

Development of the Civil Engineering Laboratory Building at Ibn Khaldun University Bogor

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ABSTRACT

This research aims to develop the design and structure of the Civil Engineering laboratory building, by considering aspects of safety, health, comfort, and security based on SNI 2847-2019. The method used is primary data collection measuring the area to be built, then a design plan and structural analysis is carried out using the Special Moment Resisting Frame System (SRPMK) method based on the *Seismic Design Category (DKDS-D)* with the *ETABS* application. The results of the design development and structural analysis of the laboratory building consist of 3 floors with a building area of 1,842 m², concrete deck roof. Structural material specifications which used are concrete quality (f_c') 25 Mpa, reinforcing steel quality (F_y) 420 Mpa and (F_y) 240 Mpa, column dimensions are K1 50x50 cm, K2 30x50 cm, K3 25x30 cm, main beam dimensions are B1 35x55 cm, B2 30x45 cm, B3 30x40 cm, secondary beam is B3 25x30 cm, floor slab thickness is 15 cm and roof slab thickness is 12 cm. The firstfloor facilities are designed for Structures, Soil Mechanics, Water Resources, and Environmental Engineering study laboratories with supporting facilities such as reception rooms, lecturer rooms, classes, *tool rooms*, and practice rooms. The second floor accommodates the Transportation laboratory which is equipped with a meeting room, archive center, and control and server rooms to support the operation and documentation of academic activities. The third floor is focused on the implementation of the Tri Dharma of Higher Education, providing lecturer rooms, lecture rooms, archive rooms, and *co-working spaces* to support academic interaction and collaboration. The roof deck is designed for *maintenance* activities and a water reservoir. The cost budget plan for the civil engineering laboratory building is Rp 4,143,962,741.00.

Keywords: Laboratory, Building Planning, Reinforced Concrete, SNI 2847:2019.

INTRODUCTION

This research focuses on developing the design and structure of the Civil Engineering laboratory building at UIKA Bogor. The current condition shows several challenges such as the condition of the existing building which is located below the road level so that it is vulnerable to flooding and practicum tools that are still incomplete and inadequate to optimally support academic activities. By considering aspects of safety, health, comfort, and security based on SNI 2847-2019, the development of this laboratory design includes structural design using the SRPMK method based on *KDS-D* with *ETABS* application, material specifications for concrete quality (f_c') 25 Mpa, reinforcing steel quality (F_y) 420 Mpa and (F_y) 240 Mpa, building dimensions consisting of 3 floors with a building area of 1.842 m², concrete slab roof, columns K1 50x50 cm, K2 30x50 cm, K3 25x30 cm, main beam B1 35x55 cm, B2 30x45 cm, B3 30x40 cm, secondary beam B3 25x30 cm, floor slab 15 cm thick, and roof slab 12 cm thick [1]-[7]. Laboratory facilities are designed for the first floor which includes Structures, Soil Mechanics, Water Resources, and Environmental Engineering laboratories with reception rooms, lecture rooms, *tool rooms*, and practicum rooms; the second floor which includes Transportation laboratories with meeting rooms, archive centers, and control and server rooms; the third floor which includes lecture rooms, lecture rooms, archive rooms, and co-working spaces to support the implementation of the Tri Dharma of Higher Education; and the roof deck which is used for maintenance activities and water reservoirs.. With this development, it is expected that the new laboratory building can provide more adequate facilities and support academic and research activities optimally [8]-[10].

RESEARCH METHODS

Materials

This research was carried out through stages that were systematically analyzed to ensure the results obtained had a high level of accuracy and comprehensiveness. The flow chart shown in Figure 1 illustrates the research flow, starting with the literature review stage, followed by primary and secondary data collection, data analysis, to produce space function planning, structural analysis, and construction cost estimation [11]. Each stage has an important role in ensuring the implementation of the research in accordance with the *methodology* that has been formulated in depth.

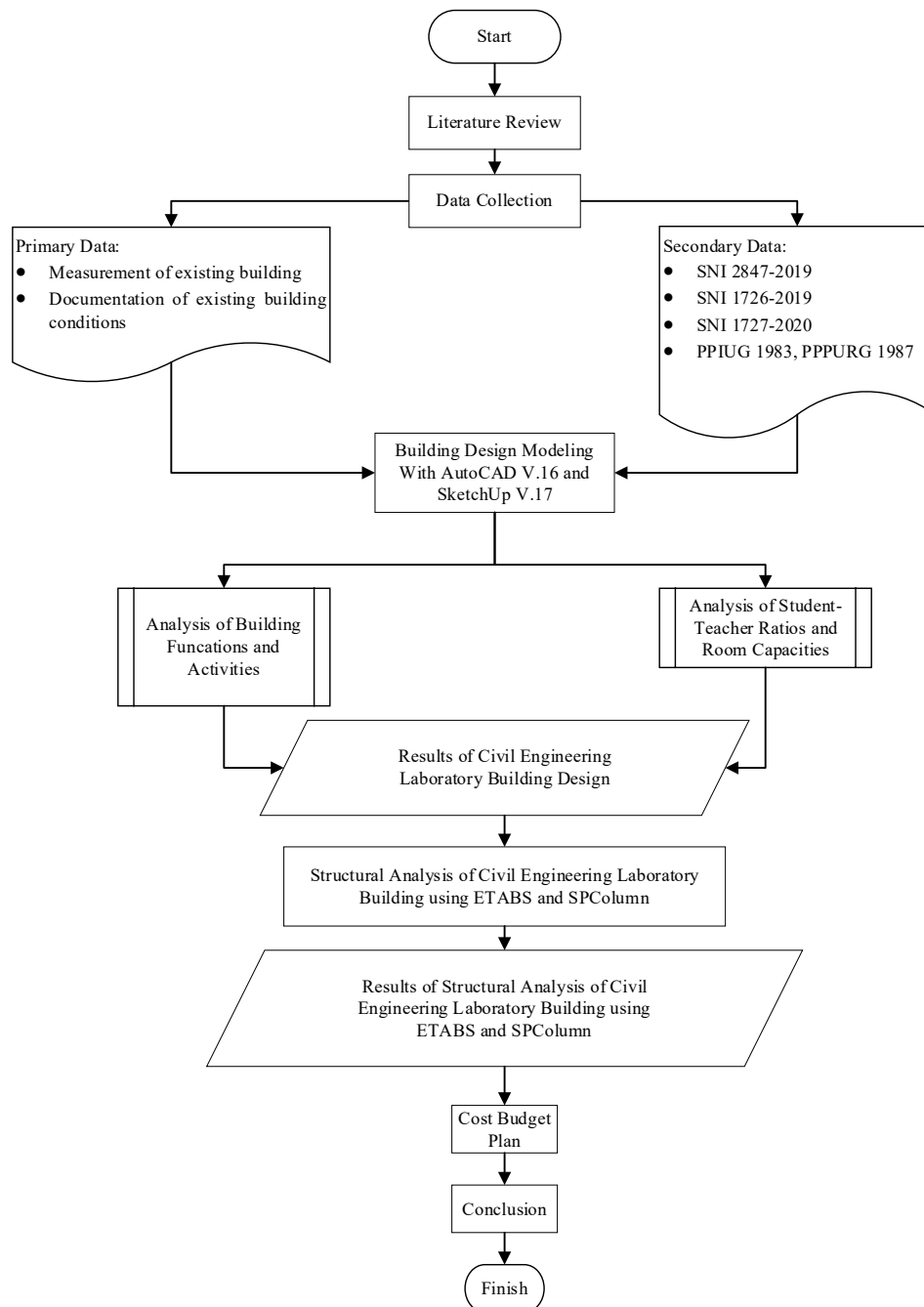


Figure 1. Research flow chart (Source: Personal Analysis)

This research begins with a preparatory stage in the form of identifying survey needs and an initial study of the existing conditions of the planned location of the civil engineering laboratory building. Furthermore, a literature review was conducted which included books, journals, and related regulations such as SNI and ministerial regulations as the main guidelines. Data collection was carried out through field surveys to obtain primary data (measurement and documentation) as well as review of technical documents and supporting literature as secondary data sources. The data obtained was then analyzed to design the function space and building facade using software such as *AutoCAD* 2016 and *SketchUp* 2017, as well as modeling and structural analysis of the laboratory building using *ETABS* and *SPColumn*. The results of this structural analysis are then used as the basis for preparing a Budget Plan (RAB) for the construction of the laboratory building [12]-[14].

Methods

The research location is still in the Ibn Khaldun University of Bogor area with Jl. Sholeh Iskandar, RT.01 / RW.10, Kedungbadak, Kec. Tanah Sereal, Bogor City, West Java 16162. More precisely at the coordinates of *longitude*: 106°47'36.11"E; *latitude*: 6°33'37.15 "S. The implementation time of this research began in August 2024. The research location map is shown in Figure 2.



Figure 2. Map of the research location (Source: Google Earth, 2025)

Data sources in this research are divided into primary and secondary data. Primary data, namely data obtained from the results of building site surveys in the form of data on the size of the land area to be built, documentation of existing building conditions. Secondary data, namely data used to serve as guidelines and requirements in the planning of building structures. This secondary data consists of several Indonesian national standards (SNI) and other regulations including SNI 1726: 2019, SNI 2847: 2019, SNI 1727-2020, PPIUG 1983 and PPIUG 1987 [15]-[18].

Data Analysis

Based on the primary data obtained, information regarding the size of the land area and the condition of the existing building allows development in accordance with SNI 2847: 2019 standards to optimize academic learning. Sketches of existing buildings serve as a reference in determining the layout of planning elements that are adapted to the available land conditions. In addition, documentation of existing conditions is used to identify physical facilities contained in civil engineering laboratory buildings. The collected primary data will later be used in the design and building structure modeling stage using the *SketchUp* V17 application, *AutoCAD* 2016, *ETABS* V21.02 and manual calculations with the *Ms. Excel* application. The results of the primary data are processed so as to get a design and analysis that meets SNI standards [19]-[20].

Concrete structures are widely used in civil engineering because of their strength, durability, versatility, and relatively low maintenance requirements. However, the performance of these structures depends significantly on the quality of the concrete mix and its compliance with applicable

standards. Concrete quality is influenced by several factors, including the proportions of cement, water, fine aggregate, and coarse aggregate, as well as the properties of the constituent materials and the mixing process [21]-[22]. An appropriate water-cement ratio is essential to achieve the required compressive strength, workability, and durability. Furthermore, proper transportation, placement, compaction, and curing are necessary to prevent defects such as segregation, bleeding, and cracking. Quality control should be implemented throughout the construction process, including material inspection, slump testing, and compressive strength testing of concrete specimens. Compliance with relevant technical standards ensures that concrete elements can withstand the anticipated loads and environmental conditions. Therefore, achieving consistent concrete quality is fundamental to ensuring structural safety, serviceability, durability, and long-term construction performance [23]-[24].

RESULT AND DISCUSSION

In the context of the Civil Engineering Study Program at Ibn Khaldun University of Bogor, the ratio of lecturers to students has been monitored for the last 5 years, starting from 2019 to 2024. The results of the Ratio analysis are shown in table 1.

Table 1. The ratio of UIKA civil engineering lecturers and students in the last 5 years

Year	Annual Reporting Data	Name of Study Program	Number of Lecturers Counting Ratio	Number of Students	Lecturer/Student Ratio
2019	Odd	Civil Engineering	19	422	1:22
	Even	Civil Engineering	10	392	1:39
2020	Odd	Civil Engineering	18	446	1:25
	Even	Civil Engineering	16	414	1:26
2021	Odd	Civil Engineering	20	453	1:23
	Even	Civil Engineering	17	454	1:27
2022	Odd	Civil Engineering	22	479	1:22
	Even	Civil Engineering	18	463	1:26
2023	Odd	Civil Engineering	20	495	1:25
	Even	Civil Engineering	21	401	1:19
2024	Odd	Civil Engineering	18	427	1:24
Average lecturer/student ratio			18	441	1:24

(Source: SIPMB UIKA 2025)

Analysis of functions and activities in the room in the civil engineering laboratory building has a specific function and is supported by appropriate facilities. The results of the analysis of functions and activities are shown in table 2.

Table 2. Results of analysis of functions and activities in the building

Room Facilities	Main Functions	Activity Type	Support facilities	Special Note
Lobby	Waiting room, welcome room, information center	Service and welcome room	Desk, chair, computer, information board	Comfort and cleanliness
Reception room	Living room	Guest reception	Desk, chair, computer, bookshelf	-
Lecturer room	Lecturer's workspace	Write, read, check and consult	Work desk, chair, computer, bookshelf	-

Room Facilities	Main Functions	Activity Type	Support facilities	Special Note
Lecture room	Learning space	Lecture, discussion, writing, presentation	Projector, whiteboard, chair, table, ac	-
Tool room	Practical tool room	Use of tools for practicum	Tool rack, tool table, drawers	-
Practice room	Student practice	Conduct research, and design practicum materials	Lab equipment, computers, workbenches	Comfortable, clean and safe
Freight elevator	Item access	Moving goods between floors	Boundary fence	Security
Meeting room	Meeting room	Staff meetings, and deliberations	Table, chair, projector, whiteboard	-
Lab archive center room	Document archive	Document storage	Bookshelves, tables, chairs, drawers	-
Toilet	Sanitation	Toilet Usage	Closet, faucet, bucket	Hygiene
Stairs	Road access	Move between floors	Railing, lighting, signage	Security
Shaft and electrical panel	Electrical	Electrical and internet	Table, chair, computer	-
Locker	Storage Area	Helmet storage	Item shelf	-
Co working space	Open space	Discussion	Table, chair, bookshelf	-

(Source: Personal Analysis)

One important aspect in building design is analyzing user capacity which aims to determine the maximum number of users that can be accommodated in each room, so that the design can be adjusted to accommodate these needs. The results of the capacity analysis are shown in Table 3.

Table 3. Capacity analysis results

Facilities	Space/ person (m²)	Capacity details		Minimum total area (m²)	Room plan area (m²)	Description
		Lecturer	Student			
1st floor						
Classroom	2	1	24	20	35	Sufficient
Lecturer Room	4	1		4	4	Sufficient
Practice Room	2,5	1	24	45	181	Sufficient
Meeting Room	4	18		20	27,9	Sufficient

(Source: Personal Analysis)

The design and structural planning of the laboratory building consists of 3 floors with a building area of 1,842 m². Modeling the design of the laboratory building uses *AutoCAD* for 2D drawings and *SketchUp* for 3D drawings. Floor plan modeling is drawn using 2 dimensions using the *AutoCAD* application as shown in Figure 3. This building has facilities and laboratories in Table 2.

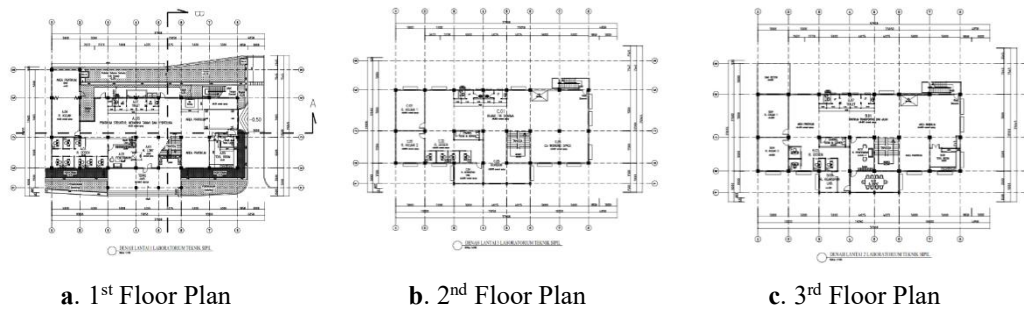


Figure 3. 2-dimensional floor plan modeling (a) 1st floor plan, (b) 2nd floor plan, (c) 3rd floor plan of engineering laboratory building (Source: Personal Analysis)

3-dimensional modeling of laboratory buildings using the SketchUp application to display 3-dimensional visual forms of laboratory buildings as shown in Figure 4.

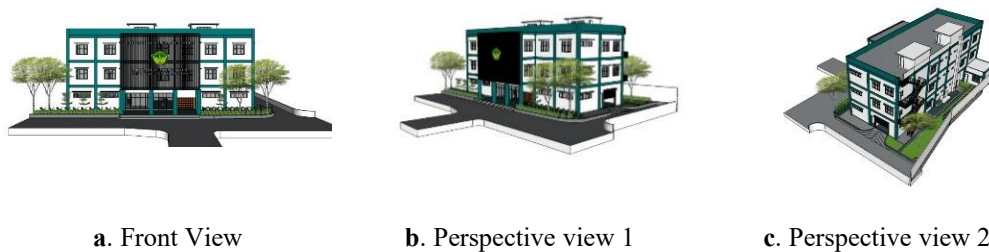


Figure 4. 3-dimensional modeling of civil engineering laboratory building (a) Front view, (b) Perspective view 1 and (c) Perspective View 2. (Source: Personal Analysis)

The parameters of the civil engineering laboratory building are based on the existing land area available. Other building parameters are shown in table 4.

Table 4. Civil engineering laboratory building analysis parameters

Parameters	Description
Building Function	Civil Engineering Laboratory of Ibn Khaldun University Bogor
Structure type	Concrete Truss System
Structure System	Special Moment Bearing Frame System (SRPMK)
Building Length	37.90 meters
Building Width	Right Side = 21 meters Left Side = 16 meters
Building Height	13.35 meters to roof plate (4.45 meters typical each floor) 16.27 meters to the roof of the werhouse
Total Level	3 Floors
Building Area	1,842 meters ²
Floor Notation	The 1 st floor is notated <i>base</i> , the 2 nd floor is notated <i>story 1</i> , the 3 rd floor is notated <i>story 2</i> the roof is notated <i>story 3</i> .

(Source: Personal Analysis)

According to SNI 2847-2019, Article 19.2.1, Table 19.2.1, the minimum concrete quality for special moment bearing frame system (SRPMK) is (f_c') 21 MPa. The maximum quality of screw reinforcement for beam and column bending elements in special seismic systems (SRPMK) is (f_y) 420 Mpa SNI 2847-2019, Article 20.2.2.4, Table 20.2.2.4a, Limitation of column dimensions according to SNI 2847-2019; Article 18.7.2. It is stated that the smallest cross-sectional dimension, measured on a straight line through the center of the *geometry*, is not less than 300 mm and the ratio of the smallest cross-sectional dimension to its perpendicular dimension is not less than 0.4. For beams refer to SNI 2847-2019; Article 9.3.1; Table 9.3.1.1.

Table 5. Structure material

Structure components	Material type
Structural material specifications	concrete quality (f_c') 25 Mpa, reinforcing steel quality (F_y) 420 Mpa and (F_y) 240 Mpa.
Column dimension	K1 50x50 cm, K2 30x50 cm, K3 25x30 cm (Floor one to three)
Beam dimensions	B1 35x55 cm, B2 30x45 cm, B3 30x40 cm, and B3 secondary beam 25x30 cm.
Thickness of floor slab	15 cm and 12 cm thick deck roof slab

(Source: Personal Analysis)

The structural plan analysis process takes into account the additional dead load, live load and earthquake load. Details of the additional dead load are shown in Table 6.

Table 6. Dead load

Additional dead load/SIDL	Value
1. Additional Dead Load (story 2-3)	
Gypsum Board (15mm)	0.12 kN/m ²
Ductwork	0.2 kN/m ²
System	0.05 kN/m ²
Ceramic tile and 12mm <i>Mortar</i>	0.8 kN/m ²
2. Additional Dead Load (Roof)	
<i>Gypsum</i> Board	0.12 kN/m ²
Ductwork	0.2 kN/m ²
System	0.05 kN/m ²
<i>Mortar</i> (25mm)	0.6 kN/m ²
Asphalt Cover	0.1 kN/m ²
3. Wall	
Double-sided plastered brick wall dead load	2.4 kN/m ²
2-3rd floor	9.6 kN/m ²
4. Stair Load	
Self Weight	16.5 kN/m ²

(Source: PPPURG 1987, SNI 1727:2020)

Details of additional live load are shown in Table 7 with space categories according to function and use.

Table 7. Live load

Live load	Value
1. Live Load (Floors 2-3)	
Reception Room	4 kN/m ²
Lecturer Room	2.4 kN/m ²
Classroom	2.4 kN/m ²
<i>Tool</i>	4 kN/m ²
Practice Room	4 kN/m ²
Meeting Room	4 kN/m ²
Lab archive center room	4 kN/m ²
Control and <i>Server</i> Room	2.4 kN/m ²
Toilet	2.4 kN/m ²
Corridor	4 kN/m ³
2. Additional Live Load (Roof)	
Roof Floor live load	0.96 kN/m ²
3. Stair Load	
Live Load	22.5 kN/m ²

(Source: PPPURG 1987, SNI 1727:2020)

The earthquake loading of this building uses earthquake zone 4 map data (Indonesia earthquake zoning map on the 2017 Indonesia earthquake source and hazard map). The plan earthquake is defined as an earthquake with a probability of exceeding the magnitude during the 50-year life of the building structure of 2%. The earthquake zoning map is shown in Figure 5.

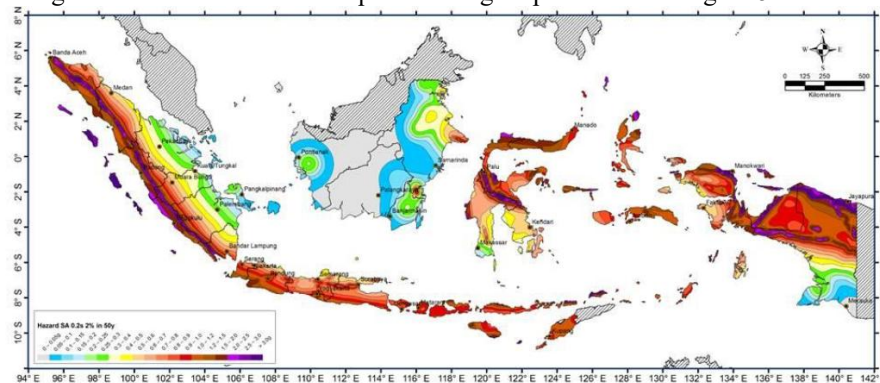


Figure 5. Earthquake zone map (Source: Indonesian earthquake hazard center 2017)

Indonesian spectra design parameters based on <https://rsa.ciptakarya.pu.go.id> with Determination of research location points using the Indonesian spectra design website is shown in Figure 6.

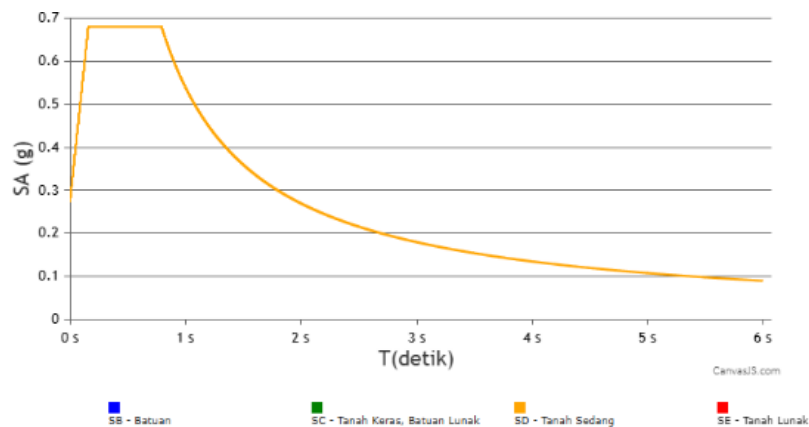


Figure 6. Parameter graph of design response spectrum (Source: rsa.ciptakarya.pu.go.id, 2021)

In the *lateral* and *vertical* earthquake resisting system used is SRPMK, the data used to analyze the dynamic load is taken from the Indonesian design *response spectrum* application shown in table 8.

Table 8. Results of spectra values and seismic design categories

Parameters	Notation	Value
Design acceleration spectral response at short periods	S_{ds}	0,68 g
Design acceleration spectral response at 1 second period	S_{d1}	0,54 g
Mapped peak ground acceleration	PGA	0,42 g
MCE_R earthquake acceleration spectral response mapped for short periods	S_s	0,89 g
MCE_R mapped earthquake acceleration spectral response for a period of 1 second	S_1	0,43 g
Transition period	T_L	20
Risk category		IV
Earthquake primacy factor	I_e	1,50
Site classification		SD
Seismic design category	KDS	D
Response modification coefficient	R	8

Parameters	Notation	Value
Strong factor over system	Ω	3
Amplification deflection coefficient	Cd	5,5

(Source: <https://rsa.ciptakarya.pu.go.id>)

Load factors and load combinations used in the design process of reinforced concrete structures, based on SNI 2847-2019. According to SNI 2847-2019 on Load Factors and Load Combinations Article 5.3, the required strength U must be at least equal to the effect of the factored loads in Table 9 as follows:

Table 9: Load combinations

Load combination	Equation	Main Load
$U=1.4D$	(5.3.1a)	D
$U=1.2D+1.6L+0.5(Lr \text{ or } R)$	(5.3.1b)	L
$U=1.2D+1.6(Lr \text{ or } R)+(1.0L \text{ or } 0.5W)$	(5.3.1c)	$Lr \text{ or } R$
$U=1.2D+1.0W+1.0L+0.5(Lr \text{ or } R)$	(5.3.1d)	W
$U=1.2D+1.0E+1.0L$	(5.3.1e)	E
$U=0.9D+1.0W$	(5.3.1f)	W
$U=0.9D+1.0E$	(5.3.1g)	E

(Source: SNI 2847-2019 on Load Factors and Load Combinations, Article 5.3)

Where:

U = combined factored load, kN, kN/m' or kNm

D = dead load, kN, kN/m' or kNm

L = live load, kN, kN/m' or kNm

Lr = roof live load, kN, kN/m' or kNm

R = rainwater load, kN, kN/m' or kNm

W = wind load, kN or kN/m'

E = earthquake load, kN or kNm.

The results of modeling the structure of the civil engineering laboratory building using the *ETABS* modeling application are declared safe against the influence of external forces with no structural elements experiencing (O/S), shown in Figure 7, then enter the manual calculation stage for the analysis of beam, column and concrete slab elements to recheck and calculate the reinforcement requirements.

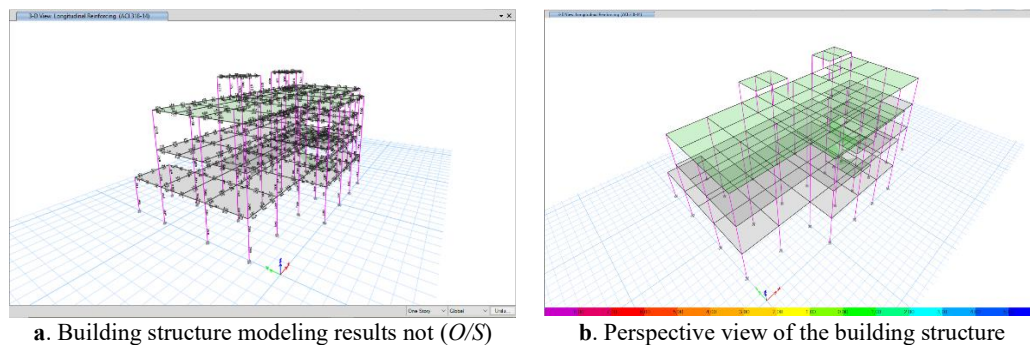


Figure 7. Building structure modeling results (a) no structural modeling results (O/S), (b) perspective view of the building structure. (Source: Personal Analysis)

Calculation of reinforcement requirements on the beam elements of the plan using the *Ms. Excel* application by entering the *output* results from the *ETABS* application to obtain the necessary moment (M_u) and the necessary load (V_u) torque load (T_u) to determine the bending and shear reinforcement. structural modeling in the form of internal forces is shown in Table 10.

Table 10. Force output in beams

Beams	Mu of support (-) (kNm)	Mu of pedestal (+) (kNm)	Mu field (-) (kNm)	Mu field (+) (kNm)	Vu pedestal (kN)	Field Vu (kN)	Vg pedestal (kN)	Tu (kNm)
B1 35x55 cm	-245.82	34.39	-2.93	118.90	177.26	1.00	141.73	15.93
B2 30x45 cm	-116.16	63.08	-8.65	45.02	113.50	46.30	82.07	3.14
B3 30x40 cm	-117.28	63.16	-20.32	16.69	70.21	43.08	39.43	4.41

(Source: Personal Analysis)

From the data, the calculation is then carried out based on SNI 2847-2019 Article 9.5.1, namely $\phi S_n \geq U$, the beam reinforcement plan is shown in Table 11.

Table 11: Beam reinforcement details

Beam Drawings (mm)	B1 35x55 cm		B2 30x45 cm		B3 30x40 cm	
	Pedestal	Field	Pedestal	Field	Pedestal	Field
Upper Reinf.	6D19	3D19	3D22	3D22	6D19	2D19
Central Reinf.	2D13	2D13	2D13	2D13	2D13	2D13
Bottom Reinf.	3D19	3D19	3D22	3D22	3D19	3D19
Shear Reinf.	3D10-100	2D10-150	3D10-90	3D10-120	3D10-60	3D10-120

(Source: Personal Analysis)

Calculation of column elements by checking the *output* results of the *ETABS* application in the form of internal forces using the *Ms. Excel* application in order to obtain the maximum *load* and *moment* shown in Table 12.

Table 12. Output column force K1 50x50

Story	Load Case/Combo	P (kN)	M2 (kNm)	M3 (kNm)
Story 1	Comb max	-1129.589	-250.8322	-6.3793

(Source: Personal Analysis)

Based on Table 12, it is then entered into the *SPColumn* application to create the column *interaction diagram* shown in Figure 8.

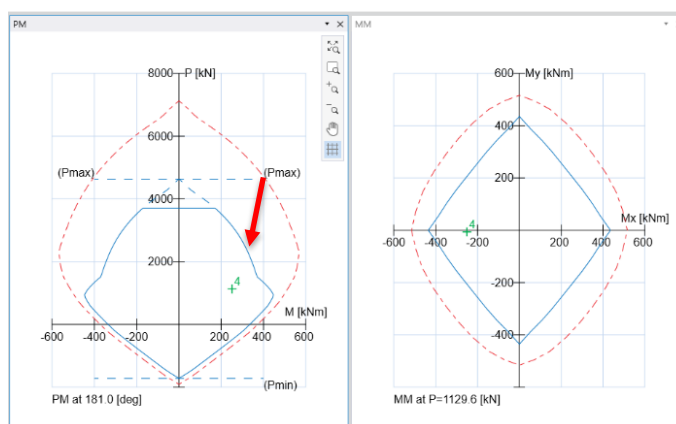


Figure 8. 50x50 cm K1 Column Interaction Diagram (Source: Personal Analysis)

The loading point is still within the interaction diagram so the column is declared safe, indicated by the arrow in Figure 8. The result of the analysis of column K1 50x50 cm using *SPColumn* is that the ratio value of column K1 50x50 cm meets the requirement of 0.72% according to SNI 2847-2019 Article 10.6.1 and the value of $\phi M_n/M_u > 1.0$ which implies that the column capacity is greater than the external load acting. The reinforcement is shown in Table 13.

Table 13. Output column force K2 30x50 cm

Story	Load Case/Combo	P (kN)	M2 (kNm)	M3 (kNm)
Story 1	Comb max	-325.3091	-12.2947	-67.9271

(Source: Personal Analysis)

Based on Table 13, it is then entered into the *SPColumn* application to create the column *interaction diagram* shown in Figure 9.

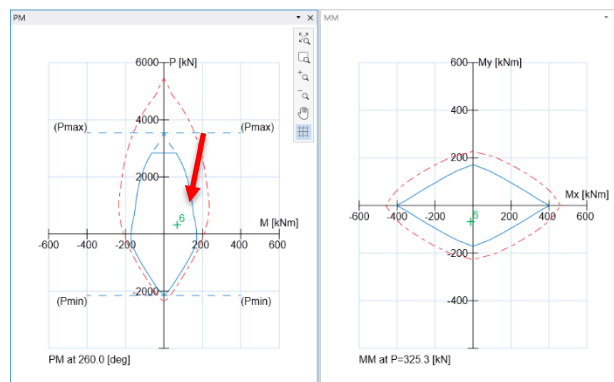


Figure 9. 30x50 cm K2 Column Interaction Diagram (Source: Personal Analysis)

The result of the analysis of column K2 30x50 cm using *SPColumn* is that the ratio value of column K2 30x50 cm meets the requirements of 0.49% according to SNI 2847-2019 Article 10.6.1 and the value of $\phi M_n/M_u > 1.0$ which contains that the column capacity is greater than the external load acting. It can be concluded that column K1 30x50 cm is safe. Details of the planned column reinforcement are shown in Table 14.

Table 14. K2 30x50 cm reinforcement details

Drawings (mm)	K1 50x50 cm		K2 30x50 cm	
	Pedestal	Field	Pedestal	Field
Dimensions	500 x 500	500 x 500	300 x 500	300 x 500
Main Reinforcement	16D19	16D19	22D19	22D19
Shear Reinforcement	4D13-110	2D13-110	4D13	2D13

(Source: Personal Analysis)

The thickness of the floor slab that has been analyzed is 15 cm and the thickness of the roof slab is 12 cm with material $f_c = 25$ Mpa, $f_y = 420$ Mpa, the reinforcement is D10-150 mm for the support and D10-200 mm for the field as shown in Figure 10.

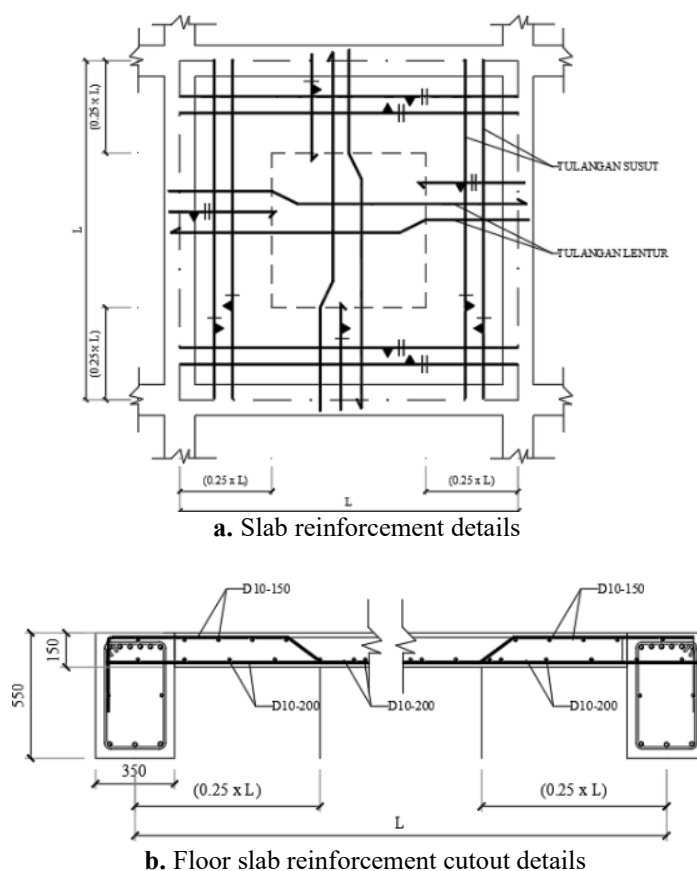


Figure 10. Reinforcement details shown (a) Slab reinforcement details (b) Floor slab cutout details (Source: Personal analysis results)

The cost budget plan required for the upper structural work of the civil engineering laboratory building is shown in table 15.

Table 15. Cost Budget Plan

No.	Job Description	unit	Volume	Unit Price (Rp.)	Total Price (Rp.)
A.	Work				
	1st floor	m ²	471.42	2.250.000,00	1.060.695.000,00
	2nd floor	m ²	456.78	2.250.000,00	1.027.755.457,00
	3rd floor	m ²	456.78	2.250.000,00	1.027.755.914,00
	Dak Roof	m ²	456.78	2.250.000,00	1.027.756.370,00
Total Amount (Rp.)					4.143.962.741,00

(Source: Personal Analysis)

CONCLUSION

Based on the results of the analysis and design and modeling, it is found that the structure of the planned UIKA civil engineering laboratory building has met the requirements based on SNI. The development of the design plan and structural analysis of the laboratory building consists of 3 floors with a building area of 1.842 m², concrete deck roof, structural material specifications are concrete quality (f_c') 25 Mpa, reinforcing steel quality (f_y) 420 Mpa and (f_y) 240 Mpa, column dimensions K1 50x50 cm, K2 30x50, K3 25x30 (Floors one to three), main beam dimensions B1 35x55 cm, B2 30x45 cm, B3 30x40, child beam B3 25x30, floor plate thickness 15 cm and roof deck plate thickness 12 cm. The completeness of the first floor facilities is designed for Structures, Soil Mechanics, Water Resources, and Environmental Engineering *study* laboratories with supporting facilities such as

reception rooms, lecturer rooms, lecture rooms, *tool rooms*, and practice rooms. The second floor accommodates Transportation laboratories equipped with meeting rooms, archive centers, and control and server rooms to support the operation and documentation of academic activities, the third floor is focused on the implementation of the Tri Dharma of Higher Education, providing lecturer rooms, classrooms, archive rooms, and *co-working spaces* to support academic interaction and collaboration, dak roof floors for *maintenance* activities and large water reservoir places. The cost budget plan for the civil engineering laboratory building structure is Rp 4,143,962,741.

ACKNOWLEDGMENTS

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