Structural and Spatial Development Study for TU Kemang Market in Bogor City

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ABSTRACT

Kemang Market in Bogor City has a strategic role in the local economy, but its existing condition does not fully standard, with only 19 out of 35 facilities available. This condition results in a lack of convenience, accessibility, and operational efficiency in trading activities. In addition, the existing infrastructure has decreased in quality, especially in the sanitation system, drainage, and accessibility for people with disabilities. Therefore, re-planning was carried out to improve the quality of facilities and infrastructure with a more efficient spatial approach and structural analysis using the method Load and Resistance Factor Design (LRFD). This re-planning includes optimizing trade zoning, adding public facilities, improving the quality of sanitation, drainage systems, and applying tropical architecture concepts to support thermal comfort and natural lighting. The structural analysis results show that the main elements designed, namely WF 250.250.9.14 columns, WF 200.100.5.5.8 beams, and WF 300.150.6.5.9 roof trusses, have met safety standards and are able to withstand the planned loads. The estimated construction cost based on AHSP Cipta Karya, IDR 7,836,400,000.00. With this re-planning, Kemang Market is expected to transform into a more modern, orderly, safe, and national standard people's market, so as to increase operational effectiveness, the welfare of traders and visitors, and support local economic growth in a sustainable manner.

Keywords: market re-planning, people's market, structure analysis, LRFD, AHSP.

INTRODUCTION

Public markets have a strategic role as centers of local economic activity that support the distribution of basic goods, provide business space for small and medium enterprises, and become one of the drivers of the regional economy. One of the public markets that has an important role in Bogor City is the Kemang Market. This market functions as a wholesale trade center that provides various basic needs, such as groceries, vegetables, meat, and fruits at relatively affordable prices. However, over time, the physical condition and facilities of the market have deteriorated. Common problems that are often found in people's markets, such as inadequate facilities and infrastructure, poor drainage and sanitation systems, and slum and smelly environmental conditions, also occur in Kemang Market. In addition, limited accessibility for people with disabilities shows that this market is not fully inclusive and friendly to all levels of society.

Various problems faced by Kemang Market today, ranging from the declining quality of facilities and infrastructure, poor sanitation and environmental management, to low accessibility for people with disabilities, indicate the need for strategic steps in improving the overall quality of the market. To optimize the function of the people's market while improving the comfort, cleanliness, and safety of the market environment, development efforts are needed through redesigning the Kemang Market concerning People's Markets [1-5]. This redesign aims to create a modern, orderly, and environmentally friendly people's market, with spatial layout and facilities that are able to support efficient and inclusive trading activities. With integrated planning, it is expected that Kemang Market will be able to maintain its role as a distribution center for basic needs while encouraging sustainable local economic growth [6-8]. This development is also expected to increase the

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competitiveness of the people's market amid the rapid growth of modern markets, as well as create a healthy, safe, and comfortable trading environment for all Bogor City residents.

RESEARCH METHODS

Materials

This research was conducted through several stages organized systematically to obtain accurate and comprehensive results. The flowchart in Figure 1 shows the research flow starting from literature review, primary and secondary data collection, data analysis, to produce space function planning, structural analysis, and construction cost estimation. Each stage has an important role in ensuring the research runs according to the established method.

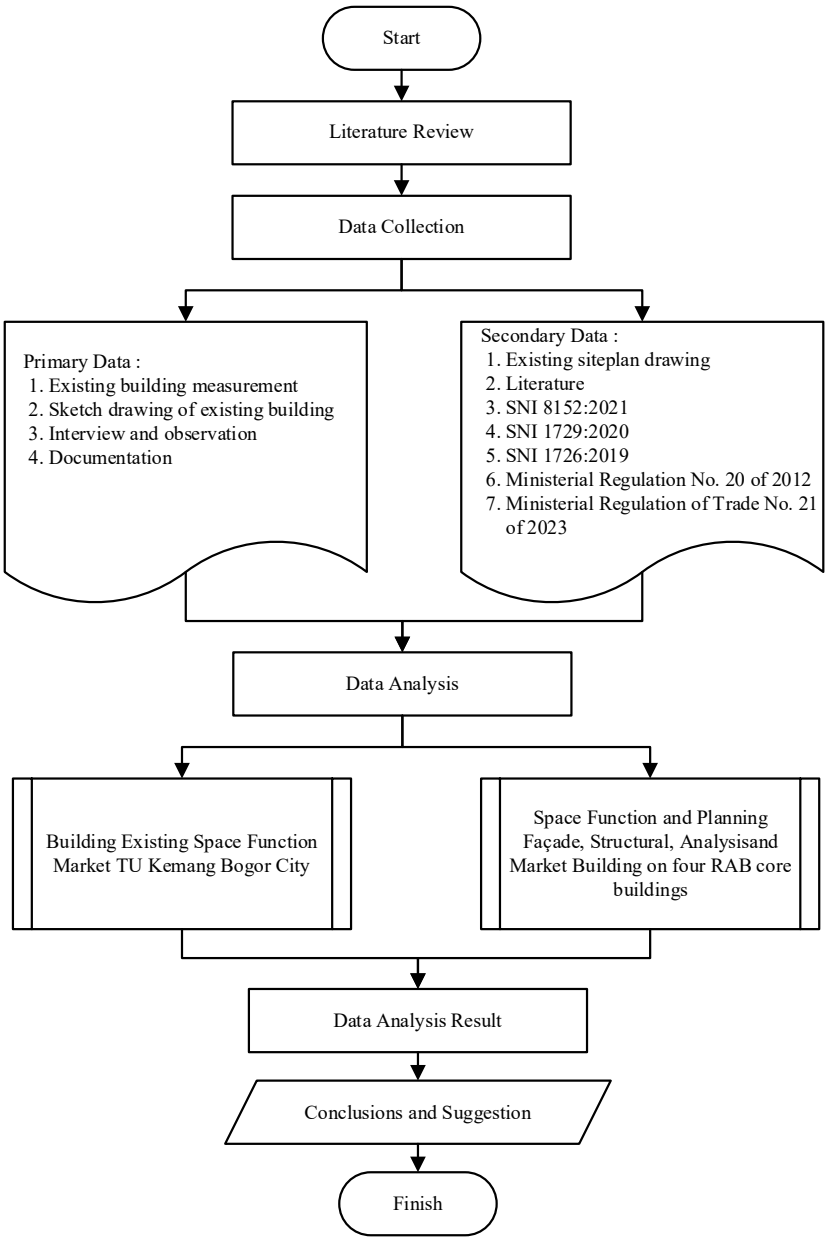

Figure 1. Research flow chart (Source: Personal analysis)

This research begins with preparation in the form of collecting survey needs and initial identification of the existing conditions of the Kemang Market. Furthermore, a literature review of books, journals, and related regulations such as SNI and ministerial regulations was conducted as a reference. Primary data was collected through field surveys (measurement, observation, interview, documentation) and secondary data from technical documents and supporting literature. data were analyzed to design space functions and building facades using. The results of the structural analysis became the basis for preparing the RAB. AutoCAD 2020 and SketchUp 2020, as well as modeling and structural analysis of four core buildings (Block A, B, C, D) using ETABS [9-12]

Methods

This research was conducted at the Kemang Public Engineering Market (TU) Building in Bogor City, which is located on Jalan KH Sholeh Iskandar, RT.02/RW.01, Cibadak Village, Tanah Sereal District, Bogor City, West Java, with a zip code of 16166. This location has coordinates of latitude 6°32'19.59 "S and coordinates of longitude 106°46'12.01 "E. The research started in August 2024 until December 2024. The research location map is shown in Figure 2.

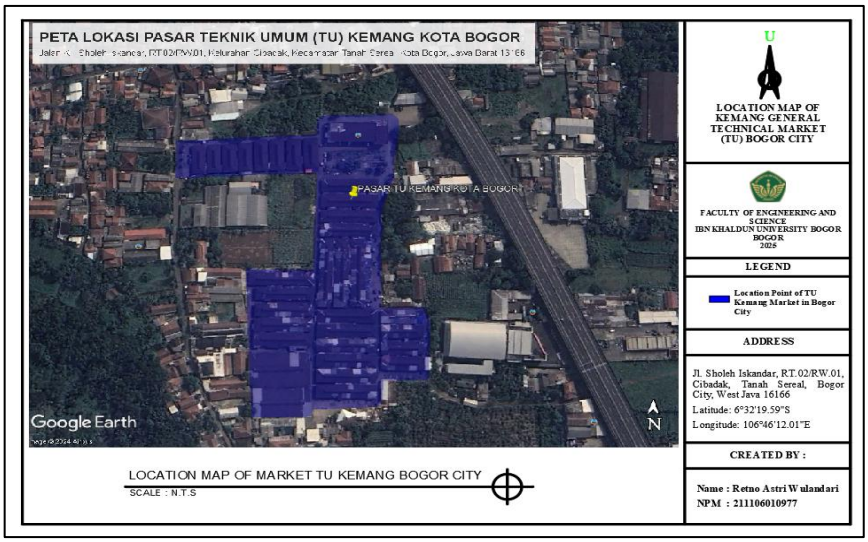

Figure 2. Map of the research location (Source: Google Earth)

The data sources in this study are divided into primary and secondary data. Primary data is obtained through direct survey at Kemang Market, Bogor City, including land measurement, building sketching, interview, observation, and documentation of existing conditions. Secondary data comes from documents, literature, and regulations that support the analysis of steel structures, such as the book Design of Steel Building Structures with ETABS, Handbook of Steel Structure Analysis and Design, as well as SNI 8152: 2021, SNI 1729: 2020, SNI 1726: 2019, and ministerial regulations [13-15].

Data Analysis

Based on the primary data obtained, information on the size of the existing building land area allows re-planning in standards to optimize its development. Sketches of existing buildings serve as a reference in determining the layout of planning elements that are adapted to the available land conditions [7]. In addition, documentation of existing conditions is used to identify the physical facilities contained in the TU Kemang Market in Bogor City, so that it can be evaluated for compliance with the people's market standards and further development needs.

RESULTS AND DISCUSSION

Data on the physical facilities of TU Kemang Market is important information for understanding the overall condition of the Market, it is important to know the physical facilities available. Table 3 below presents detailed data on the physical facilities in this market, including the type of facility, number,

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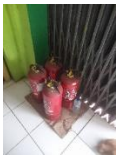
condition (good or damaged), and documentation. The results of the analysis are presented in Table 1 below.

Table 1. Data on physical facilities of TU Kemang Market, Bogor City

No.	Physical Facilities	Total	Conditions		Documentation
			Good	Broken	
1	Store	20	13	7	
2	Kiosk	104	84	20	
3	Los	564	524	40	
4	Jongko / counter / court / tent	2	2	-	
5	Weighing Scales	-	-	-	-
6	Parking Lot	4	4	-	
7	Loading-unloading Area	19	19	-	
8	Vehicle entry and exit	1	1	-	
9	Corridor/gangway	27	27	-	
10	Management Office	1	1	-	

No.	Physical Facilities	Total	Conditions		Documentation
			Good	Broken	
11	Men's Restroom	16	16	-	
12	Ladies' Restroom	12	12	-	
13	Disabled Toilet	-	-	-	-
14	Refrigerator	3	3	-	
15	Hand Wash Station	-	-	-	-
16	Breast milk room	-	-	-	-
17	CCTV	6	6	-	
18	Worship Room	4	4	-	
19	Multipurpose Area	-	-	-	-
20	Health Post	-	-	-	-
21	Security Post	4	4	-	
22	Smoking Area	-	-	-	-
23	Sanitization Room	-	-	-	-
24	Greening Area	-	-	-	-
25	Disability Access	-	-	-	-
26	Evacuation Route	-	-	-	-
27	Fire Extinguisher	11	11	-	
28	Water Hydrant	-	-	-	-
29	Clean water quality testing site	-	-	-	-
30	Effluent testing site	-	-	-	-

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No.	Physical Facilities	Total	Conditions		Documentation
			Good	Broken	
31	Waste Transportation Equipment	5	5	-	
32	Temporary Waste Disposal Sites	1	1	-	
33	Waste management bins based on 3R	-	-	-	-
34	Information and communication technology facilities	2	2	-	
35	Market digitization	-	-	-	-

(Source: Personal Analysis)

Data on the physical facilities of Kemang Market shows that out of 35 [7], only 19 are available with adequate functions and activity support. Some facilities are not available or not up to standard, so they need optimization and maintenance, especially in the aspects of cleanliness, security, comfort, and market governance.

The existing the TU Kemang Market building in Bogor City with a total of 1,360 business places with a total of 32 blocks is shown in Figure siteplan design.

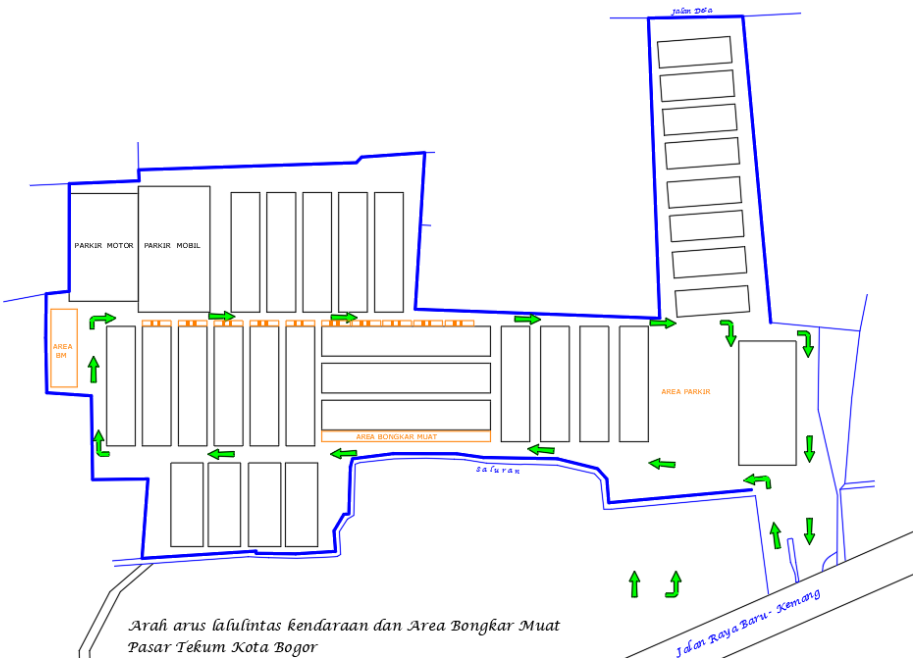
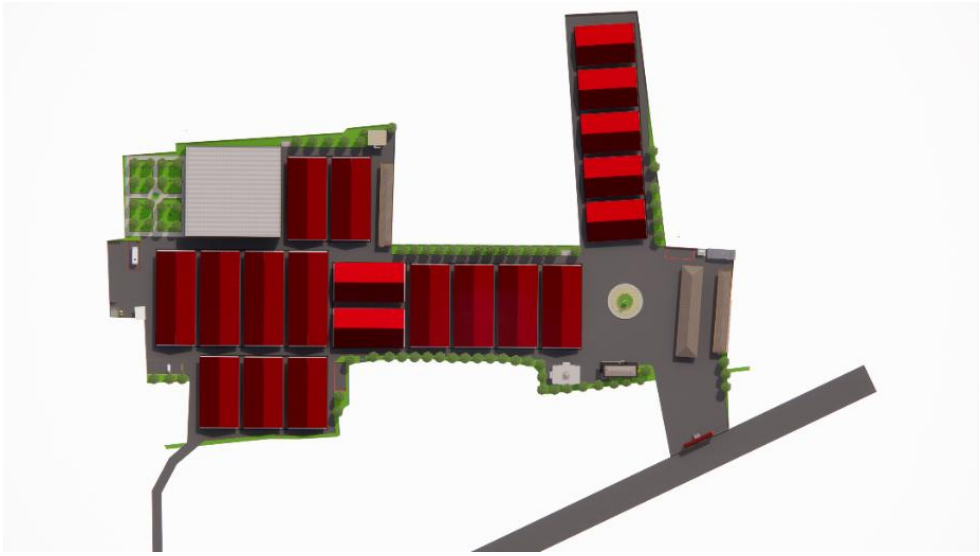


Figure 3. Existing siteplan (source: Perumda Pakuan Jaya)

The building facade of the planned Kemang Market in Bogor City carries the concept of tropical architecture to support thermal comfort and natural lighting. The division of trade space [7], with

groupings based on commodity types, namely wet food, dry food, ready-to-eat, and non-food. This zoning considers space requirements, trader activities, and smooth circulation. facade of the planned building is shown in Figure 4 below.



a. Building plan facade planand

b. Building Block A with an area of 540 m^2

c. Block B building 756 m^2

d. Block C building 648 m^2

e. Block D building with an area of 864 m^2

Figure 4. Building facade of TU Kemang Market plan of Bogor City with plan and facade (a), Block A (b), Block B (c), Block C (d), and Block D (e) (Source: Personal Analysis)

The building parameters of TU Kemang Market of Bogor City for the structure of four core market buildings, namely building with Block A typean area of 540 m^2, Block B type with an area of 756 m^2, Block C type with an area of 648 m^2, and Block D area of 864 m^2 type with an. Parameter data is shown in Table 2 below.

Table 2. Building parameter data of the plan

No.	Data Type	Description
1.	Building Function	Market
2.	Building Width	18 Meters

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No.	Data Type	Description
3.	Building Length	Block A: 30 Meters Block B: 42 Meters Block C: 36 Meters D Block: 48 Meters
4.	Building Height	6 Meters to the roof truss, 8.2 Meters to the roof
5.	Number of Floors	1 Floor
6.	Column Dimensions	WF 250.250.9.14
7.	Beam Dimensions	WF 200.100.5,5.8
8.	Steel Grade	BJ 37 (f_y = 240 MPa; f_u = 370 MPa)

(Source: Personal Analysis)

The results of the structural modeling analysis of the planned building show that the structure is safe against external forces. This is indicated by the absence of structural elements that have failed, as indicated by the color of the elements form of light blue, in the which are in the strength ratio range of 0.0 to 0.90, which indicates a very safe level of safety. Furthermore, manual calculations were carried out on column and beam elements to evaluate the capacity of the structural elements used, as well as ensuring their compliance [3]. The results of the structural modeling analysis of the Kemang Market building are presented in Figure 5 below.

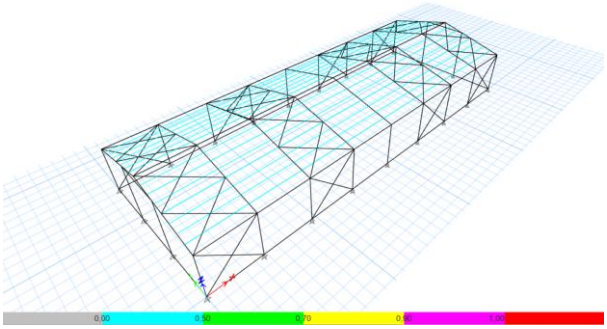

Figure 5. Results of structural modeling analysis of the planned building (Source: Structural Analysis Result)

The position of column C3 in the structural system is shown in Figure 6, where this element is analyzed to evaluate its capacity as well as its response to the acting loads.

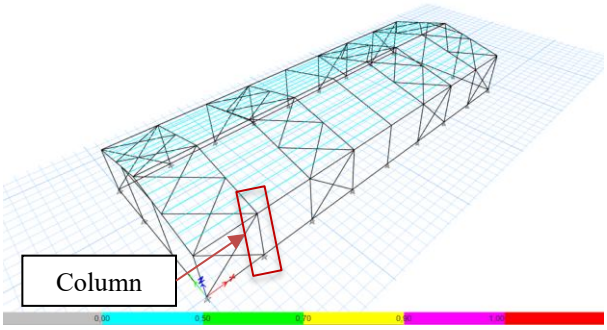

Figure 6. Column position C3 (Source: Structural Analysis Result)

The internal force values in column C3 were analyzed to evaluate the compressive section slenderness, flexural buckling strength, and torsional buckling strength to ensure the structural capacity complies with the planning standards. The material properties and cross-sectional specifications of column profile C3 with WF 250.250.9.14 are presented in Table 3 as the basis for structural performance calculations.

Table 3. Material properties of the cross section of column profile C3

Parameters	Value	Unit
Wingspan (b_f)	250	mm
Body width (h)	250	mm
Body thickness (t_w)	9	mm
Thickness of wing (t_f)	14	mm
Radius (r)	16	mm
Cross-Sectional Area (A)	92,3	cm^2
Moment of Inertia with respect to sb.x (I_x)	10842,	cm^4
Moment of Inertia with respect to sb.y (I_y)	3648,9	cm^4
Radius of rotation (r_x)	108,4	mm
Radius of rotation (r_y)	62,9	mm
Resilience modulus (S_x)	867,4	cm^3
Resilience modulus (S_y)	291,9	cm^3
Plastic section modulus (Z_x)	961,5	cm^3
Plastic section modulus (Z_y)	443,9	cm^3
Unit mass	72,36	kg/m
Compressive axial strength reduction factor (Φn)	0,85	
Flexural strength reduction factor (Φb)	0,9	
Shear strength reduction factor (Φf)	0,75	

(Source: Resultstructural Analysis Result)

The results of column analysis using the LRFD method are presented in Table 4, which includes evaluation of profile slenderness as well as strength against flexural buckling and torsional buckling.

Table 4. Analysis results of column profile

Parameters	Value	Description
Slenderness analysis		
1. Wings (flanges)	1. $8.93 \leq 16.01$ (**OK**)	$(b/t) \leq \lambda r$
2. Body (web)	2. $24.67 \leq 42.60$ (**OK**)	
Flexural bending strength	1319.99 kN ≥ 416.86 kN (**OK**)	Φc*Pn ≥ Pu
Torsional bending strength	2034.53 kN ≥ 416.86 kN (**OK**)	

(Source: Structural Analysis Result)

The position of the B3 beam in the structural system is shown in Figure 7, where this element is analyzed to evaluate its capacity as well as its response to the acting loads.

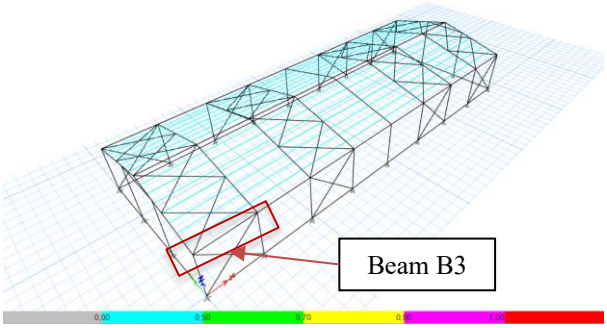

Figure 7. B3 beam position (Source: Structural Analysis Result)

The internal force values in beam B3 were analyzed to evaluate the bending and shear design and ensure that the beam is able to withstand the load according to the planning standards [16]. The material properties of the cross-section of beam profile B3 with specification WF 200.100.5.5.8 are presented in Table 5 as the basis for structural performance calculations.

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Table 5. Material properties of cross section beam profile B3

Parameters	Value	Unit
Wingspan (b_f)	100	mm
Body width (h)	200	mm
Thickness of body (t_w)	5,5	mm
Thickness of wing (t_f)	8	mm
Radius (r)	11	mm
Cross-Sectional Area (A)	27,2	cm^2
Moment of Inertia with respect to sb.x (I_x)	1847,	cm^4
Moment of Inertia with respect to sb.y (I_y)	133,9	cm^4
Radius of rotation (r_x)	82,4	mm
Radius of rotation (r_y)	22,2	mm
Resilience modulus (S_x)	184,8	cm^3
Resilience modulus (S_y)	26,8	cm^3
Plastic section modulus (Z_x)	209,8	cm^3
Plastic section modulus (Z_y)	42	cm^3
Unit mass	21,32	kg/m
Compressive axial strength reduction factor (Φn)	0,85	
Flexural strength reduction factor (Φb)	0,9	
Shear strength reduction factor (Φf)	0,75	

(Source: Structural Analysis Result)

The results of the beam analysis using the LRFD method evaluate the flexural and shear capacities to ensure the structural elements are able to withstand the working loads. Table 6 presents the calculation of the B3 beam profile, including the flexural, shear, and structural feasibility design parameters.

Table 6: Analysis results of beam profile B3

Parameters	Value	Description
Flexural design analysis	46.27 kNm ≥ 1.21 kN.m **(OK)**	Φb*Mn ≥ Mu
Shear design analysis	145.53 kN ≥ 0.84 kN **(OK)**	Φ*Vn ≥ Vu

(Source: Structural Analysis Result)

Based on the results of the design and planning of the building structureTU Kemang City Market, Bogor requires a Budget Plan (RAB) based on the AHSP Cipta Karya in accordance with SE Bina Konstruksi No. 68 of 2024 shown in Table 7 below.

Table 7. Cost Budget Plan (RAB)

No.	Market Building	Amount (IDR)
1	Type Block A Area 540 m^2	1.507.000.000,00
2	Type Block B Area 756 m^2	2.109.800.000,00
3	Type Block C Area648 m^2	1.808.400.000,00
4	Type Block D Area 864 m^2	2.411.200.000,00
Total Amount (IDR)		**7.836.400.000,00**

(Source: Structural Analysis Result)

CONCLUSIONS

The development study of TU Kemang Market in Bogor City shows that the current market condition does not standard, where out of 35 required physical facilities, only 19 are available and functioning properly, while essential facilities such as accessibility for people with disabilities and adequate waste management systems are not yet available. To improve the quality of the market, a re-planning with a concept re-planning that includes a more efficient spatial layout, commodity zoning, improved supporting facilities, and the application of tropical architecture principles to improve thermal comfort and natural lighting. From a technical aspect, structural analysis using the method *Load and Resistance Factor Design* (LRFD) with *ETABS software* shows that all structural elements, including WF 250.250.9.14 columns, WF 200.100.5.5.8 beams, and WF 300.150.6.5.9 roof trusses, have met safety standards and are able to withstand the planned workload. In addition, the estimated construction cost of the re-planning results is prepared based on the AHSP Cipta Karya in accordance with Bina Konstruksi Circular Letter No. 68 of 2024, with details of the construction cost for type A block of 540 m² amounting to IDR 1,507,000,000.00, type B block of 756 m² amounting to IDR 2,109,800,000.00, type C block of 648 m² amounting to IDR 1,808,400,000.00, and type D block of 864 m² amounting to IDR 2,411,200,000.00. With this re-planning, Kemang Market can function as a trading facility that is more modern, comfortable, and in accordance with national standards, so as to improve operational effectiveness and quality of service for traders and visitors.

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