013). In addition, government should provide guideline to contractors with the implementation of construction waste reduction in government act (Begum *et al.*, 2007) and should establish effective recycling company that will recycle a wide variety of construction waste not just on certain material waste (Shareh Musa *et al.*, 2009).

Legislation enforcement

Legislation is an important role in policy implementation. Japan and South Korea have enforced laws in recycling construction and demolition waste management. This will encourage and promote reduction of construction waste so that ensure environmental protection (Nitivattananon & Borongan, 2008). Top down approach should be implemented to mandatory contractors manage construction waste through 3R practices where to enforcing the law and act so that can close gaps between implementation of the policy of solid waste reduction through 3R with contractors in construction industry. According Yan (2002), Singapore government would prefer the top down approach by using legislations and regulations to enforce the policy in solid waste management. According Xun *et al.*, (2008), Hong Kong also promote the construction waste management reduction through the step of top down approach. In addition, weakness in existing

waste management because of lack of specific policy that focus on issue of construction waste management especially 3R method. According Yang (2011), government should establish laws and regulations and also provide support in term of financial in order to reuse the waste.

Implementation of 3R practices among contractors

Construction waste management is very important to overcome the future sustainable development in Malaysia. Current waste disposal methods are not sustainable and should try to apply the hierarchy waste management approach. This approach can reduce the negative issues of environmental, social and economic. In addition, contractors should practices reduction, reuse and recycling construction waste before the waste dispose to landfills (Nagapan *et al.*, 2012). The concept of integrate waste management have been applied to reduce waste at source. Waste must be recovered through reuse and recycling (Ngoc & Schnitzer, 2009).

Awareness of the importance of 3R in construction industry

Provided programs, training and awareness are very important to reduce waste among contractor in construction industry. Education and training programs will encourage contractors to practice 3R in construction industry (Begum *et al.*, 2007a). Besides that, Hong Kong promote some steps like waste management planning, reduction and recycling construction waste, providing the internal training on environmental management and also legal action (Nitivattananon & Borongan, 2008). Therefore, some incentives and campaigns in cooperation between public and private sector and NGO have to encourage the recycling activities to reduce the amount of solid waste from the sources (Kaosol, 2009).

Technology and the techniques of usage of construction waste.

Industrialised Building System (IBS) is a construction process that utilizes techniques, products, components or building systems which involve prefabricated components and installation at the construction site. IBS usage guarantee many advantages such as reduction of unskilled workers, construction waste reduction or materials wastage, reduction in the building material, environmental improvement and construction sites cleanliness and better quality control (CIDB, 2012). Moreover, the contractor can crush brick and concrete waste as aggregate by grinder. Contractors also shall maintain the steel structural members in project and it can be recycled. Besides that, ceramic and marble can be patched, cleaned and polished for reuse (Winkler, 2010). Inert waste consists of sand, brick and brick and concrete. It can be used for land reclamation. This strategy can reduce the amount of construction waste in landfills (Poon *et al.*, 2001). Glass waste can reuse as aggregate for concrete production material. So, the disposal of glass waste in landfills can be reduced. Timber waste is easy to reuse and recycle to be used for other purposes in construction site. Formwork timbers are the most common reuse because it can be reused for several times (Tam, 2010)

Sustainable in construction waste management

Human activities has generated waste and the amount is increasing into a very worrying state in Southeast Asian country where it is creating challenge to the government on the environmental pollution in recent years. The waste prevention approach should be done because it will develop solution towards sustainable waste management (Ngoc & Schnitzer, 2009). The important elements need to emphasis in order to close gap between the implementation of the policy of solid waste reduction through 3R with contractors to achieve sustainable construction waste management. According Kulatunga *et al.*, (2006), construction waste reduction have to emphasis in term of improving the performance in order to achieve sustainable in developed industry through better communication channels in the organization, provide appropriate training of construction waste management for workers and introduce the incentives for waste management practices will better help to develop and implement the 3R application in waste management in construction industry. According Xun *et al.*, (2008), Hong Kong also promote the reduction of construction and demolition waste and use the top down approach such as law and policies needed for construction waste management. According Hu (2011), recycling and reuse construction waste as much as possible to reduce waste in construction waste. On-site construction waste separation already proved that was an effective way to increase the recycling rate of construction waste.

Conclusion

The construction industry has generated a large quantities of solid waste disposed in landfill. Construction waste should be managed with the 3R approach and only send the useless construction waste to landfill. Land is very limited for landfill in Penang. Therefore, implementation of the policy of solid waste reduction through 3R among contractors are important for achieving sustainable in construction waste management.

Acknowledgement

The authors would like to thank the support of Faculty Technology Management and Business (FPTP), Centre for Graduates Studies (PPS) and also Office for Research, Innovation, Commercialization and Consultancy Management (ORRIC) for giving sponsor, helpful and guidance to carry out this paper.

References

- Agamuthu, P., Fauziah, S. H. & Khidzir, K. (2009). Evolution of solid waste management in Malaysia: impacts and implications of the solid waste bill, 2007. *Material Cycles and Waste Management*, Volume 11, Issue 2, pp. 96-103
- Agamuthu, P., Chenayah, S., Hamid, F.S & Victor. D. (2011). *3R Related Policies For Sustainable Waste Management In Malaysia*. Retrieved on 16 March, 2013 from http://www.google.com.my/url?sa=t&rct=j&q=3r%20related%20policies%20for%20sustainable%20waste%20management%20in%20malaysia&source=web&cd=2&cad=rja&ved=0CD4QFjAB&url=http%3A%2F%2Fumconference.um.edu.my%2Fupload%2F163-1%2FPaper%2520135.doc&ei=PPHjUY_0HsqArgfKk4CoDw&usq=AFQjCNH8d4mosyUxlWr8kvFRBeaUA7CuIA&bvm=bv.48705608,d.bmk
- Begum, R. A., Siwar, C., Pereira, J. J. & Jaafar, A. H. (2007). Implementation of Waste Management and Minimisation in the construction industry of Malaysia. *Resources, Conservation and Recycling*, Volume 51, Issue 1, pp. 190-202.
- Chen, S. S. (2005). *Kitaran semula bahan pembaziran binaan*. Universiti Teknologi Malaysia. Degree Thesis.
- Chuen, K. P. & Jamal, O. (2011). A choice experiment analysis for solid waste disposal option: A case study in Malaysia. *Environmental Management*, Volume 92, Issue 11, pp. 2993-3001
- CIDB. (2012). *IBS*. Library CIDB Malaysia. Retrieved on July 13, 2013 from https://www.cidb.gov.my/cidbweb/index.php?option=com_content&view=article&id=35&Itemid=209&lang=en
- Corporation of Solid Waste Management and Public Cleansing. (2013, April). *Kitar Semula*. Kepentingan Terhadap Manusia. Retrieved on April 19, 2013, from Corporation of Solid Waste Management and Public Cleansing: <http://www.ppsppa.gov.my/index.php/3r/recycle-kitar-semula>
- Kadis, R. (2007). *Pengurusan sisa binaan bari pelbagai aktiviti pembinaan*. Universiti Teknologi Malaysia. Degree Thesis.
- Kaosal, T. (2009). Sustainable solutions for municipal solid waste management in Thailand. *World Academy of Science, Engineering and Technology*, 60 (5), pp.665-670
- Ministry of Housing and Local Ministry. (2012). *Perangkaan Terpilih sehingga 30 september 2012* from pp. 36-38 at http://www.kpkt.gov.my/kpkt/fileupload/perangkaan_terpilih/pt2012/sept/PERANGKAAN_SEPT2012_INTERNET.pdf
- Kulatunga, U., Amaratunga, D., Haigh, R. & Rameezdeen, R. (2006). Attitudes and perceptions of construction workforce on construction waste in Sri Lanka. *Management of Environmental Quality: An International Journal*, Volume 17, Issue 1, pp. 57-72
- Muin Sapidin, A. (July 7, 2011). Proses Lupus Sampah Pulau Pinang Hampir Lumpuh. *Utusan Online*. Retrieved on February 7, 2012 from http://utusan.com.my/utusan/info.asp?y=2011&dt=0707&pub=Utusan_Malaysia&sec=Dalam_Negeri&pg=dn_13.htm
- Nagapan, S., Abdul Rahman, I. & Asmi, A. (2012). Construction Waste Management: Malaysian Perspective. *The International Conference on Civil and Environmental Engineering Sustainability 2012 (IConCEES 2012)*, Johor Bahru, Malaysia. Retrieved on May 10, 2013 from http://eprints.uthm.edu.my/2530/1/Construction_Waste_Management_Malaysian_Perspective.pdf
- National Solid Waste Management Department. (2012, April). *Dasar Pengurusan Sisa Pepejal Negara*. Retrieved on March 9, 2013, from National Solid Waste Management Department: <http://www.kpkt.gov.my/jpspn/main.php?Content=articles&ArticleID=64&IID=>
- National Solid Waste Management Department. (2013a, April). *Sejarah Penubuhan Jabatan*. Retrieved on April 19, 2013, from National Solid Waste Management Department: http://www.kpkt.gov.my/jpspn_2013/main.php?Content=vertsections&SubVertSectionID=166&VertSectionID=1&CurLocation=51&IID=&Page=1
- National Solid Waste Management Department. (2013b). *Akta Pengurusan Sisa Pepejal dan Pembersihan Awam 2007*. Retrieved on 21 April, 2013, from pp. 79 at

- http://www.kpkt.gov.my/jpspn_2013/main.php?Content=vertsections&SubVertSectionID=6&VertSectionID=5&CurLocation=5&IID=
- National Solid Waste Management Department. (2013c, April). *Soalan Lazim JPSPN*. Retrieved on April 19, 2013, from National Solid Waste Management Department:<http://mjpspn.kpkt.gov.my/index.php/page/view/227>
- Ngoc, U. N. & Schnitzer, H. (2009). Sustainable solutions For Solid Waste Management in Southeast Asian Countries. *Waste Management*, Volume 29, Issue 6, ms. 1982-1995.
- Nitivattananon, V. & Borongan, G. (2008). *Report On Reduce, Reuse And Recycle (3R) Practices InConstruction And Demolition Waste Management InAsia*. Retrieved on April 22, 2012, from PDF at http://www.3rkh.net/3rkh/files/3RKH_C&D_waste_FinalReport.pdf.
- Omran Ali, A. (2008). *Attitude Of Malaysian On Recycling Of Municipal Solid Waste: Case Studies In The Major Towns Of The East Coast And North Malaysia*. Universiti Sains Malaysia. Ph.D Thesis.
- Papargyropoulou, E., Preece, C., Padfield, R. & Abdullah, A. A. (2011). Sustainable Construction Waste Management In Malaysia: A Contractor's Perspective . *Management and Innovation for a Sustainable Built Environment*. Retrieved on May 11, 2013 from https://www.google.com.my/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDoQFjAA&url=http%3A%2F%2Fmisbe2011.fyper.com%2Fproceedings%2Fdocuments%2F224.pdf&ei=ZDOXUfjtH8zOrQei_YG4Bw&usq=AFQjCNHS2sfwrX7cIqaDNo7uvISJBksmAQ&sig2=O6q4rVjcgO_u6S_nQ0j4g&bvm=bv.46751780,d.bmk&cad=rja
- Pilus, R. (2005). *Pengurusan Pembuangan sisa binaan (kajian kes: Majlis Perbandaran Johor Bahru Tengah)*. Universiti Teknologi Malaysia. Degree Thesis.
- Poon, C.S., Yu, T.W.A. & Ng, L.H. (2001). On-Site Sorting Of Construction And Demolition Waste In Hong Kong. *Resources, Conservation and Recycling, Vol. 32 No. 2*, pp. 157-72.
- Poon, C. S, Yu, A. T. W., Wong, A. & Yip, R. (2013). Quantifying the Impact of Construction Waste Charging Scheme on Construction Waste Management in Hong Kong. *Construction Engineering and Management*, 139(5), pp. 4666479
- Seow, T. W. & Mohamad, A. H. (2007). *Pengurusan Sisa Pembinaan Di Tapak Binaan*. Retrieved on March 20, 2012, from <http://sssums.files.wordpress.com/2007/09/pengurusan-sisa-pembinaan-di-tapak-bina.pdf>
- Shareh Musa, S. M., Shafii, H. & Syed Muhammad Zubir, S. N. (2009). *Potensi Kitar Semula Dalam Industri Pembinaan: Kajian Kes Daerah Batu Pahat, Johor*. Retrieved on 21 April, 2013, from <http://eprints.uthm.edu.my/2850/1/553-559.pdf>
- Shen, L.Y., Tam, W.V.Y., Tam, C.V. & Drew, D. (2004). Mapping Approach For Examining Waste Management On Construction Sites. *Journal of Construction Engineering and Management*, Vol. 130 No. 4, pp. 472-481.
- Tam, V. W. Y. (2010). Rate of Reusable and Recyclable Waste in Construction. *Second International Conference on Sustainable Construction Materials and Technologies*. Italy: Technical Journal. pp. 329-340.
- Wei, Z. & Rotter, S. (2008). The Current Situation of Construction & Demolition Waste Management in China. *The 2nd International Conference on Bioinformatics and Biomedical Engineering 2008*. pp. 4747-4750.
- William, R. (Desember 10, 2010). Penang Should Allow More Reclamation To Address Land Shortage. *The Edge Malaysia*. Retrieved on March 9, 2013, from <http://www.theedgemaalaysia.com/in-the-financial-daily/178363-penang-should-allow-more-reclamation-to-address-land-shortage.html>
- Winkler, G. (2010). *Recycling Construction & Demolition Waste: A LEED-Based Toolkit*. USA: McGraw-Hill. pp. 19.
- Xun, D., Liu, G. W. & Hao, J. L. (2008). A Study of Construction and Demolition Waste Management in Hong Kong. *The 4th International Conference on Wireless Communications, Networking and Mobile Computing, 2008*. pp. 1-4.
- Yan, T. H. (2002). *Recycling as a Sustainable Waste Management Strategy for Singapore: An Investigation to Find Ways to Promote Singaporean's Household Waste Recycling Behaviour*. Retrieved on 18 March, 2013 from http://www.lumes.lu.se/database/alumni/01.02/theses/ho_yanyin.pdf
- Yang, Y. M. (2011). Recycling of Abandoned Concrete and Waste Asphalt in Road Construction. *The International Conference on Remote Sensing, Environment and Transportation Engineering (RSETE) 2011*. pp. 581-584.

Yu, A. T. W., Poon, C. S., Wong, A., Yip, R. & Jaillon, L. (2013). Impact of Construction Waste Disposal Charging Scheme on work practices at construction sites in Hong Kong. *Waste Management*, Volume 33, Issue 1, pp. 138-146.

Yuan, H. P., Shen, L. Y. & Wang, J. Y. (2011). Major obstacles to improving the performance of waste management in China's construction industry. *Facilities*, Volume 29, Issue 5/6, pp. 224-242.