:: IJIEEB ::
(International Journal of Integrated Education, Engineering Business)
Volume 04 Number 01 March 2021

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

Structural Analysis of Reinforced Concrete Shophouses Due to Addition of Load Mini Tower and BTS, Case Study Site Kertopati

Try Nur Hakim Sarip
Mercu Buana University
Jl Raya Kranggan No 6 Jatisampurna Bekasi 17433
Trynurhakim30@gmail.com

Abstract

The very rapid development of telecommunications in Indonesia has made business actors in the telecommunications sector compete in building telecommunications towers to fill the entire network throughout Indonesia. As a result of the increasing need for telecommunications services, towers and Base Transceiver Stations (BTS) are increasingly relatively close, especially in urban areas, land problems for tower construction are one of the constraints in improving telecommunications networks, so that the construction of towers on buildings (roof top) is one solution. As a result of this increase, the tower load increases, it can affect the structure of the building under the tower. This paper describes a re-analysis of the building structure due to additional loads on the tower.

Keywords
Base Transceiver Station, Mini Tower, Rooftop.

1. Introduction

Development has spurred an increase in the construction of telecommunication towers and Base Transceiver Station (BTS), which are important tools in communication and information technology. With the tower and Base Transceiver Station (BTS), the communication process and communication exchange are possible. In this case, it is because the tower and the Base Transceiver Station (BTS) are a medium or device for receiving and transmitting waves.

The installation of towers and Base Transceiver Station (BTS) is very important as a means of telecommunications network expansion. As a result of the increasing need for telecommunication services, towers and Base Transceiver Station (BTS) are increasingly relatively close, especially in urban areas, land problems for tower construction are one of the constraints in improving telecommunications networks, so that the construction of towers on buildings (roof top) is one of the solutions. Based on the analysis of the needs of BTS towers for the next 5 years (2015), 374 BTS towers are needed to serve cellular traffic in Sampang Regency (M. Hasan Junaidi, 2015)

Based on previous research from (Lutfi & Rusandi, 2019), stated that the size of the existing structural elements are still able to withstand the additional burden caused by the mini tower and Base Transceiver Station (BTS).

The case study in this final project is a 3-storey shop house in the Palembang area. This shophouse has existing columns measuring 34 cm x 26 cm and beams 38 cm x 29 cm. A mini tower with a height of 25 m and a Base Transceiver Station (BTS) will be installed on the rooftop. One sectoral antenna with a total weight of 174 kg and 2 microwave antennas with a total weight of 120 kg are planned to be installed on the mini tower. Due to the increased load on the roof of the building, of course the earthquake force is getting bigger, therefore earthquake load analysis is needed because it affects the behavior of the building structure. The results of the analysis are needed for planning needs. This paper is expected to provide input to building managers in overcoming problems that arise due to the addition of loads, especially telecommunications towers.

The purpose of writing this Final Project is to analyze the existing building structure after the tower load increases.

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

The purpose of writing this final project is to determine the strength of the existing building structural components after the tower load increases.

In this Final Project has a limit problem that will be discussed so that the discussion of the problem to be reviewed is not broader. The limitations in this Final Project are as follows:

a. Analyze the strength of the existing building structural components.
b. Obtain the dimensions of a strong building structure after experiencing additional loads.
c. Analyze the tower structure according to the size used. .
d. Did not analyze the existing shop foundations.
e. Calculate the need for reinforcing materials (if the existing structure requires reinforcement).
f. Static earthquake load calculation because earthquake load has no dominant effect.
g. In conducting the analysis the authors use the help of a ETABS V. 2013 structure computer program with the aim to facilitate planning.
h. The standard or regulatory approach used includes:
i. (Badan Standarisasi Nasional, 2013b) concerning "Requirements for structural concrete for buildings"
j. (Badan Standarisasi Nasional, 2013a)concerning "Minimum load for planning of buildings and other structures".
k. (Badan Standarisasi Nasional, 2015)concerning "Specifications for Structural Steel Buildings) Using the LRFD method.

2. Literature

2.1. Building

Building A building is a physical form of the result of a construction work that is partially or completely integrated with the domicile located on and / or in land and / or water, which functions as a place for humans to carry out their activities, whether they are dwellings or dwellings, religious activities, business activities, socio-cultural activities, or special activities.(Undang-Undang (UU) No. 28 Tentang Bangunan Gedung, 2002) .

2.2. Definition of Telecommunication Tower

Telecommunication towers are towers made of steel or rectangular or triangular pipes or only in the form of long stick pipes which aim to place the antenna and radio transmitter as well as the receiver of telecommunications waves. Telecommunication towers are signal transmitting towers that support the communication systems that we often use so far. This tower construction can be in the form of a tall tower or a short tower but has many antennas installed.

2.2.1. Types of Telecommunication Towers

1. Telecommunication tower based on site type:
    a. Greenfield (GF): The tower usually stands directly above the ground
    b. Rooftop : The tower that stands on the building
2. Types of telecommunication towers based on the height and size of tower pipes:
    a. Mini Tower
    b. Lattice Tower
    c. Monopole
    d. Pole
    e. Guyed Mast
    f. Camouflage tower

2.3. Loading

Loads that work on structures can be classified in 3 parts, namely:

a. Dead Load
b. Life Expenses
c. Wind Load

2.4. Combination of Expenses

The load combinations that must be reviewed are as follows:

U = 1.4 DL
U = 1,2 DL + 1,6 LL + 0.5 (A or R)
U = 1.2 DL + 1.0 LL + 1.0WL + 0.5 (A or R)
U = 1.2 DL + 1.0 LL + 1.0 E

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

U = 0.9 DL + 1.0 WL
U = 0.9 DL +1.0 WL

2.5. Earthquake Load

The planned earthquake in the structural design of this building is defined as an earthquake whose magnitude is likely to be exceeded during the structure's lifespan of 50 years is 2 percent.

2.6. Financial factors and risk categories for building structures

(Badan Standarisasi Nasional, 2012), for various risks of building and non-building structures, the effect of the earthquake plan on them must be multiplied by a priority factor Ie.

2.7. Combination of load and influence of earthquake loads

Review and calculation of expenses The design of this building is based on the Requirements for Structural Concrete for Buildings (Badan Standarisasi Nasional, 2013b) and Procedures for Earthquake Resistance Planning for Buildings and Non-Building Structures (Badan Standarisasi Nasional, 2012).

1.4 D
1,2D + 1.6L + 0.5 (Lr or R)
1,2D + 1.6 (Lr or R) + (1.0L or 0.5W)
1,2D + 1.0W + 1.0L + 0.5 (Lr or R)
1,2D + 1.0E + 1.0L
0.9D + 1.0W
0.9D + 1.0E

2.8. Classification of Citrus

In the formulation of the seismic design criteria for a building at ground level or determining the amplification of the peak earthquake acceleration from the bedrockground level for something site, then the site must be classified first.

2.9. Mapped Acceleration Parameters

After knowing the site classification and knowing the location of the building location, the next step is to know the bedrock acceleration parameters in the short period (Ss) and the bedrock acceleration in the 1 second period (S1). These two parameters can be taken from the (Badan Standarisasi Nasional, 2012) earthquake map.

2.9. Seismic Design Category (KDS)

From the SDS value, SD1 and the building risk category, two seismic design categories will be obtained. The value taken is the greatest of the two peer groups. The value obtained must be from the values in table 1 and table 2:

Table 1 Seismic Design Categories based on Short Period Acceleration Response Parameters, SDS

SDS Value	Risk Category	
	I or II or III	IV
SDS <0.167	A	A
0.167 <SDS <0.33	B	C
0.3 < SDS <0.5	C	D
0.0 < SDS	D	D

Source: SNI 1726-2012

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

Table 2 Seismic Design Categories based on Acceleration Response Parameter for 1 second period, SD1

SD value 1	Risk Category I or II or III	IV
SD1<0.067	A	A
0.067 <SD1 <0.133	B	C
0.133 <SD1 <0.2	C	D
0.20 <SD1	D	D

Source: SNI 1726-2012

2.10. Planning requirements for seismic design category A.

Buildings and non-buildings with seismic design category A only need to meet the requirements below. Non-structural elements in seismic design category A are exempt from seismic design provisions.

2.11. Lateral Style

This shop-house structural system has regular lateral rigidity and has the following conditions:

a. The height of the building structure is measured from the lateral clamping level of not more than 10 levels or 40 meters
b. The building structure system has a regular floor weight.
c. The area of the building structure is a rectangle without protrusions even if it has protrusions, the length of the protrusion is not more than 25% of the largest size of the building structure area in the direction of the protrusion.
So from this statement, to analyze this shop building can use equivalent static.

Each structure shall be analyzed for the effects of static lateral forces which are applied independently in both orthogonal directions. In each direction under consideration, a static lateral force must be applied simultaneously on each floor. For analysis purposes, the lateral forces for each floor are calculated as follows:

$Fx = 0.01\ Wx$

Note:

Fx = design lateral force applied to floor x

Wx = the total dead load share of the structure, D, acting on the floor

3. Method

The research method used in this analysis is a quantitative method, which begins with studying some literature then continues by calculating the 3-storey shophouse structure with reinforced concrete structures so as to get a strong structure to accept the loads that occur. The loading is in accordance with "(Badan Standarisasi Nasional, 2013a) regarding the minimum load for the design of buildings and other structures" and with the modeling of the ETABS V. 2013 structure (Badan Standarisasi Nasional, 2013b). The following are the steps for carrying out the research:

1. Studying literature review
2. Modeling the initial structure (existing)
3. Structure modeling by adding the load of the mini tower and the Base Transceiver Station to the existing structure
4. Evaluation of structures with ETABS
5. From the results of moment and shear evaluation on structural elements, it can be seen which structural elements require reinforcement.
6. Structural reinforcement analysis (if needed)
7. Reinforcement modeling of structures (if required)
8. Re-evaluate the retrofitted structures
9. Results

3.1. General data

The project name :Kertopati Site
Project Location : Jl. KH Wahid Hasyim Kel. I Ulu, Kec. Sebrang Ulu I, Palembang City, South Sumatra Province
Latitude : -3.0128
Longitude : 104.75642
Owner : PT. TBIG

:: IJIEEB ::
(International Journal of Integrated Education, Engineering Business)
Volume 04 Number 01 March 2021

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

Planning consultant : PT.Teleconsult Nusantara

3.2. Technical Data

Property Properties : Reinforced concrete
Building Function : Ruko (shop house)
Structure System : Frame(column, beam, plate)
Building Length : 17.45 m
Building Width : 4 m
Building height : 12 m
Upper structural components: Columns and reinforced concrete beams
Wall dimensions : 15cm thick
Floor Plate Dimensions : 12cm thick

3.3. Existing Design Drawings

The following is a picture of the shop's site layout.

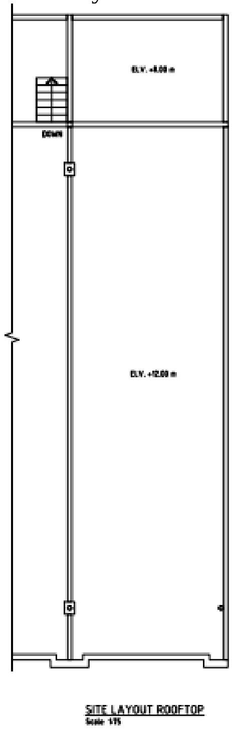

Figure 1. The rooftop plan looks over the tower above the additional building
Source: PT Teleconsult Data

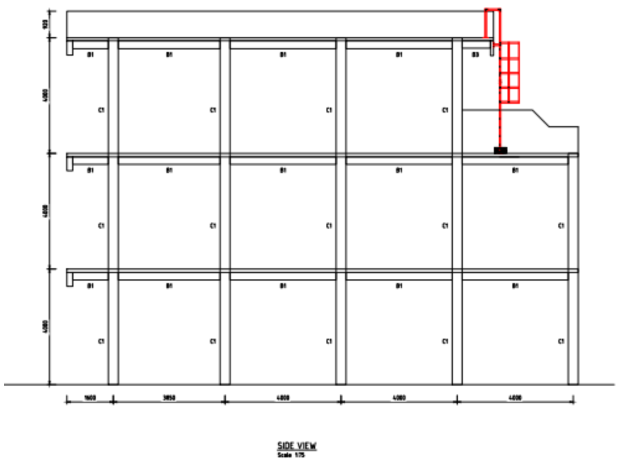

Figure 2. Plan the side view of the existing building
Source: PT Teleconsult Data

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

3.4. Structural Analysis Stages

The stages of analysis in the calculation of this final project are as described in the following figure:

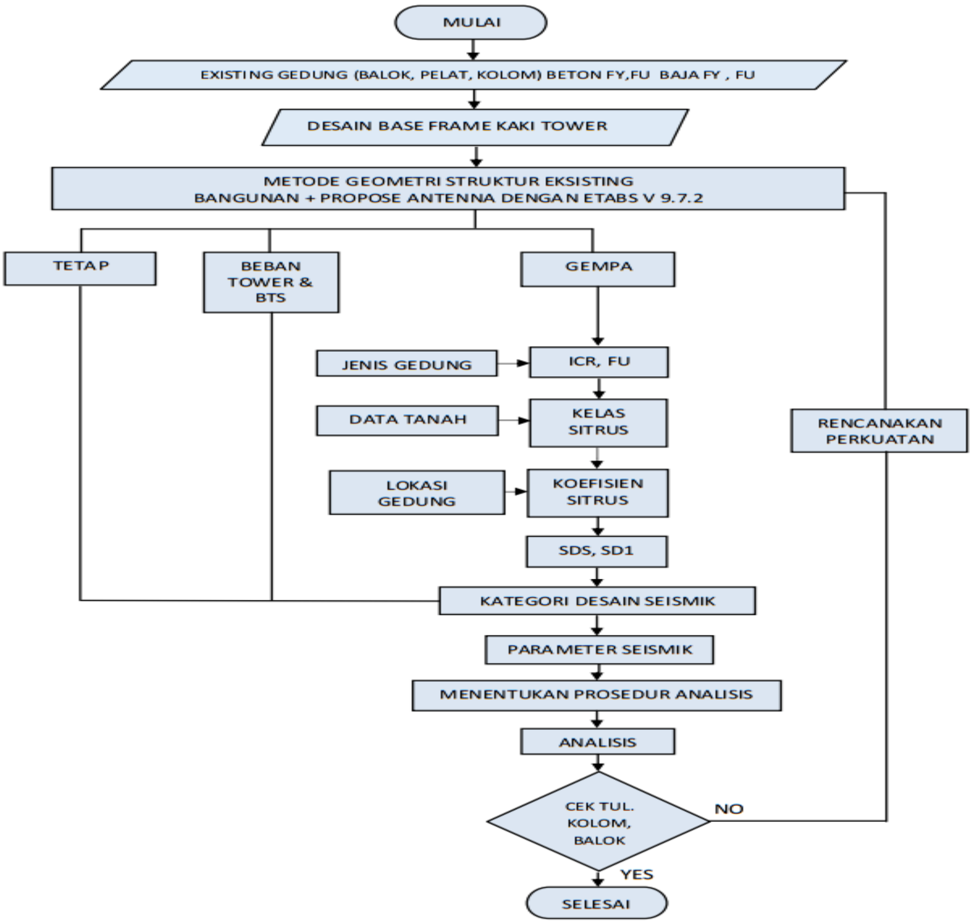

Figure 3. Structural Analysis

4. Result

4.1. Tower Existing Data

In the 4 leg tower it is planned to use an angled profile with the following design and size:

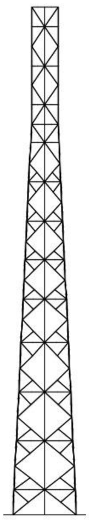

Figure 4 Outline Drawing Tower 4 feet
Source: Author's document

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

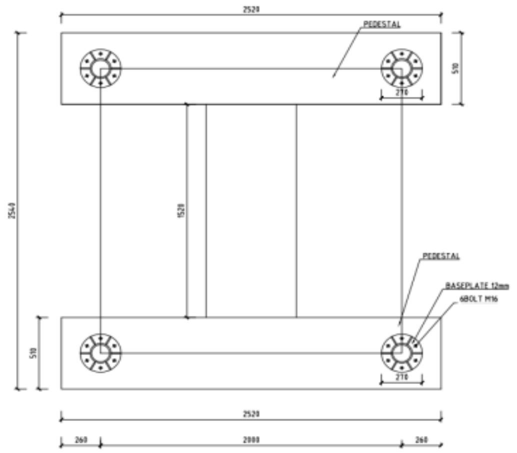

Figure 5 Base Frame Tower 4 feet
Source: PT Teleconsult Nusantara

4.2. Existing Data of Building

The following is the existing data from the shop-houses that will be analyzed:

Table 1 Building Structure Data

Jumlah Lantai (n)	:	3 lantai	
Fungsi Bangunan	:	Rumah Toko	
Lantai Atas (Roof Top)	:	Mini Tower 26 M	
Kelas Beton (Hasil Hammer Test)	:	Balok 380x290	: K-190 (f_c' = 157.7 kg/cm^2)
		Balok 380x290	: K-213 (f_c' = 176.79 kg/cm^2)
		Balok 380x240	: K-190 (f_c' = 157.7 kg/cm^2)
		Balok 380x240	: K-213 (f_c' = 176.79 kg/cm^2)
		Balok 360x270	: K-265 (f_c' = 219.95 kg/cm^2)
		Kolom 340x260	: K-213 (f_c' = 176.79 kg/cm^2)
		Kolom 340x260	: K-195 (f_c' = 161.85 kg/cm^2)
		Kolom 340x260	: K-227 (f_c' = 188.41 kg/cm^2)
		Plat Lantai t = 120	: K-125 (f_c' = 103.75 kg/cm^2)
		Dak Atap t = 100	: K-125 (f_c' = 103.75 kg/cm^2)
Baja Tulangan		: BJTD-32 (f_y = 320 MPa)	
		: BJTP-24 (f_y = 240 MPa)	
Tinggi Tingkat		: 12 M	

Source: PT.Teleconsult Nusantara

4.3. Existing Commercial Buildings

A shop house building is a building that functions as a house as well as a shop, totaling 2 floors. The following is modeling of the shop house building:

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

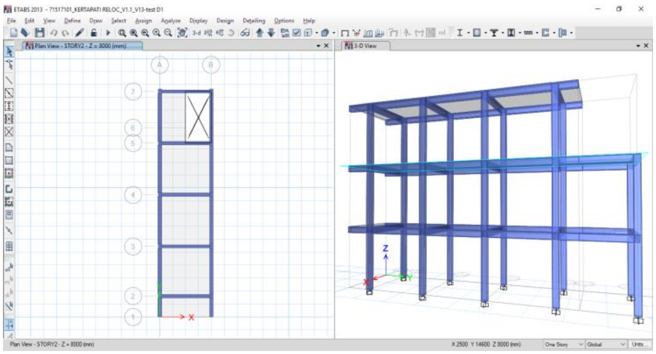

Figure 6 Building modeling using ETABS ver 2013 software
Source: Author's document

4.4. Site Class

Based on (Badan Standarisasi Nasional, 2012) earthquake earthquake, in the formulation of seismic design criteria of a building on the surface of the ground must first be classified site class. Based on the results of geotechnical investigations, it is obtained the average qc value which defines the shop-house building site class as the SC site class (Medium)

4.5. Design Response Spectrum

Table 2 The output of the design response spectrum calculation

Tanah Sedang			
PGA (g)	0.15	PSA (g)	0.225
SS (g)	0.27	SMS (g)	0.428
S1 (g)	0.167	SM1 (g)	0.356
CRS	0.932	SDS (g)	0.285
CR1	0.945	SD1 (g)	0.237
FPGA	1.499	T0 (detik)	0.166
FA	1.584	TS (detik)	0.832
FV	2.133		

Source: http://puskim.pu.go.id/Aplication/desain_spektra_indonesia

4.6. Risk Categories and Building Priority Factors (Ie)

Risk categories are based on building utilization / building functions which can be seen in the table Building and Non-Building Risk Categories for Earthquake loads, while building priority factors are based on risk categories which can be seen in the Earthquake Priority Factor Table. The risk categories and building priorities for shop houses are as follows:

Risk category : Category II
The virtue factor : 1

4.7. Seismic Design Category

Seismic design categories are based on SD1 and SDS scores and risk categories. The seismic design category for shop-house building is category A.

4.8. Loading

Tower Existing Load 4 feet

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

Table 3 Steel profile used

NO	Jenis Baja	L (m)	M (kg)
1	40X40X4	31.42	75.96
2	50X50X5	203.52	766.87
3	60X60X5	75.86	346.6
4	70X70X7	41.02	302.68
5	80X80X8	183.47	1771.5
6	90X90X9	16.03	195.05
7	130X130X12	16.03	377.52
8	150X150X15	48.09	1623.34
Total			5459.52

Source: Author data

The load of the device itself consists of:

Table 4 Antenna device

System Type	Jumlah	Berat (kg)
Propose		
Antenna Sectoral	6	333
RRU	12	300
Antenna Microwave	2	130
	Total Berat Antenna	**763**
Cable Ladder Type	**Dimension**	**Berat (kg)**
Propose		
Ladder	1	125
Feeder 6 x 7/8"	3	293.3
Feeder 1 x 1/2"	2	10.46
	Total Berat feeder	**428.76**

Source: PT. Teleconsult Nusantara

4.9. Run Analysis

The dead load of the tower plus the base load of the 4 foot tower is as follows:

Table 5 Input Data on Etabs - (Max Dead Load)

Point	Force-X	Force-Y	Force-Z	Moment-X	Moment-Y	Moment-Z
	kN	kN	kN	kNm	kNm	kNm
A 1103	-1.211	1.223	21.746	0.011	0.011	0
B 1111	-1.237	-1.223	22.209	-0.011	0.011	0
C 1131	1.237	-1.225	22.381	-0.011	-0.011	0
D 1151	1.211	1.225	21.919	0.011	-0.011	0

Source: Author's Analysis Results

Table 6 Input Data on Etabs - (Max Wind Load)

Point	Force-X	Force-Y	Force-Z	Moment-X	Moment-Y	Moment-Z
	kN	kN	kN	kNm	kNm	kNm
A 1103	3.51	-8.871	-77.384	0.053	-0.039	0.059
B 1111	-6.025	-11.362	122.307	0.031	0.061	0.059
C 1131	5.69	-11.361	120.438	0.032	-0.062	-0.06
D 1151	-3.31	-8.956	-77.107	0.053	0.04	-0.06

Node	Force-X	Force-Y	Force-Z	Moment-X	Moment-Y	Moment-Z
	kN	kN	kN	kNm	kNm	kNm
A 1103	2.77	5.422	23.587	-0.061	0.084	-0.097
B 1111	9.912	9.721	-124.35	-0.008	0.009	0
C 1131	5.469	3.248	20.421	-0.084	0.064	0.098
D 1151	12.109	12.443	168.597	0.011	-0.014	0

Source: Author's Analysis Results

4.10. Combination of Load

Table 7 Combination of Load

	D	SW	BTS	TWRDL	TWR1	TWR2	L	Qex	Qey
1	1.4	1.4	1.4	1					
2	1.2	1.2	1.2	1	1		1.6		
	1.2	1.2	1.2	1		1	1.6		
3	1.257	1.257	1.257	1	1		1	1.3	0.39
	1.257	1.257	1.257	1		1	1	1.3	0.39
4	1.257	1.257	1.257	1	1		1	-1.3	0.39
	1.257	1.257	1.257	1		1	1	-1.3	0.39
5	1.257	1.257	1.257	1	1		1	1.3	-0.39
	1.257	1.257	1.257	1		1	1	1.3	-0.39
6	1.257	1.257	1.257	1	1		1	-1.3	-0.39
	1.257	1.257	1.257	1		1	1	-1.3	-0.39
7	1.257	1.257	1.257	1	1		1	0.39	1.3
	1.257	1.257	1.257	1		1	1	0.39	1.30
8	1.257	1.257	1.257	1	1		1	-0.39	1.3
	1.257	1.257	1.257	1		1	1	-0.39	1.30
9	1.257	1.257	1.257	1	1		1	0.39	-1.3
	1.257	1.257	1.257	1		1	1	0.39	-1.30
10	1.257	1.257	1.257	1	1		1	-0.39	-1.3
	1.257	1.257	1.257	1		1	1	-0.39	-1.30
11	0.199	0.199	0.199	1	1		1	1.3	0.39
	0.1995	0.1995	0.1995	1		1	1	1.3	0.39
12	0.199	0.199	0.199	1	1		1	-1.3	0.39
	0.1995	0.1995	0.1995	1		1	1	-1.3	0.39
13	0.199	0.199	0.199	1	1		1	1.3	-0.39
	0.1995	0.1995	0.1995	1		1	1	1.3	-0.39
14	0.199	0.199	0.199	1	1		1	-1.3	-0.39
	0.1995	0.1995	0.1995	1		1	1	-1.3	-0.39
15	0.199	0.199	0.199	1	1		1	0.39	1.3
	0.1995	0.1995	0.1995	1		1	1	0.39	1.30
16	0.199	0.199	0.199	1	1		1	-0.39	1.3
	0.1995	0.1995	0.1995	1		1	1	-0.39	1.30
17	0.199	0.199	0.199	1	1		1	0.39	-1.3
	0.1995	0.1995	0.1995	1		1	1	0.39	-1.30
18	0.199	0.199	0.199	1	1		1	0.39	-1.3
	0.1995	0.1995	0.1995	1		1	1	0.39	-1.30

Source: Author data

4.11. The earthquake

Based on (Badan Standarisasi Nasional, 2012) regarding earthquake resistance planning procedures for building and non-building structures, the planned earthquake is defined as an earthquake with the probability of being overturned over the life of the building structure 50 years is 2 percent.

4.12. Equivalent Nominal Static Earthquake Load

Each structure shall be analyzed for the effects of static lateral forces which are applied independently in both orthogonal directions. In each direction under consideration, a static lateral force must be applied simultaneously on each floor. For analysis purposes, the lateral forces for each floor are calculated as follows:

$F_x = 0.01\ W_x$

Note:

F_x = design lateral force applied to floor x

W_x = the total dead load share of the structure, D, acting on the floor

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

4.13. Calculating the Weight of the Building Structure

Table 8 Building weight per floor

Diaphragm	Mass X	Mass Y	XCM	YCM
	kgf-s²/m	kgf-s²/m	M	m
D1	13,979.87	13979,87	20,365.00	92,578.00
D1	39,834.97	39834,97	18,901.00	80,814.00
D1	40,703.21	40703,21	19,201.00	82,594.00

Source: Author data

Table 9 Floor Load Distribution

Lantai	Wi	hi	hi^k	$Wi . hi^k$	Cvx	Fi
3	13,979.87	4	4	55919.48	0.147907	498.0329
2	39,834.97	4	4	159339.88	0.421454	1419.121
1	40,703.21	4	4	162812.84	0.43064	1450.052
dasar	0	0	0	0	0	0
total	94518.05	12	12	378072.2	1	3367.206

Source: Author data

4.14. Check the Concrete Reinforcement in Beams

The beams that need to be checked are the beams under the tower and the equipment with the minimum beam reinforcement
(tension) :

a. Beam size : 290 x 380 mm
   Fy : 240 MPa
   Asmin : 397,995 mm2
b. Beam size : 240 x 380 mm
   Fy : 240 MPa
   Asmin : 397,995 mm

:: IJIEEB ::
(International Journal of Integrated Education, Engineering Business)
Volume 04 Number 01 March 2021

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

4.15. Due to Tower Loading

Table 10 The need for beam reinforcement

Balok	As min tulangan (mm^2)	As tulangan aktual (mm^2)	Check
			As min tulangan > As tulangan aktual
B3 – Story 3	398	201	OK
B4 – Story 3	398	167	OK
B5 – Story 3	398	167	OK
B6 – Story 3	398	241	OK
B7 – Story 3	398	195	OK
B8 – Story 3	398	194	OK
B9 – Story 3	398	240	OK

Source: Analysis Results

4.16. Check Concrete Reinforcement in Columns

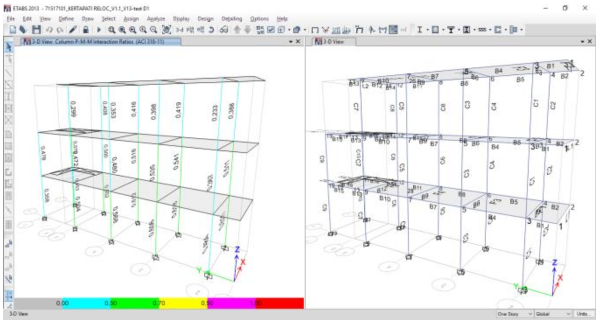

Figure 7 PMM ratio of existing building columns
Source: Analysis Results

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

Table 11 Check column reinforcement ratio

Kolom	Rasio Aktual (Output Etabs)	Syarat Rasio	Check Rasio Aktual < Syarat Rasio
C3 – Story 3	0.395	1	**OK**
C4 – Story 3	0.416	1	**OK**
C5 – Story 3	0.349	1	**OK**
C6 – Story 3	0.412	1	**OK**
C3 – Story 2	0.533	1	**OK**
C4 – Story 2	0.539	1	**OK**
C5 – Story 2	0.478	1	**OK**
C6 – Story 2	0.515	1	**OK**
C3 – Story 1	0.604	1	**OK**
C4 – Story 1	0.615	1	**OK**
C5 – Story 1	0.566	1	**OK**
C6 – Story 1	0.608	1	**OK**

Source: Analyst Results

5. Closing

5.1. Conclusion

After re-analyzing the structure of reinforced concrete shop houses in South Sumatra Province which was adjusted to the Calculation Procedures for Concrete Structures for Buildings (Badan Standarisasi Nasional, 2013b)and the Earthquake Planning Procedures for Buildings(Badan Standarisasi Nasional, 2012). The analysis was carried out using a 4 foot tower load and a base transceiver station, the following conclusions were obtained:

After analyzing the loads that work on the structure of the shop building, it can be concluded that due to the propose load on the 26m mini tower the structure of the shop is still strong to accept the load that occurs.

The maximum load that occurs lies in the building structure in direct contact with the tower leg. From the analysis, the maximum column reinforcement ratio due to tower loads is 0.608

Due to the load of the tower 3 feet, the maximum actual reinforcement in the beam is 240mm2 <ρmin = 398mm2

The size of structural elements are still able to accept the burden that occurs.

5.2. Suggestion

The suggestions related to the analysis of the shop structure are as follows:

Further study is needed regarding the performance of the column structural elements in this shophouse building due to the earthquake.

Calculating the maximum load from the tower and antenna devices that are still able to be received by the shop building structure.

ISSN : 2615-2312 (ONLINE)
ISSN : 2615-1596 (PRINTED)

References

Badan Standarisasi Nasional. (2012). Tata Cara Perencanaan Ketahanan Gempa untuk Struktur Bangunan Gedung dan Non Gedung. SNI 1726-2012.

Badan Standarisasi Nasional. (2013a). Beban Minimum untuk perancangan Gedung dan Struktur Lain. SNI 1727: 2013.

Badan Standarisasi Nasional. (2013b). Persyaratan Beton Struktural Untuk Bangunan Gedung. SNI 2847:2013.

Badan Standarisasi Nasional. (2015). Spesifikasi untuk Bangunan Gedung Baja Struktural. SNI 03-1729-2015.

Lutfi, M., & Rusandi, E. (2019). Evaluasi Struktur Bangunan Ruko Akibat Penambahan Beban Atap Berupa Mini Tower. 8. https://doi.org/10.32832/astonjadro.v8i2.2790

M. Hasan Junaidi. (2015). Analisis Pembangunan BTS Dan Perencanaan Zona Persebaran BTS Bersama Di Kabpaten Sampang. 8.

Undang-Undang (UU) No. 28 tentang Bangunan Gedung, (2002).