STRUCTURAL DEVELOPMENT OF MOSQUE BUILDING BASED ON ADDITIONAL CAPACITY OF PRAYER ROOM

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ABSTRACT

Mosques serve as a place of worship and foster Muslims who live around the mosque, so the function of this can give a positive impact for Muslims' life. Mosques also function as a place for developing people's activities from the time of Prophet Muhammad to the present. It certainly plays important roles so the condition of the mosque, especially the interior, needs to have comfort element in order to get more solemnity when carrying out those activities. Mosque Al-Hidayah is located in Kampung Belentuk RT 001 RW 001, Kelurahan Cimahpar, Kecamatan Bogor Utara, Kota Bogor. This Belentuk village area has a land area of 23 hectares with a Muslim population of 1571 and 807 of them are men. This village has three mosques which Masjid Al-Hidayah is one of them. At this time, mosque Al-Hidayah has land area of 339 m2 with a building area of 128,9 m2 so that the room capacity can only accommodate 106 people. The number of men of Kampung Belentuk are divided into those three mosques of the village, even so, Mosque Al-Hidayah is not able to accommodate the number of people especially on Friday prayer because the number of worshipers is more than the current capacity of the mosque. The result of the analysis shows the need for prayer space is 330 m2 to accommodate 270 worshipers in prayer activities, especially Friday prayers, then the result of the analysis of the existing concrete structure were carried out by means of a concrete bounce test using the Hammer test, it is known that the average value of the concrete quality in the column is fc'=13.34 MPa, the block is equal to fc'=14.41 MPa. It indicates that the quality of the existing concrete of the Al-Hidayah Mosque does not meet the requirements of SNI 2847-2019 Article 19.2 concerning the minimum allowable normal concrete quality, then the design is carried out according to space requirements and a structural analysis is carried out on the planned design. The planned design is based on the existing space and land requirements which are 15 m x 14 m with a height of 3.5 m per floor and structural analysis is declared safe.

Keyword: prayer room capacity; design and structural analysis; mosque building.

Received:	Revised:	Accepted:	Available online:
2021-08-25	2021-10-09	2021-12-07	2022-01-08

INTRODUCTION

Mosque buildings as a place of worship for Islam are scattered in almost all parts of the archipelago, both in urban and rural areas with various shapes, sizes and scales. Buildings that have a small size with the smallest service scale at the local settlement level at the level of the Rukun Tetangga (RT) or Rukun Warga (RW) are known as prayer rooms, at the kelurahan level it is known as the grand mosque and at the state level it is known as the state mosque. The mosque functions as a place of worship for prayer and protects and fosters the people or congregation around the mosque, so the function of the mosque has a positive impact on the lives of the congregation. The mosque also functions as a place for fostering the activities of the people whose development from time to time from the time of the Prophet Muhammad until now plays a very important role. This is marked by the existence of a culture that has taken root in the life of the Muslim community, the first and foremost being the establishment of a mosque. The condition of the mosque, especially the inner room, should have an element of comfort, so that worship activities can be carried out more solemnly (Nur Rahmawati, 2013).

Al-Hidayah Mosque is located in Belentuk Village, RT 001 RW 001, Cimahpar Village, North Bogor District, Bogor City. Based on demographic data in 2020 Cimahpar Village, the area of Kampung Belentuk has a land area of 23 hectares with a Muslim population of 1571 people and the number of mosques has 3 buildings, one of which is the Al-Hidayah Mosque. Currently, Al-Hidayah

pISSN 2302-4240
eISSN 2655-2086

Volume 11, Issue 1, February 2022, pp.30-39
DOI: http://dx.doi.org/10.32832/astonjadro.v11i1

Mosque has a land area of 339 m2 with a building area of 128.9 m2, so that it can accommodate as many as 106 worshipers. Based on this data, the number of worshipers is divided into three mosques located in the Belentuk Village area, but the current condition is that the capacity of the Al-Hidayah Mosque has not been able to accommodate the number of worshipers, especially for Friday prayer activities, considering the number of worshipers is more than the current capacity of the mosque. .

Based on these problems, building development in the form of design and planning of building structures is carried out to accommodate and create comfort in the worship space which refers to the regulations of SNI-1726-2019 concerning Earthquake Resistance Planning for Buildings, and SNI 2847-2019 concerning Requirements for Structural Concrete for Buildings and SNI 03-1733-2004 concerning Procedures for Planning the Urban Housing Environment.

In fact, a sturdy building with added materials including strong forming materials. The strength of a building is determined by the shape, quality of the material and the proper working of concrete mixing. Accuracy of mixing and mixing will ensure the quality of the concrete will be better and stronger. The strength of the concrete is determined by the water content, the type of mixture and the added materials used in accordance with the dose determined by the SNI on mixing concrete for structures (Sinabariba D.et.al, 2021; Prastowo I, 2020; Lutfi M and Maulana A, 2020; Lutfi M and Mulyadi EB, 2021; Syaiful S, 2021; Syaiful S, 2020; Sutarno S,et.al, 2021; Bagio TH, et.al, 021).

RESEARCH METHODS

This research was conducted in Belentuk Village, RT 001 RW 001, Cimahpar Village, North Bogor District, Bogor City, the implementation of this research started from August to October 2020.

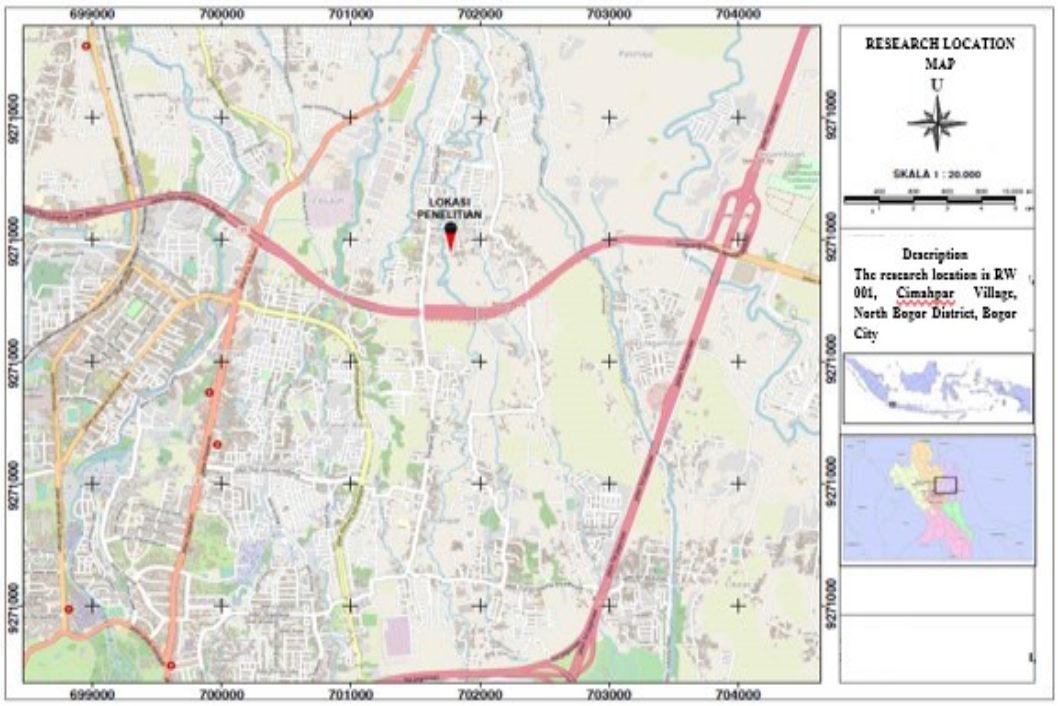

Figure 1. Research Location Map (Source: Analysis Results)

The stages of this research are shown in the form of a flow chart as follows:

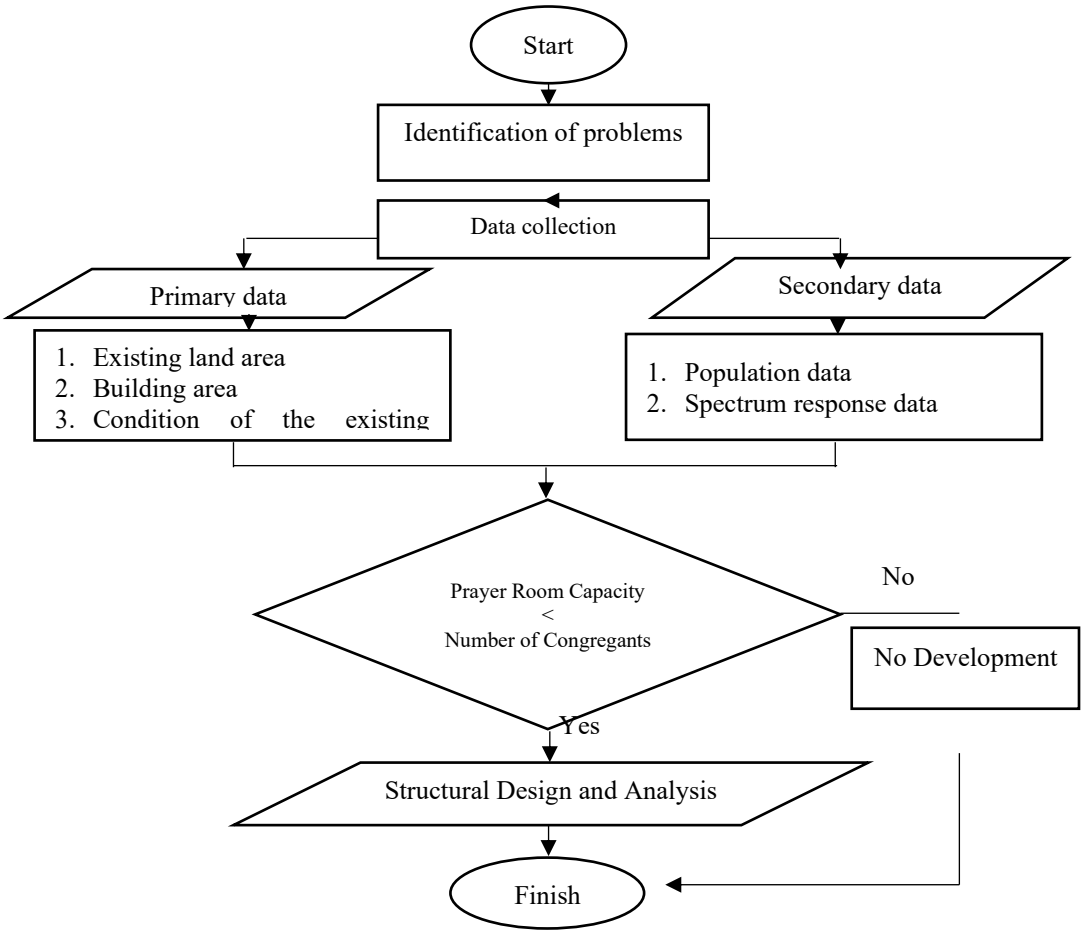

Figure 2. Research Flowchart (Source: Analysis results)

RESULTS AND DISCUSSION

Analysis of existing buildings

The existing condition of Al-Hidayah Mosque

The land area is 339 m2 which consists of a mosque building covering an area of 88 m2, a madrasa building covering an area of 53 m2, and supporting facilities such as ablution places, bathrooms, terraces and other buildings covering an area of 191 m2. The existing plan is shown in Figure 3.

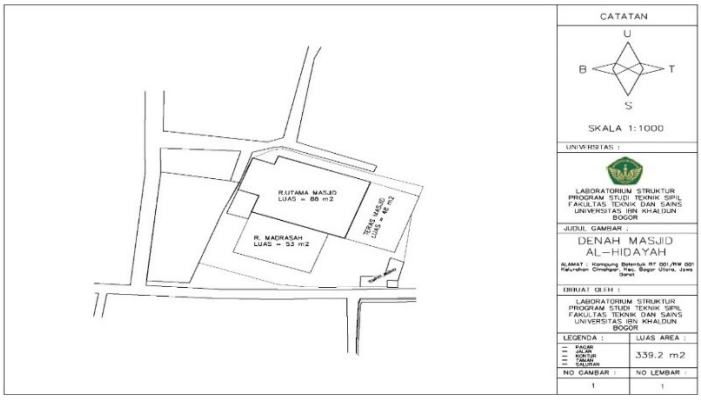

Figure 3. Situation map of Al-Hidayah Mosque (Source: Analysis Results)

pISSN 2302-4240
eISSN 2655-2086

Volume 11, Issue 1, February 2022, pp.30-39
DOI: http://dx.doi.org/10.32832/astonjadro.v11i1

Analysis of prayer room capacity

Calculating the capacity of the prayer room of Al-Hidayah Mosque based on SNI 1733-2004 Article 7.3.4 where each congregation needs 1.2 m2.

Room capacity = (area of the room)/1.2

= 128/1.2

= 106 worshippers

Space requirement analysis

The need for space for prayer, especially for Friday prayer activities, is obtained from the following table:

Table 1. Total Muslim population of RW 001 Cimahpar Village

Year	Total male population (person)
2016	754
2017	684
2018	678
2019	730
2020	807

(Source: Report on the Number of Population Statistics in Cimahpar Village)

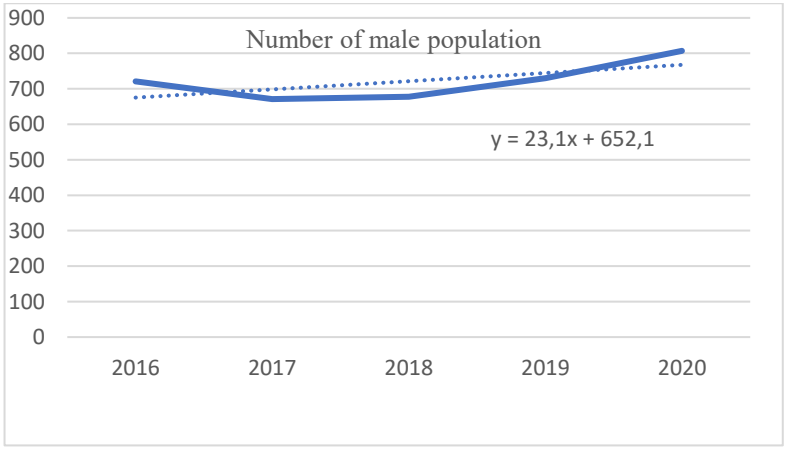

Figure 4. Linear regression equation graph (Source: Analysis Results)

From the graph results, it can be calculated the prediction of the male population in 2030 using the formula Y= 15.2x+685.

So, the need in 2030 is (15.2 x 10) + 685 = 837 worshipers with the assumption that it is spread over three mosque buildings in Belentuk Village, so the average number of worshipers in each mosque is 279 people.

Existing concrete quality test Pemeriksaan

Examination of the existing structure of the Al-Hidayah Mosque building is carried out by means of a reflection test using a Hammer test to determine the quality of the existing concrete. The results of the Hammer test on Al-Hidayah Mosque concrete are shown in Table 2.

Table 2. Existing concrete quality test

1.	Concrete quality		
	Concrete Quality (fc')	=	30 MPa
2.	Steel Quality		
	BJTD steel quality (fy)	=	400 MPa
	BJTP steel quality (fy)	=	240 MPa
3.	Column Dimension	=	40 x 40 cm, 35 x 40 cm
4.	Beam Dimension	=	30 x 60 cm, 25 x 50 cm, 20 x 25 cm, 15 x 25 cm
5.	Plate Dimension	=	Thick 15 cm

(Source: Analysis results)

The results of the concrete test examination show that the average value of the existing concrete quality for the columns and beams does not meet the requirements of SNI 2847-2019 Article 19.2 regarding the minimum allowable normal concrete quality, so a redesign and structural analysis of the existing building and land area is carried out.

Design and analysis of planned building structures

Design

The land area of Al-Hidayah Mosque is 339 m2, the planned building area is 15 x 14 m2, while the preliminary design is shown in table 3. The 3D design is shown in Figure 5.

Figure 5. Al-Hidayah Mosque Design (Source: Analysis Results)

pISSN 2302-4240
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Volume 11, Issue 1, February 2022, pp.30-39
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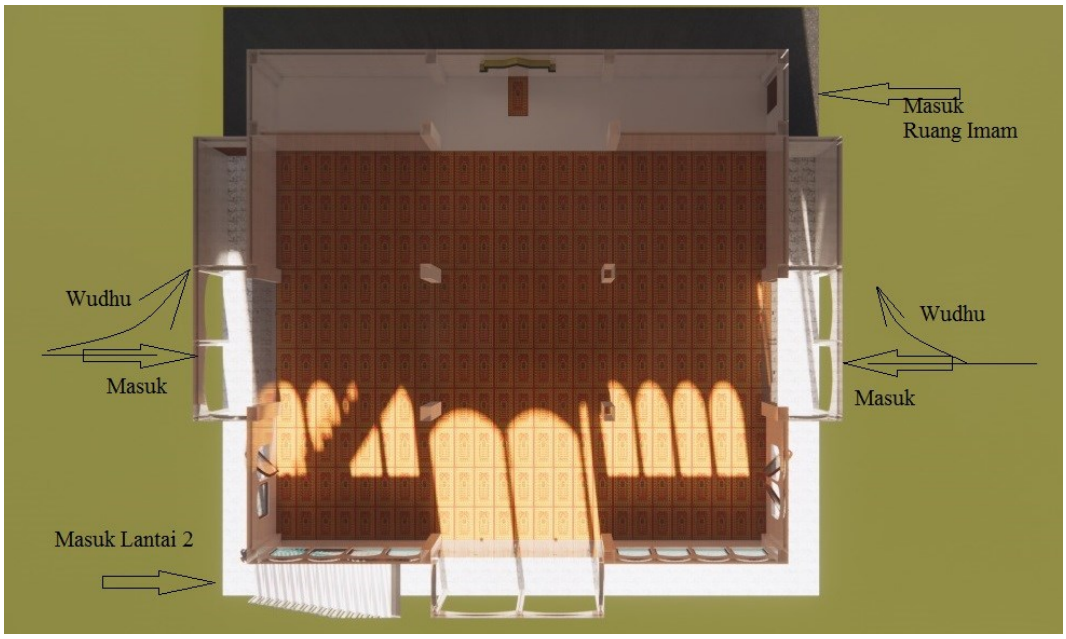

Figure 6. Floor plan 1 (Source: Analysis Results)

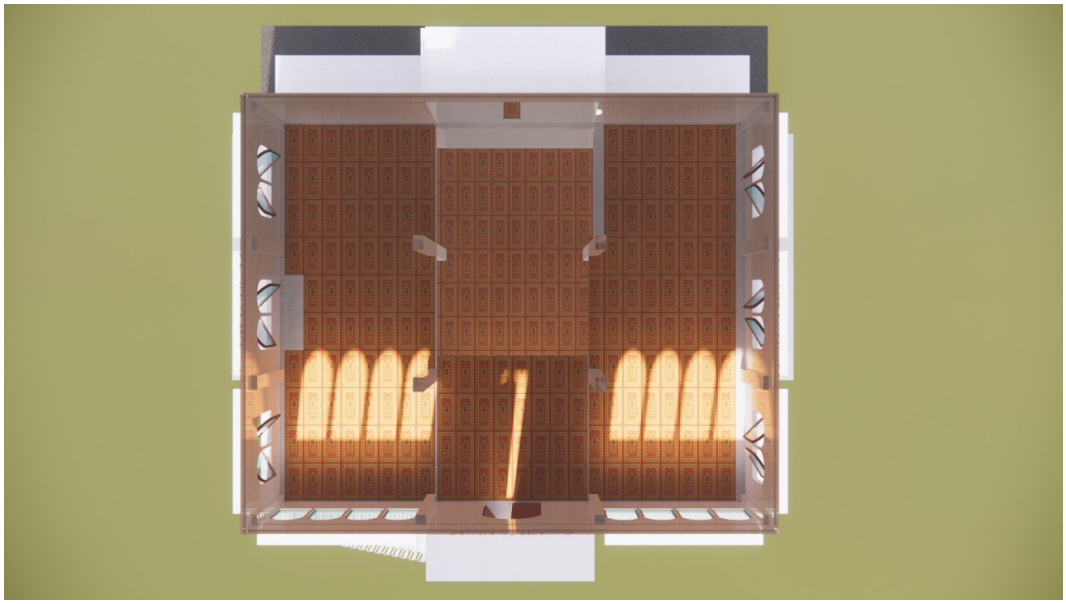

Figure 7. Floor plan 2 (Source: Analysis Results)

Structural analysis

The structural modeling is shown in Figure 6.

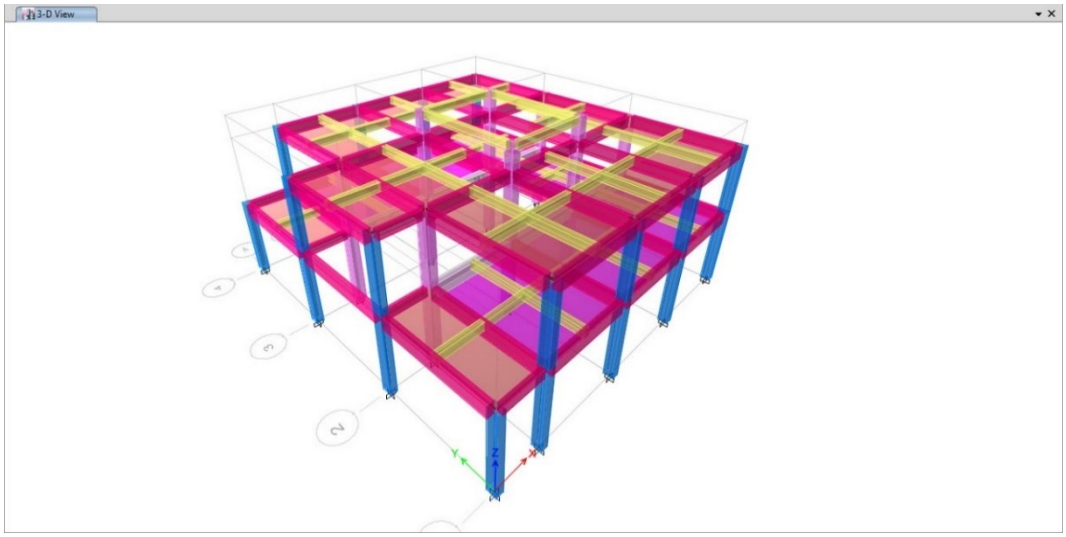

Figure 8. Al-Hidayah Mosque Design (Source: Analysis Results)

Dead load and live load

The analysis is carried out by entering data on dead loads and live loads that work on the building structure, these loads can be seen in table 3.

Table 3. Loading

1. Dead Load			
A. 1 cm thick sand load	=	0,01 X 16 =	0,16 kN/m^2
Specific load 3cm thick	=	0,03 x 22 =	0,66 kN/m^2
Ceramic load 1cm thick	=	0,01 x 22 =	0,22 kN/m^2
Weight of waterproofing with 2 cm thick asphalt	=	0,02 x 14 =	0,25 kN/m^2
Ceiling and hanger loads	=		0,2 kN/m^2
ME installation weight	=		0,25 kN/m^2
B. Load of masonry wall stone = 3.5 x 2,5	=	3,5 x 2,5 =	8,25 kN/m^2
2. Live Load			
A The living burden of the mosque's main room	=		4,79 kN/m^2
B. Live load on dak plate	=		0,96 kN/m^2

(Source: Analysis results)

Earthquake Load

Analysis of dynamic seismic load response spectrum is determined by the design earthquake acceleration and the total mass of the structure. In structural analysis of earthquake loads, the mass of the building greatly determines the magnitude of the inertial force due to the earthquake. Then the additional mass includes the mass due to the additional dead load and the live load which is reduced by a reduction factor of 0.25. Earthquake acceleration taken from zone 4 earthquake data (SNI-1726-2019) is shown in Figure 7. The design of the spectrum response curve is taken according to the research location shown in Figure 8.

ASTONJADRO: CEAESJ

pISSN 2302-4240
eISSN 2655-2086

Volume 11, Issue 1, February 2022, pp.30-39
DOI: http://dx.doi.org/10.32832/astonjadro.v11i1

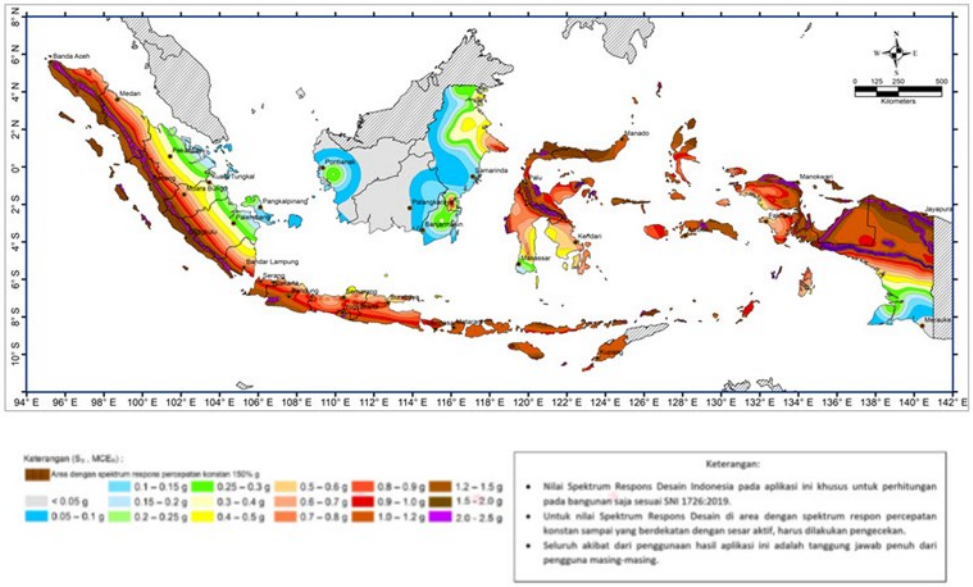

Figure 9. Earthquake zoning map (Source: http://rsa.ciptakarya.pu.go.id/2021/)

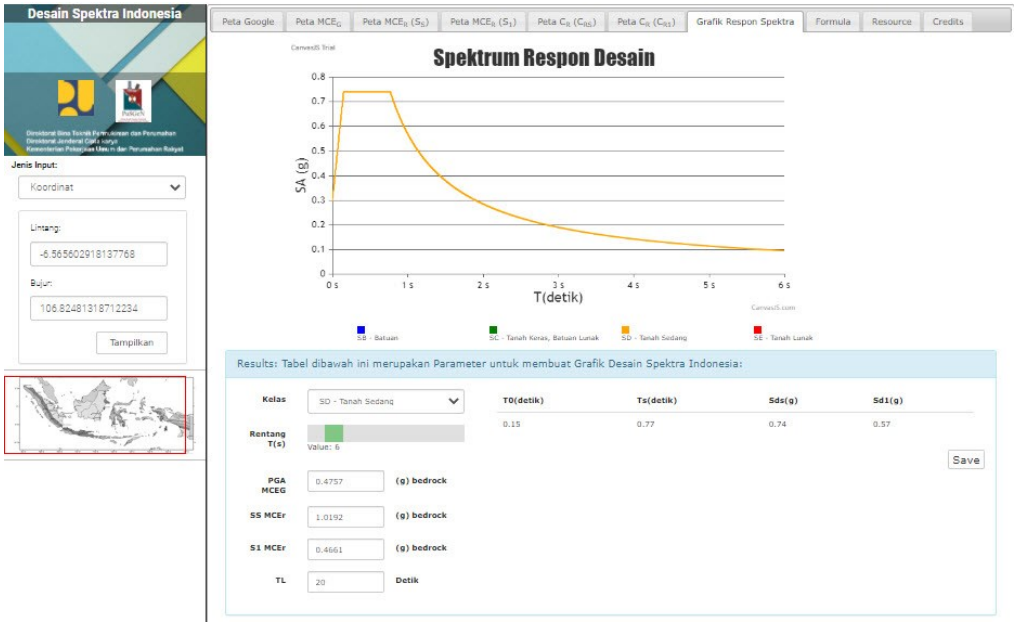

Figure 10. Spectrum response curve (Source: http://rsa.ciptakarya.pu.go.id/2021/)

Load combination

Table 3. Combination of loads

1	U =	1,4 D	8	U =	0,9 D + 1,0 Ex - 0,3 Ey
2	U =	1,2 D + 1,6 L	9	U =	0,9 D - 1,0 Ex + 0,3 Ey
3	U =	1,2 D + 1,0 L + 1,0 Ex + 0,3 Ey	10	U =	0,9 D - 1,0 Ex - 0,3 Ey
4	U =	1,2 D + 1,0 L + 1,0 Ex - 1,0 Ey	11	U =	1,2 D + 1,0 L + 0,3 Ex + 1,0 Ey
5	U =	1,2 D + 1,0 L-1,0 Ex+0,3 Ey	12	U =	1,2 D + 1,0 L + 0,3 Ex - 1,0 Ey

6	U =	1,2 D + 1,0 L - 1,0 Ex - 0,3 Ey	13	U =	1,2 D + 1,0 L - 0,3 Ex + 1,0 Ey
7	U =	0,9 D + 1,0 Ex + 0,3 Ey	14	U =	1,2 D + 1,0 L -0,3 Ey -1,0 Ey

Where :

U = Strong need

D = Dead load

L = Live load

Ex = Earthquake load x . direction

Ey = Earthquake load direction y

Structural analysis results

The results of the analysis can be concluded that the structural elements are safe against earthquake loads and gravity loads, indicated by the column and beam structural elements that do not experience over strength (O/S).

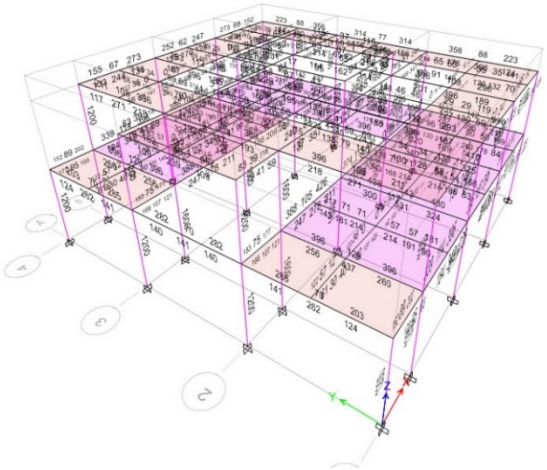

Figure 11. Results of structural analysis (Source: Analysis results)

CONCLUSION

The results of the analysis show the need for a prayer room of 330 m2 to accommodate 270 worshipers in prayer activities, especially Friday prayers, and the results of the analysis of the existing concrete structure carried out by means of a concrete reflection test using a Hammer test, it is known that the average value of the concrete quality in the column fc'=13.34 MPa, beams of fc'=14.41 MPa indicate that the quality of the existing concrete of Al-Hidayah Mosque does not meet the requirements of SNI 2847-2019 Article 19.2 concerning the minimum allowable normal concrete quality, so planning is carried out with a broad design the room is 15 mx 14 m2, and the height per floor is 3.5m with a total of 2 floors.

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