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Design of Waste Collection Sites at President University Campus: The Principles of Reduce, Reuse, Recycle (3R)

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Abstract

Waste management is a critical issue in Indonesia, where most of the waste produced is still not separated for disposal and handled properly. Despite having separate waste bins, President University has not consistently implemented waste separation, making it an appropriate case study for designing a 3R-based Temporary Waste Storage Site. This study aims to calculate the volume of existing waste and design a user-friendly 3R Temporary Waste Storage Site that supports the principles of Reduce, Reuse, and Recycle on campus. This study uses a mixed methods approach, combining direct observation and measurement of waste volume in Buildings A and B for eight consecutive days in accordance with SNI 3964:2025, as well as a questionnaire survey to assess students perception, behaviors, norms, and responsibility regarding waste management. The results show that the average waste production on campus is 79.75 kg/day, dominated by inorganic waste such as plastic bottles (17.5%) and plastic food containers (16.6%), followed by paper, cardboard, and organic food waste. The proposed technical design includes separate organic, inorganic, and residual waste facilities, composting using bamboo aerators, and leachate reservoirs. This design meets Indonesian regulatory requirements, with increased sorting and processing capacity. Social analysis using multiple linear regression revealed that perception significantly influenced student responsibility in waste management (p = 0.001), while behavior and norms showed weaker effects.

Keywords: *waste management, president university, design temporary waste storage site 3r*

Abstrak

Pengelolaan sampah merupakan isu kritis di Indonesia, di mana sebagian besar sampah yang dihasilkan masih belum dipisahkan untuk pembuangan dan ditangani dengan benar. Meskipun memiliki tempat sampah terpisah, Universitas Presiden belum secara konsisten menerapkan pemisahan sampah, sehingga menjadi studi kasus yang tepat untuk merancang Tempat Penyimpanan Sampah Sementara berbasis 3R. Studi ini bertujuan untuk menghitung volume sampah yang ada dan merancang Tempat Penyimpanan Sampah Sementara 3R yang ramah pengguna yang mendukung prinsip-prinsip Reduce, Reuse, dan Recycle di kampus. Studi ini menggunakan pendekatan campuran, menggabungkan pengamatan langsung dan pengukuran volume sampah di Gedung A dan B selama delapan hari berturut-turut sesuai dengan SNI 3964:2025, serta survei kuesioner untuk menilai persepsi, perilaku, norma, dan tanggung jawab mahasiswa terkait pengelolaan sampah. Hasil menunjukkan bahwa produksi limbah rata-rata di kampus adalah 79,75 kg/hari, didominasi oleh limbah anorganik seperti botol plastik (17,5%) dan wadah makanan plastik (16,6%), diikuti oleh kertas, karton, dan limbah makanan organik. Desain teknis yang diusulkan mencakup fasilitas terpisah untuk limbah organik, anorganik, dan sisa, kompos menggunakan aerator bambu, serta reservoir lindi. Desain ini memenuhi persyaratan regulasi Indonesia, dengan peningkatan kapasitas pemilahan dan pengolahan. Analisis sosial menggunakan regresi linier berganda menunjukkan bahwa persepsi secara signifikan mempengaruhi tanggung jawab mahasiswa dalam pengelolaan limbah (p = 0,001), sementara perilaku dan norma menunjukkan efek yang lebih lemah.

Keywords: *pengelolahan sampah, universitas presiden, design tempat penyimpanan sampah sementara 3r*

1. Introduction

Waste is material discarded from human activities or natural processes and has no economic value. Waste management refers to the collection, transportation, processing, recycling, or disposal of waste materials [1]. It aims to minimize impacts on health, the environment, and beauty. And involves solid, liquid, gaseous, or radioactive substances with specific methods required for each type [1].

According to the World Bank, solid waste is expected to increase by about 70% by 2025 [2]. This increase can be seen from the calculation of waste from 1.3 billion tons annually to 2.2 billion tons [2]. Based on the data shown, waste will continue to increase globally, so a strategy is needed to address this issue. Therefore, efforts must be made by local communities and the government to reduce waste and improve sustainable waste management [2]. In line with global trends, Indonesia is currently facing significant waste management challenges. Data from the National Waste Information System, Indonesia, indicates that about 67.8 million tons in the year 2020 of waste were generated annually, and only about 33.0% was disposed of properly. It is estimated that the waste generated by people living in metropolitan cities reaches 4.75 tons/year, and for large cities, reaches 175,200 tons/year [3]. Plastic waste is a serious problem, and the Indonesian government has taken steps to reduce the use of single-use plastics through regulations and public awareness campaigns, such as outreach programs [3].

In Indonesia, household waste contributes the largest proportion (39.10%), followed by waste from traditional markets (20.40%) and commercial centers (17.80%) [4]. Based on composition, organic food waste dominates at 41.40%, while inorganic waste, such as plastics, paper, glass, and metals, accounts for 39.10% [4]. These figures highlight the urgent need for effective waste management solutions. To address these challenges, the legal and regulatory framework plays a critical role. Law No. 18 of 2008 concerning waste management emphasizes that conventional waste management (collect–transport–dispose) is no longer sufficient and must be transformed into a system based on waste reduction and handling, in line with the principles of Reduce, Reuse, Recycle (3R) [5].

One widely promoted approach is applying the 3R principle (Reduce, Reuse, Recycle) as stipulated in Government Regulation 81 of 2012. Waste management has become an urgent environmental issue in various parts of the world, including Indonesia. As the population and human activities increase, so does the production of waste. Improperly managed waste can cause various environmental problems, such as soil, water, and air pollution, and can have negative impacts on humans. One way to address this issue is by introducing the concept of Reduce, Reuse, and Recycle (3R) as an effective approach to waste management [6]. This concept aims to reduce the amount of waste generated (Reduce), reuse items that are still usable (Reuse), and recycle materials that can be processed again (Recycle). Through the implementation of the 3R concept, it is hoped that the amount of waste that must be handled by Landfills (TPA) can be reduced and the negative impacts on the environment minimized [6].

Education is crucial, particularly for students, as knowledge and attitudes significantly shape behavior. Wartama and Nandari (2020) found that training programs foster environmental awareness and skills while revealing recycled waste's economic potential [7]. Although awareness of the importance of maintaining cleanliness is increasing, the implementation of Reduce, Reuse, and Recycle (3R) practices in the environment is still not optimal [8]. This is due to several factors, such as a lack of in depth understanding of the concept and benefits of the Reduce, Reuse, Recycle (3R) principle, and inadequate facilities [8]. Structured and sustainable educational activities need to be organized to increase public knowledge and awareness of the importance of waste management based on Reduce, Reuse, Recycle (3R) [8].

Community participation is another critical factor in 3R-based waste management, providing both environmental benefits and social and economic value [9]. However, success depends on social, cultural, and economic conditions. Sustainable management requires broader strategies, including efficient collection, environmentally friendly processing, and waste-to-energy initiatives. As knowledge-based institutions, universities play a strategic role in promoting sustainable practices, yet student awareness and behavior are often limited [9]. Infrastructure also plays a vital role in supporting 3R implementation. The availability of Temporary Waste Storage Sites (TPS 3R) is mandated by the Minister of Public Works Regulation No. 3 of 2013 [10]. These facilities reduce waste volumes transported to final disposal sites and serve as community-scale solutions, as emphasized in the Technical Guidelines for TPS 3R (2017) [11]. In supporting facilities, according to Regulation of the Minister of Public Works No. 03 of 2013, a waste container is defined as a place to temporarily store waste, aiming to prevent scattered waste, facilitate collection, and ensure safety. Law No. 18 of 2008 also emphasizes that waste management is a shared responsibility between central and local governments, requiring regulations that cover collection, sorting, and container management based on technical and health standards.

However, the study of Hao, Zhang, and Morse (2020) showed that regulations alone are not enough to change student behavior, as only 17.8% consistently sorted waste. Factors such as bin accessibility, labeling clarity, and user perception are crucial, suggesting that TPS 3R development must integrate technical, ergonomic, and behavioral aspects. These insights form a foundation for designing waste management at President University, where infrastructure and community awareness must go hand in hand to achieve effective 3R implementation [12].

Despite these guidelines, implementation in campuses remains limited. Indriyani [13] conducted a case study at President University using SNI-3964-1994, finding waste generation of 238 grams per person per day, with 55% residual, 31% recyclable, and 14% organic. Recommendations included composting, fermentation, and third-party partnerships. However, changes in SNI 3964:2025 have revised waste measurement methods, and previous research has not explored facility design, architectural planning, or circular economy concepts. Based on these gaps, this study introduces innovations in designing user-friendly TPS 3R facilities that encourage waste sorting.

President University was chosen as the research location because, although separate bins exist, sorting is inconsistently applied. Observations showed that waste collected at existing TPS remains unsorted, while high student activity generates significant waste volumes. These conditions make President University an ideal case study for designing a waste collection and sorting system aligned with the 3R principles.

2. Research Method

Research Location

The Temporary Waste Storage Site location was planned at President University, Central Cikarang District, Bekasi Regency, West Java. This sampling is to measure the generation and composition of waste from Buildings A and B, President University then from the data obtained, it is used for the design of Temporary Waste Storage 3R. The sampling time for this final project will be June 9 – June 18, 2025.

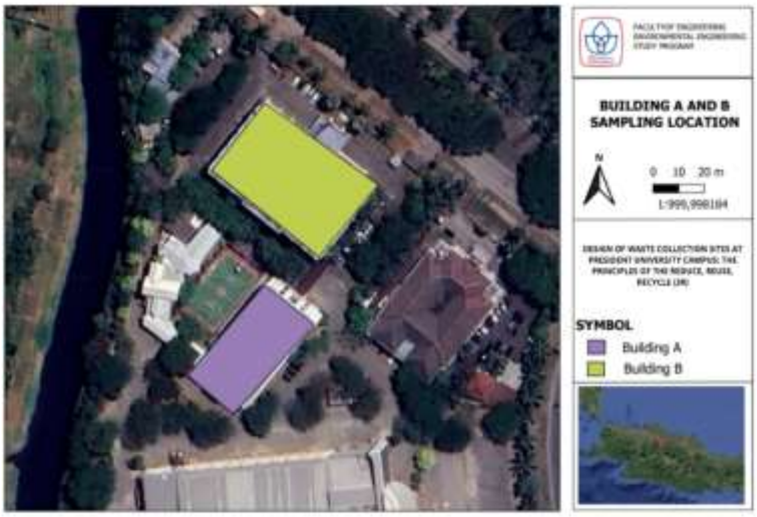

Fig. 1: Building A and B Sampling Location

Fig. 2: Planning Location in President University

Design Considerations

This design is based on several assumptions and considerations based on the following references:

1) SNI 3964:2025 concerning Methods for Collecting and Measuring Samples of Waste Generation and Composition of Household Waste and Similar Household Waste. Meanwhile, the facility design also refers to SNI 19-2454-2002 on Technical Operational Procedures for Urban Waste Management, as well as Ministry of Environment Regulation No. 13 of 2012 on Guidelines for the Implementation of Reduce, Reuse, Recycle (3R), and Minister of Public Works Regulation No. 3 of 2013.
2) Primary data was obtained through direct observation by recording the results of campus waste measurements in Building A and Building B. In addition, questionnaires were also used to determine students' perceptions of waste management on campus. Waste generation calculations were conducted over 8 days, from Monday to Wednesday (June 9–18, 2025). Measurements were not taken on Saturday and Sunday because there were no student activities on campus, resulting in no waste being generated

Tools and Materials Used in Field Observations

Field observations in this study were conducted over eight consecutive effective days, from June 9 to 18, 2025. Waste accumulation measurements were taken twice daily, during the first shift at 1:00 p.m. (afternoon) and the second at 8:00 p.m. (evening). However, due to field conditions, measurements for the evening shift were not taken directly at night but rather the following morning. Data collection was conducted directly in the field using several tools, such as a measuring box with dimensions of 55 × 28 × 34 cm (volume ±54 liters) to collect waste, a digital scale to determine the weight of waste per shift, and a measuring tape to measure the height of waste in the box. All observation data were recorded in prepared observation sheets, accompanied by visual documentation to support data accuracy. This observation aimed to obtain accurate information regarding the volume, weight, and density of waste generated from daily activities in the environment of Building A and Building B of President University, as a basis for designing the appropriate capacity of the Temporary Waste Storage Site 3R.

Table 1. Tools and Equipment

No	Items	Details
1		Plastic bags to collect all trash from the building.
2		A box measurement tool with 55 cm x 28 cm x 34 cm as the dimensions, following the standard size used in waste measurement SNI 3964:2025
3		Measure the weight of each building waste generation.
4		Measuring the height of waste per type.
5		Personal protective equipment.

3. Results and Discussion

Existing Condition

The research location at President University is located in the Jababeka industrial area, Cikarang, and has been established since 2004. The campus has more than 20 active study programs and is one of the fastest-growing higher education institutions in the region. Based on the observation, the existing condition of the waste management in the campus environment shows that the availability of waste bins is sufficient at various points. Some areas have been equipped with two types of bins, for organic and non-organic.

Fig. 3: Waste Container for Collection on Campus

However, from the results of field observations, it is still found that the behavior of the campus community students, staff, and lecturers has not disposed of waste according to the type of waste bins available. Organic and non-organic waste is often simply mixed. When compared to the SNI 3964:2025 standard on Methods of Taking and Measuring Examples of Waste Generation and Composition of Household Waste and Household Waste, the waste storage system at President University has not fully met the criteria for sorting three types of waste, namely organic waste, inorganic waste, and hazardous waste.

Fig. 4: Waste in President Campus

Cleaning staff carry out a waste collection system during the day and night, then collect waste at Temporary Waste Storage Sites (TPS) located on the campus area. The current Temporary Waste Storage Site (TPS) is located behind the PUCC Building and functions only as a temporary storage site without further processing. In addition, waste is transported to the Final Disposal Site (TPA) using trucks three times a week.

Fig. 5: Temporary Waste Storage Site & Garbage Truck on Campus

Total Active Population in the Campus Environment

To determine the number of waste-generating units at President University, data on the number of active students and staff active in the campus environment, especially in Buildings A and B, is needed. However, not all of these active students are on campus every day. The 2023 and 2024 batch students are the ones who regularly attend lectures offline, so they are considered the main population in the calculation of daily waste generation. Meanwhile, the 2021 batch of students has entered the thesis preparation phase or has graduated, and most of the 2022 batch of students are undergoing internship programs outside the campus; therefore, the waste contribution from the 2021 and 2022 batches is only calculated at 10% of the total population, respectively. In addition to students, the number of active staff in Building A and Building B is also considered. Based on the results of the data obtained, there are around 100 staff and lecturers who work actively in both buildings.

Table 2. Active Population on Campus Environment

Batch	Total Student
2021	222
2022	2876
2023	1894
2024	2667
Staff and Lecturers	100
Total	**4961**

Population Projections

Population projections must be made for 10-year intervals during the planning period. Waste generation is projected for each 5-year interval. The assumptions used in calculating waste generation projections must be by the master plan for waste management.

$$Pt = Po\ (1+r)^2$$

Where:
Pt = number of students in the elementary year
Po = annual growth rate
t = number of years since the base year

Table 3. Active Population on Campus Environment

Projected Number of Students	
2025	2934
2026	3227
2027	3550
2028	3905
2029	4295
2030	4725
2031	5197
2032	5717
2033	6289
2034	6918

Notes: R= 0.10 (taken 10% due to student growth assumptions)

Based on data reported by the University System of Georgia (2024), the growth rate at various educational institutions ranges from approximately 2.9% to 12.7% per year. Therefore, in my research, I assumed an annual student growth rate of 10%, which is still within that range and represents a high growth scenario [8].

Table 4. Annual student growth rate and waste

Year	Number of Students	Average Waste Generation		Volume of Garbage		Weight of Garbage	Density of Garbage
		V (L/person /day)	W (kg/person/ day)	(L/day)	(m3/day)	(kg/day)	(kg/m3)
2025	2934	0,400	0,011	1173,48	1,17	33,15	28,3
2026	3227	0,400	0,011	1290,83	1,29	36,47	28,3
2027	3550	0,400	0,011	1419,91	1,42	40,11	28,3
2028	3905	0,400	0,011	1561,90	1,56	44,12	28,3
2029	4295	0,400	0,011	1718,09	1,72	48,54	28,3
2030	4725	0,400	0,011	1890,00	1,89	53,4	28,3
2031	5197	0,400	0,011	2078,80	2,08	58,7	28,3
2032	5717	0,400	0,011	2286,80	2,29	64,6	28,3
2033	6289	0,400	0,011	2515,60	2,52	71,7	28,3
2034	6918	0,400	0,011	2767,20	2,77	78,17	28,3

Based on projections for the next ten years, the number of students is expected to continue to increase, reaching 6.918 in 2034.

Waste Generation Data

Waste generation measurements were conducted for eight consecutive days in Building A and Building B of President University, by the provisions with SNI 3964:2025. Building A and Building B were chosen as sampling locations because they are the centers of teaching, learning, and administrative activities at President University. Most of the campus main activities, such as lectures, faculty activities, administration, and daily student interactions, take place in these two buildings. Therefore, the waste generated from Buildings A and B can be considered a dominant representation of academic activities on campus. In addition, although the canteen also contributes significantly to waste generation, especially organic waste, the canteen data is considered supporting data in the design of the Temporary Waste Storage Site. Sampling was focused on Buildings A and B because daily academic activities in these two buildings are more consistent and representative of campus operations. To ensure data accuracy, observations were only conducted on Monday – Friday. Consequently, no waste disposal activity was recorded on Saturday and Sunday, and there was no waste disposal activity on Saturday and Sunday because campus activities were not taking place.

During the observation, waste from each building was collected daily to determine the total amount produced. The data in **Table 4.** shows the waste generation calculations conducted over 8 days during the day and night shifts in both buildings A and B at President University. In the table, A1 represents waste generated from Building A during the afternoon shift, A2 from Building A during the night shift, B1 from Building B during the afternoon shift, and B2 from Building B during the night shift.

Table 5. Waste Generation Data of Buildings A and B

Day	A1	B1	A2	B2	Total	Average (kg/day)
1	39,32	16,40	15,40	10,00	81,12	79,75
2	33,10	25,00	21,00	17,40	96,50	
3	28,10	14,90	12,70	19,80	75,50	
4	31,10	17,00	25,30	8,40	81,80	
5	22,40	25.10	16,80	8,10	72,40	
6	33,10	10,70	16,90	8,30	69,00	
7	15,10	25,50	18,95	20,00	79,55	
8	22,85	18,50	27,84	12,90	82,09	

In the next section, the waste data will be further classified based on the types found during collection, along with their total weight and percentage. This classification is done to identify the dominant types of waste, adjust the management needs, and design effective processing facilities in the campus environment.

Table 6 summarizes the types of waste generated from Building A and Building B during the eight days of observation. It shows the existing waste categories to provide a clearer picture of the waste composition in each location.

Table 6. Classification of Waste Generation Data

Type of Waste	Building A (kg)	Building B (kg)	Total	Percentage (%)
Food scraps	36,39	25,40	61,79	9,8%
Platic bottles	63,42	46,60	110,02	17,5%
Leaves	1,00	-	1,00	0.16%
Cardboard/cartoon	49,10	35,60	84,70	13.45%
Tissue	37,40	30,50	67,90	10.79%
Plastic (mica, plastic food bowl)	63,40	41,10	104,50	16.6%
Fabric	2,60	-	2,60	0,41%
Paper	50,30	19,70	70,00	11,12%
Cans	1,70	4,30	6,00	0,95%
Styrofoam	41,20	33,10	74,30	11,80%
Masks, chopsticks, markers, cutlery	25,00	21,70	46,70	7,42%
Total	**371.51**	**258,00**	**629,51**	**100%**

After knowing the composition and weight of each type of waste in Buildings A and B, **Table 6.** presents the value of the recovery factor used to describe the potential of every kind of waste to be recycled based on its type. The recovery factor is the percentage of waste that still has the potential to be reused. For example, plastic bottles have a high recovery factor because they can be sold or recycled, while food waste can be processed into compost. Conversely, some types of waste, such as tissues, styrofoam, and disposable masks, do not have a recovery factor because they are difficult to recycle, so they are categorized as residue. By knowing the percentage in the recovery factor, the capacity of organic, inorganic, and residue can be adjusted in the design of the Temporary Waste Storage Site [15].

Table 7. Recovery Factor for Each Type in Building A and B

No	Type of Waste	Weight (kg/day)	Total Weight of Each Type (kg/day)	Recovery Factor (%)	Processed (kg/day)	Residue (kg/day)
Organic Waste						
1	Food Scraps	61,79	62,79	50	31,40	31,40
2	Leaves	1,00				
Anorganic Waste						
3	Plastic bottles	110,02	110,02	80	88,016	22,00
4	Cardboard/carton	84,70	84,70	50	42,35	42,35
5	Paper	70,00	70,00		35,00	35,00
6	Plastic (mica, plastic food bowl)	104,50	104,50		52,25	52,25
7	Cans	6,00	6,00	90	5,400	0,600
Residue						
8	Strofoam	74,30	153,80	0	0,000	153,800
9	Tissue	67,90				
10	Masks, chopsticks, markers, cutlery)	46,70				
11	Fabric	2,60				
	Total	**629,51**	**432,01**		**254,411**	**337,399**

To support the proper planning of waste management facilities, daily measurements of waste volume and weight were made using a measuring box with a size according to the SNI 3964: 2025 standard. The height of the waste was measured according to field conditions. **Table 8** summarizes the volume of waste in cubic meters and its density in kg/m³, which is useful for estimating the space capacity required in the design of Temporary Waste Storage Site 3R.

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Table 7. Daily Waste Volume and Density in Building A and B

Name of Building	Day	Measuring Box P (m)	Measuring Box L (m)	Measuring Box T (m)	Volume (m3)	Garbage Weight (kg)	Garbage Density (kg/m3)
A	**1**	0,55	0,28	1,93	0,30	54,720	184,11
	2	0,55	0,28	1,71	0,26	46,000	174,68
	3	0,55	0,28	1,96	0,30	40,800	135,17
	4	0,55	0,28	2,24	0,35	56,400	163,06
	5	0,55	0,28	1,31	0,20	39,200	194,31
	6	0,55	0,28	2,24	0,34	47,900	138,86
	7	0,55	0,28	1,50	0,23	35,800	154,98
	8	0,55	0,28	1,37	0,21	50,690	240,26
B	**1**	0,55	0,28	1,87	0,29	26,400	91,67
	2	0,55	0,28	0,90	0,14	42,400	304,56
	3	0,55	0,28	1,35	0,21	34,700	166,91
	4	0,55	0,28	1,77	0,27	25,400	93,18
	5	0,55	0,28	1,45	0,22	33,200	148,68
	6	0,55	0,28	1,63	0,25	19,000	75,69
	7	0,55	0,28	1,47	0,22	45,500	200,99
	8	0,55	0,28	1,30	0,20	31,400	156,84
Average Density							**164.00**

The pie chart aims to identify waste generation patterns originating from campus activities. In addition, the chart shows that the highest amount of waste comes from plastic bottles, followed by other plastics, and then other categories of waste. The figure below shows the percentage of waste generated in the President University environment, visually illustrating the proportion of each type of waste. A more detailed comparison of the composition of waste in the campus environment can be seen in **Fig. 6**

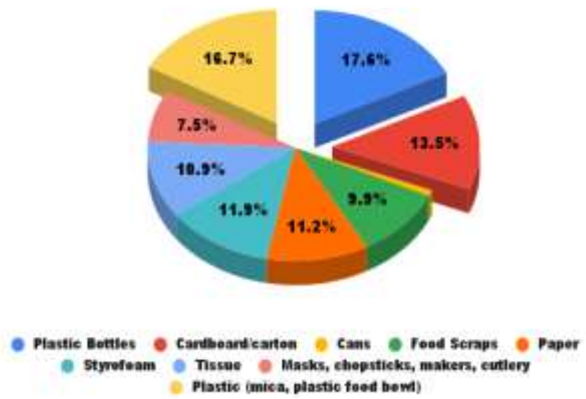

Fig. 6: Pie Chart President University Waste Composition

Calculation Engineering Design
Storage Area

Table 9. Anorganic Waste Calculation

No.	Parameter	Formula	Value	Unit	Reference
1	Recovery Factor	-	50	%	Table
2	10 year projection	-	2,77	m^3/day	Table
3	Anorganic Volume	60% x Waste input volume 2034 (60% is data from the recovery factor of anorganic waste)	1,662	m^3/day	Calculation
4	Plan Height	-	1	m	Assume
5	Plan Length	-	1,5	m	Assume
6	Shelter width	$\sqrt{\text{shelter land area}}$	1.17	m	Calculation

Table 10. Organic Waste Calculation

No.	Parameter	Formula	Value	Unit	Reference
1	Recovery Factor	50% x Volume of incoming waste 2029 (50% is data from the recovery factor of organic waste)	50	%	Table
2	Organic Volume	$\frac{\text{Volume of organic waste}}{\text{Plan generation height}}$	1.385	m^3/day	Calculation
3	Plan height	-	1	m	Assume
4	Shelter length	-	1,5	m	Assume

Table 11. Residue Waste Calculation

No.	Parameter	Formula	Value	Unit	Reference
1	Residue volume		2,06	m^3/day	Calculation
2	Shelter length	-	1,5	m	Assume
3	Shelter width	-	1,4	m	Assume

Table 12. Sorting Area Calculation

No.	Parameter	Value	Unit	Reference
1	Length	1,5	m	Assume
2	Width	3,4	m	Assume

The Proposed Detail Engineering Design

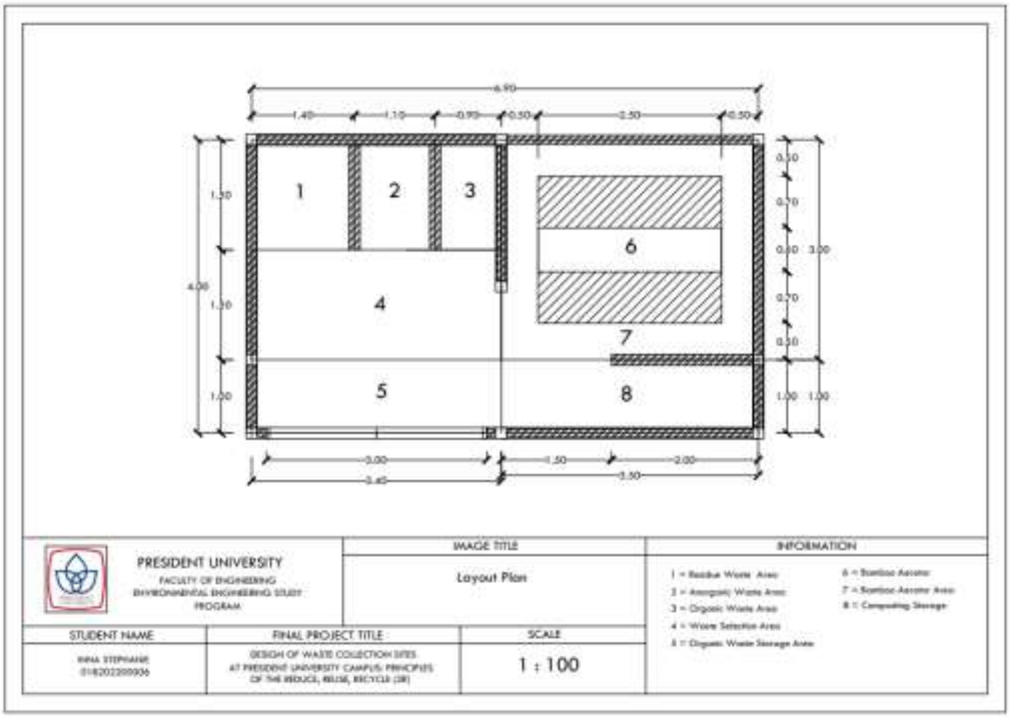

Fig. 7: Layout TPS at President University

Jurnal Serambi Engineering JSE Volume X, No.4, Oktober 2025 Hal 15924 - 15936 p-ISSN : 2528-3561 e-ISSN : 2541-1934

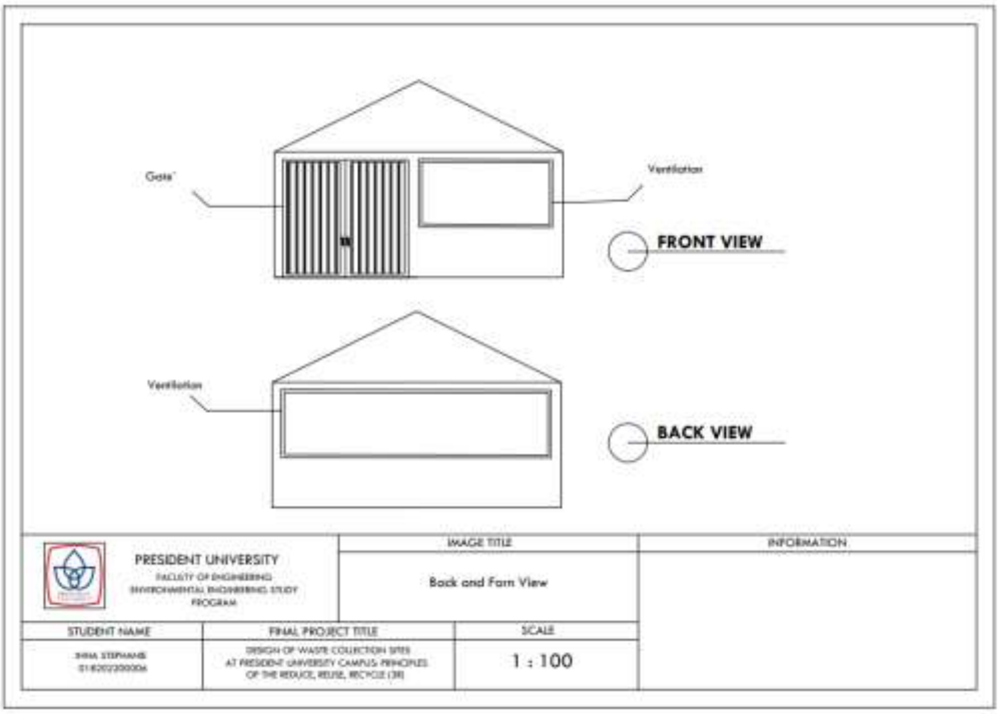

Fig. 8: Back and Front View

Design Evaluation

The following table shows the results of the proposal and design of temporary household waste storage areas in accordance with Indonesian Regulatory and Standard Requirements criteria.

Table 13. Design Evaluation

No	Items	Regulation	Existing Condition	In Design
1	Maximum area 200 m²	Minister of Public Works Regulation No. 3 of 2013	✓	✓
2	Waste segregation	Minister of Public Works Regulation No. 3 of 2013	X	✓ (According to the waste category)
3	Based on the volume of waste generated	Minister of Public Works Regulation No. 3 of 2013	X	✓
4	Accessibility	Minister of Public Works Regulation No. 3 of 2013	✓	✓
5	Does not pollute the environment	Minister of Public Works Regulation No. 3 of 2013	X	✓
6	Placement does not interfere with traffic	Minister of Public Works Regulation No. 3 of 2013	✓	✓

Social Aspect Analysis

Multiple Linear Regression

Based on the result of multiple linear regression, the model of this research will be:

$$\text{Responsibility} = 1{,}114 + 0{,}262\ \text{Perception} + 0{,}157\ \text{Behavior} + 0{,}135\ \text{Norms}$$

Table 14. Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,390[a]	,152	,130	,57780	2,001

a. Predictors: (Constant), Ave N, Ave P, Ave B

b. Dependent Variable: Ave R

Table 15. Result of the ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6,726	3	2,242	6,715	,000[b]
	Residual	37,392	112	,334		
	Total	44,118	115			

a. Dependent Variable: Ave R

b. Predictors: (Constant), Ave N, Ave P, Ave B

Table 16. Result of the Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,114	,559		1,994	,049
	Ave P	,262	,075	,310	3,507	,001
	Ave B	,157	,090	,154	1,744	,084
	Ave N	,135	,088	,134	1,530	,129

a. Dependent Variable: Ave R

Table 14 shows that the R Square value is 0.152. This means that the variables of perception, behavior, and norms together can explain 15.2% of the variation in the variable of student responsibility. **In Table 15**, the ANOVA test produced an F value of 6.715 with a significance level of 0.000 (<0.05). Thus, the regression model used is deemed appropriate (fit) and can explain the relationship between the independent and dependent variables.

Furthermore, in **Table 16**, the Coefficients test results show that of the three independent variables, only Perception (p = 0.001) significantly influences the Responsibility variable. Meanwhile, Behavior (p = 0.084) and Norms (p = 0.129) do not have a significant effect.

Thus, it can be concluded that the most dominant factor influencing students' responsibility toward 3R-based waste management is perception, while behavior and norms have not shown significant contributions. However, all three variables are highly influential toward responsibility.

Based on the questionnaire results, most students at President University have difficulty distinguishing between organic and inorganic waste and show a lack of discipline in sorting waste, even though they are aware of the importance of applying the principles of Reduce, Reuse, and Recycle. Therefore, the Temporary Waste Storage Site design is equipped with a waste sorting area and separate storage areas for residual, inorganic, and organic waste.

In addition, the questionnaire also shows that students hope for stronger environmental education and stricter rules to support better waste management. Therefore, this design also includes a compost storage area and a bamboo aerator area, which not only function technically but also serve as educational tools to demonstrate how organic waste can be processed. Thus, the design of this 3R TPS connects the technical aspects of waste management with the social aspect of behavioral change among the campus community.

4. Conclusion

From the research can be concluded that waste management at President University is still not yet effective, especially in terms of sorting. Although some areas have provided separate bins for organic and non-organic waste, it is still common to find mixed waste. Research in Buildings A and B of President University, the largest composition of waste comes from plastic bottles with a percentage of 17.6%. The calculation of capacity and facility requirements resulted in the design of a Temporary Waste Storage Site consisting of inorganic, organic, and residue waste, as well as a facility for processing organic waste using the bamboo aerator method. This design also takes into account population projections and waste volume for the next 10 years. Based on the results of multiple linear regression testing, an R-squared value of 0.152 was obtained, meaning that perception, behavior, and norms can only explain 15.2% of the variation in student responsibility in waste management. ANOVA testing showed a significance value of 0.000 (<0.05), so the regression model used was declared valid. From the coefficient test results, only the perception variable had a significant effect on student responsibility (p = 0.001), while behavior and norms did not have a significant effect.

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