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Enhancing Construction and Demolition Waste Management Programs at NEUST Sumacab Campus: Assessment and Strategic Improvements

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ABSTRACT: Construction waste management is crucial for sustainable urban development. At NEUST Sumacab Campus, effective waste handling is essential to minimize environmental impact. This study evaluates the efficiency of the current construction and demolition waste (CDW) management system and identifies areas for improvement. A structured approach was used, incorporating surveys and site observations. Data were gathered from key stakeholders, including NEUST's Infrastructure and Development Office, contractors, engineers, architects, and foremen, to assess perceptions and practices.

Findings indicate that while some aspects of the waste management system are functional, the overall effectiveness is low, with a rating of 2.47, classified as "rarely." The study highlights the need for improved recycling efforts and better waste management strategies to enhance sustainability on campus. Strengthening waste segregation, recycling, and disposal methods can significantly improve environmental outcomes. These insights contribute to developing a more efficient construction waste management program for NEUST Sumacab Campus, promoting sustainable construction practices.

KEYWORDS: Construction and Demolition Waste, Recycling, waste management practices, waste management program, Construction debris

I. INTRODUCTION

Waste generation is a growing global concern, with construction and demolition waste (CDW) accounting for over 40% of total waste worldwide. By 2025, CDW is expected to reach 2.2 billion tons annually, posing environmental challenges. Addressing this issue aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) by promoting sustainable waste management, recycling, and reduced landfill use.

In the Philippines, rapid infrastructure growth under the Build Better More (BBM) program has led to increased CDW, yet existing waste management policies, such as Republic Act No. 9003, primarily focus on general solid waste. In Nueva Ecija, particularly in Cabanatuan City, no structured CDW management program exists despite ongoing urbanization.

At NEUST Sumacab Campus, construction waste is not part of the current Material Recovery Facility (MRF) operations, leaving disposal responsibilities to the Infrastructure and Development Office (IDO). This study aims to assess the campus's CDW management practices, identify gaps, and develop a structured waste management program. The proposed initiative will integrate sustainable practices into the university's existing system, ensuring long-term environmental benefits. Ultimately, this research will lead to a formal CDW management policy, benefiting NEUST by improving waste handling, promoting sustainability, and aligning with national and global environmental goals.

A. General Objective

This study aims to assess the effectiveness of the current construction waste management system at NEUST Sumacab Campus, identify areas for improvement, and develop a sustainable waste management program that promotes waste reuse, recycling, and responsible disposal in alignment with the campus's Material Recovery Facility.

B. Specific Objective

1. Evaluate the current construction waste management system at NEUST Sumacab Campus, Cabanatuan City;
2. Determine whether it efficiently manages the construction waste volume;
3. Identify gaps and areas for improvement that can lead to a more sustainable environment and;
4. Develop a sustainable waste management program at NEUST Sumacab Campus, focusing on waste reuse, recycling, and responsible disposal practices for CDW in

line with the existing Material Recovery and Facility of the campus which focuses on solid waste.

II. METHODOLOGY

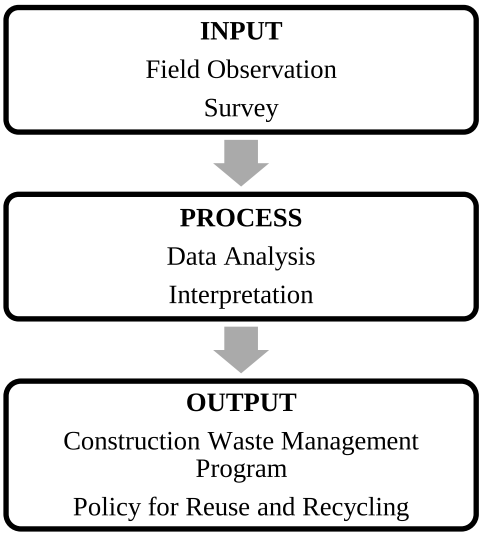


Figure I. Research Flow

This study follows a descriptive research design to develop a Construction and Demolition Waste (C&D) Management Program at NEUST Sumacab Campus. The research begins with data collection through questionnaires, interviews, and field observations involving key stakeholders such as contractors, project engineers, site architects, foremen, and NEUST representatives.

The survey questionnaire is developed based on a review of existing waste management studies, guidelines, and best practices. A pilot survey is conducted to test and refine the questionnaire, ensuring its reliability and validity. After finalizing the survey instrument, the final survey is administered to a limited number of respondents, using a census sampling method. Since the study focuses on ongoing construction projects, the total number of respondents is expected to be less than 50, eliminating the need for traditional sampling and ensuring that all relevant stakeholders are represented.

The collected data undergoes statistical analysis using descriptive statistics, weighted mean, and Analysis of Variance (ANOVA) to identify trends, evaluate stakeholder perspectives, and assess significant differences in waste management practices. The weighted mean is computed to measure stakeholder perceptions based on the following rating scale:

Table I Rating Scale

Verbal Description	Weighted Mean Range	Scale
Always	4.21 - 5.00	5
Often	3.41 - 4.20	4
Sometimes	2.61 - 3.40	3
Rarely	1.81 - 2.60	2
Never	1.00 - 1.80	1

The ANOVA test is used to determine whether significant differences exist between respondents' years of experience and their approach to construction waste management. This will help in understanding variations in waste handling practices among different stakeholder groups.

III. RESULTS AND DISCUSSION

The socio-demographic profile of the respondents showed that most were school employees (53.80%) working in the Infrastructure and Development Office (IDO) and had 2-10 years of experience (53.80%). The assessment of the current construction waste management system at NEUST Sumacab Campus indicated a high level of effectiveness (mean = 4.52, "Always"**)**, with material quality checks **(**5.00**)** and coordination between project heads and workers **(**4.77**)** being the most consistently practiced. However, the willingness to use recycled materials **(**3.92, "Often"**)** suggests room for improvement.

Recycling efforts varied by material type. Concrete recycling was the most common **(**2.87, "Sometimes"**),** while glass recycling was nearly nonexistent **(**1.40, "Never"**).** Metals, ceramics, wood, plastic pipes, and plumbing fixtures were rarely recycled, highlighting the need for better waste utilization. An ANOVA test found no significant difference **(**$p = 0.865$**)** between respondents' years of experience and their perception of the waste management system.

To address gaps, a Proposed Construction Waste Management Program was developed using the Integrated Sustainable Waste Management (ISWM) approach**.** The program aligns with NEUST’s Material Recovery Facility (MRF) and focuses on improving policies, planning, and collaboration between contractors and NEUST personnel to enhance waste management and recycling efforts on campus.

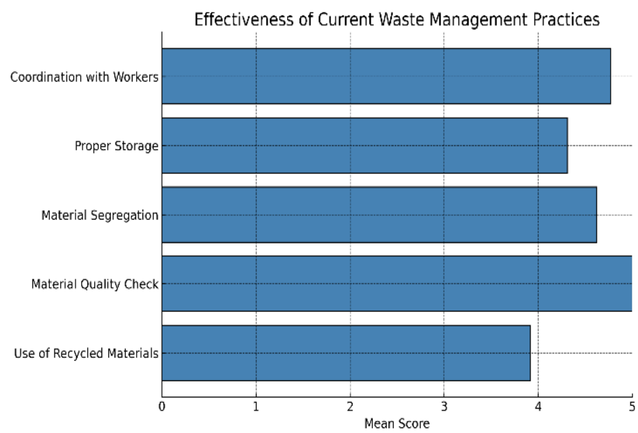


Figure II Effectiveness of Current Wate Management Practices

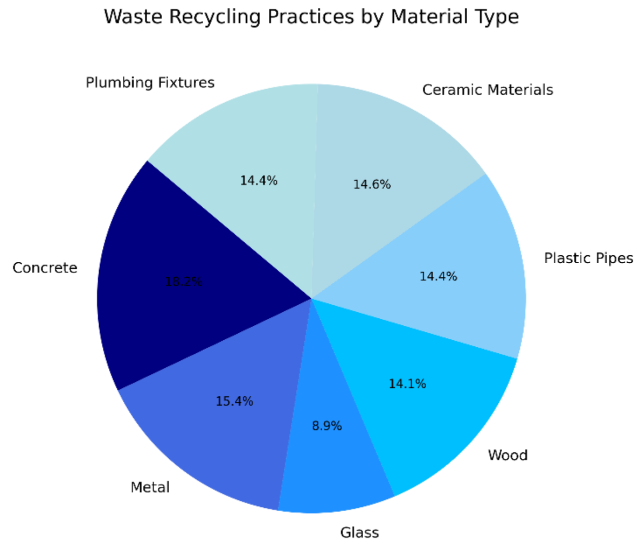


Figure III – Wate Recycling Practices by Material Type

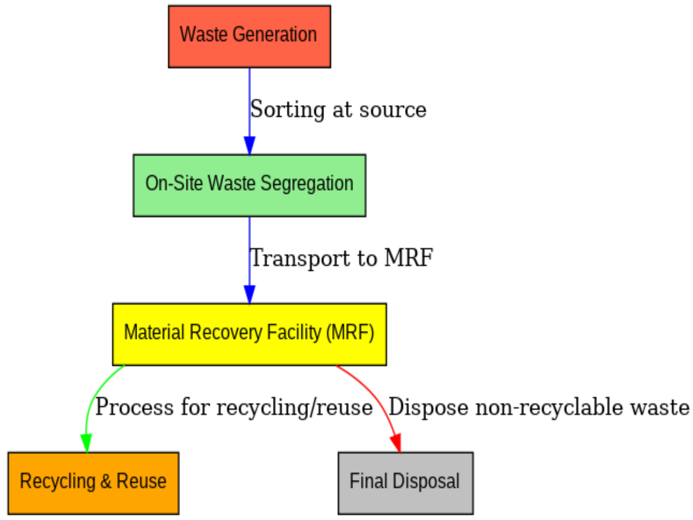
Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (p-value)	Interpretation
Between Groups	0.048	3	0.016	0.241	0.865	No Significant Difference
Within Groups	0.597	9	0.066			
Total	0.645	12				

Table II – Result of ANOVA The significance value (p = 0.865) is greater than 0.05, meaning there is no significant difference between years of experience and waste management effectiveness.

CONCLUSIONS

This study assessed the effectiveness of the construction and demolition waste (CDW) management system at NEUST Sumacab Campus, focusing on current practices, efficiency, and areas for improvement. Responses from 13 construction professionals, including contractors, engineers, architects, and foremen, revealed that coordination between project heads and workers (mean = 4.77) and proper storage and segregation (mean > 4.3) were highly effective. However, actual recycling efforts varied, with concrete being the most commonly recycled material (mean = 4.15), while metals, wood, plastics, and glass were rarely recycled (mean < 2.5), highlighting gaps in waste utilization.

To improve CDW management, the study recommends that, instead of contractors hauling their waste, the Infrastructure and Development Office (IDO) and NEUST's Materials Recovery Facility (MRF) collaborate to store, segregate, and reuse materials. This approach benefits contractors by reducing hauling expenses and effort while providing the university with reusable materials for small-scale projects like repairs and landscaping. By retaining CDW, NEUST can enhance sustainability efforts and reduce costs associated with new construction materials, fostering a more efficient and eco-friendly waste management system.



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REFERENCES

1. Abd El-Mageed, T., Abou-Aly, H., El-Saadony, M. T., Saad, A., ElWafai, N., Salem, H., & Soliman, S. (2023). Hazardous wastes and management strategies of landfill leachates: A comprehensive review. Environmental Technology & Innovation,31,103150. https://doi.org/10.1016/j.eti.2023.103150
2. Abdullah, H., Fadhullah, W., Imran, N. I., Ismail, S. N., & Jaafar, M. H. (2022). Household solid waste management practices and perceptions among residents in the East Coast of Malaysia. BMC Public Health, 22, Article Number 1. https://doi.org/10.1186/s12889-021-12274-7
3. Ahmed, S., & Ali, M. (2023). Potential Applications of Different Forms of Recycled Plastics as Construction Materials—A Review. https://doi.org/10.3390/iocbd2023-15177

4. Aleksanin, A. (2019, May 29). Development of Construction Waste Management. E3S Web of Conferences. https://doi.org/10.1051/e3sconf/20199706040
5. Amasuomo, E., & Baird, J. (2016). The Concept of Waste and Waste Management. Journal of Management Studies, 6(4), 88–96. https://doi.org/10.5539/jms.v6n4p88
6. Alvarez, C. J., Bagus, D., Burog, E., Flores, R. M., Feratero, V. J., Gonzales, R. P., & Soneja, S.K. (2017). A Case Study about the Improper Waste Disposal in Barangay Mojon Tampoy. https://www.researchgate.net/publication/331702185_A_Case_Study_about_the_Improper_Waste_Disposal_in_Barangay_Mojon_Tampoy
7. Alqahtani, F. K., & Zafar, I. (2023). Construction of green concrete incorporating fabricated plastic aggregate from waste processing. Sustainability, 15(5),4114. https://doi.org/10.3390/su15054114
8. Aquino, A. P. (2022, July 25). Ecological Solid Waste Management Act: Environmental protection through proper solid waste practice. FFTC Agricultural Policy Platform (FFTC-AP). https://ap.fftc.org.tw/article/588
9. Arslan, H., Cosgun, N., & Salgin, B. (2012, October 26). Construction and Demolition Waste Management in Turkey. Chapter metrics overview. https://www.intechopen.com/chapters/40493
10. Bhada-Tata, P., & Hoornweg, D. (2013). What a Waste: A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers. https://openknowledge.worldbank.org/entities/publication/1a464650-9d7a-58bbb0ea-33ac4cd1f73c
11. BigRentz. (2024, February 27). 24 construction waste statistics. https://www.bigrentz.com/blog/construction-wastestatistics?srsltid=AfmBOoq5FN41x_kssec00xrHiBYPcpiysmhhlBSLIz2Q19G-Z1qCbI-8
12. Boutlikht, M., Hebbache, K., Douadi, A., & Tabchouche, S. (2023). Assessment of the PVC waste addition effect on the concrete mechanical performance. Revue Des Composites Et Des Matériaux Avancés, 33(2), 85–94. https://doi.org/10.18280/rcma.330203
13. Brunner, P. H., & Rechberger, H. (2015). Waste to energy – key element for sustainable waste management. Waste Management, 37, 3–12. https://doi.org/10.1016/j.wasman.2014.02.003
14. Cariaso, B. (2023). Philippines produces 61,000 million metric tons of waste daily. https://www.philstar.com/headlines/2023/08/06/2286595/philippines-produces-61000-million-metric-tons-waste-daily
15. Castillo, A., & Otoma, S. (2013). Status of Solid Waste Management in the Philippines. https://www.jstage.jst.go.jp/article/jsmcwm/24/0/24_677/_pdf
16. Congressional Policy and Budget Research Department. (n.d.). FF2024-13: Build better more (BBM) - CPBRD policy brief. https://cpbrd.congress.gov.ph/2012-06-30-13-06-51/2012-06-30-13-36-50/1720-ff2024-13-build-better-more-bbm
17. Crawford, R. H., Mathur, D., & Gerritsen, R. (2017). Barriers to Improving the Environmental Performance of Construction Waste Management in Remote Communities. Procedia Engineering, 196,830–837. https://www.researchgate.net/publication/320607926_Barriers_to_improving_the_environmental_performance_of_construction_waste_management_in_remote_communities
18. Dimaculangan, E. P. (2023, March). Current construction and demolition waste management strategies for Philippine construction sector- A systematic literature review. Journal of Sustainable Construction Materials & Technologies. https://doi.org/10.1016/j.proenv.2016.07.074
19. Do, M. (2024, September 5). Waste wood recycling: Process, benefits and Innovations. Vinawood 22 Vietnam Plywood. https://vinawoodltd.com/blogs/news/waste-wood-recycling-in-indiaits-benefits
20. Ecological Solid Waste Management Act of 2000 (RA 9003). (n.d.). One Planet Network. https://www.oneplanetnetwork.org/knowledge-centre/policies/ecological-solid-wastemanagement-act-2000-ra-9003
21. Enp.Tinio (2022). 15 Statistics about Solid Waste Management in the Philippines that Every Filipino should Know (Updated 2022!). https://enptinio.com/statistics-philippines-solid-waste-management/
22. Epure, C., Munteanu, C., Istrate, B., Harja, M., & Buium, F. (2023). Applications of recycled and crushed glass (RCG) as a substitute for natural materials in various fields—a review. Materials, 16(17), 5957. https://doi.org/10.3390/ma16175957
23. Eser, A. (2024, July 23). Global alarm: Startling construction waste statistics reveal environmental crisis ahead. Construction Waste Statistics: Market Data Report 2024. https://worldmetrics.org/construction-wastestatistics/?fbclid=IwY2xjawE2oa5leHRuA2FlbQIxMAABHW62EtxxXvfndyqTQnNT11Uk00T

B59bN1twq3-0Xz8NJ_gRPesT7hBdANQ_aem_WpcgwMmqnxu6tc8iO0utag
24. Guberman, R. (2022, March 10). How is construction & demolition waste recycled: RTS. Recycle Track Systems. https://www.rts.com/blog/how-is-construction-an-demolition- wasterecycled/
25. Handbook on the Ecological Solid Waste Management Act of 2000 and its Implementing Rules and Regulations | Department of Environment and Natural Resources Foreign-Assisted and Special Projects Service eLibrary. (n.d.). https://faspselib.denr.gov.ph/node/1680
26. Hosansky, D. (2023, October 2). Material Recovery Facility. Encyclopedia Britannica. https://www.britannica.com/technology/materials-recovery-facility
27. Iges (2013). Policy Implementation of the Republic Act (RA) 9003 in the Philippines: A case study of CebuCity.https://www.iges.or.jp/en/pub/policy-implementation-republic-act-ra-9003/en
28. Jwaida, Z., Dulaimi, A., & Bernardo, L. F. A. (2024). The Use of waste ceramic in Concrete: a review. CivilEng, 5(2), 482–500. https://doi.org/10.3390/civileng5020024
29. Kaseva, M., Kihila, J. M., & Wernsted, K. (2021). Waste segregation and potential for recycling A case study in Dar es Salaam City, Tanzania. Sustainable Environment, 7(1). https://www.researchgate.net/publication/353238932_Waste_segregation_and_potential_for_recycling_A_case_study_in_Dar_es_Salaam_City_Tanzania
30. Jwaida, Z., Dulaimi, A., & Bernardo, L. F. (2024). The use of waste ceramic in concrete: A Review. CivilEng, 5(2), 482–500. https://doi.org/10.3390/civileng5020024
31. Keiski, R. L., Phillips, P. S., & Pongrácz, E. (2004). Evolving the theory of waste management: Defining key concepts. https://www.researchgate.net/publication/289022652_Evolving_the_theory_of_waste_management_Defining_key_concepts
32. Kerry Rowe, R. (2013). Systems Engineering the Design and Operation of Municipal Solid Waste Landfills to Minimize Contamination of Ground Water. Advances in Environmental Geotechnics, pp. 3–18. https://link.springer.com/chapter/10.1007/978-3-642-04460-1_1
33. Kou, S. C., Lee, G., Poon, C. S., & Lai, W. L. (2009). Properties of lightweight aggregate concrete prepared with PVC granules derived from scraped PVC pipes. Waste Management, 29(2), 621–628. https://doi.org/10.1016/j.wasman.2008.06.014
34. Loubani, H. (n.d.). Use of Polyvinyl Chloride (PVC) As an Aggregate for Concrete. Final Report MSc in Resource Recovery Polymers for circular economy. https://www.divaportal.org/smash/get/diva2:1783708/FULLTEXT01.pdf
35. Lu, W., & Tam, V. W. Y. (2013). Construction waste management policies and their effectiveness in Hong Kong: A longitudinal review. Renewable and Sustainable Energy Reviews, 23, 214–223. https://www.researchgate.net/publication/236588663_Construction_waste_management_policies_and_their_effectiveness_in_Hong_Kong_A_longitudinal_review
36. Macrotrends (n.d.). Philippines Population 1950-2023. https://www.macrotrends.net/globalmetrics/countries/PHL/philippines/population
37. National Waste Associates (n.d.). Wood Recycling for the Construction Industry (Don't Let Your Money Get Hauled Away!). https://www.nationalwaste.com/blog/wood-recycling-for-the-construction-industry-dont-let-your-money-get-hauled-away/
38. Noor, T., Javid, A., Hussain, A., Bukhari, S. M., Ali, W., Akmal, M., & Hussain, S. M. (2020). Types,sources and management of urban wastes. Urban Ecology. https://doi.org/10.1016/B978-0-12-820730-7.00014-8
39. Plastic Scrap Recycling (2021). Plastic Recycling Company. https://scrapmanagement.com/programs/plastic-recycling-california/pvc-recycling/
40. Roadrunner Modern Waste + Recycling (2019, October 15). What is a Materials Recovery Facility (MRF)? https://www.roadrunnerwm.com/blog/what-is-a-materials-recovery-facility
41. Saez, P. V., Del Rio Merino, M., Gonzalez, A. S.-A., & Porras-Amores, C. (2013, March 27). Best practice measures assessment for construction and demolition waste management in building constructions. Resources, Conservation and Recycling. https://doi.org/10.1016/j.resconrec.2013.03.009
42. Santos, M. A., Mendoza, D. V. M., Guzman, R. V. M. D., & Gabriel, A. G. (2017).Biodegradability of formulated enzymatic solution an alternative waste reduction system. SCIRP. https://www.scirp.org/journal/paperinformation?paperid=75866#:~:text=The%20former%20dumpsite%20in%20Valle,within%20and%20around%20the%20vicinity

43. Schyns, Z. O. G., & Shaver, M. P. (2020). Mechanical Recycling of Packaging Plastics: A Review. Macromolecular Rapid Communications, 42(3), 2000415. https://doi.org/10.1002/marc.202000415
44. Singh, J., & Singh, P. (2016). A REVIEW ON Recycling Of Waste Glass In Construction Industry. International Journal of Advanced Research in Engineering and Applied Sciences, 6(7). https://garph.co.uk/IJAREAS/July2016/4.pdf
45. Tihomirovs, P., De Maeijer, P. K., & Korjakins, A. (n.d.). Demolition Waste Glass Usage in the Construction Industry. Infrastructures. https://www.mdpi.com/2412-3811/8/12/182
46. Using recycled glass fines in construction and product design. (n.d.). Sustainability Victoria. https://www.sustainability.vic.gov.au/news/news-articles/using-recycled-glass-fines-in-construction-and-product-design
47. Walaa S. E. Ismaeel, Nada Kassim (2023). An environmental management plan for construction waste management. Ain Shams Engineering Journal, 14(12), 102244. https://doi.org/10.1016/j.asej.2023.102244
48. Weng, Y.-C., Fujiwara, T., Houng, H. J., Sun, C.-H., Li, W.-Y., & Kuo, Y.-W. (2015). Management of landfill reclamation with regard to biodiversity preservation, global warming mitigation and landfill mining: experiences from the Asia–Pacific region. Journal of Cleaner Production, 104, 364–373. https://doi.org/10.1016/j.jclepro.2015.05.014
49. Wu, Z., Yu, A. T. W., Shen, L., & Liu, G. (2014, September). Quantifying construction and demolition waste: An analytical review. ScienceDirect. https://doi.org/10.1016/j.wasman.2014.05.010