Building Analysis of the Lill Hajj Wall Umrah Building Based on Functionality of the Building for Umrah and Hajj Pilgrims

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ABSTRACT

PT Lill Hajj Wall Umrah is targeted to get 5,226 consumers per year or equivalent to 436 people per month by 2030. The old office in the form of a shophouse with a building area of 119.75 m² for a capacity of 99 people is considered inadequate to serve 436 consumers per month, so PT Lill Hajj Wall Umrah needs a new office with a meeting room of at least 523.2 m². A new office will be planned based on SNI 2847-2019, SNI 1726-2019, SNI 1727-2020, and PBI 1983. The planning results are in the form of an analysis of the new office structure with building dimensions of 28.30 x 23.35m, four floors with a building area of 4,503 m². The material specifications of the building structure are concrete quality (fc') 41.5 MPa, melted reinforcing steel quality (fy) 400 MPa (BJTS), and 280 MPa (BJTP). Basement floor column dimensions 0.6 x 0.6 m, first to fourth floor columns 0.5 x 0.6 m, rooftop columns 0.4 x 0.4 m, main beam dimensions 0.25 x 0.35 m, child beams 0.25x0.5 m, stair beams 0.25 x 0.35 m, roof deck beams 0.25 x 0.3 m and 0.3 x 0.4 m, concrete slab thickness 0.15 m. The results of structural modeling using the Etabs application showed that there was no over-strength (O/S) in the column and beam structure elements. The results of the design of the new office building Lill Hajj Wall Umrah in the form of a basement floor equipped with prayer room facilities covering an area of 14 m2, a generator room covering an area of 15.28 m2, a pump room covering an area of 15.28 m2, parking covering an area of 781.53 m2. The first floor is equipped with VIP room facilities covering an area of 33.33 m2, a prayer room covering an area of 25.87 m2, a toilet covering an area of 44.93 m2, and a boutique room covering an area of 55.22 m2, and a warehouse covering an area of 12.3 m2. The second floor is equipped with a meeting room covering an area of 47.9 m2, a manager's room covering an area of 36.7 m2, a toilet covering an area of 30.9 m2, a prayer room covering an area of 16.08 m2, a boardroom covering an area of 80.59 m2 and a waiting room covering an area of 45 m2. The third and fourth floors are equipped with toilets covering an area of 25.75 m2, a prayer room covering an area of 23.95 m2, and a ballroom of 383.75 m2. The estimated budget for the construction of lill Hajj Wall Umrah's new office is Rp 7.612.645.721.- and takes 406 working days for construction.

Keywords: structural analysis; building design; umrah; hajj facility; cost budget plan.

INTRODUCTION

PT Lill Hajj Wall Umrah Semarang City branch which located at Jalan Majapahit number 75 Saka Square Blok 12A Semarang City, is one of the travel companies in Ibadah Hajj, Umrah and religious tourism. The development of the number of consumers in the last three years (2019 to 2021) was 2,800, 3,800, and 4000 people, respectively. The target of congregations in 2030 is 5,226 people or the equivalent of 436 people per month. The old office building is only a two-story shophouse building with a building area of 119.75 m² for a capacity of 99 people is considered inadequate in carrying out services to the congregation to the maximum, thus a new office with a meeting room (*ballroom*) is needed a minimum area of 523.2m² (according to SNI 03-1733-2004) to accommodate consumers every month. The construction of the new office building follows SNI 2847-2019 on structural concrete requirements of buildings, SNI 1726-2019 on earthquake resistance planning procedures for buildings, and SNI 1727-2020 on minimum design load and related criteria for buildings and other structures, regulations for loading Indonesia for buildings in 1983. This study aims to analyze a four-story office building cording to the needs of the space needed, determine the budget plan for the upper structure costs, and determine the duration of the implementation of the office construction.

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Structure Analysis

Structure analysis aims to estimate the inner force and deformations of the structural system and to ensure the fulfillment of strength, serviceability, and stability requirements within the SNI 2847-2019 standard (Article 4.5, SNI 2847-2019). The planning of reinforced concrete structures is based on the necessary strength calculated from the combination of the factored load and the design strength calculated from the combination of the factored load and the design strength calculated as φRn, where φ is the strength reduction factor and Rn is the nominal strength. The general concept of the force method of having can be expressed in equation 1 below:

$Ru \leq \phi$ x Rn.. (1)

Where:

R_u = Necessary strength derived from a combination of factored loads
R_n = Nominal strength of the structural elements under review
ϕ = Reduction factor

Based on SNI 2847-2019, the combination of loads is regulated in SNI 2847-2019, Article 5.3.1, while the value of the reduction factor is regulated in SNI 2847-2019, Article 21. The amount of load factor given to each load acting on a cross-section of the structure will vary depending on the type of load combination concerned. According to SNI 2847-2019 on Load Factors and Load Combinations Article 5.3, the need strength U must be at least equal to the influence of the factored load shown in Table 1 as follows:

Table 1. Load Combinations

Load Combinations	Equation	Main Load
U = 1.4*D*	(5.3.1a)	*D*
U = 1.2*D* + 1.6*L* + 0.5(*Lr* or *R*)	(5.3.1b)	L
U = 1.2*D* + 1.6(*Lr* or *R*) + (1.0L or 0.5*W*)	(5.3.1c)	*Lr or R*
U = 1.2*D* + 1.0*W* + 1.0*L* + 0.5(*Lr* or *R*)	(5.3.1d)	*W*
U = 1.2*D* + 1.0*E* +1.0*L*	(5.3.1e)	*E*
U = 0.9*D* + 1.0*W*	(5.3.1f)	*W*
U = 0.9*D* + 1.0*E*	(5.3.1g)	*E*

Source: SNI 2847-2019 about Load Factors and Load Combinations Article 5.3, Table 5.3.1, page 84

With:

U = Factored Load Combinations, kN, kN/m' or kNm
D = Dead Load, kN, kN/m' or kNm
L = Life Load, kN, kN/m' or kNm
A = Roof Life Load, kN, kN/m' or kNm
R = Rain Load, kN, kN/m' or kNm
W = Wind Load, kN or kN/m'
E = Earth Quake Load, kN or kNm.

The principle of concrete columns

The column is an element of the main structural element that carries the load of a combination of compressive axials and bending moments. Columns are also the main structural elements that take the most important role in sustaining lateral loads (especially earthquakes) on building structures (Lesmana, Yudha 2020). Based on SNI 2847-2019, Article 10.6.1.1 states that the minimum reinforcement ratio is 0.01 and the maximum limit is 0.08 (for general cases). In building construction, columns serve as support for loads of beams and slabs, to be passed to the ground bottom through the foundation. The load from these beams and slabs is in the form of compressive axial loads and bending moments (due to construction continuity). Therefore it can be defined, a column as one of the structural elements that support an axial load with or without bending moments. The design of the column dimensions is determined based on SNI 2847-2019, Article 18.7.2.1 states that the column cross-section must not be less than 0.3 m and the cross-sectional dimension ratio is not less than perpendicular, besides that it can also be used as an approach 2, namely:

$A_g \geq P_u/0.35\, f'c$ .... (2)

With:

A_g	= Gross cross-sectional area, mm^2
P_u	= Factored axial load, kN
$f'c$	= Concrete quality, MPa

1. Axial force and factored moment

The combination of critical loads is quite hard to understand without a checking method on each combination. As shown in Figure 1, considering only the combinations of factored loads due to maximum axial force ($LC1$) and maximum bending moment ($LC2$) is not necessarily appropriate with design regulations for other load combinations such as $LC3$.

The connection requirements have been formulated on the basis that the press-through joint has a tensile strength of at least $0.25fy$. Thus, if the column reinforcement is designed as a compressive column in accordance with Article 10.7 of SNI 2847-2019, the hood of tensile strength must also be available.

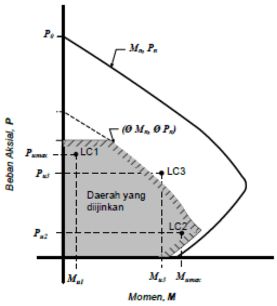

Figure 1. Column critical load combination

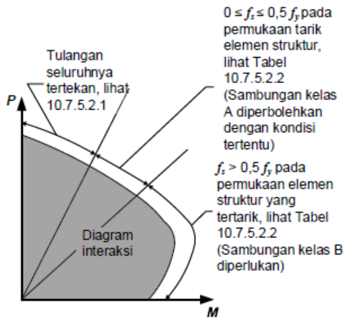

Figure 2. Pass-through connection requirements for columns

1. Design strength

In Article 10.5 of SNI 2847-2019 it is explained that for each established combination of factored loads, the design forces at all cross sections must meet the requirement of $\phi Sn \geq U$, including in equation 3, equation 4, equation 5, and equation 6 below the interaction between the load effects should be considered:

$\phi P_n \geq P_u$ ....(3)
$\phi M_n \geq M_u$ ....(4)
$\phi V_n \geq V_u$ ....(5)
$\phi T_n \geq T_u$ ....(6)

2. Sliding reinforcement

The minimum area of shear reinforcement, $A_{s,min}$ should be provided in all areas where $V_u > 0.5\, \emptyset V_c$. When shear reinforcement is required, $A_{v,min}$ must be greater than equation 7 and equation 8 below:

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$0{,}062\sqrt{f_c'}\frac{b_{ws}}{f_{yt}}$ ....(7)

$0{,}35\frac{b_{ws}}{f_{yt}}$ ....(8)

3. Transverse reinforcement

Table 2 Transverse reinforcement for the columns of the special moment-bearing truss system

Transverse Reinforcement 1	Condition	Applicable equations	
Ash/Sbc for square restraint zinc	$P_u \leq 0{,}3A_g f_c'$ and $f_c' \leq 70MPa$	Largest between (a) and (b)	$0{,}3\left(\frac{A_g}{A_{ch}} - 1\right)\frac{f_c'}{f_{yt}}$ (a)
	$P_u > 0{,}3A_g f_c'$ or $f_c' > 70MPa$	Largest between (a), (b), and (c)	$0{,}09\frac{f_c'}{f_{yt}}$ (b) $0{,}2k_f k_n\frac{P_u}{f_{yt}A_{ch}}$ (c)
ρ_s for spiral or stinging circle restraints	$P_u \leq 0{,}3A_g f_c'$ And $f_c' \leq 70MPa$	Greatest between (d) and (e)	$0{,}45\left(\frac{A_g}{A_{ch}} - 1\right)\frac{f_c'}{f_{yt}}$ (d)
	$P_u > 0{,}3A_g f_c'$ Or $f_c' > 70MPa$	Largest between (d), (e) and (f)	$0{,}12\frac{f_c'}{f_{yt}}$ (e) $0{,}35k_f k_n\frac{P_u}{f_{yt}A_{ch}}$ (f)

Source: SNI 2847-2019 on Transverse Reinforcement Article 18.7.5, Table 18.7.4, page 390

In earlier standards, the requirements for transverse reinforcement in columns, walls, beam-column joints, and diagonally reinforced coupling beams referred to the same equation. At this standard, the equations and the reinforcement requirements differ depending on the type of element and are functions and loads, deformations, and other requirements. In addition, hs was previously referred to as the distance between the legs of the restraint or cross-tie. In
this standard, hs refers to the distance between the longitudinal reinforcements bound by the restraint or cross-tie.

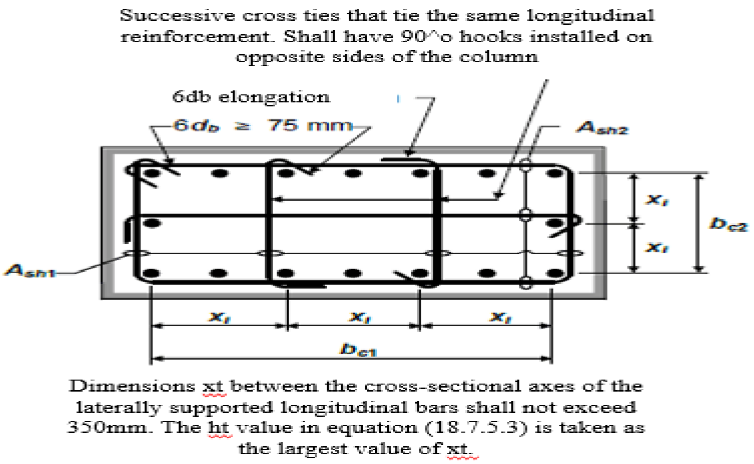

Figure 3. Example of transverse reinforcing on a column Source: SNI 2847-2019 concerning Transverse Reinforcement Article 18.7.5.3

The principle of concrete blocks

Beams can be defined as one of the elements of the portal structure with a span whose direction is horizontal, while the portal is the main framework of the building structure, in particular the building. The load acting on the beam is usually in the form of bending loads, sliding loads, and torque (twisting moments), so steel members must support these loads. This reinforcement is in the form of elongated reinforcement or longitudinal reinforcement (which withstands bending loads) and shear/seal reinforcement (which withstands shear and torsional loads) (Ali Asroni, 2010).

Types of pedestal conditions where the shear force at a distance d from the pedestal is used includes:
1. The beam is supported by a pad at the bottom of the beam, as shown in Figure 4.
2. The beams string monolithically into columns, as illustrated in Figure 4.

Types of pedestal conditions where a critical cross-section is taken in advance of the pedestal include:
1. The beams are stringed into the supporting compound that receives the tensile, as shown in Figure 5. the slide in this joint should also be reviewed and a special angular reinforcement should be provided.
2. Beams whose load is not worked on or near the top. The beam is loaded in such a way that the shear at the cross-section between the pedestal and the history d of the pedestal differs radically from the shear at a distance d. this usually occurs in corbells and on beams where the centralized load is located close to the pedestal, as shown in Figure 5.

Based on SNI 2847-2019, the planning provisions for the elements of the beam structure are as follows:
1. Strength/Force
Article 9.5 of SNI 2847-2019 explains that for each combination of factored loads used, the design forces in all cross-sections must meet the requirement of including equation 9, equation 10, equation 11, and equation 12 below. The interaction between the impact of the load must be calculated.

$$Mn \geq Mu \quad (9)$$
$$Vn \geq Vu \quad (10)$$
$$Tn \geq Tu \quad (11)$$
$$Pn \geq Pu \quad (12)$$

must be determined in accordance with SNI 2847-2019 of Reduction Factors article 21.2.
2. Moment
If; Mn shall be calculated as per Article 22.3 .... (13)
If; Mn shall be calculated as per Article 22.4 .... (14)
In Article 9.5.3 of SNI 2847-2019 Vn must be calculated according to Article 22.5.
3. Torque
If, where Tth on Article 22.7. the influence of torque should be ignored. The minimum reinforcement required by Article 9.6.4 and the requirements of Article 9.7.5 and Article 9.7.6.3 does not need to be met. The requirements for torsion and shear reinforcement are summed and the supplied sting is at least the total amount required. Since the area of reinforcement Av for shear is defined as the area of reinforcement At for torque is defined as one leg only, the summation of the area of transverse reinforcement is calculated based on equation 15 as follows:

$$Total\left(\frac{A_{v+t}}{s}\right) = \frac{A_v}{s} + 2\frac{A_t}{s} \quad (15)$$

If a group of stingers has more than two legs for sliding, only the legs adjacent to the sides of the beam are included in this summation because the inner legs are not effective for resisting torque.
4. Reinforcement limitations
Article 9.6 of SNI 2847-2019 explains that the minimum area of flexible reinforcement As,min must be provided at each cross section where tensile reinforcement is needed according to the analysis. This provision is intended to produce bending strength in excess of crack strength by considerable magnitude. The goal is to produce a beam capable of surviving after the occurrence of a bending crack, with visible cracks and deflections, thereby warning of the possibility of overload. Beams with less reinforcement can occur sudden failures with the occurrence of bending cracks. The difference in the definitions of Av and At is worth noting: Av is the area of two closed cross bars legs, while At is the area of one closed cross-tie leg. If a group has more than two legs, only legs adjacent to the side of the beam are taken into account. As.min must be greater than equation 16 and equation 17 unless provided in Article 9.6.13. For certain static beams with wings in a tensile state, the value of bw must be smaller than bf and 2bw.

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$$\frac{0{,}25\sqrt{f_c'}}{f_y} \quad (16)$$

$$k\frac{1{,}4}{f_y}bw_d \quad (17)$$

If torsion reinforcement is required, the minimum transverse reinforcement (A_v + 2A_t) min/S must be greater than equation 18 and equation 19 below:

$$0{,}062\sqrt{f_c'}\frac{b_w}{f_{yt}} \quad (18)$$

$$0{,}35\frac{b_w}{f_{yt}} \quad (19)$$

If torsional reinforcement is required the minimum longitudinal reinforcement $A_{t,min}$ should be smaller than equation 20 and equation 21 below:

$$0{,}42\sqrt{f_c'}\frac{A_{cp}}{f_{yt}} - \left(\frac{A_t}{s}\right)Ph\frac{f_{yt}}{f_y} \quad (20)$$

$$0{,}42\sqrt{f_c'}\frac{A_{cp}}{f_{yt}} - \left(\frac{0{,}175b_w}{f_{yt}}\right)Ph\frac{f_{yt}}{f_y} \quad (21)$$

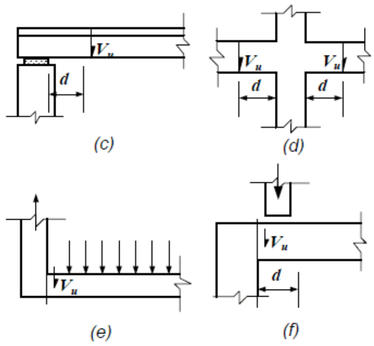

Figure 4. Typical of the conditions of the fulcrum to determine the location of the factored shear force V_u

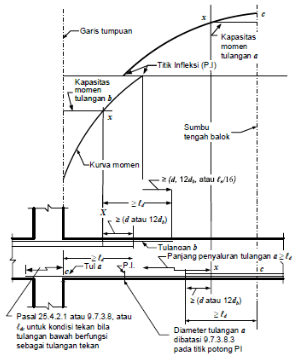

Figure 5. The channeling of bending reinforcement in a typical continuous beam

The principle of concrete slabs

Concrete slabs are structural elements that are generally used to distribute dead loads and live loads to other main structures, such as beams and columns. (Yudha Lesmana, 2020). To plan a reinforced concrete slab that needs to be considered not only loading alone but also the type of laying and the type of link in the fulcrum. The rigidity of the relationship between the slab and the fulcrum will determine the magnitude of the bending moment that occurs on the slab. (Asroni, 2010) For buildings, generally, the slabs are rested by beams in a monolith, that is, the slabs and beams are cast together so that they become one unit, as presented in Figure 7 (a), or are rested by the walls of the building as in Figure 7 (b), Another possibility, namely that the slabs are supported by steel beams with a composite system as shown in Figure 7 (c), or supported by a column directly without a beam, known as a boletus slab, as in Figure 7 (d). The rigidity of the relationship between the slabs and their supporting construction (beams) becomes one part of the planning of the slabs. There are 3 types of placing slabs on beams, which are as follows:

a. Freely Located

This circumstance occurs if the slab is simply placed on the beam, or between the slab and the beam is not cast together, so that the slab can rotate freely on that pedestal (see Figure 6.a). The slabs superimposed by the wall also belong to the category of freely located.

b. Elastic Pinched

This circumstance occurs if the slabs and beams are cast together in a monolith, but the size of the beam is small enough, so the beam is not strong enough to prevent the rotation of the slab (see Figure 6.b).

c. Fully Pinched

This situation occurs if the slabs and beams are cast together in a monolith, but the size of the beams is large enough, so as to be able to prevent the rotation of the slabs (see Figure 6.c).

The provisions on the dimensions of the thickness of concrete slabs are regulated based on SNI 2847-2019, SNI 2847-2019, Article 8.3.1.2, Table 8.3.1.2 states that in determining the thickness of concrete floor slabs that have beams on all sides must be provided in equation 22 as follows:

$\alpha fm \leq 0.2$ .... (22)

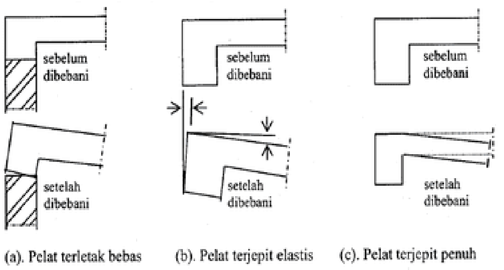

Figure 6. Types of placing slabs on beams

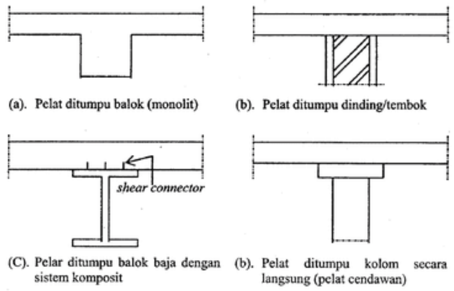

Figure 7. Slab Stacker

RESEARCH METHODS

The timing of the implementation of this

study starts from November 2021 to July 2022, with the location of the research on Prof. Sudarto Tembalang street, Tembalang District, Semarang Java City middle. The research stage carried out is first, explaining the beginning of the research implementation, in the research stage it must be clear in order to get the desired results. The second stage is the collection of primary data, namely architectural and secondary drawings in the form of literature on building structures such as SNI 2847-2020 concerning Procedures for Calculating Concrete Structures for Building Buildings and SNI 1726-2019 concerning Procedures for PlanningEarthquakes for Buildings. The third stage is the modeling of the structure using architectural design. Gravity loads (dead and live loads) are transmitted from the beam slabs and distributed to the columns and structural components are planned until all cross-sections have a minimum plan strength equal to the required strength which is calculated based on a combination of load and factored forces in accordance with the regulations. In the fourth stage, the results of structural modeling in the form of inner forces and structural failure conditions displayed by the ETABS V17.0.1 application are marked in green if the structural conditions are safe and red if the structure condition fails. If the structural elements are declared not strong, then the remodeling design is carried out so that a safe structure is achieved. The fifth stage is the creation of structural drawings (drawings of the location of blocks, drawings of the location of columns, and their details) for application in the field. The data entered in the study must be in accordance with SNI 2847-2022 and SNI 1726-2019. The sixth phase is the creation of a cost nod plan that refers to the unit price in the Semarang City area in 2022. The last stage is the conclusion of the calculation of the cost nod plan and the working drawing (asbuild drawing).

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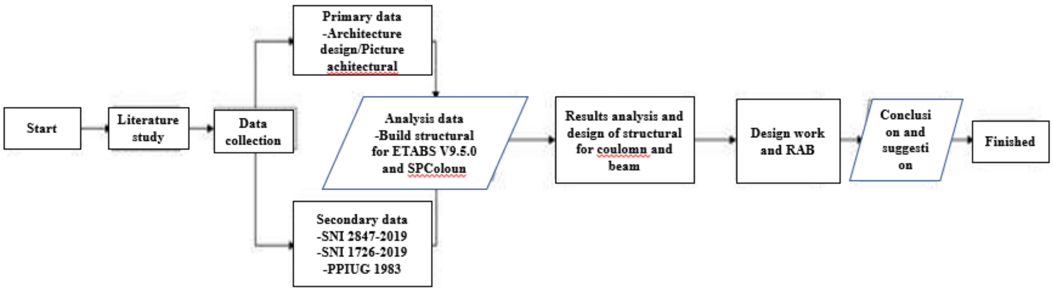


Figure 8. Research FlowChart

RESULTS AND DISCUSSIONS

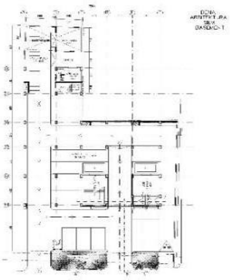
Building Data

The function of the Lill Hajj Wall Umrah Office building is an office building, with a dimension building length of 28.3 meters, a width of the building is 23.35 meters, a total of four floors of reinforced concrete structure, and a concrete deck roof. The material specifications of the new office building structure are concrete quality (fc') 41.5 MPa, melted reinforcing steel quality (fy) 400 MPa (BJTS), and 280 MPa (BJTP). Basement column dimensions 0.6 x 0.6 m, first floor column 0.5 x 0.5, second floor column 0.5 x 0.6 m, third floor column 0.5 x 0.6 m, fourth floor column 0.5 x 0.6 m, rooftop column 0.4 x 0.4 m, parent beam dimensions 0.3 x 0.6 m, child beam beam 0.25 x 0.55 m, Stair beam 0.25 x 0.35 m, roof deck beam 0.25 x 0.3 m and 0.3 x 0.4 m, concrete slab thickness 0.15 m. the basement floor is equipped with praying room driver facilities with an area of 14 m2, Emergency staircase with an area of 10.81 m2, generator room with an area of 15.28 m2, pump room with an area of 15.28m2, parking area with an area of 781.53 m2. The first floor is equipped with VIP room facilities with an area of 33.33m2, a prayer room with an area of 25.87 m2, a toilet with an area of 44.93 m2, a boutique room with an area of 55.22 m2, a warehouse with an area of 12.3 m2, a receptionist with an area of 48.61 m2, and a waiting room with an area of 189.80 m2. The second floor is equipped with a meeting room with an area of 47.9 m2, a manager's room with an area of 36.7 m2, an outdoor lounge with an area of 30.45 m2, a pantry room with an area of 13.49 m2, a toilet with an area of 30.9 m2, a prayer room with an area of 16.08 m2, a boardroom with an area of 80.59 m2, a waiting room with an area of 45m2, and a hallway of 71.25 m2. The third floor is equipped with a toilet with an area of 25.75m2, a prayer room with an area of 23.95 m2, an outdoor lounge with an area of 30.45 m2, and a ballroom of 383.75 m2. The fourth floor is equipped with a toilet with an area of 25.75m2, a prayer room with an area of 23.95 m2, an outdoor lounge with an area of 30.45 m2, a ballroom of 383.75 m2.

Figure 9. Layout buildings

Figure 10. Front view

Figure 11. Side View



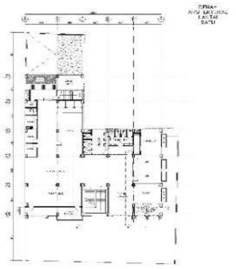


Figure 13. 1st Floor Plan

Figure 14. 2nd Floor Plan

Figure 12. Basement Plan

Figure 15. 3rd Floor Plan

Figure 16. 4th Floor Plan

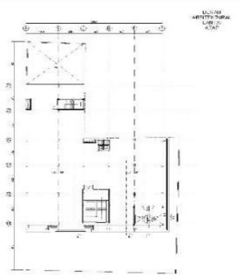


Figure 17. Rooftops and Rooftops

Structural Loading

The loading analysis of the office building structure of PT Lill Hajj Wall Umrah included analysis is an additional dead load, living load, and earthquake load. Dead load in the basement loading analysis = 7.5 kN/m², first floor =11.75 kN/m², second floor 11.75 kN/m², second floor=9.25 kN/m², third floor=9.25 kN/m², fourth floor=9.25 kN/m², rooftop area=1.19kN/m², roof area=25kg/m². live load on the first floor loading analysis=4.79 kN/m², second floor=4.79 kN/m², third floor=4.79 kN/m² fourth floor=4.79 kN/m², rooftop area=4.79 kN/m²,roof area=1 kN/m². Earthquake load refers to SNI 1726-2019 concerning earthquake resistance planning procedures for buildings. The magnitude of the earthquake load value of the plan is taken from the design value of the Indonesian spectra, the value is taken by determining the coordinate points of the research location according to the address and type of rocks around the research site, the data figures are then entered into the analysis with ETABS V17.0.1 modeling. The result of the Indonesian spectra design is that a value is obtained which will later be used in structural modeling. shown in Table 3. The determination of the location of the study using the Indonesian spectra design website is shown in Figure 18.

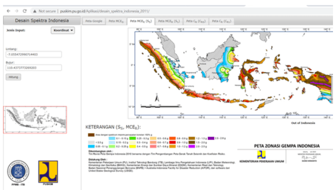


Figure 18. Earthquake zoning map of Indonesia

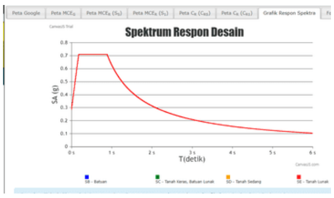


Figure 19. Indonesian Scpecta Design Parameters

Kelas	T0	Ts	Sds	S
SE- Tanah Lunak	0,18	0,89	0,71	0,
Bujur/ Longitude	110,43611729670			
Lintang/ Latitude	-7,05499446813368			
PGA	0,382			
SS	0,8915			
S1	0,3804			
TL	20			

Figure 20. Indonesian Specta Design

After obtaining the required Indonesian spectra design value, an earthquake-resistant structure with an equivalent static load method was planned. The equivalent static loading procedure is regulated based on SNI 1726-2019, Article 7.8.

Plan Structure Modeling

The structural modeling of the office building of PT Lill Hajj Wall Umrah Semarang City uses the ETABS V17 application. 1.0 which includes elements of the structure of columns, beams, and slabs, in the process the structural elements will be given a dead load, a live load, and an earthquake load. Then it produces an output in the form of inner and outer forces that act on the building structure.

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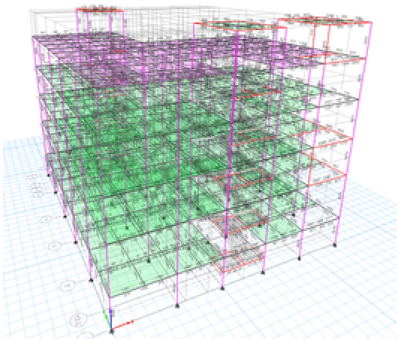

Figure 21. Results of Column and Beam Structure Analysis

The results of structural modeling using the Etabs application showed that there was no overstrength (O/S) in the elements of the column and beam structure, the plan structure was declared safe against inner forces in buildings, then enter the stage of manual calculations for the analysis of elements of blocks, columns, and concrete slabs in order to calculating the reinforcement needs.

Recapitulation of force in beams is shown in Tabel 3.

Table 3. Recapitulation of the inner force on the beam.

No.	Beam	Mu, the Minimum Fulcrum	Mu, Maximum Fulcrum	Mu, Minimum field	Mu, Maximum field	Vu, the fulcrum	Vu, field	Vg, fulcrum	Tu
		(kNm)	(kNm)	(kNm)	(kNm)	(kN)	(kN)	(kN)	(kNm)
1	B1- 0.3 x 0.6 Span 4.4 m	-78,1	104,2	-56,7	60,6	122,3	67,2	17,1	25,3
2	B1- 0.3 x 0.6 Span 4.8 m	-313,6	97,9	-309,4	291,4	47,3	98,9	1,0	13,4
3	B1- 0.3 x 0.6 Span 5.6 m	-219,6	242,6	-58,3	139,7	284,6	120,4	4,7	30,6
4	B1- 0.3 x 0.6 Span 5.15 m	-158,8	212,9	-14,4	12,9	139,8	31,8	9,3	32,4
5	B1- 0.3 x 0.6 Span 6 m	-165,6	201,9	-164,6	140,0	168,9	132,9	9,0	-132,4
6	B2- 0.25 x 0.5 Span 4.4 m	-48,4	87,8	-37,0	73,7	-109,1	52,4	3,8	29,1
7	B2- 0.25 x 0.5 Span 4.8 m	-8,4	-0,5	-14,4	72,0	-31,8	30,1	0,3	18,3
8	B2- 0.25 x 0.5 Span 5.6 m	-8,9	27,8	-15,7	86,3	39,2	37,5	0,4	3,5
9	B2- 0.25 x 0.5 Span 5.15 m	-8,5	22,5	-14,1	70,0	34,2	32,7	0,8	5,5
10	B2- 0.25 x 0.5 Span 6 m	-8,6	28,3	-16,0	83,4	35,8	36,2	1,1	6,6
11	B3- 0.3 x 0.4 Span 4.4 m	-25,2	14,7	-7,4	31,9	41,8	39,4	0,9	18,6
12	B3- 0.3 x 0.4 Span 4.8 m	-76,0	17,6	-14,1	39,7	68,5	65,1	0,9	23,8
13	B3- 0.3 x 0.4 Span 5,150 m	-35,6	12,1	-8,3	34,0	46,3	44,1	0,4	15,1
14	B3- 0.3 x 0.4 Benpliers 6 m	-71,5	15,2	-32,5	49,9	-67,4	64,7	2,7	27,0
15	B4- 0.25 x 0.3 Span 4.4 m	-0,4	4,0	-1,4	11,5	11,3	11,4	0,0	0,2
16	B4- 0.25 x 0.3 Span 4.8 m	-0,3	4,8	-1,2	13,6	-12,4	11,1	0,0	3,1
17	B4- 0.25 x 0.3 Span 5.15 m	-0,6	0,9	-1,7	19,3	2,0	12,6	0,0	0,5
18	B4- 0.25 x 0.3 Span 6 m	-0,8	1,0	-3,0	26,4	-2,4	14,6	0,3	-6,0
19	B5- 0.25 x 0.35 Span 1.5 m	-7,9	16,5	-2,6	2,3	25,0	25,0	1,0	7,1
20	B5- 0.25 x 0.35 Span 2 m	-4,3	8,4	-0,3	2,8	5,6	7,8	0,3	11,0

21	B5- 0.25 x 0.35 Span 2.575 m	-6,8	9,0	-13,6	11,3	13,2	15,1	1,3	8,8
22	B5- 0.15 x 0.35 Span 4.4 m	-23,3	53,4	-123,7	60,6	105,9	129,1	1,3	20,8
23	B5- 0.15 x 0.35 Span 5.15 m	-24,3	24,9	-43,0	22,6	30,4	17,3	2,1	27,2
24	B5- 0.25 x 0.35 Span 6 m	-58,1	99,9	-43,4	26,3	79,2	79,2	0,3	6,2

The following is a detailed picture of the repeating results on the B1, B2, B3, B4 and B5 beams.

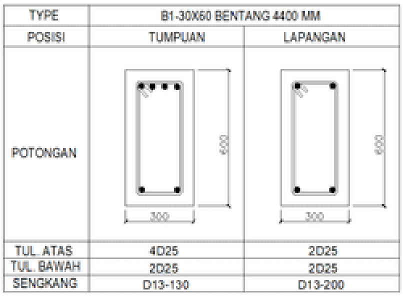

Figure 22. B1- 0.3 x 0.6 Span 4.4 m

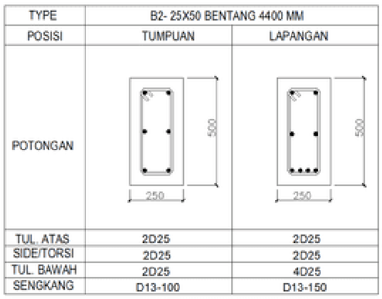

Figure 23. B2- 0.25 x 0.5 Span 4.4 m

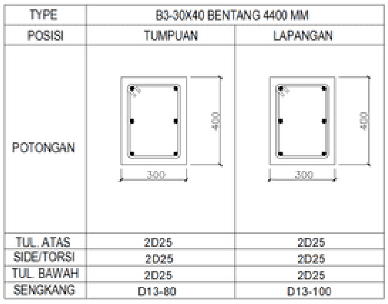

Figure 24. B3- 0.3 x 0.4 Span 4.4 m

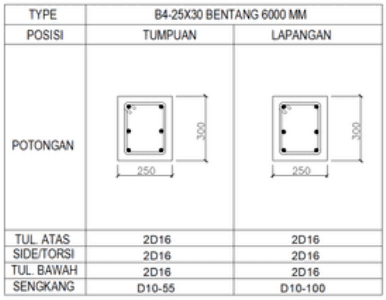

Figure 25. B4- 0.25 x 0.3 Span 6 m

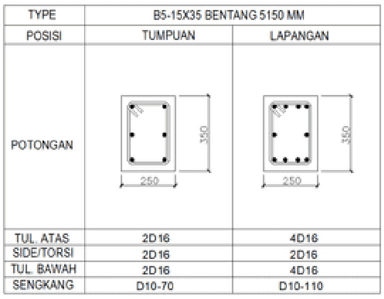

Figure 26. B5- 0.15 x 0.35 Span 5.15 m

Recapitulation Of the forces in the structural column is shown in Table 5.

Table 4. Style styles in columns

Description	P (kN)	V2 (kN)	V3 (kN)	T (kN-m)	M2 (kN-m)	M3 (kN-m)
K1- 0.6 x 0.6 Height 3 m Basement	1075,3876	229,3012	185,9833	83,6906	311,8006	344,541
	-6462,333	-255,2264	-214,3841	-58,9016	-251,2097	-383,5304
K2- 0.5 x 0.6 Height 4.7 m First Floor	626,5008	168,3202	134,9404	11,5112	252,1923	320,0602
	-4972,0339	-168,6514	-188,8903	-16,5197	-285,9403	-293,8469
	298,7319	165,9436	162,803	9,9511	239,1863	311,8238

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K2-0.5 x 0.6Height 3.7 m Second Floor	-3928,0857	-193,2107	-185,9228	-12,1613	-280,475	-287,1294
K2- 0.5 x 0.6 Height 3.7 m Third Floor	141,5776	149,1173	176,9379	7,6949	306,1994	288,5225
	-2577,2555	-223,8395	-181,2269	-9,2064	-251,1631	-405,3801
K2- 0.5 x 0.6 Height 3.7 m Fourth Floor	108,5855	143,2307	159,7803	7,396	324,4699	353,6731
	-1309,0049	-282,5783	-192,3795	-14,5594	-290,0666	-522,3196
K3- 0.4 x 0.4 Height 3 m Rooftop Floor	10,72	117,74	134,13	8,28	165,61	190,69
	-313,5002	-106,278	-142,4029	-3,5746	-213,7739	-124,9349

Based on the results of the column interaction diagram using SPColum, it was found that the column structure can withstand the load on it that works in the building. It is shown that the load point and moment are in the interaction diagram. The recapitulation of analysis results of columns using SPColumn is as follows :
The following is an image of the interaction of columns K1, K2, and K3.

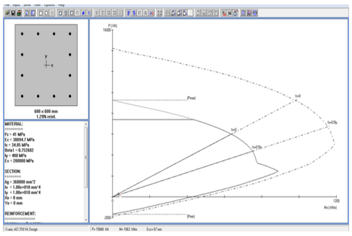

Figure 27. K1 column interaction

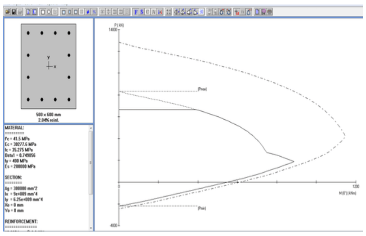

Figure 28. K2 column interaction

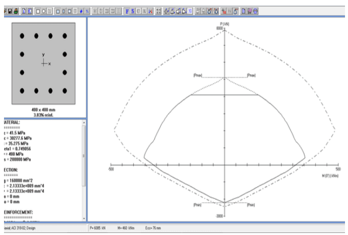

Figure 29. K3 column interaction

The following is a detailed picture of the results of the looping in columns K1, K2, and K3.

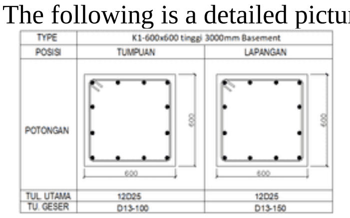

Figure 30. Column K1 looping details.

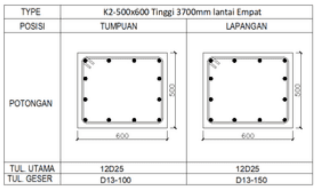

Figure 31. Column K2 looping details.

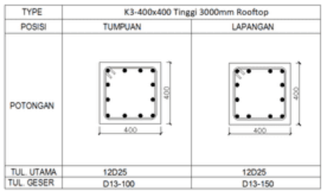

Figure 32. Column K3 looping details.

The following is the result of an analysis of the slab structure and the voltage that occurs on the slab due to a combination of loads.

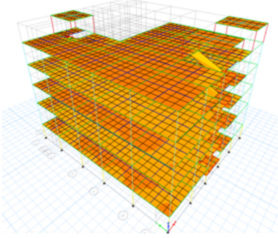

Figure 33. The results of the slab structure analysis

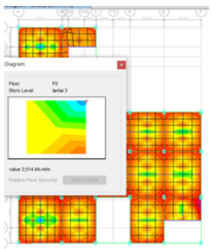

Figure 34. Voltage that occurs on the slabs due to a combination of loads

The calculation of the concrete slab is planned by fixing the two-way slab. Analysis of the concrete slab structure is carried out to determine the required slab repeating by conducting a run analysis, then reviewing the sheel stresses display menu to see the stress that occurs on the slab due to load contamination shown in Figure 33. Then analysis check is carried out against the nominal moment requirement which must be greater than or equal to the ultimate moment using the Ms. Excel application.

Slab Design Data:
Concrete quality (fc') = 30 MPa
Quality of reinforcing steel (fy) = 240 MPa
Obtained Mu (data from ETABS) = 3,514 kN-m
Used plain reinforcement (P) = D10-200 (assumed/trial and error)
Area of used reinforcement (As) = 392.50 mm²
Height of the buffer block (a) = 3.69 mm
Nominal Moment (Mn) = 7,833 kN-m
Condition Ø Mn≥Mu = 7,833 ≥ 3,514 (OK, the slab is capable of receiving loads)

The following is a detailed picture of the repeating of the 0.15 m concrete slab.

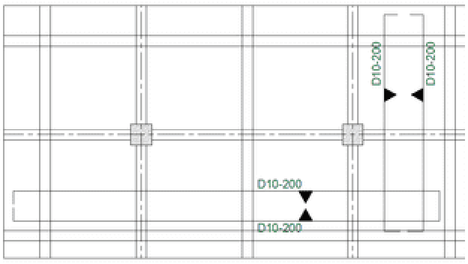

Figure 35. Floor slab 0.15 m

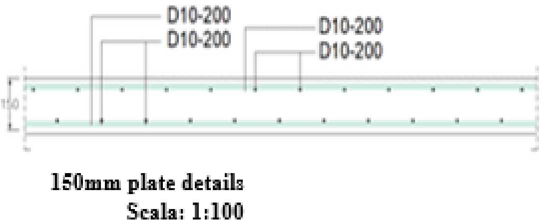

Figure 36. Details 0.15 m floor slab

Cost Budget Plan
Based on the results of the design and design of the upper structure of the new office building of PT. Lill Hajj Wall Umrah Tembalang Semarang Central Java required anggaran costs shown in Table 5. And the Job Schedule
is shown in Table 6.

Table 5. Cost budget plan

No.	Job Description	Sum	Job Weight (%)
1	Basement Shoal Work	214,962,337.33	3.106
2	Basement Cleaning Work	143,428,588.05	2.072
3	Basement Concrete Works	194,823,692.24	2.815
4	First Floor Shoal Work	650,303,677.00	9.397
5	First Floor Cleaning Work	331,772,577.91	4.794
6	First Floor Concrete Works	286,963,963.92	4.147
7	Second Floor Shoal Work	622,536,098.63	8.995
8	Second Floor Finishing Work	314,422,222.52	4.543
9	Second Floor Concrete Works	328,152,680.30	4.742
10	Third Floor Shoal Work	622,536,098.63	8.995
11	Third Floor Cleaning Work	314,422,222.52	4.543
12	Third Floor Concrete Works	328,152,680.30	4.742
13	Fourth Floor Shoal Work	622,536,098.63	8.995
14	Fourth Floor Finishing Work	314,717,601.90	4.548
15	Fourth Floor Concrete Works	328,152,680.30	4.742
16	Rooftop Floor Shoal Work	522,610,772.83	7.552
17	Rooftop Floor Cleaning Work	249,737,948.26	3.609

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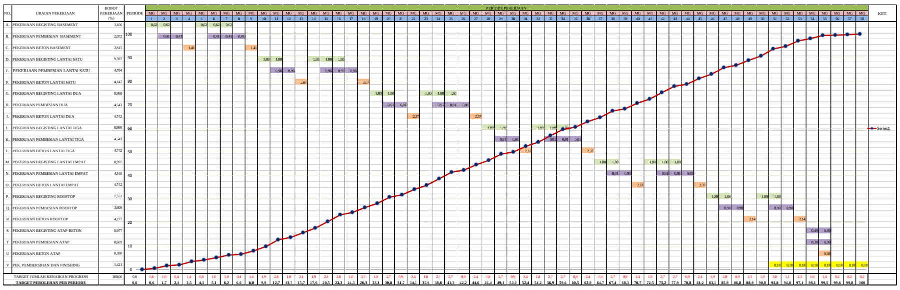
18	Rooftop Floor Concrete Works	295,996,430.03	4.277
19	Concrete Roof Shoal Work	67,585,550.61	0.977
20	Roof Floor Cleaning Work	42,163,033.15	0.609
21	Roof Floor Concrete Work	26,292,264.47	0.380
22	Pek. Cleaning And Finishing	98,317,800.00	1.421
Sum		**6,920,587,019.52**	**100**
Contractor Services And *Over Head* 10%		**692,058,701.95**	
Grand Total		**7,612,645,721.47**	

Source: Personal Analysis Results

Table 6. Time schedule plan for construction of new office



Source: Personal Analysis Results

CONCLUSION

Based on the results of the analysis, the travel company PT. Lill Hajj Wall Umroh needs a meeting room or ballroom covering an area of 524.31 m² to serve pilgrims every month in 2030. Based on the analysis of the old office building cannot accommodate congregations in 2030 because the old office is only a two-story shophouse with an area of 119 m2 which only fits 99 congregations, a new office building is needed to meet consumer needs in 2030. The resulting analysis of the structure of the new office building according to SNI obtained the dimensions of the building 28.30 meters long 23.35 meters wide by four floors, with a reinforced concrete structure, and a concrete deck roof. The material specifications of the new office building structure are concrete quality (fc') 41.5 MPa, melted reinforcing steel quality (fy) 400 MPa (BJTS), and 280 MPa (BJTP). Basement column dimensions 0.6 x 0.6, first floor column 0.5 x 0.6 m, second floor column 0.5 x 0.6 m, third floor column 0.5 x 0.6 m, fourth floor column 0.5 x 0.6 m, rooftop column 0.4 x 0.4 m, parent beam dimensions 0.3 x 0.4 m, child beam 0.25 x 0.5 m, Stair beams 0.25 x 0.35 m, roof deck beams 0.25 x 0.3 m and 0.3 x 0.4 m, concrete slab thickness 0.15 m. Budget plan for the construction of the pt office superstructure construction. Lill Hajj Wall Umrah is Rp. 7.612.645.721.- and planned requires a construction work process of 58 weeks or 405 days.

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