



Building Responsibly: Managing Construction Waste for a Healthier Future

Zuriani Tarmidi¹, Nurul Syazwani Kizzon¹, C. W. Muhd Hafizzal Ali¹, Mohd Badrul Hassan¹, Nik Syamimi Balkhis Nik Hassan¹, Mohamad Shafiq Mohd Sukri¹, Farah Ayuni Shafie^{1,6*}, Hashim Wahab², Mohd Faizal Abdullah³, Rosmawati Mamat⁴ & Muhamad Afif Mohamed Jamil⁵

¹ Centre for Environmental Health and Safety Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Kampus Puncak Alam, Selangor, Malaysia

² Worldwide Holdings Berhad, Shah Alam, Selangor, Malaysia

³ China State Construction Engineering (M) Sdn. Bhd., Wilayah Persekutuan Kuala Lumpur, Malaysia

⁴ Faculty of Civil Engineering, Universiti Teknologi MARA, Kampus Shah Alam, Selangor, Malaysia

⁵ Construction Industry Development Board Malaysia (CIDB), Wilayah Persekutuan Kuala Lumpur, Malaysia

⁶ Malaysian Association of Environmental Health

*Corresponding author: admin@maeh4u.org

Abstract

In Malaysia, urbanization and population growth contribute to increase in construction waste. The waste management practices in the construction industry are insufficient, which has led to illegal dumping and health risks. The efficiency to manage construction waste is challenging due to limited space, lack of awareness and insufficient enforcement. Mismanagement construction waste can cause environmental and health impacts such as respiratory problems and diseases especially to marginalized communities. Policy frameworks and MyCREST aim to promote sustainability. While BIM and IBS are introduced to reduce waste and improve management in the construction industry. It is also highlighted that education and awareness are important to improve practices. Other than that, policy and enforcement are needed for sustainable waste management. To address challenges in construction waste management, holistic urban health approach, incorporating better waste segregation, timely disposal and green technology are important. This article aims to highlight the challenges of construction waste management, evaluate the use and awareness tools and to assess the environmental and health impacts of construction waste in Malaysia.

Keywords: C&D waste, Building Information Modelling, sustainable construction, waste tracking

© 2025 MAEH
 All rights reserved

INTRODUCTION

Rapid urbanization and population growth in Malaysia has led to the risen in construction waste. The construction waste includes materials like concrete, timber, steel, bricks and plastics (Shukor et al., 2021). These issues give negative impacts which are environmental pollution, depletion of natural resources and risks to public health, emphasizing sustainable construction waste management solutions are needed (Mohd Noor et al., 2023). Various industries such as government, industry stakeholders and the Construction Industry Development Board (CIDB) are involved in efforts to address construction waste management in Malaysia (Marhani et al., 2025). The efforts to tackle these issues are done through implementation of policies such as the 3Rs (Reduce, Reuse, Recycle) and promoting sustainable building techniques using digital technology like Industrialized Building System (IBS) (Shukor et al., 2021).

The aim of this article is to highlight the challenges associated with waste segregation and recycling at construction site in Malaysia. Other than that, it is to evaluate the use and awareness of tools in promoting sustainable waste management

in construction. Finally, this article's purpose is to assess the environmental and health impacts of construction waste.

ON- SITE CHALLENGES AND INDUSTRY PRACTICES

The construction industry significantly contributes to global carbon dioxide emissions (at least 40%) and waste generation approximately one-third of all waste leading to environmental concerns like global warming. Rapid construction development in Malaysia has resulted in a substantial amount of construction material waste, yet awareness and documentation regarding current waste management practices remain low, Wahab, H (personal communication, June 19, 2025). Current challenges in construction waste management include an increase in illegal disposal activities and a shortage of expertise and education in proper waste management procedures (SWCorp et al., 2019). For instance, SWCorp reported around 1446 illegal waste disposal locations in 2019 (CIDB et al., 2021). In the federal capital, construction waste accounts for a staggering 94.6% of all illegal waste, a rise attributed to the increasing demand for construction projects (CIDB et al., 2021).

The main operational obstacles to proper waste segregation and recycling at construction sites are numerous Abdullah, M. F. (personal communication, June 19, 2025). Another critical challenge is the limited site space in urban areas, which severely hampers effective waste segregation due to insufficient room for designated bins. Despite their support for the 3R (Reduce, Reuse, Recycle) principle, contractors face substantial barriers to implementation due to both cost and space constraints. Furthermore, the presence of a large foreign workforce (typically 200-300 workers per project) contributes to a high volume of domestic waste, adding to the overall waste management complexity. Waste from machinery must also strictly comply with the Environmental Quality (Scheduled Wastes) Regulations 2005, necessitating specialized handling. While proper bins depend on the capacity and types of waste, especially for roll-on / roll-off bins usually used for construction waste, especially in heavy waste, their practical deployment and consistent use within limited site footprints remain an ongoing operational challenge.

Additionally, overlapping enforcement powers between the Solid Waste and Public Cleansing Corporation (SWCorp) and local authorities create inefficiencies, further hindering effective waste management (Muhamad & Secow et al., 2019). Mohamed Jamil, M.A. (personal communication, June 19, 2025) CIDB's standpoint, the challenges in waste management are often related to a lack of awareness and consistent adoption of best practices, despite their advisory role. CIDB actively advises project owners and contractors on solid waste management and promotes tools like Malaysia Carbon Reduction and Environmental Sustainability Tool MyCREST to assess and encourage sustainable practices, which includes document-based audits and offers ratings and certification upon voluntary request. They also provide toolbox talks and training for waste bin usage, indicating recognition of the need for education and consistent practice on site.

MyCREST is a voluntary tool and that awareness among developers regarding available incentives offered in collaboration with Malaysian Green Technology and Climate Change (MGTC) is low suggests that the industry sometimes lacks the full impetus or knowledge to overcome operational hurdles to segregation and recycling. CIDB supports the use of MyCREST to benchmark sustainability performance, including the effective management of construction and demolition waste as part of their educational initiatives, Project at site need conduct toolbox talk, site briefings & training sessions. Landfill capacity is often inadequate to accommodate the total volume of waste generated by the construction sector (Nawi et al., 2018). While waste incineration is considered an effective solution in Malaysia, its negative environmental impacts, such as air pollution from emissions and high temperatures, are a concern. Construction debris presents a substantial and costly burden for solid waste management, especially with the proliferation of infrastructure projects (Maniam et al., 2018).

However, the efficient management of construction waste on-site is a critical imperative for modern construction projects, driven by both environmental sustainability goals and economic considerations. Moreover, digital platforms for waste tracking and reporting allow for better transparency and accountability, especially in large-scale the integration of such technologies into daily construction practices not only aligns with global trends in green building and circular economy principles but also positions the Malaysian construction sector to meet international standards and compete globally minimize environmental impact and improve operational productivity. The adoption of innovative technologies offers practical and proven solutions for minimizing waste generation and streamlining disposal processes (Wahab, H. [personal communication, June 19, 2025]).

ENVIRONMENTAL AND PUBLIC HEALTH IMPACTS

Despite regulatory efforts under the Environmental Quality (Scheduled Wastes) Regulations 2005 and involvement of agencies such as the Construction Industry Development Board (CIDB), Worldwide Holdings Berhad and the Solid Waste and Public Cleansing Management Corporation (SWCORP), effective waste segregation and recycling remain minimal. Most construction waste ends up in landfills, contributing to long-term environmental degradation and greenhouse gas emissions (Chong et al., 2023). Without more robust waste management strategies, Malaysia's increasing construction activity will exacerbate environmental and health challenges in already vulnerable urban settings.

Wahab, H (personal communication, June 19, 2025) stated that construction waste mismanagement poses a direct threat to urban public health, primarily through air pollution. The release of fine particulate matter (PM₁₀) from open dumping of construction debris such as dust, cement particles, and combustion emissions leads to respiratory ailments including asthma, bronchitis, and lung function impairment. These pollutants often exceed Malaysia's air quality standards, especially around construction waste sites situated near schools and residential areas (Yusof et al., 2020). Chronic exposure to airborne toxins, including dioxins released from burning plastic and metal waste, is also linked to elevated cancer risks (National Library of Medicine, 2022). Water and soil contamination from construction waste particularly from leachate and illegal dumping introduces hazardous substances into rivers and groundwater, threatening food safety and drinking water supply.

These contaminants harm ecosystems and add to the buildup of toxic materials in the environment (Gunarathne et al., 2024). The total health impact includes not only physical problems but also increased stress among communities living near polluted areas (Hamka et al., 2020). Poor disposal of construction waste creates ideal conditions for disease carriers like mosquitoes and rodents. Stagnant water in discarded containers, piled-up organic waste, and unmanaged landfill sites help spread dengue, leptospirosis, and malaria. These outbreaks hit urban communities near illegal dumping sites the hardest (Ho, 2018; Wahab et al., 2018; Garuda, 2021). The health issues are made worse by bad sanitation, particularly in crowded urban neighborhoods.

Environmental and public health effects from poorly managed construction waste are not equal. Marginalized and low-income communities near waste hotspots face the most pollution and health risks. These groups often do not have access to clean water, adequate healthcare, or legal ways to push for environmental protection. Open burning of waste, water contamination, and dust emissions impact these communities more intensely, showing the problem of environmental injustice (Singh et al., 2021). This situation increases health disparities and reinforces existing socioeconomic inequalities. Even though Malaysia has put laws in place, like the Environmental Quality (Scheduled Wastes) Regulations 2005, enforcement is uneven. Many construction sites do not separate waste properly or follow standard procedures for disposal.

Regulatory institutions such as CIDB and SWCORP have challenges in enforcing, monitoring, and spreading recycling activities at the construction site (CIDB, 2022). From research, recycling activities are low, and most of the waste is dumped in landfills without treatment and hence accelerating environmental degradation (UNEP, 2018; Wahab et al., 2018). Waste management is a new issue in Malaysia's construction sector with far-reaching impacts on environmental sustainability and public health in urban areas. Mismanagement leads to air and water pollution, sustains vectors of disease, and disproportionately impacts poor populations. Strengthening legal enforcement, embracing digital innovations, and pushing on sustainable practices are essential to mitigate these risks. Responsible construction is not only an environmental necessity

but a public health necessity to make Malaysia's urban future resilient and inclusive.

EDUCATION, AWARENESS AND CAPACITY BUILDING

For Malaysia to shift towards a sustainable construction sector, the solutions are through education, awareness and capacity building, where it highlighted the challenges in construction waste. However, the efficiency to adapt to better waste management practices in this sector remains slow due to a lack of information sharing and inadequate skill development. The Construction Industry Development Board (CIDB) plays an important role in promoting tools like MyCREST to enclose sustainability in construction decisions and offering training programs; however, developer awareness remains limited. Marhani et al. (2025) highlights a lack of exposure to digital tools for waste tracking due to inefficiencies and material loss, indicating the need for improved digital usage in the construction sector.

From an academic perspective, Mamat, R (personal communication, June 19, 2025) highlights the disconnect between academic research and industry practice, accentuates lack of funding and limited collaboration. Research on reusing construction waste, such as plastic in concrete, remains underutilized. While universities offer sustainability courses, practical, project-based learning is often insufficient, as students cannot frequently apply sustainability principles on-site (Akinradewo et al., 2024). Mamat, R (personal communication, June 19, 2025) also advocates for curriculum redesign, hands-on sustainability projects, and the integration of digital tools to bridge this gap. Health and safety concerns also arise from waste mismanagement. According to Abdullah, M. F. (personal communication, June 19, 2025), in infrastructure construction, risks are generally lower, but poor machinery maintenance can lead to chronic health issues.

Conversely, building sites face greater risks, such as disease vectors and water flow disruption from improper waste disposal, especially in worker accommodations. Research by Mohd Fateh et al. (2020) shows inconsistent enforcement of health risk precautions, particularly in informal labour quarters. Overall, to promote sustainable construction in Malaysia, the gaps in industry training, academic integration, and health risk enforcement through practical instruction, the adoption of digital tools, and consistent regulatory enforcement must be addressed.

POLICY, REGULATION AND GOVERNANCE

Malaysia's waste management of construction has several challenges within its policy, regulation, and governing framework. Even though there are legislations such as the Environmental Quality Act 1974 as well as the Solid Waste and Public Cleansing Management Act 2007, enforcement of these is usually wanting, resulting in rampant illegal dumping and uneven use across states due to decentralization. This translates into gaps of noncompliance, as witnessed in uneven enforcement of Building Regulations and Local Authority By-Laws, as well as hesitation among contractors to embrace good waste separation for recycling, oftentimes due to ambiguities of costs. Data underscores this improper management, as 933 tons of waste were produced in Klang Valley, resulting in more than 52 illegal dumping grounds, and 42% of illegal dumping within Johor District being construction waste (Sa'adi et al., 2016).

The absence of a dedicated national or C&D waste management policy with an integrated framework of guidelines necessitates the need for a singular construction and demolition waste management policy. Policies of this nature, which focus on integrated framework guidelines and purpose and policies targets for stakeholders, would elucidate precisely defined roles, benchmarks for reduction targets, and provide guidelines for the recirculation of waste in line with circular economy principles whilst fully incorporating C&D waste into national planning frameworks. Malaysia's hazardous waste policies over 30 years

necessitate constant renewal such as the Development of Policy and Regulations (DPR) for Hazardous Waste Management (HWM) which has been slated for the 12th Malaysia Plan (2021-2025) (Zainu et al., 2019).

While clear accountability mechanisms exist through the Department of Environment (DOE) and local authorities under the Environmental Quality Act 1974 and Local Government Act 1976, enabling legal consequences like fines and prosecution for illegal dumping, their effectiveness is limited (Mohd Noor et al., 2023). Environmental Management Plans (EMP) and Scheduled Waste Regulations are mandatory, with Environmental Officers overseeing compliance. However, contractors perceive local authorities as inadequately empowered (mean 2.30), and project developers show low awareness of environmental legislation (Koh et al., 2023). This perception gap and lack of awareness hinder effective governance.

Municipalities and local government councils are crucial in integrating construction waste control with the overall urban health objectives. They have the responsibilities of enforcement, long-term urban planning, appropriate waste management infrastructure, monitoring and auditing of sites, public awareness campaigns, as well as motivating through reward systems for waste minimization, reuse, and recycling (Mohd Noor et al., 2023). Strengthening the urban resilience greatly hinges on interdisciplinary convergence with developers, health authorities, waste managers, town planners, environmental engineers, and the policy makers having a central role. Such integrated planning, starting from the design phase for sustainable materials and waste minimization, coordinated zoning, and waste logistics ensures comprehensive waste management in consideration to urban sustainability and public health (Mohd Noor et al., 2023).

To effectively address these complex, systemic risks, more integrated assessment methods are needed. Integrated environmental health impact assessment (IEHIA) is defined as a means of evaluating health-related problems stemming from the environment and the health impacts of policies affecting the environment, accounting for complexities, interdependencies, and uncertainties. This approach goes beyond traditional risk assessment by considering multiple causes, diverse outcomes, and various intervening pathways. Similarly, Health Impact Assessment (HIA) focuses on policies and interventions, recognizing the environment's beneficial role in providing natural capital and ecological services, in addition to posing hazards. These integrated assessment frameworks are crucial for informing comprehensive policies that enhance human well-being and reduce risks by evaluating both negative and positive effects (Briggs, 2008).

CIRCULAR ECONOMY AND FUTURE SUSTAINABILITY

The Malaysian construction industry is a key driver of national development. However, it is also challenged with environmental degradation resulting from the generation of construction and demolition (C&D) waste. The circular economy strategy is a solution to this challenge as it transforms construction waste into valuable resources. The strategy is all about reducing waste, reusing, recycling, and closed-loop production to achieve long-term economic and environmental sustainability (Abdullah et al., 2021). Malaysia has set up structured systems like MyCREST (Malaysian Carbon Reduction and Environmental Sustainability Tool) by CIDB to drive sustainability in the construction industry. MyCREST evaluates projects based on carbon footprint, waste, and environmental performance. Developers increasingly demand green certifications like the Green Building Index (GBI) and GreenRE that reward resource-saving and low-carbon building schemes.

However, the adoption of these frameworks is often hindered by cost concerns and limited awareness within the industry (Ellen MacArthur Foundation, 2024). Centralized reporting systems through Worldwide Holdings Berhad and the integration of Environmental, Social, and Governance (ESG) indicators are

gradually enhancing transparency and accountability. Nevertheless, broader industry participation remains limited and will require stronger enforcement, mandatory waste segregation at the source, and improved financial incentives to succeed (UNEP, 2018). Circular practices in construction emphasize the reuse and recovery of high-impact materials such as concrete, steel, bricks, and timber. Demolition waste, particularly concrete, can be repurposed for temporary access to roads, filtration media, and as aggregate in new construction (Zawawi et al., 2019; Azman et al., 2023).

Strategic collaborations between contractors and concrete producers are essential to ensure the technical performance and economic viability of recycled materials (CIDB Malaysia & UiTM, 2021). Furthermore, Malaysia has seen the gradual adoption of Industrialized Building Systems (IBS) and prefabrication methods, which help minimize on-site waste and allow for component reuse (Majid et al., 2021). Technologies such as Building Information Modelling (BIM), RFID tracking systems, and smart bins have been introduced to enhance precision in material planning and to streamline waste management operations (Nawari & Oti, 2021; CIDB, 2022a). In addition, sustainable building materials like autoclaved aerated concrete (AAC) blocks and recycled wood panels are gaining popularity due to their eco-friendly characteristics and cost efficiency. However, logistical constraints and limited industry readiness continue to hinder the widespread application of these green alternatives (Nor & Ramly, 2023).

Despite these advancements, several challenges impede the transition towards a circular construction economy. High operational costs associated with recycling technologies, insufficient financial incentives, and inadequate technical expertise among contractors and developers continue to limit progress. Moreover, Mohamed Jamil, M.A. (personal communication, June 19, 2025) stated that regulatory enforcement remains weak, and national policies are inconsistently implemented, which undermines the systemic adoption of CE practices. Addressing these issues requires a multi-stakeholder effort involving education and training, policy harmonization, and substantial investment in green infrastructure.

Wahab, H (personal communication, June 19, 2025) informed that several countries offer valuable lessons for Malaysia. Singapore's Zero Waste Masterplan, for instance, aims to cut landfill use by 30% by 2030 and has achieved a 99% recycling rate for C&D waste. The country enforces mandatory on-site segregation and converts incinerator ash into construction materials while fostering public participation through national recycling campaigns (National Environment Agency, 2025.; MALBA Project, 2023). Japan employs a legislation-led model through its Construction Material Recycling Law, which mandates the recycling of key materials like concrete, wood, and asphalt. This has resulted in recycling rates exceeding 90% thanks to strong regulatory oversight and collaboration between the public and private sectors. Australia promotes market-based incentives via its Green Star Rating System, which rewards projects that incorporate waste reduction, material reuse, and sustainable practices (Shooshtarian et al., 2021). Thailand, through its National Waste Management Master Plan, prioritizes the reuse of construction materials in government projects and invests in urban recycling centers to reduce landfill dependency (Sharp & Sang-Arun, 2012).

For Malaysia to achieve a circular construction economy in 2030, there must be a comprehensive roadmap. It includes implementing national CE policies, enhancing compliance procedures, and offering financial incentives and tax relief for green construction. Investment in recycling plants and green technology needs to be enhanced, and training in the industry promoted and public awareness enhanced. Moreover, Malaysia should create cross-sectoral collaborations among government agencies, the private sector, and educational institutions to co-develop new solutions. Malaysia is able to build stronger policy

and technical frameworks by adopting good practices from Singapore and Japan. All of these will reduce virgin resource dependency, halt environmental degradation, and allow low-carbon, resilient cities that complement the nation's sustainability agendas.

HOLISTIC URBAN HEALTH APPROACHES

A holistic urban health approach emphasizes the interconnection between urban development, environmental quality and public health outcomes. In the context of construction waste, this approach integrates waste management strategies into the broader goal of urban well-being. The mismanagement of construction waste not only burdens landfills and ecosystems but directly threatens human health through water contamination, air pollution and the spread of vector-borne diseases. In Malaysia, the construction waste generated during construction activities is estimated to reach approximately 30%–35% of the total project production, with projected costs reaching 368.31 tons per day by 2023 (Abkar et al., 2024). Waste management is the process of eliminating or removing the unusable or polluted waste materials which demand efficient and sustainable management, including collection, reuse and recycling, handling, and waste disposal, which requires appropriate management of disposal at construction areas (Amry et al., 2023).

The construction waste is often overlooked, yet it significantly impacts urban health if it is not properly managed. According to Hasmori et al., (2020), the most popular method for managing construction waste is eliminating the waste materials directly in landfills and this method has been commonly used because Malaysian contractors believe that the waste materials have a very little value for influencing them to favor this method of disposal. According to Nawi et al., (2018), the total quantity of waste produced by the construction sector is not adequate to be accommodated by the landfill. Burning construction materials releases toxic gases that can trigger respiratory illnesses, especially in urban neighborhoods. These risks are even greater for low-income communities living near dumping sites, resulting in serious environmental justice concerns. As a result, sustainability requirements are neglected in managing construction waste where these problems already cause huge impacts towards the environment where quick alternatives need to be done as a solution (Amry et al., 2023).

A holistic urban health approach means integrating construction waste management into the broader public health planning. This involves implementing proper waste segregation, timely disposal, fogging, larviciding and water management to prevent stagnant conditions. According to Abdullah, M. F. (personal communication, June 19, 2025), the site-level efforts like fogging, larviciding, and hygiene monitoring are preventive strategies against vector-borne diseases. Key agencies, including local councils, public health departments, and construction stakeholders, must be involved from the early planning stage through to the demolition phase, ensuring that all activities are aligned with health and hygiene objectives. By doing so, urban environments can minimize pollution, reduce health hazards and build resilience against future public health crises. According to Wahab, H (personal communication, June 19, 2025), airborne pollutants from toxic leachate from improperly disposed of hazardous construction materials contribute to respiratory issues and environment degradation. They also emphasized that leachate from waste has the potential to cause the death of aquatic life within 5 to 10km if it enters rivers untreated, showing the severe ecological and health impact of unmanaged waste runoff.

Coordinated systems supported by policy, proper waste tracking, awareness campaigns, and infrastructure are vital. Wahab., H (personal communication, June 19, 2025). Digital tools like BIM, green building certification like CIDB MYCREST, and design for disassembly techniques also enhance sustainability while promoting health friendly construction

practices. Furthermore, BIM allows developers to map waste flow and design waste reduction in mind, thus minimizing the potential environment and health hazards. These technologies make it possible to connect construction waste tracking with urban health monitoring. The use of BIM technology has a significant impact on material management in Malaysia's construction sector and is essential to development of the industry (Abkar et al., 2024). EIA is essential to the holistic health approach because it requires thorough assessment that covers water quality and waste management. According to Mohamed Jamil, M.A (personal communication, June 19, 2025), a well-executed EIA involves multiple stakeholders, including local authorities (PBT), the Department of Environment (DOE) and public health departments. To make sure that the construction site functions within safe environmental and health bounds, EIA evaluates more than 50 factors. Construction waste management must be integrated into urban health policy rather than being handled as a stand-alone environmental concern in order for a holistic health strategy to be successful. Mamat, R. (personal communication, June 19, 2025) stated that the efficacy of existing legislation is limited by Malaysia's dispersed enforcement. It will take uniform on site enforcement and standardized procedures across agencies to achieve results like those in Singapore and Japan. In line with Malaysia's sustainability aims and international norms such as the Sustainability Development Goals (UNEP, 2015), cities may lower pollution, stop disease outbreaks, and guarantee a safer environment for future generations by integrating waste management into urban health systems.

CONCLUSION

In conclusion, the management and handling of construction waste in Malaysia addressing the growing challenges significant risk to environmental sustainability, public health, and social welfare. The rapid pace of urban growth and infrastructure enhancement has resulted in an increase and has notably raised waste production, revealing significant weakness in existing waste management methods and regulatory implementation. Despite the framework such as the Environmental Quality (Scheduled waste) regulations 2005 and initiatives like MyCREST, and the absence of dedicated notional waste policy have limited progress toward sustainable waste management. By taking assertive measures now, Malaysia can synchronize its construction industry with national development goals and international sustainability pledges, protecting the environment and public well-being for both present and future generations.

ACKNOWLEDGEMENT

The Focus Group Discussion was held at Eco Recycling Plaza, Petaling Jaya on 19th June 2025 and the Urban Health Forum (UHF) was conducted via online platform on 26th July 2025. This manuscript was made possible through the collective insight and contributions of professionals and experts. Special thanks to Majlis Bandaraya Petaling Jaya (MBPJ) for sponsoring the event and MAEH and IFEH for collaborating with UiTM to conduct the forum. All professionals and experts from various fields contributed to the focus group discussion that produced this article and approved the final version.

REFERENCES

Abdullah, M. I., Zawawi, N. A. W. A., Ismail, F., & Ahmad, N. (2021). Construction waste generation and recycling in Malaysia: Towards sustainable development. *IOP Conference Series: Earth and Environmental Science*, 655(1), 012071. <https://doi.org/10.1088/1755-1315/655/1/012071>

Akinradewo, O., Hafez, M., Aigbavboa, C., Ebekozi, A., Adekunle, P., & Otasowie, O. (2024). Innovating built environment education to achieve SDG 4: Key drivers for integrating augmented reality technologies. *Sustainability*, 16(19), Article 8315. <https://doi.org/10.3390/su16198315>

Amry, N. N. S., Noor, M. Z. bin M., & D'Silva, J. L. (2023). Recovering Construction Industry: Incorporate Circular Waste Management Towards Lower Construction Waste. *International Journal of Academic Research in Business and Social Sciences*, 13(14), 199-207.

Azman, M. N. A., Ali, A. S., & Fattah, M. Y. A. (2023). Utilization of recycled construction materials in sustainable buildings. *Journal of Construction in Developing Countries*, 28(1), 45-59. <https://doi.org/10.21315/jcdc2023.28.1.3>

Briggs, D. J. (2008). A framework for integrated environmental health impact assessment of systemic risks. *Environmental Health*, 7(1), 61.

CIDB. (2022). Construction waste management and sustainability: Malaysia's progress. Construction Industry Development Board Malaysia. <https://www.cidb.gov.my>

CIDB Malaysia & UiTM. (2021). Towards sustainable construction through industrialized building systems and material recycling. Construction Industry Research Report.

Chong, J. H., Liu, M. S., Hernandez, E., & Albescu, M. (2023). Implementation of Green Materials in Construction Management System in Malaysia. *Civil and Sustainable Urban Engineering*, 3(1), 51-69. <https://doi.org/10.53623/csue.v3i1.212>

Ellen MacArthur Foundation. (2024). Circular economy in cities: Transforming the built environment. <https://ellenmacarthurfoundation.org>

Garuda. (2021). Public health impact of construction waste mismanagement in Southeast Asia. *Garuda: Indonesian Journal Platform*. <https://garuda.kemdikbud.go.id>

Gunarathne, V., Phillips, A. J., Zanoletti, A., Rajapaksha, A. U., Vithanage, M., Di Maria, F., Pivato, A., Korzeniewska, E., & Bontempi, E. (2024). Environmental pitfalls and associated human health risks and ecological impacts from landfill leachate contaminants: Current evidence, recommended interventions and future directions. *Science of the Total Environment*, 912(December 2023), 169026. <https://doi.org/10.1016/j.scitotenv.2023.169026>

Hamka, H., Ni'matuzahroh, N., Astuti, T., Suen, M. W., & Shieh, F. A. (2020). Psychological well-being of people living near landfills: preliminary case study in Indonesia. *International Journal of Human Rights in Healthcare*, 13(4), 365-379. <https://doi.org/10.1108/IJHRH-09-2019-0076>

Ho, S. S. (2018). Construction waste and public health risks: The Malaysian experience. *Malaysian Journal of Environmental Management*, 19(2), 91-102.

Koh Zhi Yee, C., Ta Wee, S., Omar, R., & Sarpin, N. (2023). Implementation of Legislation Related to Construction Waste among Contractors. *Research in Management of Technology and Business*, 4(2), 507-522.

Majid, M. Z. A., Rahman, I. A., & Aibinu, A. A. (2021). IBS implementation in Malaysian construction: Towards zero waste strategy. *International Journal of Built Environment and Sustainability*, 8(2), 15-24. <https://doi.org/10.11113/ijbes.v8.n2.644>

Maniam, M., Latifah, A. M., & Md Tap, A. O. (2018). Challenges in construction waste management: A Malaysian perspective. *Journal of Construction in Developing Countries*, 23(1), 87-107. <https://doi.org/10.21315/jcdc2018.23.1.6>

Marhani, M. A., Abd Rahim, M. H., Raja Muhammad Rooshdi, R. R., Ismail, N. A. A., & Sahamir, S. R. (2025). Innovative waste management in the Malaysian construction industry: Challenges and strategic approaches. *International Journal of Service Management and Sustainability*, 10(1), 39-50. <https://doi.org/10.24191/ijsms.v10i1.24215>

- Mohd Fateh, M. A., Arshad, R. A., & Hamzah, F. H. (2020). The unfair welfare practices towards foreign workers in the Malaysian construction industry. *Infrastructure University Kuala Lumpur Research Journal*, 8(1), 23–46.
- Mohd. Nawi, Mohd. Nasrun and Mohd. Nasir, Najuwa and Abidin, Rahimi and Salleh, Nurul Azita and Harun, Aizul Nahar and Osman, Wan Nadzri and Ahmad, Md. Fauzi (2018). Enhancing construction health and safety through the practices of reuse and recycle in waste management among Malaysian contractors. *Indian Journal of Public Health Research & Development*. DOI Number: 10.5958/0976-5506.2018.01664.9
- Mohd Noor, S. N. A., Holelkusairi, M. S., Ab Wahab, L., Mohd Kamar, I. F., & Ramly, M. K. A. (2023). Identifying the initiatives of construction waste management in Malaysia towards achieving sustainable construction. *Construction*, 3(1), 130–134. <https://doi.org/10.15282/construction.v3i1.9462>
- Nawari, N. O., & Oti, A. H. (2021). Digital twins and circular economy in construction: A BIM-based waste reduction approach. *Automation in Construction*, 126, 103646. <https://doi.org/10.1016/j.autcon.2021.103646>
- Nor, N. M., & Ramly, A. (2023). Green building materials adoption: Challenges in Malaysian construction. *International Journal of Sustainable Building Technology and Urban Development*, 14(1), 39–52.
- Sharp, A., & Sang-Arun, J. (2012). *A Guide for Sustainable Urban Organic Waste Management in Thailand: Combining Food, Energy, and Climate Co-Benefits Supporting organization Asia-Pacific Network for Global Change Research (APN)*. <http://www.iges.or.jp>
- Shooshtarian, S., Maqsood, T., Wong, P.S.P., Khalfan, M., & Yang, R.J. (2021) Extended Producer Responsibility in the Australian Construction Industry. *Sustainability*, 13, 620. <https://doi.org/10.3390/su13020620>
- Shukor, A. S. A., Idris, N. H., & Bakri, A. S. (2021). Assessing site waste management practices and cost between conventional and industrialised building system (IBS) projects in Malaysia. *International Journal of Sustainable Construction Engineering and Technology*, 12(5), 156–163. <https://doi.org/10.30880/ijscet.2021.12.05.016>
- Singh, S. K., Chokhandre, P., Salve, P. S., & Rajak, R. (2021). Open dumping site and health risks to proximate communities in Mumbai, India: A cross-sectional case-comparison study. *Clinical Epidemiology and Global Health*, 9(June), 34–40. <https://doi.org/10.1016/j.cegh.2020.06.008>
- Sa'adi, N., Ismail, Z., Makmor, M., & Ahmad Zawawi, E.M. (2016). Implementation of Malaysian Government Initiatives in Managing Construction Waste. *Jurnal Teknologi*, 78(5-2), 55-60.
- National Environment Agency. (2025). *Towards Zero Waste*. <https://www.nea.gov.sg/our-services/towards-zero-waste>
- UNEP. (2018). Waste management outlook for Asia and the Pacific. United Nations Environment Programme. <https://www.unep.org>
- Wahab, S. N. A., Yusof, N. M., & Ismail, S. (2018). Construction waste generation in Malaysia: Challenges and strategies for sustainable management. *Journal of Cleaner Production*, 204, 564–573. <https://doi.org/10.1016/j.jclepro.2018.09.040>
- Yusof, N. A., Azmi, N. I., & Hassan, M. A. (2020). PM¹⁰ exposure in construction zones and respiratory health impacts. *Asian Journal of Environment-Behaviour Studies*, 5(17), 47–56.
- Zawawi, N. A. W. A., Abdullah, M. I., & Ismail, F. (2019). Recycling construction waste into value-added materials: A Malaysian perspective. *International Journal of Integrated Engineering*, 11(6), 137–147. <https://doi.org/10.30880/ijie.2019.11.06.015>
- Zainu, Z.A. (2019). Development of Policy and Regulations for Hazardous Waste Management in Malaysia. *JOSTIP*, 5(2), 34-42.