International Journal of Civil Engineering and Infrastructure
Vol. 1, No. 1, March 2023

EVALUATION STUDY OF BOGOR MARKET BUILDING STRUCTURE DUE TO THE ADDITION OF DEAD LOAD FROM RENOVATION

Muhamad Lutfi[1], Subtoni[1]
[1]Civil Engineering Study Program, Ibn Khaldun Bogor University, Indonesia
Correspondence email: mlutfi@ft.uika-bogor.ac.id
Received November 18, 2022 | Accepted December 23, 2022

ABSTRACT

Bogor Market building until now is still operating in serving trade and sale and purchase transactions of various kinds of community needs in Central Bogor and surrounding areas to maintain market conditions, renovations are needed, one of which will currently be carried out in Bogor market is to renew the floor tiles on the ground floor, 1st floor and 2nd floor, but, thus it is necessary to conduct a study to determine whether the structure of the building is still strong to withstand the load on it after experiencing the addition of the load, from the results of field observations obtained from the addition of the thickness of the mortar is as high as 5 cm in accordance with PPURG load weight for mortar is 21 kg / m² then obtained the addition of a load of 5 x 21 kg is 105 kg/m² with analysis using softwere Etabs obtained the maximum moment value on the beam of 204.076 KNm then the required reinforcement needs of 1315 mm², after the value of the maximum moment and the need for reinforcement obtained then compared with the moment and the need for existing reinforcement, it can be concluded that all the beams of the X-axis direction (longitudinal direction) are able to withstand the load on it, while for the Y-direction beams can not withstand the load on it, due to the additional load so that the need for reinforcement is needed more. Then the recommendations given are due to the need for reinforcement on the Y axis is not sufficient, it is recommended the addition of steel plates as a substitute for the need for reinforcement to withstand the load after renovation.

Keywords: *Etabs, market, and renovations.*

1. PRELIMINARY

Trade and shopping centers in the city of Bogor from year to year is growing. In terms of quantity, small trade businesses until 2012 still dominated the trade sector of Bogor city. In 2012, the number of small trading companies reached 8,216 entrepreneurs or 83.02 percent (Bogor City in Figures, 2012). The location of the small-scale trading business including traditional and modern markets, and Bogor market is one of the trading business locations in the city of Bogor which has long been established because it has existed since 1990.

Bogor Market building until now is still operating in serving trade and sale and purchase transactions of various kinds of community needs in Central Bogor and surrounding areas, but at this time it is considered less optimal in terms of comfort, safety and feasibility as a market building that serves to provide all the facilities that support all transactions of buying and selling and trading in the city of Bogor in general.

Based on Law No. 28 of 2002 on building in Article 3 states that to realize a building that is functional and in accordance with the layout of the building that is harmonious and in harmony with its environment, must ensure the reliability of the building in terms of safety, health, comfort and convenience.

To maintain market conditions, renovations are needed, one of which will currently be carried out in Bogor market is to renew the floor tiles on the ground floor, 1st floor and 2nd floor, but the work is done by not dismantling the existing floor ceramic conditions so that it will make the load conditions on the floor increase, especially the dead load on the building, thus it is necessary to conduct a study to determine whether the structure of the building is still strong to withstand the load on it after experiencing the addition of the load.

2. ACTIVITY OVERVIEW

Study Location

The location of the study was conducted in Bogor market Jl. Wheel No. 50 Central Bogor Bogor market was established around 1770 during the reign of the Dutch Governor General named Petrus Albertus van Der Parra. From time to time the Bogor market underwent various changes and renovations in 1989 the Bogor market was rebuilt to build its structure so that a building was formed that is still maintained, the Bogor market has a 5-storey building intended entirely for stalls, but in 2017 the Bogor market underwent renovation on the floor where the change of ground floor ceramics, 1st floor and 2nd floor was made. The following data Bogor market:

a. Building area	= 29.085 m^2
b. Land area	= 5,832 m^2
c. Number of floors	= 4 floors and 1 Ground Floor

d. Allocation per floor;
- Ground floor = other vegetable, meat and seasoning stalls
- 1st floor = grocery kiosk
- 2nd Floor = Clothing kiosk
- 3rd floor =not functioning (renovation stage)
- 4th floor = car and motorcycle parking

Stages of Work

The study conducted is research with quantitative descriptive analysis method by processing descriptive data and quantitative data. Descriptive Data in the form of; supporting documents, field notes, photographs and interviews. Quantitative Data in the form of; Count, size figures,quantified recording.

Broadly speaking, the steps taken in conducting the study are as follows:

a. Determining the study is the analysis of the structure of the Bogor Market building due to the addition of the burden of renovation. Components used as a reference for building reliability are taken based on PP 36 of 2005 on building SLF. Make the background, purpose and objectives of the study, the benefits of the study, the scope of discussion. Background is based on facts on the ground, laws and government regulations.

b. Conducting a literature review that supports the study of the physical feasibility of the building in terms of building reliability, with a case study of Bogor Market Building.

c. Collect physical and non-physical data related to the topic, in the form of:

i. Primary Data

- Get technical Data by observing directly to the field (field survey)to get physical data on the existing condition of the Bogor Market Building. Data collection is done by recording techniques, photo documentation, and measurement. Measurements were made with a meter to calculate the area and perform a concrete test to determine the type of concrete characteristics of the building.
- Conduct interviews with relevant parties. Related parties consist of decision makers, on the technical part of the building. The interview aims to verify field data related to the reliability of the building.
- Perform data collection on the structural elements of the building Bogor market to

determine the uniformity of the quality of the concrete surface by means of a test without damaging the hammer test (hammer concrete) that can be used to test and evaluate the hardness of the concrete surface.

- Test the dimensions of the structure on beams, columns and floor slabs.
- Measuring the dimensions and number of reinforcement in the structure of beams, columns and plates on the floor.

ii. Secondary Data

- Picture Data of market area
- Indonesian national standard (SNI) and regulations relating to SLF and building reliability Support Systems.
- Data or other information about the evaluation of the strength of the building that can be obtained from books and websites.

d. Perform data analysis

- Analyze the sub-components in the SLF building that match the sub-components contained in the Bogor Market Building. Analysis is done by step:
- Comparing the sub-components contained in the SLF building with sub-components contained in the Bogor Market Building. Sub components-sub components that are analyzed is a constituent of the main components of the building. The five main components of the building include structural components, and utilities it is carried out by scenarios before and after renovation.
- If the sub-components in the SLF building component group with sub-components in the Bogor Market Building are in accordance, there is no need for re-weighting. All sub-components in the SLF building component group and their value weights can be directly used on the reliability of the Bogor Market Building.
- Analyzing the test data from the hammer test tool to determine the uniformity of the quality of concrete on the surface of the building Bogor Market Building.
- Taking data on the number and dimensions of reinforcement used by each part of the structure of columns, beams and floor slabs, in order to determine the tensile strength of the structure of beams, columns and floor slabs with structural strength analysis before and after the renovation of the Bogor market building.

e. Make conclusions based on the results of data analysis and develop recommendations that can be used as one of the inputs for the market manager in this case PD Pasar Pakuan Jaya Bogor in determining the next policy.

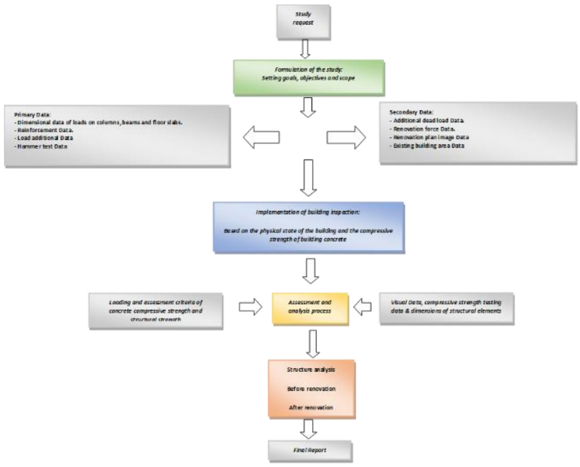


Figure 2.1 Study Flow Diagram

3. BASIC THEORY

Meaning of Building

A building is a physical form of construction work that integrates with its place of position, partially or completely above and/or in the ground and/or water, which serves as a place for humans to carry out their activities, whether for housing or residence, religious activities, business activities, social activities, culture, or special activities.

Public buildings are buildings whose function is for the public interest, in the form of religious functions, business functions, and social and cultural.

Certain buildings are buildings that are used for public purposes and special function buildings, which in their construction and/or use require special management and/or have a certain complexity that can have an important impact on society and the environment.

Function of Building

The function of the building is the provision of compliance with the technical requirements of the building, both in terms of building layout and environment, as well as the reliability of the building. Building functions include residential functions, religious functions, business functions, social and cultural functions, and special functions. In one building the building can have more than one function as referred to in the functions mentioned above.

Examination of the structural strength of a building is considered important and is an obligation for building managers, on the basis of the following:

a. Building owner/user request;

b. A change in function, load changes, or changes in The Shape of the building;

c. The existence of damage to buildings due to disasters such as earthquakes, tsunamis, fires, and / or other disasters; or

d. There are community reports of buildings that are indicated to endanger the safety of the community and the surrounding environment.

Methods commonly used in the examination of the concrete construction of a building there are two types, namely:

a. Methods of examination without damage (Non-Destructive Test). Non-destructive inspection method is a method of testing concrete / steel construction by not destroying structural elements for test sampling or direct testing in the field. Classified in this type of testing include hammer testing, ultrasonic and others.

b. Destructive testing (DT). Destructive inspection is a test of concrete/steel construction by destroying structural elements.

The type of loading that must be taken into account in the planning of this building is vertical load. Analysis of the main structure is a combination of loading in accordance with the provisions of SKSNI 1991, for the vertical load is divided into 3, namely:

a. Dead load, which is the weight of all fixed parts of the building including all additional elements, finishing, machinery or fixed equipment that is an integral part of the building.

b. Living expenses, which include all expenses incurred due to the use of the building and therein including loads on the floor derived from goods, machinery and equipment that are not an integral part and can be replaced during the lifetime of the building the amount of living expenses that work depends on the functional of the building or floor (PPI 1983 articles 3.1 and 3.2).

c. Earthquake load, that is, it includes all the loads that act on the structure caused by soil movements that are the result of earthquakes (whether tectonic or volcanic earthquakes) that affect the structure.

Structural analysis is carried out in 3 (three) dimensions with Etabs software gravity load and earthquake load will be applied to the structural system and with a certain combination of loading it will produce dimensions and reinforcement of building structures. Dynamic load (earthquake) analysis of spectral response values is shown in Table 3.5.

Table 3.1 Spectral Response Values

Time T (seconds)	C (g)
0	0,34
0.2	0,85
1	0,85
2	0,425
3	0,283
4	0,213

(Source: columns, foundations and T-beams, Ali Asroni)

and or axial, used = 0.65

- Determinants of earthquake load

Earthquake load used in planning, can be determined by the analysis of equivalent static load using the formula in the following equation (SPKGUSBG-2002):

$$V = \frac{CI}{R} . W_t$$

with :

V = total horizontal base shear force due to earthquake, [kN]

C = earthquake response factor

I = store priority factor

R = earthquake reduction factor
Wt = total weight (total dead weight and reduced vertical live load) [kN]
In this research modeling is done with software Extended three dimensional analysis of building systems (Etabs) is a software used to perform analysis and design on the structure of the building,. with an easy-to-use interface and tools, Etabs software will help in analyzing and designing building structures, which were done manually for a relatively long time and their accuracy is not guaranteed. Creation of structural models in Etabs software, modeled in 3 Dimensions by inserting structural elements in the form of columns, beams and plates, each structural element is depicted with a grid system with the center of The AXIS at the location of the center of mass of the building on the ground floor.

4. RESEARCH RESULTS AND DISCUSSION

Analysis of Loading On Building Before Renovation

Dead load (DL)

a. Dead Load On The Floor Slab
i. Ground Floor
- Ceramic weight = 24 Kg / m^2 = 24 Kg/m^2
- Mortar weight = 3 cm x 21 Kg / m^2 = 63 Kg/m^2
- Mechanical and electrical weight = 17 Kg/m^2
= 104 kg/m^2
ii. 1st floor
- Ceramic weight = 24 Kg / m^2 = 24 Kg/m^2
- Mortar weight = 3 x 21 Kg/m^2 = 63 Kg/m^2
- Mechanical and electrical weight = 17 Kg/m^2
= 104 kg/m^2
iii. 2nd floor
- Ceramic weight = 24 Kg / m^2 = 24 Kg/m^2
- Mortar weight = 3 x 21 Kg / m^2 = 63 Kg/m^2
- Mechanical and electrical weight = 17 Kg/m^2
= 104 kg/m^2
iv. 3rd floor
- Ceramic weight = 24 Kg / m^2 = 24 Kg/m^2
- Mortar weight = 3 x 21 Kg/m^2 = 63 Kg/m^2
- Mechanical and electrical weight = 17 Kg/m^2
= 104 kg/m^2
v. 4th floor
- Ceramic weight = 24 Kg / m^2 = 24 Kg/m^2
- Mortar weight = 3 x 21 Kg/m^2 = 63 Kg/m
= 87 kg/m^2
b. Dead load on beam
i. Ground Floor
- Load-bearing wall masonry ½ brick height 3.8 m = 250 x 3.8 = 950 Kg/m^2
- Load-bearing wall masonry ½ brick height 1 m = 250 x 1 = 250 kg/m^2
ii. 1st floor
- Load-bearing wall masonry ½ brick height 3.8 m = 250 x 3.8 = 950 Kg/m^2
- Load-bearing wall masonry ½ brick height 1 m = 250 x 1 = 250 kg/m^2
iii. 2nd floor
- Load-bearing wall masonry ½ brick height 3.8 m = 250 x 3.8 = 950 Kg/m^2
- Load-bearing wall masonry ½ brick height 1 m = 250 x 1 = 250 kg/m^2
iv. 3rd floor
- Load-bearing wall masonry ½ brick height 3.6 m = 250 x 3.6 = 900 Kg/m^2
- Load-bearing wall masonry ½ brick height 1 m = 250 x 1 = 250 kg/m^2
v. 4th floor
- Load-bearing wall pair ½ brick = 250 x 1.8 meters = 450 Kg/m^2
- Load-bearing wall masonry ½ brick height 3.8 m = 250 x 3.8 = 950 Kg/m^2

Live load (LL)

i. Ground Floor
- Market building floor = 250 kg/m^2
ii. 1st floor
- Market building floor = 250 kg/m^2
iii. 2nd floor
- Market building floor = 250 kg/m^2
iv. 3rd floor
- Market building floor = 250 kg/m^2
v. 4th floor
- Floor weight parking allocation = 400 Kg/m^2

Earthquake load

The magnitude of the earthquake load plan is calculated from the analysis of dynamic response Spectra.
- Earthquake zone = 4th zone = 0.4
- Response modification factor (R) = 3.5
- Soil type = soft soil (based on field observations)
- Natural period of structure (CT) = 0.02
- Reduction factor of ductility of the structure (R) = 8.5

Analysis Of Existing Buildings

Building Structure Data

a. Dimension area and height of column structure components

i. Ground Floor Column
Dimensions = 55 x 55 cm
Height = 400 cm
Number of columns = 164 columns

ii. Column 1st Floor
Dimensions = 55 x 55 cm
Height = 400 cm
Number Of Columns = 164 Columns

iii. Column 2nd Floor
Dimensions = 50 x 50 cm
Height = 400 cm
Number of columns = 164 columns

iv. Column 3rd Floor
Dimensions = 50 x 50 cm
Height = 380 cm
Number of columns = 164 columns

v. Column Expose = 125 x 115 cm
Height = 1580 cm
Number of columns = 4 columns

vi. Distance Between Columns
X axis = 600 cm
Y axis = 600 cm

b. Broad dimensions of beam structure components

i. 1st floor
Beam 1 = 30 x 60 cm
Number Of Blocks 1 = 424 Blocks
Beam 2 = 25 x 60 cm
Number of blocks 2 = 30 blocks
Distance between beams = 600 cm

ii. 2nd floor
Beam 1 = 30 x 60 cm
Number Of Blocks 1 = 424 Blocks
Beam 2 = 25 x 60 cm
Number of blocks 2 = 30 blocks
Distance between beams = 600 cm

iii. 3rd floor
Beam 1 = 30 x 60 cm
Number Of Blocks 1 = 424 Blocks
Beam 2 = 25 x 60 cm
Number of blocks 2 = 30 blocks
Distance between beams = 600 cm

iv. 4th floor
Beam 1 = 30 x 60 cm
Number Of Blocks 1 = 424 Blocks
Beam 2 = 25 x 60 cm
Number of blocks 2 = 30 blocks
Distance between beams = 600 cm

c. Floor slab thickness = 12 cm

d. Quality of concrete used
- Column = K-400 or 33.20 N/mm
- Beam = K-350 or 29.05 N/mm
- Floor slab = K-350 or 29.05 N/mm

e. Quality of steel used
- Iron screw = 390 N/mm

Structure Modeling with Etabs 9.7.2 Software

The structure of the Bogor market building consists of 4 floors and 1 ground floor, the floor structure is modeled as a space frame in a 3-dimensional portal with 6 degrees of freedom (degree of freedom/dof) at each node which includes elements of plates, beams, stairs, and columns. Because the floor plate of the Bogor market building is built with a preacast system, the floor plate is modeled as a membrane element, the column is considered fully sandwiched at the bottom because it uses a deep foundation. The gravity loads (dead load and live load) are transmitted from the plate to the beam and then distributed to the column. The structure and structural elements are designed so that all cross sections have a minimum plan strength equal to the necessary strength which is calculated based on the combination of loads and forces factored in according to the rules.

Input made on Etabs 9.7.2 software in accordance with the strength characteristics of concrete and steel, the unit used in this input data is Mpa or N/mm. Input material structure is shown in Figure 4.1

Figure 4.1 Input Material Structure

a. Loading on Softwere Etabs 9.7.2

In the model using Etabs 9.7.2 software, the included load is live load, dead load, additional dead load indicated in SIDL notation and earthquake load, for dead load of building components such as concrete and reinforcement can be calculated by the Etabs software itself so that the value does not need to be input, and only the additional dead load indicated by SIDL naming, while for earthquake load in terms of two directions, namely the X direction and the Y direction indicated by GEMPAX and GEMPAY notation. The Static load case definition is shown in Figure 4.12

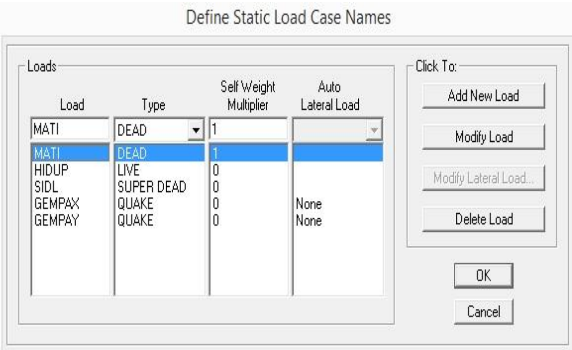


Figure Error! No text of specified style in document.**.1 Static load case definition**

Live load Input on the 3rd floor slab is shown in Figure 4.16 while the live load on the 4th floor is distinguished because on the 4th floor the floor is designated for parking and mosques, the value of the live load it receives is different, the live load input on the 4th floor is shown in Figure 4.13 and the dead load input on the floor slab is shown in Figure 4.14 and the dead load input of floors 1-3 is shown in Figure 4.15.

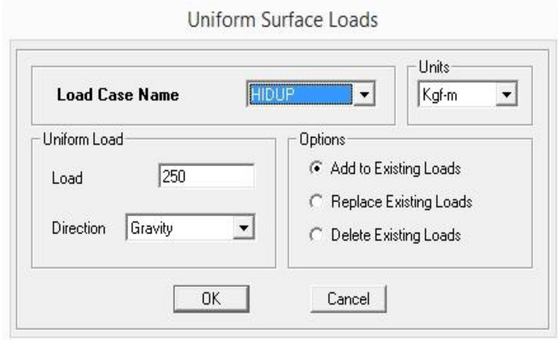


Figure 4.3 live load Input on floor slabs 1-3

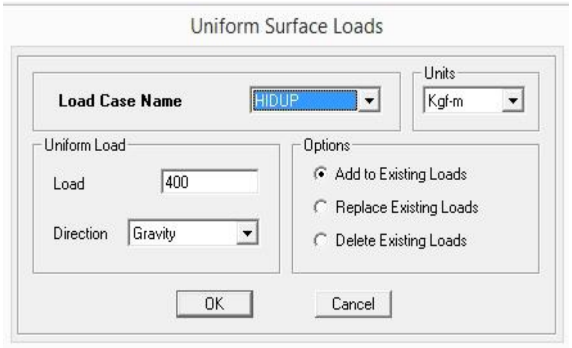


Figure 4.4 live load Input on floor slab 4

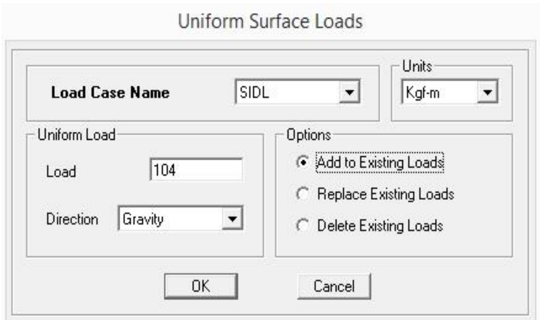


Figure 4.5 additional dead load Input on floor slabs 1-3

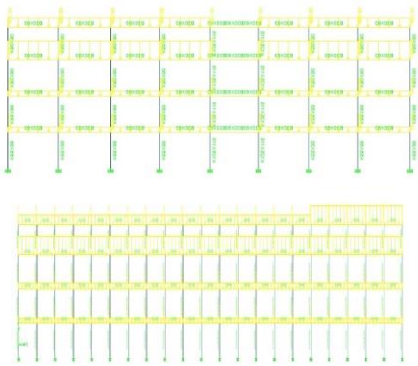


Figure 4.6 dead load Input on X (left) and Y (right)direction beams

b. Earthquake load

As the analysis has been done for the earthquake load at point 4.2.3 above, the mass data input shown in Figure 4.18.

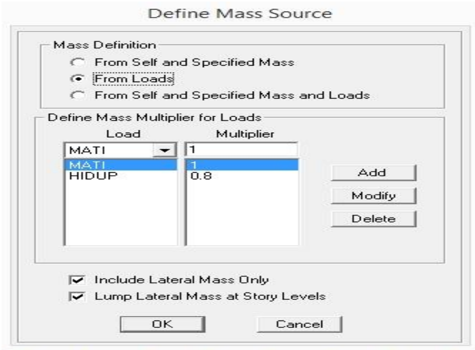


Figure 4.7 massa data input

Based on PPPURG 1987, for market buildings and shops using a reduction factor of 0.8. The Input diaphragm of each floor is shown in Figure 4.19 and the diaphragm on the floor is shown in Figure 4.20.

Figure 4.8 diaphragm input of each floor

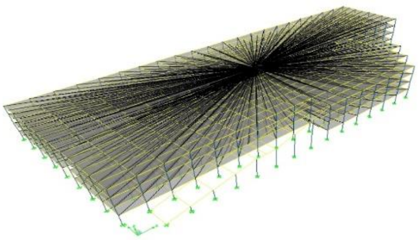


Figure 4.9 diaphragm on the floor

c. Spectral response analysis method

The magnitude of the earthquake load is determined by the acceleration of the earthquake plan and the total mass of the structure. The total mass of the structure consists of the self-weight of the structural elements, the dead load and the live load multiplied by the reduction factor of 0.8. Earthquake acceleration data taken from Zone 4 earthquake area map (SNI 03-1726-2012), earthquake spectrum curve plan shown in Figure 4.21.

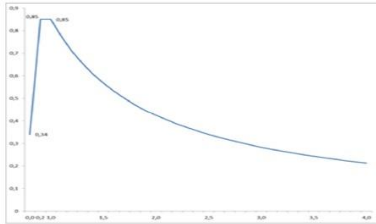


Figure 4.10 earthquake spectrum curve plan

The input data of earthquake response spectrum (SPEXY & SPEXX) is shown in Figure 4.22.

Figure 4.11 input data response spectrum (SPEX & SPEX)

d. Combined loading

After the analysis of loading in point 4.1 above, the Etabs software does the loading combination process with a total of 18 loading combinations. For the combination of earthquake loading with equivalent static method, according to SNI 03-1726-2012 should be done by reviewing simultaneously 100% earthquake direction x (Qx) and 30% earthquake direction y (Qy), and vice versa. Input load combination is shown in Figure 4.223 and an example of input load combination this time the example taken is COMB2 shown in Figure 2.24.

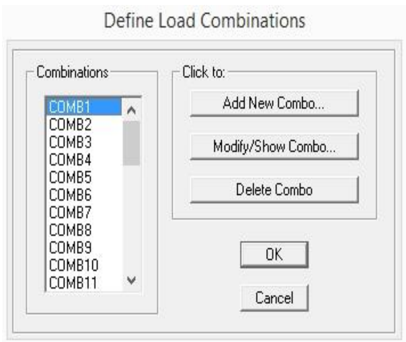


Figure 4.12 input load combination

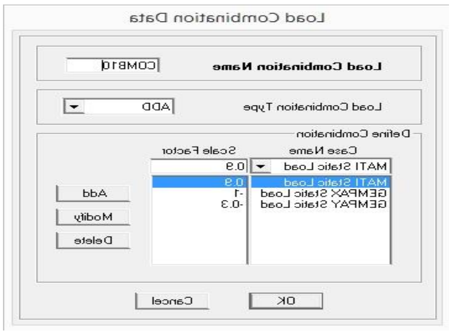


Figure 4.13 example input load combination (COMB10)

e. Results of modeling analysis

The results of the calculation of column and beam reinforcement with a predetermined loading combination can be seen in the figure below. It appears that no column or beam element experiences over strength (O/S) marked in red on its element. Thus the overall structure is safe against various combinations of loads that have been set. Longitudinal reinforcement is shown in Figure 4.25 and Concrete design Information is shown in Figure 4.26.

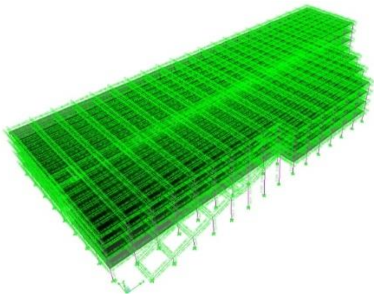


Figure 4.14 longitudinal reinforcement

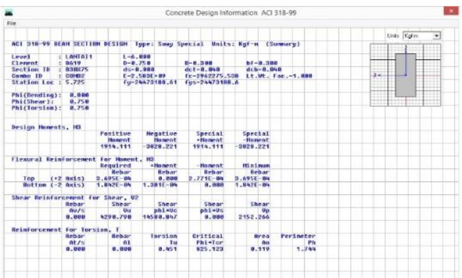


Figure 4.15 concrete design information

f. Results of the necessary reinforcement analysis

After modeling by taking into account the loading analysis,and structural analysis then obtained the value of the maximum moment that occurs in the beam and the amount of reinforcement required area. The value of one of the moments in the beam is shown in Figure 4.27, and the required area of reinforcement in the structure of the beam and column is shown in Figure 4.28.

Figure 4.16 moment on the beam

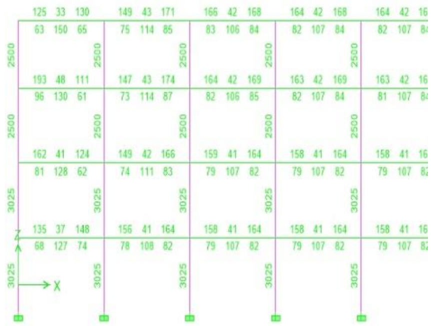


Figure 4.17 number of reinforcement required

Analysis Of Loading On Buildings After Renovation

After the renovation of the Bogor market building, namely by changing the ceramics on the ground floor, 1st floor and 2nd floor but without dismantling the mortar on the existing building, the load received by the building structure increases, according to the data we received from the field executor for the addition of mortar 5 cm thick, the picture of the renovation work on the building is shown in Figure 4.29.

Figure 4.18 the addition of a layer of cement mortar performed

Dead load (DL)

a. Some die on the floor slab

i. Ground Floor

- Ceramic weight = 24 Kg / m^2 = 24 Kg / m^2
- Weight gain = (3 + 5) x 21 Kg / m^2 = 168 Kg / m^2
- Mechanical and electrical weight = 17 Kg / m^2

= 209 kg / m^2

ii. 1st floor

- Ceramic weight = 24 Kg / m^2 = 24 Kg / m^2
- Increase in weight = (3 + 5) x 21 Kg / m^2 = 168 Kg / m^2
- Mechanical and electrical weight = 17 Kg / m^2

= 209 kg / m^2

iii. 2nd floor

- Ceramic weight = 24 Kg / m^2 = 24 Kg / m^2
- Weight gain = (3 + 5) x 21 Kg / m^2 = 168 Kg / m^2
- Mechanical and electrical weight = 17 Kg / m^2

= 209 kg / m^2

iv. 3rd floor

- Ceramic weight = 24 Kg / m^2 = 24 Kg / m^2
- Weight gain = 3 x 21 Kg / m^2 = 83 Kg / m^2
- Mechanical and electrical weight = 17 Kg / m^2

= 124 Kg / m^2

v. 4th floor

- Ceramic weight = 24 Kg / m^2 = 24 Kg / m^2
- Weight gain = 3 x 21 Kg / m^2 = 83 Kg / m^2

= 107 Kg / m^2

b. Some die in the beam

i. Ground Floor

- Masonry of load-bearing walls ½
- Several pairs of height brick wall height 1 m = 250 x 1 = 250 kg / m^2

ii. 1st floor

- Masonry of load-bearing walls ½
- Several pairs of height brick wall height 1 m = 250 x 1 = 250 kg / m^2

iii. 2nd floor

- Masonry of load-bearing walls ½
- Several pairs of height brick wall height 1 m = 250 x 1 = 250 kg / m^2

iv. 3rd floor

- Masonry of load-bearing walls ½
- Several pairs of height brick wall height 1 m = 250 x 1 = 250 kg / m^2

v. 4th floor

- Several pairs of height brick wall height 1.5 m = 250 x 1.5 = 375 Kg / m^2
- Masonry of load-bearing walls ½

Free life (LL)

a. Ground Floor

- Market building floor = 250 kg / m^2

b. 1st floor

- Market building floor = 250 kg / m^2

c. 2nd floor

- Market building floor = 250 kg / m^2

d. 3rd floor

- Market building floor = 250 kg / m^2

4th floor

- Market building floor = 250 kg / m^2
- Allocation of Garden floor weight = 400 Kg / m^2

Earthquake free

In fact, some of these events are known from the analysis of spectral response dynamics.

- Gempel zone = 4th zone = 0.4
- Response modification factor (R) = 3.5
- Soil type = soft soil (based on field conditions)
- Natural structure period (CT) = 0.02
- Structure performance factor (R) = 8.5

Analysis On Buildings After Renovation

Building Analysis With Softwere Etabs 9.7.2

In the building model after renovation for the input grid structure, Structure Plan, material input, and input dimensions of the structure is the same as the model in the existing building because the analysis is carried out in the same building, then for the structural components are still the same, but the difference in this model is the loading due to the additional dead load resulting from the renovation and it is only done on the ground floor, floor 1 and Floor 2, and for the value of the loading itself has been discussed in point 4.4.

a. Loading on Etabs

In the model using Etabs software, the included load is live load, dead load, additional dead load shown in SIDL notation and earthquake load, for the dead load of building components such as concrete and reinforcement can be calculated by Etabs so that the value does not need to be entered, and only the additional dead load is indicated by the SIDL naming, while for the earthquake load in terms of two directions, namely the X direction and the Y direction shown in GEMPAX and GEMPAY notation. Static load case definition shown in Figure 4.30

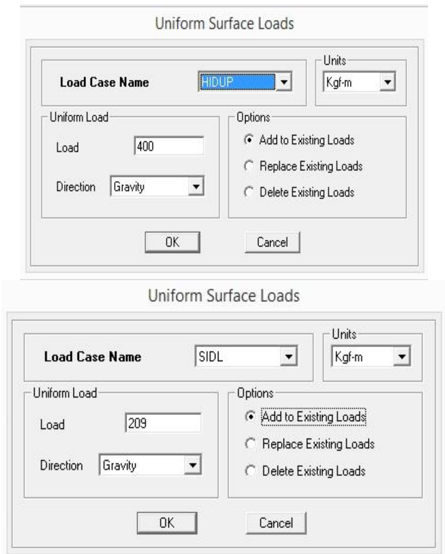


Figure 4.19 live load Input on floor slab 4

b. Results of the necessary reinforcement analysis

After modeling by taking into account the loading analysis, and structural analysis then obtained the value of the maximum moment that occurs in the beam and the amount of reinforcement required area, the maximum moment value obtained at elevation B. The moment value on the beam is shown in Figure 4.46, and the required reinforcement area on the beam structure and the X direction column is shown in Figure 4.47 then for the reinforcement resistance on each component of the structure is shown in Table 4.1.

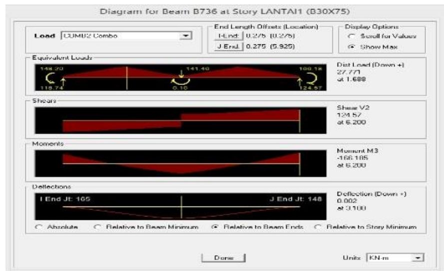


Figure 4.20 moments on balo

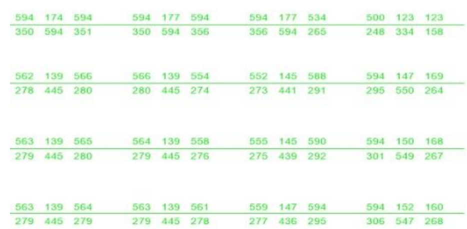


Figure 4.21 number of reinforcement required on the X axis

It can be seen that the maximum requirement of reinforcement on the X axis at Elevation 6 with the number of beam needs 594 + 356 = 950 mm.

Table 4.1 reinforcement requirements for structural components at elevation B

No	Types Of Structures	Floor	Dimensions	Number of reinforcement required (mm)	Pictures
1	Kolom	Base	55x55	3025	
2	Kolom	1	55x55	3025	
3	Kolom	2	50x50	2500	
4	Balok	Base	30x60	1277	
5	Balok	1	30x60	1279	
6	Balok	2	30x60	1315	

From the analysis with Softwere Etabs 9.7.2 then obtained the value:

Required reinforcement area on columns :

Ground floor-1st Floor = 3025 mm

Floor 2 – 3 = 2500 mm

Example used reinforcement deform D16

Then the area of 1 reinforcement = ¼ * π * D2

= ¼ * 3,14 * 16^2

= 200.96 mm^2

Amount of reinforcement required = 3025/200. 96

= 15,053 pieces

Then used reinforcement 16 D 16

As an example of one of the required reinforcement area on the beam

Tensile reinforcement = 1315 mm

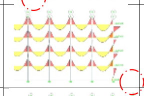
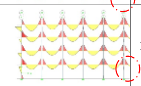
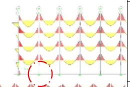
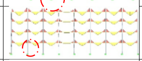
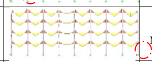
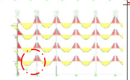
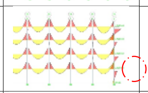
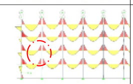
Reinforcement press = 1219 mm

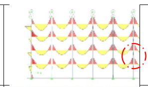
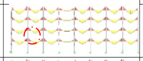
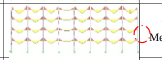
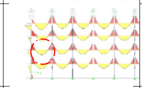
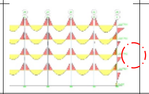
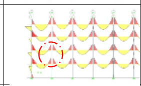
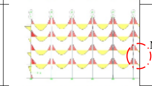
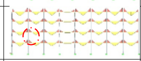
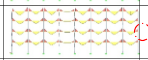
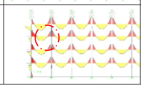
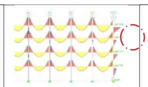
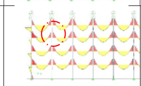
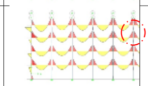
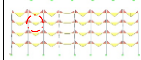
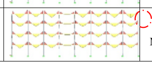
Structural analysis before and after renovation

Analysis Of Moments In The Cross Section Of The Structure

After analyzing with Sofftwere Etabs 9.7.2, the obtained moment comparison value on each component of the structure both before renovation and after renovation were taken randomly, then it can also be known the amount of reinforcement needed so that the building structure can withstand the load on it, taking into account the dimensions of structural components such as beams, columns in accordance with, if the need for reinforcement is smaller than that installed in the field, the structure is strong, on the contrary, if the need for reinforcement is greater than the reinforcement installed in the field, the structure is not strong to withstand the load on it and the value of the moment comparison and the need for reinforcement is shown in Table 4.11.

Table 0.3 comparative values of moments before and after renovation and the need for their reinforcement

No	Floor	Structure Components	Axis Direction	Momen (KNm)		Reinforcement requirement (mm2)		Pictures	Description
				Before	After	Required	Installed		
1	1	Kolom A20	X	5,48	15,56	3025	3400,62		Mencukupi
2		Kolom V20	Y	5,67	15,85	3025	3400,62		Mencukupi
3		Balok A20	X	15,373	44,659	388	1004,8		Mencukupi
4		Balok V20	X	15,973	44,060	388	1004,8		Mencukupi
5		Balok B3	Y	123,559	166,185	1315	1004,8		Tidak Mencukupi
6		Balok B19	Y	119,222	159,820	1315	1004,8		Tidak Mencukupi
7	2	Kolom A20	X	11,07	30,78	3025	3400,62		Mencukupi
8		Kolom V20	Y	11,30	31,9	3025	3400,62		Mencukupi
9		Balok A20	X	17,453	42,151	388	1004,8		Mencukupi

10		Balok V20	X	18,048	42,674	388	1004,8		Mencukupi
11		Balok B3	Y	120,790	161,186	1315	1004,8		Tidak Mencukupi
12		Balok B19	Y	114,526	154,651	1315	1004,8		Tidak Mencukupi
13		Kolom A20	X	8,46	21,61	2500	3215,36		Mencukupi
14		Kolom V20	Y	8,82	22,08	2500	3215,36		Mencukupi
15	3	Balok A20	X	19,488	45,848	488	1004,8		Mencukupi
16		Balok V20	X	20,170	46,341	488	1004,8		Mencukupi
17		Balok B3	Y	120,790	150,609	1271	1004,8		Tidak Mencukupi
18		Balok B19	Y	112,744	149,598	1271	1004,8		Tidak Mencukupi
19	4	Kolom A20	X	13,60	37,85	2500	3215,36		Mencukupi
20		Kolom V20	Y	13,95	38,4	2500	3215,36		Mencukupi
21		Balok A20	X	15,124	54,436	488	1004,8		Mencukupi
22		Balok V20	X	15,598	54,008	488	1004,8		Mencukupi
23		Balok B3	Y	160,411	208,776	1271	1004,8		Tidak Mencukupi
24		Balok B19	Y	149,540	204,076	1271	1004,8		Tidak Mencukupi

5. CONCLUSION

The conclusion that can be drawn is that the column structure can support the load on it both before and after renovation.

a. All beams of the X-axis direction (longitudinal direction) are able to withstand the load on it.

b. All y-direction beams cannot withstand the load on them, due to the additional load so that the reinforcement needs are needed more.

c. In shape 2 simulation mode, there is a torsion moment or torsion moment where in the event of a large earthquake, the period of time for people to save themselves is quite short.

REFERENCES

[1] A. N., 2022, 'Structural Development of Mosque Building Based on Additional Capacity of Prayer Room', Astonjadro: CEAESJ, 11(1).

[2] Asroni, Ali 2010, 'Foundation Columns & Reinforced Concrete T-Beams', Graha Ilmu, Yogyakarta.

[3] Asroni, Ali. 2017, ' theory and design of reinforced concrete slab beams based on SNI 2847-2013', Surakarta.

[4] Department of Public Works, 1983, Indonesian imposition regulation (PPIUG) 1983, Jakarta: Yayasan Badan Penerbit PU.

[5] Department of Public Works, 1987, guidelines for the planning of encumbrances for houses and buildings (PPURG) 1987, Jakarta: Yayasan Badan Penerbit PU.

[6] Lesmana, Yudha, 2020, 'Handbook of Reinforced Concrete Structure Design based on SNI 1726-2019', Makassar.

[7] Lesmana, Yudha, 2020, 'Handbook of earthquake load analysis procedures for building structures based on SNI 1726-2019', Makassar.

[8] Lesmana, Yudha, 2020, 'Handbook of analysis and design of reinforced concrete earthquake resistant structures (SRPMB, SRPMM, and SRPMK) based on SNI 2847-2019 & SNI 1726-2019', Makassar.

[9] Lutfi M, Prabowo a, 2020, 'structural analysis of school buildings due to the addition of new classrooms (case study at SMK Bina Putera Kota Bogor)', Journal of infrastructure & facilities Asset Management, 4(2).

[10] Lutfi M, Ersa, 2021, 'Evaluation of integrated Islamic schools (Sit) Aliya

Bogor Building Structure System Based on the Requirements of SNI 2847:2019', Journal of Civil Engineering ASTONJADRO, 8 (2), pp. 87-96.

[11] Lutfi M, Rusandi E 2019, 'evaluation of shophouse building structure due to the addition of roof load in the form of Mini towers', Astonjadro: Civil Journal, vol 8, no. 2, hh. 87-96.

[12] Lutfi M, Rulhendri, R, 2020, 'Study of motorcycle parking building planning in the area of the Faculty of Engineering and Science of Ibn Khaldun University Bogor', Composite Journal, 4(1), 19-26.

[13] National Standardization Agency, 2019, structural concrete requirements for buildings and explanations, SNI 2847:2019, BSN, Jakarta.

[14] National Standardization Agency, 2019, procedures for earthquake resistance planning for building and non-building structures, SNI 1726:2019, BSN, Jakarta.

[15] National Standardization Agency, 2020, Minimum design loads and related criteria for buildings and other structures, SNI 1727-2020, BSN, Jakarta.

[16] Revani AN, Alrasyid H, & Irmawan M. 2015. 'Evaluation of 50 years old reinforced concrete building structure based on SNI 1726 2012 and SNI 2847 2013'. Surabaya. ITS FTSP.

[17] SNI 03-1733-2004, 2004, 'environmental planning procedures in urban areas, Indonesian National Standardization Agency'.

[18] Spectra Indonesia Design, Input Type: Coordinates, City Name. Coordinates. Coordinates; City Name. Latitude: Longitude: Calculate. City name: Count, accessed January 03, 2023, from http://rsa.ciptakarya.pu.go.id/2021/

[19] The Faithful. 2016. 'Design of reinforced concrete structures based on SNI 2847: 2013'. Jakarta: Erlangga.