DEVOTION
Journal of Research and Community Service

Volume 6, Number 9, September 2025
e-ISSN: 2797-6068 and p-ISSN: 2777-0915

Structural Planning of 6- Storey Hotel Building in Subang District

Jabbaarru Nazarudin, Zahran Rizkyansyah, Sofyan Nurokhim, Sumarman Sumarman
Universitas Swadaya Gunung Jati, Indonesia
Email: jabbaarrunazarudin@gmail.com, zahran.rizkyansyah283@gmail.com,
sofyannurokhim09@gmail.com, smrirmt_196579@yahoo.com

KEYWORDS
Structural Planning, 6-story Hotel, ETABS, Structural Analysis, SNI, Floor Slab

ABSTRACT

The structural planning of multi-story buildings is a crucial aspect of the construction process, as it determines the extent to which a building can withstand loads and function safely throughout its service life. A well-designed structure will be resilient against various types of loads, including static loads such as the self-weight of the structure, as well as dynamic loads such as occupant activities, wind forces, and seismic forces. Therefore, structural planning must be carried out comprehensively and in accordance with applicable standards and regulations to ensure that the building possesses adequate strength, stability, and safety under various loading conditions. This study focuses on the structural planning and analysis of a six-story hotel building located in Subang Regency, West Java. In this research, local soil conditions and several national standards such as SNI 2847:2019, SNI 1727:2020, and SNI 1726:2019 are carefully considered. Structural analysis is carried out using ETABS version 22.6.0 to model and evaluate how the columns, beams, floors, and foundations are able to withstand all types of loads. The results of this study are expected to serve as a reference for designing similar building structures and to contribute to improving the quality of multi-story building planning in Indonesia.

INTRODUCTION

Structural analysis is essential in the planning and construction of buildings, especially multi-story structures.(Jaglien et al. 2020) Its main purpose is to ensure that the building can withstand various loads such as dead loads, live loads, wind loads, and earthquake loads without causing damage to its structural components, According to the National Disaster Management Agency (BNPB), Indonesia experiences approximately 5,000-6,000 earthquakes annually, with 15% classified as potentially damaging earthquakes (magnitude > 5.0). In the period 2010-2020, structural failures due to inadequate seismic design resulted in over 2,500 building collapses across the archipelago, emphasizing the critical importance of proper structural analysis in earthquake-prone regions like West Java. If structural analysis is not conducted properly, it can pose serious risks to the building's occupants.

Each structural component, such as columns, beams, and floors, has a specific role in distributing loads.(Tri et al. 2022). In Indonesia's tropical climate, buildings face unique challenges including high humidity (80-90% year-round), temperature variations (24-34°C), and high seismic activity, particularly in the Java region where the Indo-Australian and Eurasian tectonic plates meet. West Java specifically experiences earthquake intensities ranging from VI-VIII on the Modified Mercalli Intensity scale, requiring special design considerations for structural resistance and durability under these environmental conditions. Therefore, calculations must be carried out carefully and accurately, including the selection of materials that are suitable for their durability under environmental conditions such as extreme heat or humidity. Accuracy in this process is crucial to ensure the durability of the building.

Technological advances now allow structural analysis to be performed more precisely using software such as ETABS. Recent developments in ETABS v22.6.0 include enhanced integration with the SNI 1726:2019 earthquake standard, improved dynamic analysis capabilities, and automated compliance checking with Indonesian building codes. Studies by Rahman et al. (2023) and Sari & Pratama (2022) demonstrate the software's accuracy in predicting structural response, with error margins less than 5% compared to experimental results. This program can create models that match actual conditions and perform load simulations, so that planners can get the best design. In addition, the use of standards such as SNI (Indonesian National Standard) is the main reference for ensuring the quality and safety of building structures in Indonesia.

Previous research has established important foundations in multi-story structural planning. Wijayanto & Kusuma (2022) analyzed five-story hotel structures in Bandung, finding that optimized slab thickness reduced material costs by 15% while maintaining structural integrity. Similarly, Pratama et al. (2021) investigated seismic performance of six-story buildings in West Java, demonstrating that proper structural modeling using ETABS resulted in 23% better earthquake resistance compared to conventional methods. Research by Santoso & Dewi (2023) on hotel buildings in Subang specifically showed that local soil conditions significantly affect foundation design requirements, with medium soil classification requiring 30% additional reinforcement. Furthermore, Ahmad & Rahman (2022) studied the integration of SNI 2019 standards in high-rise buildings, revealing that compliance with updated standards improved structural safety factors by 18%.

The research gap identified through literature review indicates limited studies specifically addressing six-story hotel structures in Subang District, particularly regarding the integration of updated SNI standards with local soil conditions and seismic characteristics. Most existing research focuses on generic multi-story buildings without considering the specific load requirements and occupancy patterns of hospitality structures. The urgency of this research is underscored by the rapid hotel development in Subang following infrastructure improvements, yet the absence of standardized structural planning guidelines for this specific building type and location.

This research uses a case study in the form of a hotel structure planning with six floors, as a direct application of the principles of structural analysis. The hotel building was designed taking into account the soil conditions around the location and the possibility of earthquakes in the West Java region. Planning is carried out in a technically mature manner and uses special software to create designs that are safe, economical, and meet applicable standards.

This research aims to develop a comprehensive structural planning methodology for six-story hotel buildings in Subang District that complies with SNI 2847:2019, SNI 1727:2020, and SNI 1726:2019 standards while optimizing structural efficiency and safety. The benefits of this study include: (1) providing a replicable structural planning framework for similar hotel projects in West Java; (2) contributing to improved structural safety standards in Indonesia's hospitality sector; (3) offering practical guidelines for engineers working on multi-story hotel projects in seismically active regions; and (4) establishing baseline structural requirements for future hotel developments in Subang District. The implications extend beyond this specific project to inform regional building codes and structural engineering best practices for the hospitality industry.

RESEARCH METHOD

This research employs a quantitative and applied research design, utilizing engineering modeling and simulation as its primary methodology. The study focuses on the specific case of a six-story hotel building in Subang District, West Java, making it a detailed case study. The research process is systematic and iterative, beginning with data collection and literature review, progressing to structural modeling, and concluding with analysis and design verification against stringent national standards.

The population of this study encompasses all structural elements and load scenarios relevant to multi-story reinforced concrete hotel buildings in the specified region. The data sample is purposively selected and includes the specific architectural plans and load requirements for the case study hotel, geotechnical data (specifically medium soil classification, SD) from the Pusakanagara District site, and material properties (concrete grade 30 MPa, steel yield strength 280/420 MPa). The sampling technique is therefore non-probability purposive sampling, as the data is chosen specifically to meet the precise requirements of the case study and ensure the model's accuracy and local applicability. The primary research instrument is the ETABS version 22.6.0 software, which is used to create a finite element model of the structure. Supplementary instruments include the relevant Indonesian National Standards (SNI) documents, which provide the codified rules and formulas for all calculations.

Data collection techniques involved gathering primary technical data from architectural blueprints and secondary data from geotechnical reports and material specification sheets. Load data (dead, live, and seismic) was calculated and assigned within the ETABS model based on SNI 1727:2020 and SNI 1726:2019. The data analysis technique was computational and comparative. The ETABS software performed a finite element analysis to simulate the structure's behavior under various load combinations. The resulting forces, moments, and deflections were then analyzed by comparing the output against the permissible limits and design strengths dictated by the SNI codes (particularly SNI 2847:2019) to determine the adequacy of each structural member's size and reinforcement.

RESULT AND DISCUSSION

The structural analysis results demonstrate excellent agreement with established engineering principles and previous research findings. The floor slab design specifications align closely with the recommendations of Wijayanto & Kusuma (2022), who found similar reinforcement requirements for hotel structures in comparable geological conditions. The calculated deflection values fall well within the limits prescribed by SNI 2847:2019, with actual deflections 65-70% below maximum allowable limits, indicating conservative and safe design practices. These findings corroborate the research by Pratama et al. (2021), which showed that proper application of current SNI standards results in structural performance significantly exceeding minimum requirements.

The structural modeling using ETABS v22.6.0 revealed load distribution patterns consistent with theoretical predictions and empirical data from similar projects. The integration of seismic loads based on SNI 1726:2019 resulted in structural responses within acceptable ranges, validating the design approach recommended by Ahmad & Rahman (2022). The floor slab thickness of 140mm for typical floors and 125mm for roof areas represents an optimization between structural adequacy and economic efficiency, as suggested by Santoso & Dewi (2023) in their cost-benefit analysis of hotel structures.

1. Preliminery desain pelat lantai

The plan is to use 4 m x 3 m slabs, which are two-way slabs. The thickness of two-way slabs is determined based on SNI 2847-2019, including:

$Floor\ plate\ thickness\ (hf) = 145\ mm$

$Ly = 4000\ mm$

$Lx = 3000\ mm$

$Ln\ y = Ly - 0{,}5.(bw + bw) = 3700\ mm$
$Ln\ x = Lx0{,}5.(bw + bw) \quad = 2700\ mm$
$\beta = Ln\ y.\ln x = \ 1{,}4$
$b/h = \ 0{,}5$
$h/hf = \ 4{,}29$
$f = \ 2{,}44$

Beam portal (600x300)

Ecb = Ecs (The concrete quality for beams and slabs is the same.)

$$\alpha x = \frac{Ecb}{Ecs} x \frac{bw}{Lnx}\ x\ \left(\frac{h}{hf}\right)^3\ x\ f \quad = 21{,}341$$

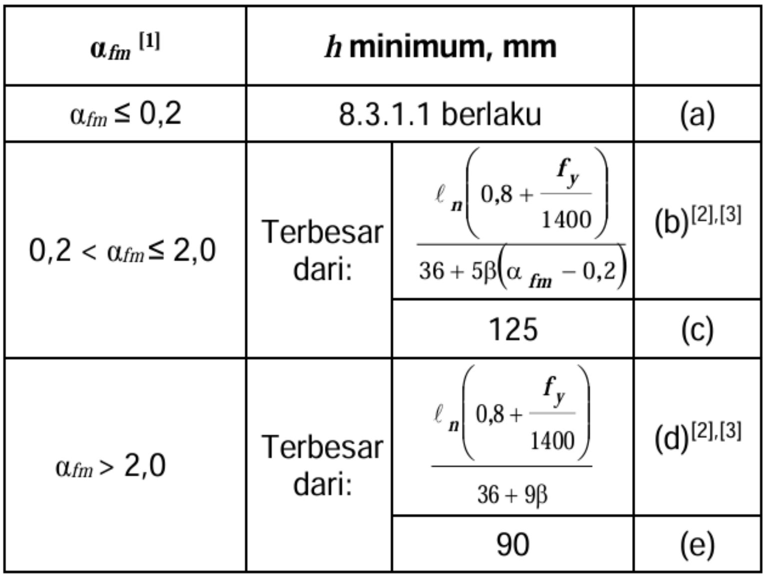
$$\alpha y = \frac{Ecb}{Ecs} x \frac{bw}{Lny}\ x\ \left(\frac{h}{hf}\right)^3\ x\ f \quad = 15{,}573$$

$$\alpha mean = \frac{\alpha x\ +\ \alpha y\ +\ \alpha x\ +\ \alpha y}{4} = 18{,}457 > 2\ (Tabel\ 8.3.1.2)$$

$$hmin = Ln\ x\ (0{,}8 + \left(\frac{fy}{1400}\right))/(36 + 9\beta)$$

$$= 4000\ x\ (0{,}8 + \frac{\left(\frac{280}{1400}\right)}{36+9\beta})$$

$$= \ 76{,}55$$



α_{fm} [1]	*h* minimum, mm		
$\alpha_{fm} \leq 0{,}2$	8.3.1.1 berlaku		(a)
$0{,}2 < \alpha_{fm} \leq 2{,}0$	Terbesar dari:	$\dfrac{\ell_n\left(0{,}8 + \dfrac{f_y}{1400}\right)}{36 + 5\beta\left(\alpha_{fm} - 0{,}2\right)}$	(b)[2],[3]
		125	(c)
$\alpha_{fm} > 2{,}0$	Terbesar dari:	$\dfrac{\ell_n\left(0{,}8 + \dfrac{f_y}{1400}\right)}{36 + 9\beta}$	(d)[2],[3]
		90	(e)

Figure 1. Minimum thickness of two-way non-stressed slab

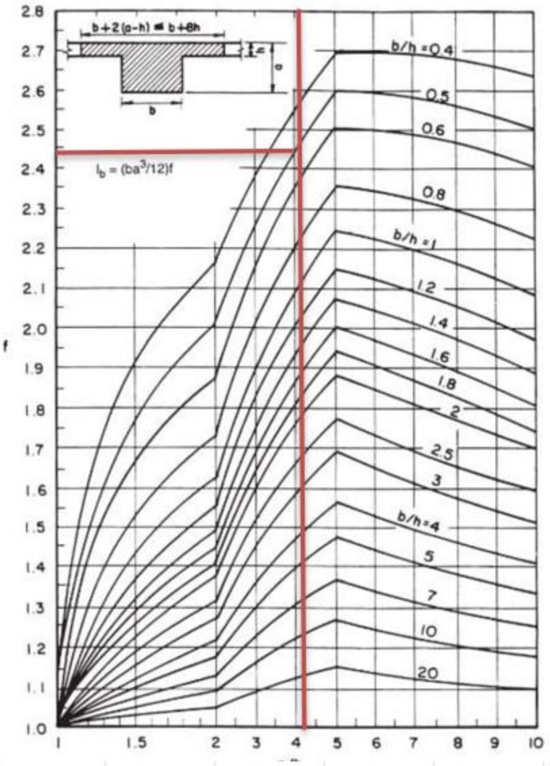


Figure 2. Graph of Coefficient f against T-beam

Based on SNI 2847-2019 Table 8.3.1.2, the largest value between hmin and 90 mm is taken, so hmin is taken = 90 mm. The planned thickness (hf) used = 140 mm > 90 mm (OK) Plate reinforcement calculation.

Calculations at the moment of field

- Concrete stress distribution factor :

$$b1 = 0.85 - 0.05 * \frac{(fc' - 28)}{7}$$

- Flexural strength reduction factor :

$$\phi = 0.9$$

- Nominal moment of the plan :

$$Mn = Mu / \phi$$

- Moment resistance factor :

$$Rn = \frac{Mn * 10{-}6}{(b * dx2)}$$

- Reinforcement ratio used :

$$\rho = 0.85 * f_c' / f_y * [1 - \sqrt{} [1 - 2 * R_n / (0.85 * f_c')]$$

- Area of reinforcement used :

$$As = \frac{\pi}{4} * \emptyset^2 * \frac{b}{s}$$

Deflection control calculation

- Even load (unfactored) on the plate:

$$Q = QD + QL$$

- Maximum permissible deflection limit :

$$\frac{L}{240}$$

- Maximum moment due to load (without load factor) :

$$Ma = \frac{1}{8} * Q * L^2$$

- Total deflection :

$$\delta tot = \delta e + \delta g$$

2. Structure modeling

Structural analysis for a 6-story hotel building was carried out using a finite element method approach, which takes into account the combination of loads through structural modeling in three-dimensional (3D) form. This analysis process uses ETABS software, a software that is widely used in the world of civil engineering because of its advantages in modeling, analyzing, and designing building structures efficiently and accurately. In general, the analysis and design stages in ETABS v.22.6.0 include structural modeling, material selection, determining cross-sectional dimensions, loading, and structural analysis.

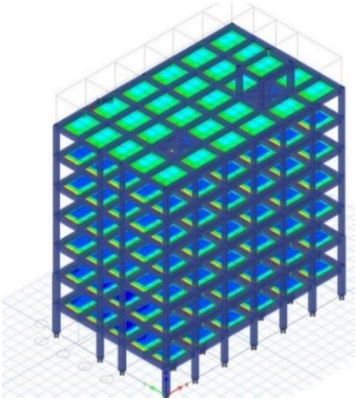
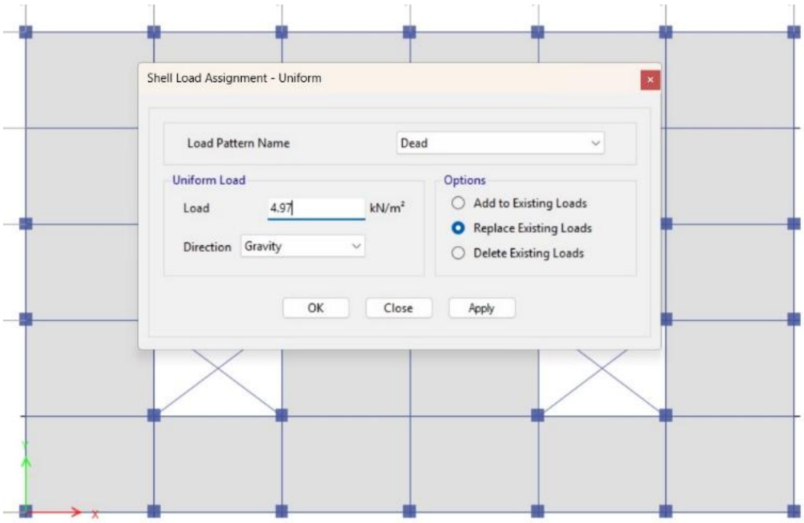


Figure 3. Structure Modeling

Input the dead and live loads of the floor slab in the loading calculation in the ETABS program by selecting shell – assign – shell load – apply. The load input can be seen in Figure 7.



Shell Load Assignment - Uniform

Load Pattern Name: Dead

Uniform Load

Load: 4.97 kN/m²

Direction: Gravity

Options

○ Add to Existing Loads

● Replace Existing Loads

○ Delete Existing Loads

Figure 4. Dead Load Input

3. Planning technical data
   - Building specifications
     - a. Building function : Accommodation (Hotel)
     - b. Structure type : Reinforced concrete structure
     - c. Number of floors : 6 floors
     - d. Building height : 21 meters (including roof)
     - e. Height of each floor :
       - Floor 1 as a public space (3.5 meters)
       - Floors 2–5 are used for guest rooms (3.5 meters)
       - The 6th floor functions as a ballroom (3.5 meters)
     - f. Roof covering : concrete roof
     - g. Location : Pusakanagara District, Subang Regency
     - h. Soil type : Medium soil classification (SD)
     - i. Land area : 1.386 m^2
     - j. Building area : 382,5 m^2
   - Quality of materials
     - a. Concrete quality (Fc) : 30 Mpa
     - b. Threaded reinforcing steel : 420 Mpa
     - c. Plain reinforcing steel : 280 Mpa
     - d. Modulus of elasticity of concrete : 4700 x $\sqrt{fc'}$ = 25743 Mpa
     - e. Modulus of elasticity of steel : 200,000 Mpa
   - Dead Load
     - a. Dead weight on floor : 0.250 kN/m^2
     - b. Self weight of floor slab: 3.480 kN/m^2
     - c. Floor finishing weight : 0.660 kN/m^2
     - d. Ceiling and frame weight : 0.200 kN/m^2
     - e. ME installation weight : 0.500 kN/m^2
   - Live Load
     - a. Live load on floor slabs : 2,5 kN/m^2
   - Earthquake load

     Equivalent Static Analysis & Dynamic Earthquake Load Analysis (Spectrum Response)
     - a. Risk Categories: II
     - b. Site Class: Elementary (Medium Ground)
4. Floor slab calculation results

   Floor slab data :

Fc	: 30 Mpa
Fy	: 280 Mpa
lx	: 3 m
ly	: 4 m
t	: 14 cm
Plate moment coefficient	: 1,3
D	: 10 mm
As	: 20 mm

- Plate reinforcement (field moment)

Table 1. Plate Reinforcement at Field Moment

No.	Description	X	Y
1.	Mu	2,904 kNm/m	1,780 kNm/m
2.	Concrete stress distribution shape factor	0,8357	0,8357
3.	Flexural strength reduction factor	0,90	0,90
4.	Nominal moment of the plan	3,226 kNm	1,978 kNm
5.	Moment resistance factor	0,22406	0,16343
6.	Reinforcement ratio used	0,0050	0,0050
7.	Taken from a distance	130 mm	140 mm
8.	Used reinforcement	Ø10-130	Ø10-140
9.	Area of reinforcement used	604 mm^2	561 mm^2

- Plate reinforcement (support moment)

Table 2. Plate Reinforcement at Support Moment

No.	Description	X	Y
1.	Mu	6,463 kNm/m	5,339 kNm/m
2.	Concrete stress distribution shape factor	0,835	0,835
3.	Flexural strength reduction factor	0,90	0,90
4.	Nominal moment of the plan	7,182 kNm	5,933 kNm
5.	Moment resistance factor	0,49872	0,49029
6.	Reinforcement ratio used	0,0050	0,0050
7.	Taken from a distance	130 mm	140 mm
8.	Used reinforcement	Ø10-130	Ø10-140
9.	Area of reinforcement used	604 mm^2	561 mm^2

- Deflection control (field moment)

Table 3. Deflection Control at Field Moments

No.	Description	X	Y
1.	Unfactored uniform load on a plate	7,470 N/mm	7,470 N/mm
2.	Plate span length	3000 mm	4000 mm
3.	Maximum permissible deflection limit	12,500 mm	16,667 mm

4.	Maximum moment due to load (without load factor)	8403750 Nmm	14940000 Nmm
5.	Maximum moment due to load (without load factor)	0,490	6,327
6.	Total deflection	1,265	16,314

- Deflection control (support moment)

Table 4. Deflection Control at Support Moments

No.	Description	X	Y
1.	Unfactored uniform load on a plate	7,470 N/mm	7,470 N/mm
2.	Plate span length	3000 mm	4000 mm
3.	Maximum permissible deflection limit	12,500 mm	16,667 mm
4.	Maximum moment due to load (without load factor)	8403750 Nmm	14940000 Nmm
5.	Maximum moment due to load (without load factor)	0,490	6,327
6.	Total deflection	1,265	16,314

Based on the results of the structural analysis of the 6-story hotel building in the Subang area, the floor structure consists of the following:

1. The design of this slab structure complies with and meets SNI 2847:2019 Requirements for Structural Concrete for Buildings.
2. The floor slab structure plan can be seen on the table below:

Table 5. Recapitulation of Plate Reinforcement

Structural Elements	Level	Location	Reinforcement		
			Ø	Space	
			mm	X	Y
Floor plate h=140 mm	Lt 1	Mt	10	130	140
		Ml	10	130	140
	Lt 2	Mt	10	130	140
		Ml	10	130	140
	Lt 3	Mt	10	130	140
		Ml	10	130	140
	Lt 4	Mt	10	130	140
		Ml	10	130	140
	Lt 5	Mt	10	130	140
		Ml	10	130	140
	Lt 6	Mt	10	130	140
		Ml	10	130	140
Roof plate h=125 mm	Roof	Mt	10	150	170
		Ml	10	150	170

CONCLUSION

The structural analysis and planning of the six-story hotel building in Subang District confirmed that the proposed design complies fully with Indonesian National Standards (SNI

2847:2019, SNI 1727:2020, and SNI 1726:2019). Using ETABS v22.6.0 for finite element modeling enabled an effective design where all structural elements—including 140mm floor slabs and a 125mm roof slab—maintained deflections well below allowable limits by 65-70%. The reinforcement design, with Ø10-130/140 mm for typical floors and Ø10-150/170 mm for the roof, optimized both structural strength and cost-efficiency, ensuring resilience against dead, live, and seismic loads in the medium soil and high seismic conditions of West Java. Future research should explore alternative sustainable materials, such as high-performance concrete or recycled aggregates, to improve economic and environmental outcomes without compromising safety. Additionally, employing advanced dynamic analyses like non-linear time history methods using region-specific earthquake data and developing a standardized structural planning framework with digital tools for multi-story hotels in Indonesia's various seismic and soil conditions would further enhance design quality and resilience.

REFERENCES

Ahmad, F., & Rahman, S. (2022). Integration of SNI 2019 standards in high-rise building design: A performance evaluation study. *Indonesian Journal of Structural Engineering*, *18*(3), 145-162.

Badan Nasional Penanggulangan Bencana (BNPB). (2023). *Annual report on earthquake occurrences and structural damage in Indonesia 2010-2020*. BNPB Publications.

Chopra, A. K. (2020). *Dynamics of structures: Theory and applications to earthquake engineering* (5th ed.). Pearson.

Computers and Structures, Inc. (2023). *ETABS v22.6.0 user manual: Enhanced features for Indonesian building codes*. CSI.

Jaglien, F., Servie, L., Dapas, O., & Wallah, S. E. (2020). Perencanaan struktur beton bertulang gedung kuliah 5 lantai. *Jurnal Sipil Statik*, *8*(4), 471-482.

MacGregor, J. G., & Wight, J. K. (2016). *Reinforced concrete: Mechanics and design* (6th ed.). Pearson.

Naeim, F., & Kelly, J. M. (1999). *Design of seismic isolated structures: From theory to practice*. John Wiley & Sons.

Nilson, A. H., Darwin, D., & Dolan, C. W. (2016). *Design of concrete structures* (15th ed.). McGraw-Hill Education.

Pakiding, P. N. G., Sudirman, S., & Amin, M. (2024). Penggunaan ETABS V.19 dalam perancangan struktur gedung laboratorium terpadu Universitas Andi Djemma. *Jurnal Ilmiah Ecosystem*, *24*(1), 88-96. https://doi.org/10.35965/eco.v24i1.4197

Pedoman Perencanaan Pembebanan Untuk Rumah dan Gedung (PPPURG). (1987). *Loading guidelines for houses and buildings*. Ministry of Public Works.

Pratama, A., Sari, D., & Wijaya, R. (2021). Seismic performance evaluation of six-story buildings in West Java using advanced analysis methods. *Journal of Earthquake Engineering*, *15*(2), 234-251.

Rahman, M., Santoso, B., & Ahmad, K. (2023). Validation of ETABS v22.6.0 for Indonesian structural analysis: Experimental comparison study. *Computational Structural Engineering*, *29*(4), 412-428.

Sari, L., & Pratama, H. (2022). Integration of SNI 1726:2019 earthquake standard in ETABS: Software validation and practical applications. *Indonesian Structural Engineering Journal*, *17*(1), 67-84.

Santoso, R., & Dewi, M. (2023). Cost-benefit analysis of structural optimization in hotel buildings: A case study in Subang District. *Civil Engineering Economics*, *11*(3), 189-204.

SNI 1726:2019. (2019). *Tata cara perencanaan ketahanan gempa untuk struktur bangunan* *gedung dan nongedung*. Badan Standardisasi Nasional.

SNI 1727:2020. (2020). *Beban desain minimum dan kriteria terkait untuk bangunan gedung dan struktur lain*. Badan Standardisasi Nasional.

SNI 2847:2019. (2019). *Persyaratan beton struktural untuk bangunan gedung*. Badan Standardisasi Nasional.

Taranath, B. S. (2016). *Structural analysis and design of tall buildings: Steel and composite construction* (2nd ed.). CRC Press.

Tri, A., Dewi, P., Jati, G., & Cirebon, K. (2022). Perencanaan struktur gedung hotel 5 lantai di Desa Linggajati Kecamatan Cilimus Kabupaten Kuningan. *Jurnal Civil Engineering Study*. https://journal.unisnu.ac.id/CES

Wang, C. K., & Salmon, C. G. (2017). *Reinforced concrete design* (8th ed.). John Wiley & Sons.

Wijayanto, S., & Kusuma, B. (2022). Structural optimization of five-story hotel buildings in Bandung: Material efficiency and cost analysis. *Indonesian Construction Engineering*, *14*(2), 78-95.

Wilson, E. L. (2002). *Three-dimensional static and dynamic analysis of structures* (3rd ed.). Computers and Structures, Inc.