ISSN :

JOURNAL OF GREEN SCIENCE AND TECHNOLOGY

ANALYSIS STRUCTURE THE PT. TEMPO LAND BUILDING

Subhan Manthofani*, Arief Firmanto**

*) Student of Civil Engineering Major, Faculty of Engineering, University of Swadaya Gunung Jati Cirebon
**) Lecturer of Civil Engineering Major, Faculty of Engineering, University of Swadaya Gunung Jati Cirebon

ABSTRACT

Mundu is an area in the district of Cirebon that passed by the Pantura lane, in the area of the Mundu there are various kinds of trading industry, one of which is the trading industry from PT. TEMPO LAND that are producing medicines for health. In order to create a good production and marketing, so in the area is built office production and marketing of PT. TEMPO LAND.

PT. TEMPO LAND is a group company in the form of by the TEMPO GROUP or PT. TEMPO SCAN PACIFIC Tbk . The company PT. TEMPO GROUP started its business on November 3, 1953. Production from this company produces a variety of pharmaceutical and healthcare products with different brands.

In order to create a structure that is safe and meets serviceability limit, so in the process of design the building structure must be according to SNI - 2847 - 2013 of reinforced concrete, which is the latest regulations adapted from the latest material technology development refers to the AISC. Beside planning, the loading structure must be according to SNI – 1727 – 2013 , then for calculation of earthquake engineering refers to SNI – 1726 – 2012.

Analysis structure using SAP2000, for the material of structures is used concrete including frame section (column, sloof, beam, and slab). And then the result from analysis are the PT. TEMPO LAND building is safe or not, with check the deflection and check load maximum permit from analysis foundation of PT. TEMPO LAND.

Keywords : Analysis structure, SAP2000, frame section, deflection.

A. BACKGROUND

Cirebon is a city that quite rapidly progress in the field of tourism, economy, and services. The one factor that dominates development the Cirebon city is the economy, a wide variety field of the economy competition for example like trading industry.

Cirebon city itself has a very strategic geographical location, besides of Cirebon city is also a city track that connects West Java and Central Java, this condition potentially attracting tourists to visit the Cirebon city, causing the trade industry competition is very strict.

Mundu is an area in the district of Cirebon that passed by the Pantura lane, in the area of the Mundu there are various kinds of trading industry, one of which is the trading industry from PT. TEMPO LAND producing medicines for health. In order to create a good production and marketing, so in the area is built office production and marketing of the PT. TEMPO LAND.

PT. TEMPO LAND is a group company in the form of by the TEMPO GROUP or PT. TEMPO SCAN PACIFIC Tbk . The company PT. TEMPO GROUP started its business on November 3, 1953. Production from this company produces a variety of pharmaceutical and healthcare products with different brands.

In order to create a structure that is safe and meets serviceability limit, so in the process of design the building structure must be according to SNI - 2847 - 2013 of reinforced concrete, which is the latest regulations adapted from the latest material technology development refers to the AISC.

Beside planning, the loading structure must be according to SNI – 1727 – 2013 then for calculation of earthquake engineering refers to SNI – 1726 – 2012.

B. PROBLEM FORMULATION AND PROBLEM IDENTIFICATION

1. Problem Formulation
   a. To design the PT. TEMPO LAND building, according to the SNI – 2847 – 2013 reinforced concrete, PPPURG 1987 and SNI – 1727 – 2013 for loading, and than calculate the seismic forces according to SNI – 1726 – 2012.
   b. Do not design Retaining Wall, ME and Plumbing.
   c. Analysis Structure with SAP2000.
   d. Calculate the budget structure.

2. Problem Identification
   Based on the description formulation of the problem, so the problem can be identified as follows:
   a. How to design the structure PT. TEMPO LAND building according with the regulations of SNI?
   b. How to design the dimension of Slab, Beam, Column, and Foundation?
   c. How seismic force that occur in the structure PT. TEMPO LAND building?
   d. How to calculate the budget structure of PT. TEMPO LAND building?

C. RESEARCH PURPOSE

1. Design frame section with SAP2000 including Slab, Beam Column and Foundation of the PT. TEMPO LAND building.
2. Analysis structure PT. TEMPO LAND building with SAP2000.
3. Calculate the budget of the structure.

D. FRAMEWORK THINKING

Framework thinking of this thesis use qualitative research methods, its conducting data collection. The collection data was obtained by way as follows :

1. References and study literature
2. Data obtained from the agencies
3. Field Observation
4. Browsing the Internet.

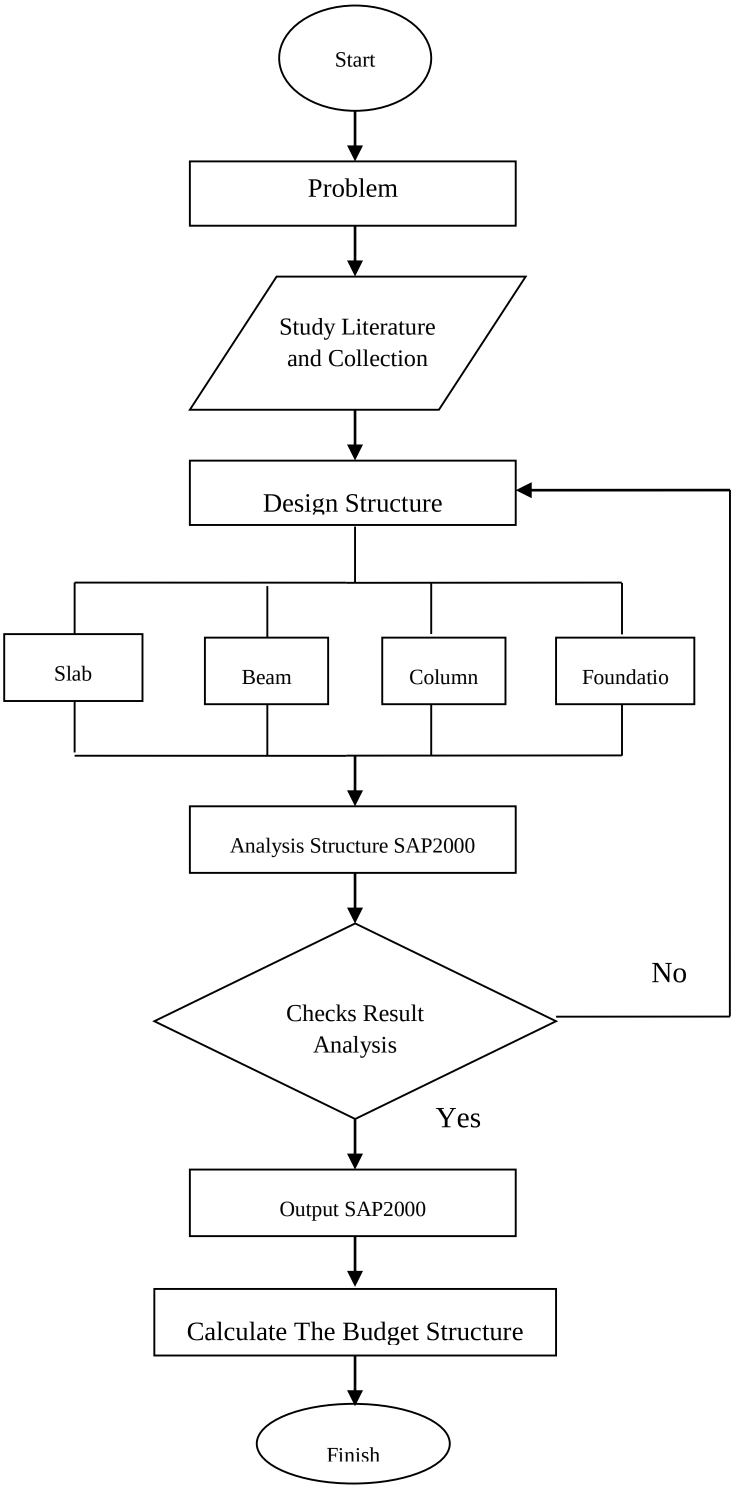

Figure 1.1 Flowchart

A. BASIS THEORY OF ANALYSIS STRUCTURE

1. Structural Portal System

Portal structure is the structure formed of elements of a straight stem, generally composed of beams and columns with the connection between the ends of the stem are assumed to be "stiff perfect" in order to prevent rotation of the relative rotation between the structural elements relate.

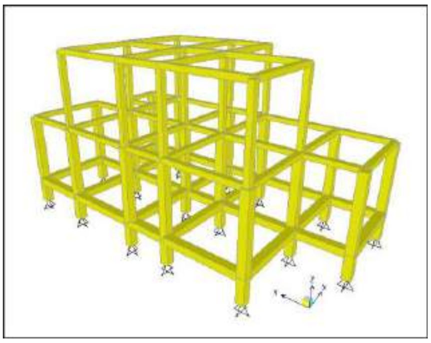

Figure 2.1 System structural

2. Loading System of The Structure

Load operation system for multistory building structural elements can generally be expressed as: load slab are distributed to the joist and beam portal, portal beam load distributed to load the column and the column is then forwarded to the sub-grade through the foundation.

For example, Figure in the below shows the distribution pattern of the slab load beam, the beam span of D-C to bear the burden on the span trapezoidal beams bear the burden of 5-6-7 triangle.

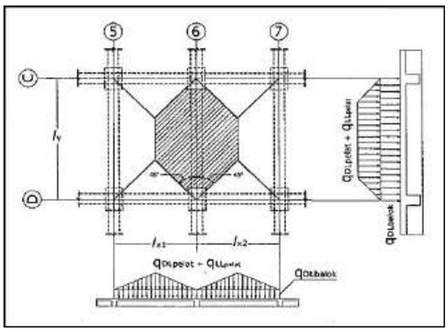

Figure 2.2 Loading system

3. Structural Behavior

Portal structure consists of beams and columns, which have a rigid connection, if will be burdened load will arise deflection and forces (moments, shear, normal). For more details about changes to the structure of the portal due to the load can be seen in Figure 2.3.

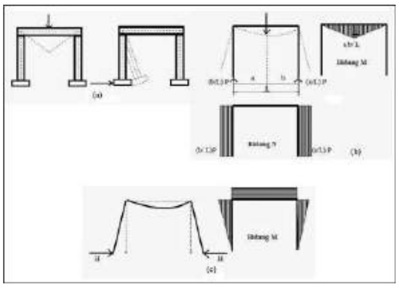

Figure 2.3 Structural behavior

B. MODELING STUCTURE SAP2000

1. System Coordinate SAP2000

SAP2000, Structural Analysis Program, is one program civil engineering applications for structural analysis and design on a wide variety of buildings.

Analysis of the structure is meant is looking for any response to the loading a given structure, it is form of internal forces of structural elements or forces of reaction placement, as well as deformation (deflection) of the structure itself.

The coordinate system used is a square three-dimensional coordinate system (Cartesian) which refers to the right-hand rule. With the right hand (thumb, index and middle fingers) to form a line perpendicular to one another, and the direction indicated by the three right hand fingers shows the positive direction of the axis coordinate system. Where thumb as the X-axis, Y-axis and your index finger as middle as the Z axis.

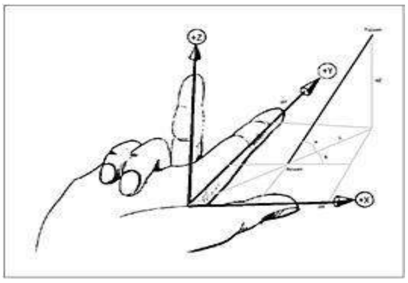

Figure 2.4
Coordinate system

2. Modeling the Structure

The initial stage before to do analysis of the structure is to create a model structure, structural modeling is numeric data generation (mathematical) represents the real structure used as computer data input.

On the program SAP2000 provided some of the structural model by default, see Figure 2.5 The model of this structure can be modified or create a new model that is in accordance with planning.

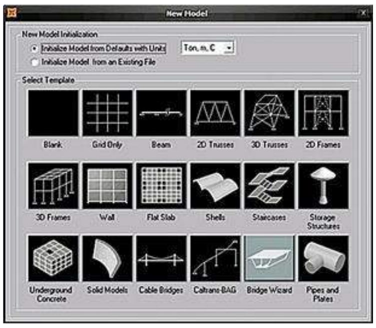

Figure 2.5
Modeling structure

3. Material and Section Properties

At SAP 2000 are available various types of structural materials include concrete, steel and aluminum. Various types of materials can be applied to any element that has been modeled. In determining the property, the initial parameters relating to material that can be modified according to Planning for or standards used. Likewise, the section material.

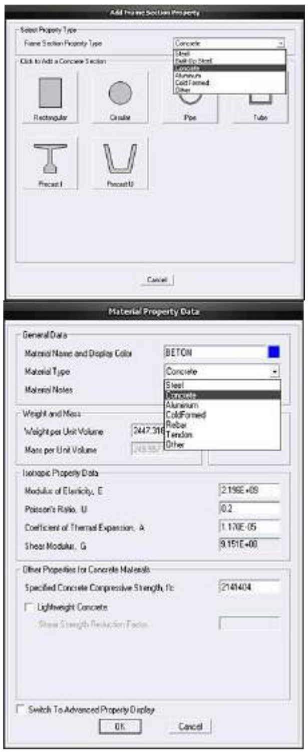

Figure 2.6 Material and section properties

4. Loads

A structure requires a review on the various loading conditions. It is generally in the section design process to find critical condition. In this case, the need to load grouping that has the same type. For example a group of dead load (self weight, walls) or live load (load workers) or lateral loads (wind, earthquake). The group within the meaning of expressed by Static Load analyzed separately from each other.

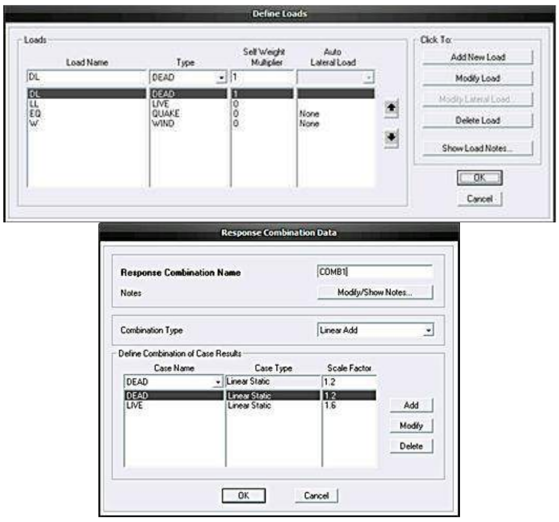

Figure 2.7 Loads

A. OBJECT AND RESEARCH METHOD

1. Research Location

The research location of office PT. TEMPO LAND building, on Jl. Mundu Pesisir No. 35 Cirebon.

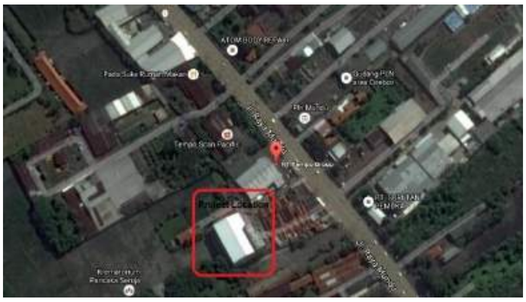

Figure 2.8 Project Location

2. Time Research

The time research, begin on March 12th 2016 until June 12th at the time of practical work, the activity done are survey and collecting the data.

The thesis preparation begins on November 8th 2016 until April 8th 2017, which predicted during five months.

B. TYPE METHOD AND SOURCE OF DATA.

Based on the origin, the data are grouped to be two data, as follows :

1. Primary Data

   Primary data are the data obtained from survey and direct observation to the location or object research.

2. Secondary Data

   Secondary data is data obtained from references, books and the internet related to the building design.

Collection data method used are the literature method and observation method, the explanation as follows :

1. The literature method are the method performed by collecting, learning, and identifying from literature, that comes from books and the Internet, which is related to the building design.

2. The observation method are the method obtained from the survey directly, to the location or object research. With the survey to location of research, it can be seen and obtained data on the structural design of buildings PT. TEMPO LAND building.

A. ANALYSIS AND DISCUSSION

1. Analysis Structure Data

Building Specification

a. Building function : Building office

b. Building area 1504,80 m^2

c. Building height : 14,00 m (including dak roof)

d. Building Configuration :

No.	Building	Elevation (m)
1	Basement	-3,00
2	1st floor	+0,00
3	2nd floor	+3,00
4	3rd floor	+6,00
5	4th floor	+10,00
6	Roof	+14,00

2. Material Specification

a. Concrete : K-250, fc = 21 Mpa

b. Rebar :

D19 (BJTD40), fy = 400 Mpa

Ø10 (BJTP24), fy = 240 Mpa

3. Frame Structure Data

a. Slab :

Basement slab thickness (h) = 15 cm

Slab 1st – 4th thickness (h) = 12,5 cm

Slab dak roof thickness (h) = 10 cm

b. Sloof (Tie beam) :

No.	Type Sloof	Dimension (cm)
1	Sa	45/25
2	S2	50/30
3	S1	50/30

c. Beam

No.	Type Beam	Dimension (cm)
1	Ba	45/25
2	B2	50/30
3	B1	50/30

d. Column

No.	Type Column	Dimension (cm)
1	K1	55/55
2	K2	50/50
3	K3	40/40

B. ANALYSIS STRUCTURE

1. Model Structure

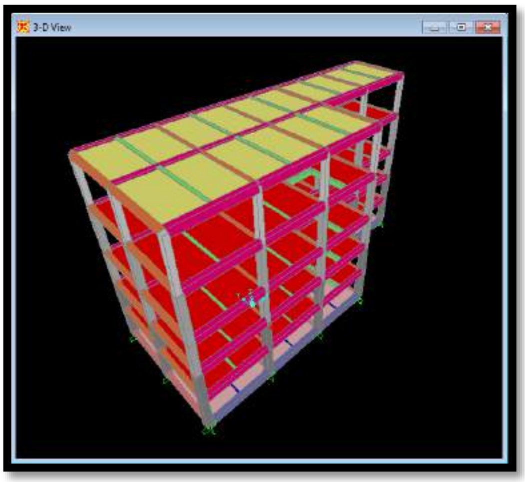

Figure 4.22 Model structure
PT. TEMPO LAND

2. Define Materials (Concrete and Rebar)

- Material used are concrete, longitudinal reinforcing (deform) and transversal reinforcing (shear). And then for section property are sloof (tie beam), beam, column and slab.

Define materials concrete, rebar, and specification are as follow :

a. Concrete :

Weight unit per volume

(2400 Kg/m^3) = $2{,}4.10^{-5}$ N/mm^3

Concrete Quality f_c = 21 Mpa

E_c = $4700*f_c^{1/2}$ = 21538,106 Mpa (N/mm)

Poisson ratio = 0,2

b. Longitudinal rebar (deform) :

Weight unit per volume

(7850 Kg/m^3)= $7{,}850.10^{-5}$ N/mm^3

Yield Stress, fy = 400 Mpa (N/mm)

E_S = 200.000 Mpa (N/mm)

Poisson ratio = 0,3

c. Transversal rebar (shear) :

Weight unit per volume

(7850 Kg/m^3) = $7{,}850.10^{-5}$ N/mm^3

Yield Stress, fy = 240 Mpa (N/mm)

E_s = 200.000 Mpa (N/mm)

Poisson ratio = 0,3

To make it easily data input, then used the unit N, mm, C because the unit Mpa is equal to N / mm.

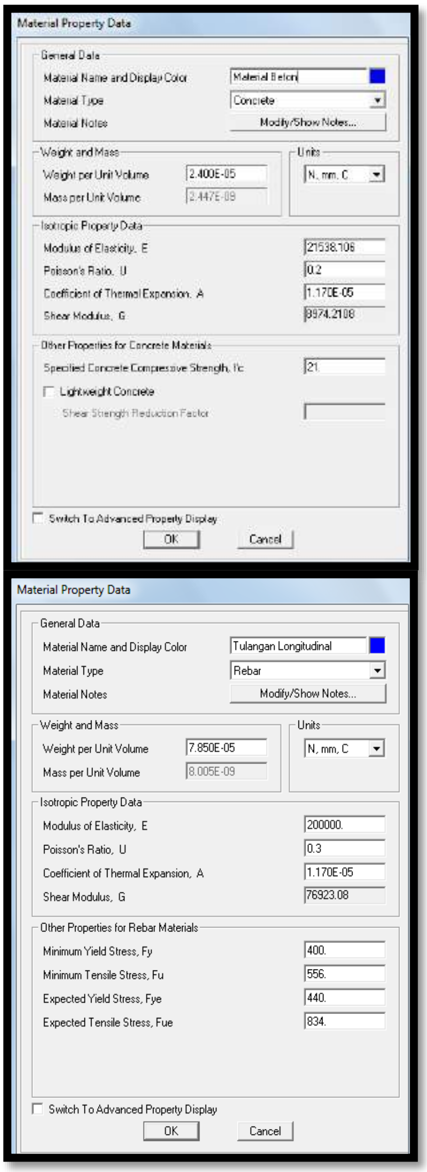

Figure 4.23 Materials

3. Define Section Properties

After define the material, the next steps are define and design frame section (sloof, beam, column and slab), frame section was define, must be same with the data from PT. TEMPO LAND :

a. Sloof

Sa, 45 x 25 cm
S1, 50 x 30 cm
S2, 50 x 30 cm

b. Beam

Ba, 45 x 25 cm
B1, 50 x 30 cm
B2, 50 x 30 cm

c. Column

K1 55 x 55 cm
K2 50 x 50 cm
K3 40 x 40 cm

d. Slab

Basement slab, h = 15 cm
Slab 1^{st} – 4^{th}, h = 12,5 cm
Dak roof, h = 10 cm

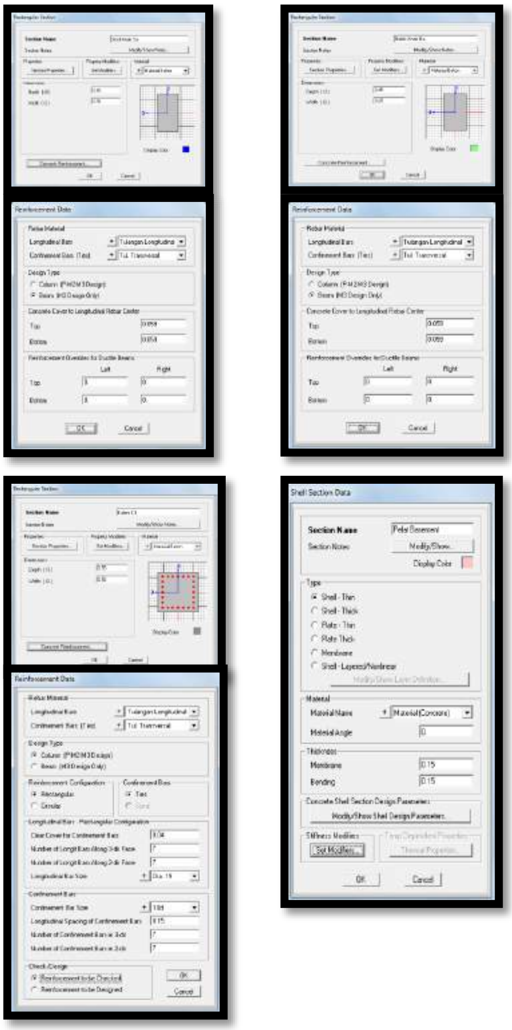

Figure 4.23 Section properties

4. Define Loads

Dead Load

Self weight the structure :

Concrete material, weight unit per volume = 24 kN/m^3 with concrete quality fc 21 Mpa. Steel material deform (BJTD40) Steel material shear (BJTP24).

The additional dead load inputted to slab, **without added** with "density concrete" (weight unit per volume of concrete 24 kN/m^3) are as follow :

Slab Basement = 1,6 kN/m^2

No	Jenis Beban Mati	Berat satuan	Tebal (m)	Q (kN/m^2)
1	Berat *finishing* lantai	22.0	0.05	1.100
2	Berat instalasi ME	0.5	-	0.500
∑				1.600

Slab 1^{st} – 4^{th} = 1,8 kN/m^2

No	Jenis Beban Mati	Berat satuan	Tebal (m)	Q (kN/m^2)
1	Berat *finishing* lantai	22.0	0.05	1.100
2	Berat instalasi ME	0.5	-	0.500
3	Berat plafon dan rangka			0.200
∑				1.800

Dak roof = 0,42 kN/m^2

No	Jenis Beban Mati	Berat satuan	Tebal (m)	Q (kN/m^2)
1	*Waterproffing*	22.0	0.01	0.220
2	Berat plafon dan rangka	0.2	-	0.200
∑				0.420

Live Load

Slab Basement = 1,92 kN

(Lahan parkir SNI – 1727 – 2013)

Slab 1^{st} = 4,79 kN

(Koridor lantai pertama SNI – 1727 – 2013)

Slab 2^{nd} - 4^{th} = 3,83 kN

(Koridor diatas lantai pertama SNI – 1727 – 2013)

Dak roof = 1,00 kN

(Beban hidup dak atap SNI – 1727 – 2013)

Wall Loads

The load a half brick wall is 2,5 kN/m^2.
(q_D = 2,5 kN/m2, including dead load according PPPURG 1987)

- To be as a uniform load to beam :

  W = q_D * h = 2,5 * h (height each story).
- Height each story h_1 = 3.00 m

  and h_2 = 4.00 m

W_1 = 2,5 * 3 = 7,5 kN/m
W_2 = 2,5 * 4 = 10 kN/m.

Wind Loads (Wx and Wy)

In the define wind loads, the data must be known, is wind velocity on the area of building, with search data from BMKG the wind velocity in the Cirebon on Mundu is, (v = 9 km/h) because in SAP2000 input the wind velocity must be use unit mph, so (v = 5,592 mph).

Earthquake (EQx and EQy)

There are many parameter if define input the earthquake loads, the new earthquake analysis is based on SNI – 1726 – 2012, and website www.puskim.go.id it is the website if define site class earthquake.

This is, the steps input the loads in SAP2000 :

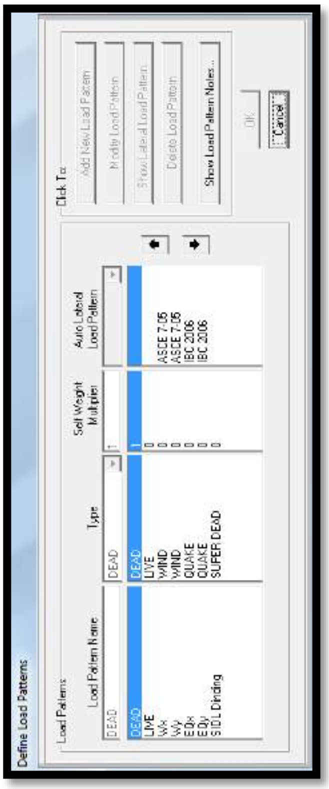

Figure 4.40
Load patterns

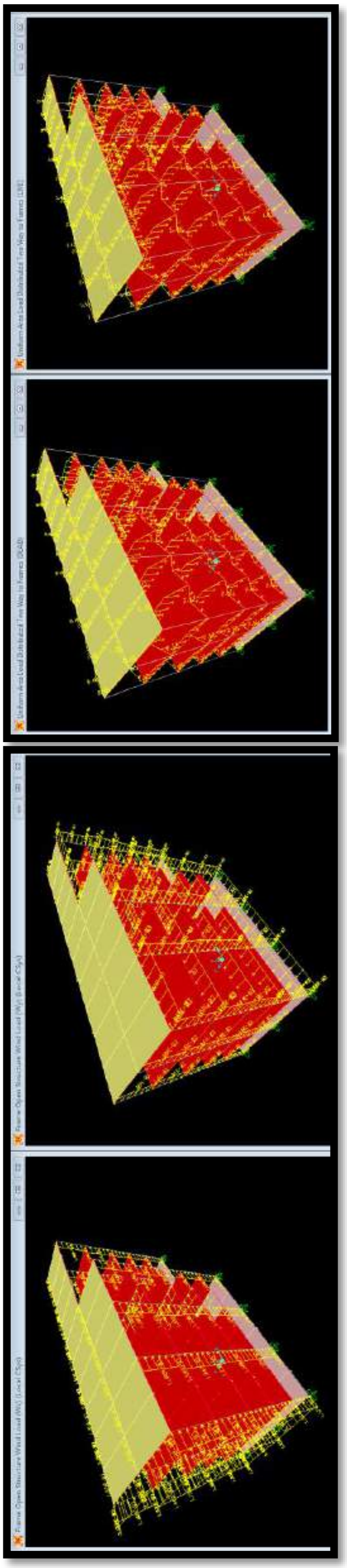

Figure 4.41 Kinds of loads

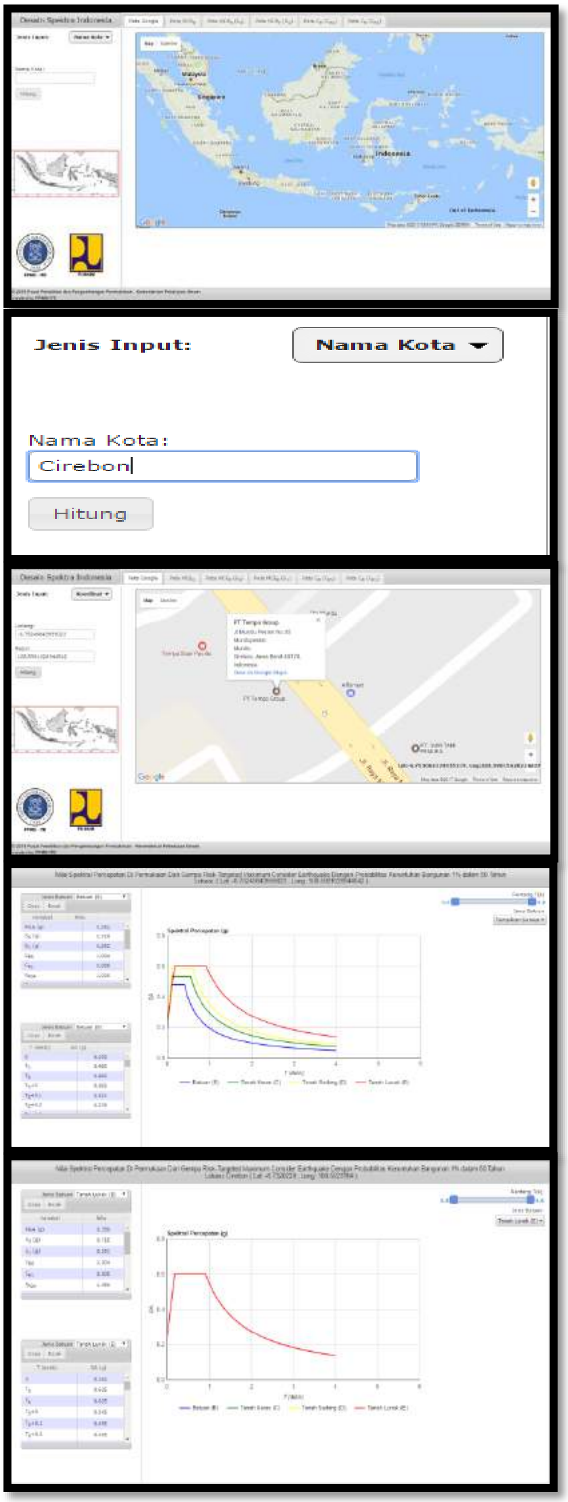

Figure 4.45 Earthquake loads

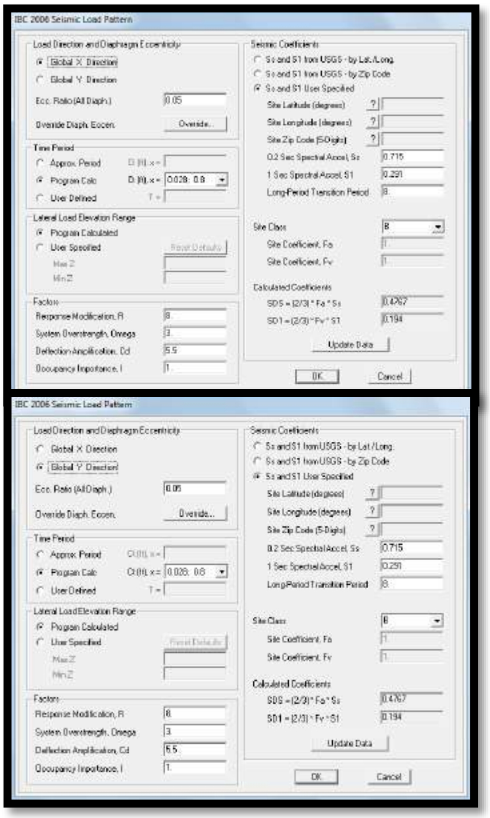

Figure 4.48

5. Run Analysis

Before doing the Run Analysis, there are some parameters that must be edited and input, are as follows :

- Select the load combination, input and then move to the right, in order to design by SAP2000.

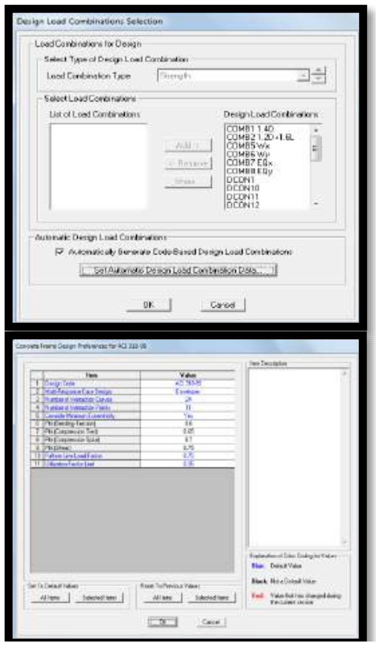

Figure 4.51 Design load to analysis

- Edit reduction factor based on design code ACI-99 :

Figure 4.55 reduction factor for concrete

- Choose the options from type of analysis structure :

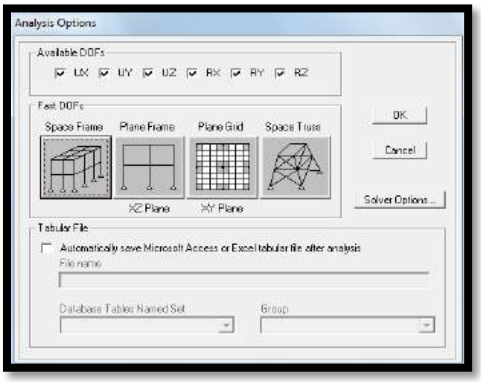

Figure 4.56 Type of analysis structure

- Run Analysis :

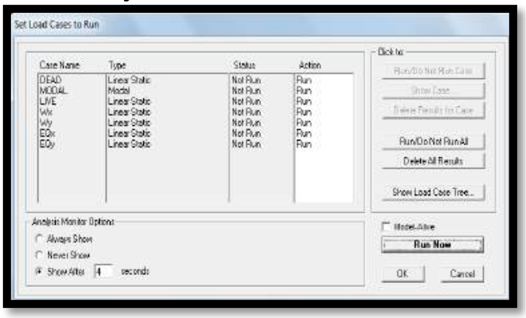

Figure 4.57 Run Analysis

6. Output SAP2000 (Analysis structure PT. TEMPO LAND) :

➢ **Output Earthquake Analysis** :

Self weight each floor on the structure,

TABLE: Groups 3 - Masses and Weights	
GroupName	SelfWeight
Text	KN
ALL	9531.3
Lantai Basement	1486.44
Lantai 1	1311.165
Lantai 2	1311.165
Lantai 3	1311.165
Lantai 4	1311.165
Lantai 5 Atap	1185.480

➢ **Lateral Force on each floor (Fx)** :

Each structure should be analyzed for the influence of static lateral force is applied independently in both directions orthogonal. In every direction were reviewed, lateral static force must be applied simultaneously in each floor. For analysis purposes, the lateral force in each floor is calculated by a formula, as follows :

$F_x = 0{,}01*W_x$

With :

F_x = lateral force each floor

W_x = Self weight structure is work each floor.

Table 4.6 The lateral force each floor

Lantai	Berat tiap lantai (kN)	Fx = 0,01Wx (kN)
Lantai Basement	1486.44	14.8644
Lantai 1	1311.165	13.11165
Lantai 2	1311.165	13.11165
Lantai 3	1311.165	13.11165
Lantai 4	1311.165	13.11165
Lantai 5 Atap	1185.480	11.8548
Total	9531.3	95.313

- **Output Rebar Area :**

  Output rebar area, given by SAP2000 are rebar require (design rebar), and then for calculate rebar used, using manual method.

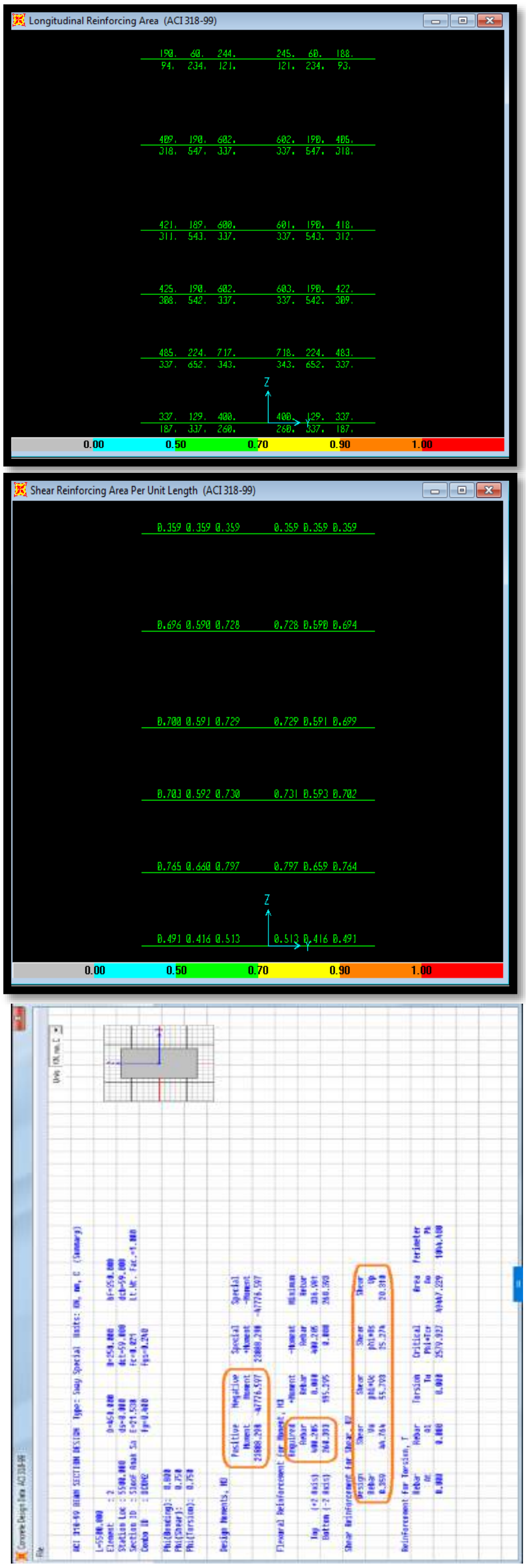

Figure 4.63 Rebar area of Sloof and beam secondary

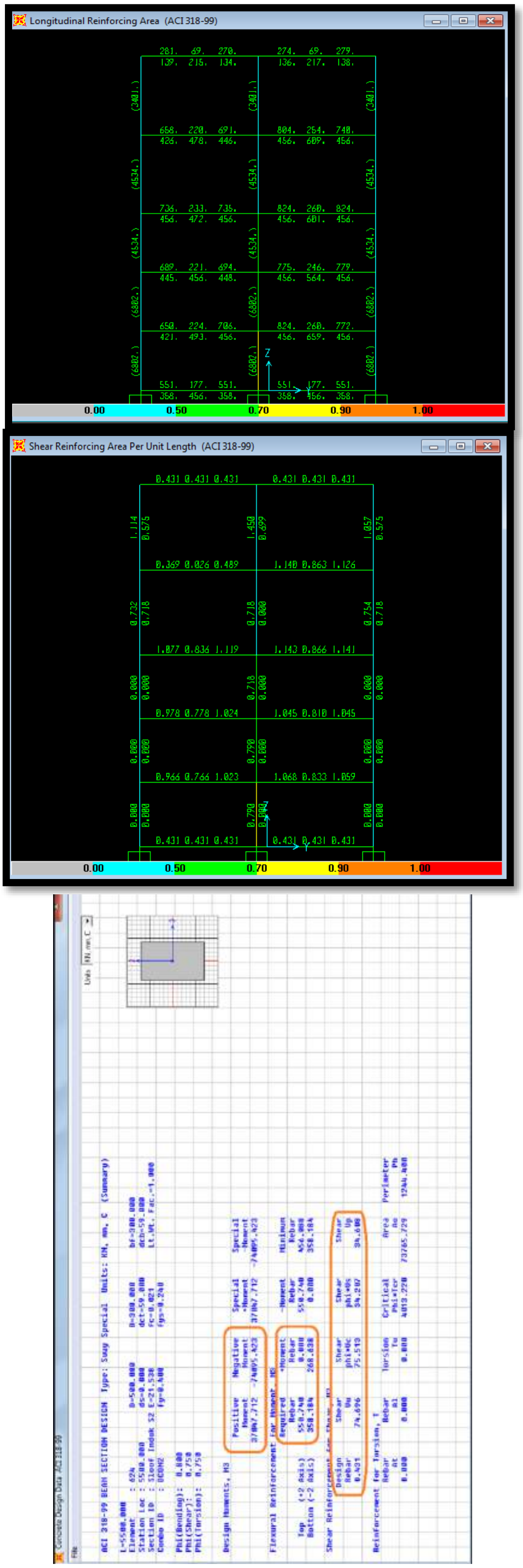

Figure 4.67 Rebar area of Sloof and beam primary

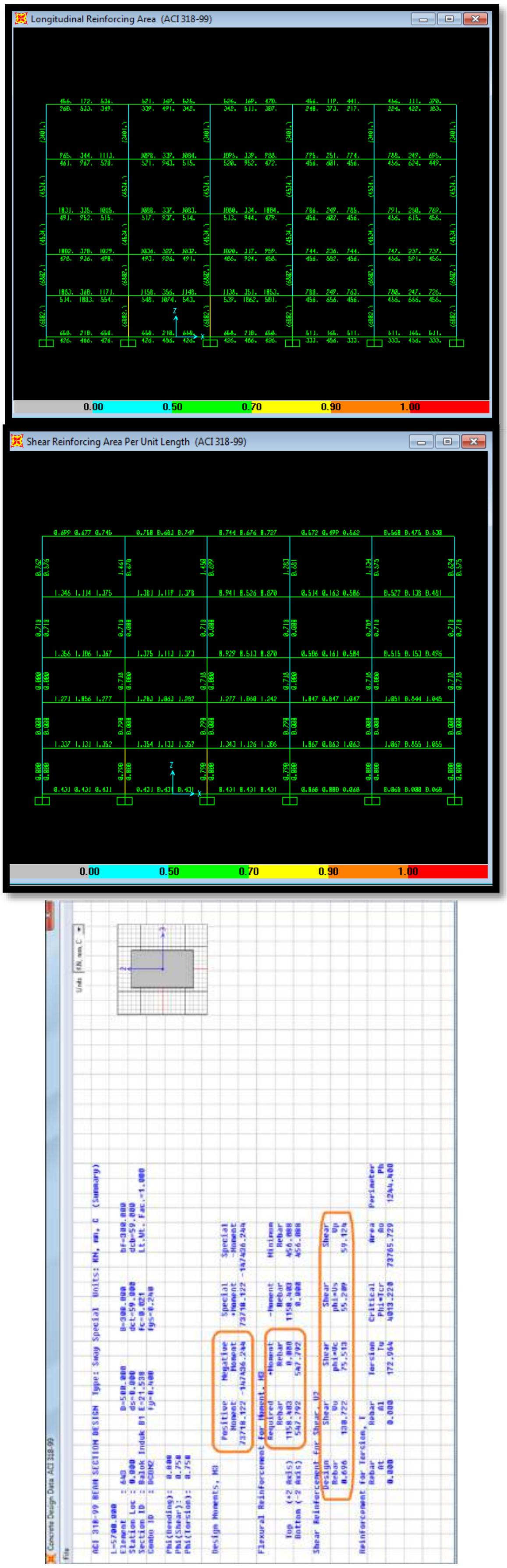

Figure 4.69 Rebar area of Sloof and beam primary

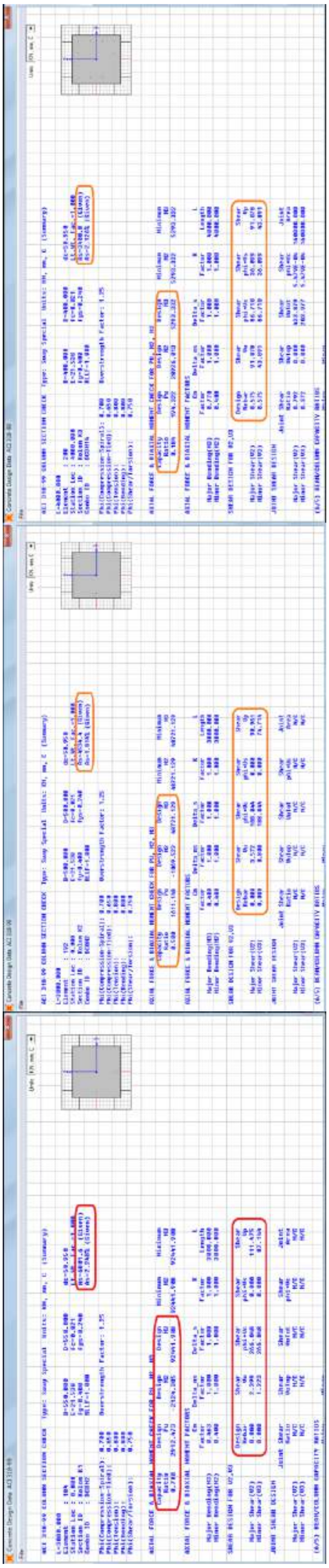

Figure 4.72 Rebar area of Column K1,K2,K3

C. RESULT ANALYSIS AND CHECK THE STRUCTURE

➢ The result of Analysis

The result analyze are compare from manual with excel method and SAP2000. The following are result for analysis structure sloof (tie beam), beam, and column :

Table 4.7 The result of analysis

FRAME		SAP2000		Manual		Tulangan Terpakai	
		Longitudinal mm^2	Shear mm^2/mm	Longitudinal mm^2	Shear mm^2/mm	Longitudinal	Shear
Sloof Anak (Sa)	Tump.	400	0.359	401	0.350	2D19	Ø10 - 190
	Lap.	260	0.359	280	0.350	2D19	Ø10 - 190
Sloof Induk (S1)	Tump.	657	0.431	658	0.420	3D19	Ø10 - 190
	Lap.	425	0.431	391	0.420	2D19	Ø10 - 190
Sloof Induk (S2)	Tump.	551	0.431	551	0.420	3D19	Ø10 - 190
	Lap.	358	0.431	378	0.420	2D19	Ø10 - 190
Balok Anak (Ba)	Tump.	718	0.359	719	0.350	3D19	Ø10 - 190
	Lap.	342	0.359	414	0.350	2D19	Ø10 - 190
Balok Induk (B1)	Tump.	1158	0.696	1160	0.694	5D19	Ø10 - 190
	Lap.	548	0.696	761	0.694	4D19	Ø10 - 190
Balok Induk (B2)	Tump.	824	0.431	825	0.420	4D19	Ø10 - 190
	Lap.	452	0.431	421	0.420	3D19	Ø10 - 190
Kolom (K1)	Tump.	6802	0.790	6800	0.764	24D19	Ø10 - 150
	Lap.	6802	0.790	6800	0.764	24D19	Ø10 - 150
Kolom (K2)	Tump.	4534	0.718	4525	0.700	16D19	Ø10 - 150
	Lap.	4534	0.718	4525	0.700	16D19	Ø10 - 150
Kolom (K3)	Tump.	3401	0.575	3392	0.560	12D19	Ø10 - 150
	Lap.	3401	0.575	3392	0.560	12D19	Ø10 - 150

Table 4.8 The result analysis manual slab

FRAME	Tulangan Arah x mm	Tulangan Arah y mm
Pelat Lantai Type S	Ø10 - 125	Ø10 - 125
Pelat Lantai Type A	Ø10 - 150	Ø10 - 150
Pelat Lantai Type B	Ø10 - 150	Ø10 - 150
Pelat Lantai Type C	Ø10 - 150	Ø10 - 150

➢ Check The Structure

After getting the results of rebar used from frame section sloof (tie beam), beam and column, then will check the deflection from analysis SAP2000 the beam frame. The formula for check deflection are (L/480) based on SNI – 2847 – 2013 "Perencanaan Struktur Gedung Beton Bertulang". The result for check deflection are as follow :

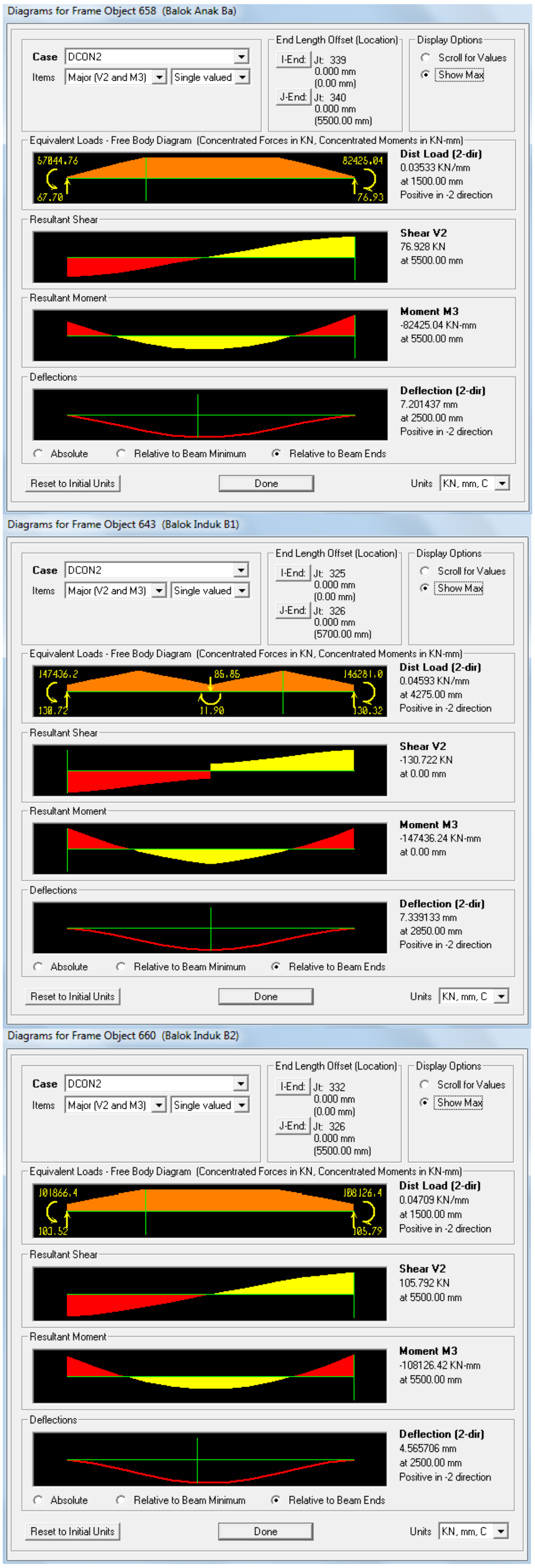

Figure 4.75

Check the deflection of beam

D. THE BUDGET OF STRUCTURE

RENCANA ANGGARAN BIAYA STRUKTUR					
Pekerjaan	: Gedung Kantor PT. TEMPO LAND				
Lokasi	: Jl. Mundu Pesisir No. 35 Cirebon				
Sumber Dana	: THE TEMPO GROUP				
Tahun Anggaran	: 2016				
NO	**URAIAN PEKERJAAN**	**SAT**	**VOLUME**	**HARGA SATUAN (Rp)**	**JUMLAH SATUAN (Rp)**
	PEKERJAAN STRUKTUR **PROYEK GEDUNG KANTOR PT. TEMPO LAND**				
1	**PEKERJAAN PONDASI**				
	1.1 Galian Tanah Pile Cap	m3	26.24	70,000.00	1,837,080.00
	1.2 Urugan Tanah Bawah Lantai	m3	0.79	85,000.00	67,150.00
	1.3 Urugan Pasir Bawah Lantai	m3	1.98	130,000.00	256,750.00
	1.4 Material Pile ukuran 25 x 25	bh	64.00	2,280,000.00	145,920,000.00
	1.5 Biaya pemancangan dengan hidraulic jacking	m1	804.00	500,000.00	402,000,000.00
	1.6 Pile Cap ukuran 13.5/13.5 K-250	m3	26.24	1,485,500.00	38,979,520.00
	Tulangan Pile Cap	kg	1312.76	18,930.00	24,850,546.80
	Bekisting	m2	77.76	766,490.00	59,602,262.40
2	**PEKERJAAN STRUKTUR LANTAI BASEMENT**				
	2.1 Kolom 1 55/55 K-250 (K1)	m3	14.52	1,485,500.00	21,569,460.00
	Tulangan Kolom	kg	3,855.36	18,930.00	72,981,964.80
	Bekisting	m2	105.6	766,490.00	80,941,344.00
	2.2 Sloof Anak 45/25 K-250 (Sa)	m3	4.95	1,485,500.00	7,353,225.00
	Tulangan Sloof	kg	746.88	18,930.00	14,138,381.61
	Begisting	m2	50.60	766,490.00	38,784,394.00
	2.3 Sloof Induk 50/30 K-250 (S1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Sloof	kg	1,444.50	18,930.00	27,344,385.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	2.4 Sloof Induk 50/30 K-250 (S2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Sloof	kg	857.20	18,930.00	16,226,796.00
	Begisting	m2	57.20	766,490.00	43,843,228.00
	2.5 Plat lantai basement, h= 15 cm K-250	m3	46.41	1,485,500.00	68,942,055.00
	Tulangan Plat Lantai	kg	6189.74	18,930.00	117,171,778.20
	Begisting	m2	312.13	766,490.00	239,240,691.25
	2.6 Pintu (Alumunium Grade A)	bh	14.00	3,500,000.00	49,000,000.00
	2.7 Jendela	bh	16.00	2,300,000.00	36,800,000.00
	2.8 Toilet	set	4.00	10,000,000.00	40,000,000.00
3	**PEKERJAAN STRUKTUR LANTAI 1**				
	3.1 Kolom 1 55/55 K-250 (K1)	m3	14.52	1,485,500.00	21,569,460.00
	Tulangan Kolom	kg	3,855.36	18,930.00	72,981,964.80
	Begisting	m2	105.6	766,490.00	80,941,344.00
	3.2 Balok Anak 45/25 K-250 (Ba)	m3	5.27	1,485,500.00	7,830,070.50
	Tulangan Balok	kg	883.50	18,930.00	16,724,655.00
	Begisting	m2	50.60	766,490.00	38,784,394.00
	3.3 Balok Induk 50/30 K-250 (B1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Balok	kg	2,330.00	18,930.00	44,106,900.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	3.4 Balok Induk 50/30 K-250 (B2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Balok	kg	1119.87	18,930.00	21,199,101.24
	Begisting	m2	57.20	766,490.00	43,843,228.00
	3.5 Plat Lantai 1, h = 12.5 cm K-250	m3	38.60	1,485,500.00	57,340,300.00
	Tulangan Plat Lantai	kg	5158.12	18,930.00	97,643,211.60
	Begisting	m2	312.13	766,490.00	239,240,691.25
	3.6 Pintu (Alumunium)	bh	17.00	3,500,000.00	59,500,000.00
	3.7 Jendela	bh	26.00	2,300,000.00	59,800,000.00
	3.8 Toilet	set	2.00	10,000,000.00	20,000,000.00
4	**PEKERJAAN STRUKTUR LANTAI 2**				
	4.1 Kolom 2 50/50 K-250 (K2)	m3	12	1,485,500.00	17,826,000.00
	Tulangan Kolom	kg	2,669.44	18,930.00	50,532,499.20
	Begisting	m2	96	766,490.00	73,583,040.00
	4.2 Balok Anak 45/25 K-250 (Ba)	m3	5.27	1,485,500.00	7,830,070.50
	Tulangan Balok	kg	883.50	18,930.00	16,724,655.00
	Begisting	m2	50.60	766,490.00	38,784,394.00
	4.3 Balok Induk 50/30 K-250 (B1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Balok	kg	2,330.00	18,930.00	44,106,900.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	4.4 Balok Induk 50/30 K-250 (B2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Balok	kg	1119.87	18,930.00	21,199,101.24
	Begisting	m2	57.20	766,490.00	43,843,228.00
	4.5 Plat Lantai 2, h = 12.5 cm K-250	m3	38.60	1,485,500.00	57,340,300.00
	Tulangan Plat Lantai	kg	5158.12	18,930.00	97,643,211.60
	Begisting	m2	312.13	766,490.00	239,240,691.25
	4.6 Pintu (Alumunium)	bh	17.00	3,500,000.00	59,500,000.00
	4.7 Jendela	bh	26.00	2,300,000.00	59,800,000.00
	4.8 Toilet	set	2.00	10,000,000.00	20,000,000.00
5	**PEKERJAAN STRUKTUR LANTAI 3**				
	5.1 Kolom 2 50/50 K-250 (K2)	m3	16	1,485,500.00	23,768,000.00
	Tulangan Kolom	kg	3,559.25	18,930.00	67,376,659.29
	Begisting	m2	128	766,490.00	98,110,720.00
	5.2 Balok Anak 45/25 K-250 (Ba)	m3	5.27	1,485,500.00	7,830,070.50
	Tulangan Balok	kg	883.50	18,930.00	16,724,655.00
	Begisting	m2	50.60	766,490.00	38,784,394.00
	5.3 Balok Induk 50/30 K-250 (B1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Balok	kg	2,330.00	18,930.00	44,106,900.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	5.4 Balok Induk 50/30 K-250 (B2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Balok	kg	1119.87	18,930.00	21,199,101.24
	Begisting	m2	57.20	766,490.00	43,843,228.00
	5.5 Plat Lantai 2, h = 12.5 cm K-250	m3	38.60	1,485,500.00	57,340,300.00
	Tulangan Plat Lantai	kg	5158.12	18,930.00	97,643,211.60
	Begisting	m2	312.13	766,490.00	239,240,691.25
	5.6 Pintu (Alumunium)	bh	16.00	3,500,000.00	56,000,000.00
	5.7 Jendela	bh	28.00	2,300,000.00	64,400,000.00
	5.8 Toilet	set	2.00	10,000,000.00	20,000,000.00
6	**PEKERJAAN STRUKTUR LANTAI 4**				
	6.1 Kolom 3 40/40 K-250 (K3)	m3	10.24	1,485,500.00	15,211,520.00
	Tulangan Kolom	kg	2,689.28	18,930.00	50,908,070.40
	Begisting	m2	102.4	766,490.00	78,488,576.00
	6.2 Balok Anak 45/25 K-250 (Ba)	m3	5.27	1,485,500.00	7,830,070.50
	Tulangan Balok	kg	883.50	18,930.00	16,724,655.00
	Begisting	m2	50.60	766,490.00	38,784,394.00
	6.3 Balok Induk 50/30 K-250 (B1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Balok	kg	2,330.00	18,930.00	44,106,900.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	6.4 Balok Induk 50/30 K-250 (B2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Balok	kg	1119.87	18,930.00	21,199,101.24
	Begisting	m2	57.20	766,490.00	43,843,228.00
	6.5 Plat Lantai 2, h = 12.5 cm K-250	m3	38.60	1,485,500.00	57,340,300.00
	Tulangan Plat Lantai	kg	5158.12	18,930.00	97,643,211.60
	Begisting	m2	312.13	766,490.00	239,240,691.25
	6.6 Pintu (Alumunium)	bh	15.00	3,500,000.00	52,500,000.00
	6.7 Jendela	bh	25.00	2,300,000.00	57,500,000.00
	6.8 Toilet	set	2.00	10,000,000.00	20,000,000.00
7	**PEKERJAAN STRUKTUR DAK ATAP**				
	7.1 Balok Anak 45/25 K-250 (Ba)	m3	5.27	1,485,500.00	7,830,070.50
	Tulangan Balok	kg	883.50	18,930.00	16,724,655.00
	Begisting	m2	50.60	766,490.00	38,784,394.00
	7.2 Balok Induk 50/30 K-250 (B1)	m3	11.12	1,485,500.00	16,511,332.50
	Tulangan Balok	kg	2,330.00	18,930.00	44,106,900.00
	Begisting	m2	96.33	766,490.00	73,835,981.70
	7.3 Balok Induk 50/30 K-250 (B2)	m3	6.60	1,485,500.00	9,804,300.00
	Tulangan Balok	kg	1119.87	18,930.00	21,199,101.24
	Begisting	m2	57.20	766,490.00	43,843,228.00
	7.4 Plat Lantai Atap, h = 10 cm K-250	m3	30.73	1,485,500.00	45,653,871.50
	Tulangan Plat Lantai	kg	5158.12	18,930.00	97,643,211.60
	Begisting	m2	312.13	766,490.00	239,240,691.25
	JUMLAH HARGA (STRUKTUR)				**6,170,934,880.400**

A. CONCLUSION

Based on the result of analysis and discussion, it can be concluded as follows :

1. In analyzing the structure with SAP2000, the steps that must be done consists of modeling the structure, define material, define and design frame section, define the load patterns and run analysis model of the structure.
2. The results from analysis structure are as follows:
   a. Internal forces (moment, axial and shear) that will be used in the design phase of the structure. In the design of the structure (output SAP2000) is produced rebar required by the elements (frame) structure.
   b. The result from analysis lateral force (earthquake), it can concluded the lateral force greatest is 14,864 kN.
   c. The result from analysis structure using SAP2000 with manual method, is the almost same, but there are some differences at number of rebar on sloof and beam, the result are as follows :

Table 5.1 The different result analysis structure.

FRAME		DATA PROYEK		DATA HASIL ANALYSIS	
		Longitudinal	Shear	Longitudinal	Shear
Sloof Anak (Sa)	Tump.	3D19	Ø10 - 150	2D19	Ø10 - 190
	Lap.	2D19	Ø10 - 200	2D19	Ø10 - 190
Sloof Induk (S1)	Tump.	3D19	Ø10 - 150	3D19	Ø10 - 190
	Lap.	3D19	Ø10 - 200	2D19	Ø10 - 190
Sloof Induk (S2)	Tump.	3D19	Ø10 - 150	3D19	Ø10 - 190
	Lap.	3D19	Ø10 - 200	2D19	Ø10 - 190
Balok Anak (Ba)	Tump.	3D19	Ø10 - 150	3D19	Ø10 - 190
	Lap.	2D19	Ø10 - 200	2D19	Ø10 - 190
Balok Induk (B1)	Tump.	5D19	Ø10 - 150	5D19	Ø10 - 190
	Lap.	4D19	Ø10 - 200	4D19	Ø10 - 190
Balok Induk (B2)	Tump.	4D19	Ø10 - 150	4D19	Ø10 - 190
	Lap.	3D19	Ø10 - 200	3D19	Ø10 - 190

d. From manual analysis slab, there are differences from data project PT. TEMPO LAND, the differences are as follows :

Table 5.2 The different result analysis manual slab

FRAME	DATA PROYEK Tulangan (mm)		DATA HASIL ANALYSIS Tulangan (mm)	
	Arah x	Arah y	Arah x	Arah y
Pelat Lantai Type S	Ø10 - 125		Ø10 - 125	
Pelat Lantai Type A	Ø10 - 200		Ø10 - 150	
Pelat Lantai Type B	Ø10 - 150		Ø10 - 150	
Pelat Lantai Type C	Ø10 - 200		Ø10 - 150	

e. The result from check ratio color (SAP2000) on the structure, that produce green color for beams and blue color for columns, but there are 2 (two) columns is get yellow colors, and then from check the deflection it can, the value greatest from balok induk B1 is 7,339 mm with span is 5700 mm, but not more than deflection permit (L/480) is 11,875 mm. So it can be concluded that, the structure from PT. TEMPO LAND is safe.

f. The vertical load of pile group is 595,706 kN, less then more from the maximum load permitted is 1128,704 kN, it can be concluded that the foundation in PT. TEMPO LAND is safe.

3. From the result analysis budget of the structures, it can be total budget structures is Rp 6,170,934,880,400,-

B. RECOMMENDATION

The recommendation submitted regarding this thesis, are as follows :

1. In the analysis using SAP2000, needed preliminary design and accurate when inputted the data included material, section properties and loads.
2. Regarding the design of the structure, according to the design code (standar perencanaan).

REFERENCES

Departemen Pekerjaan Umum. 1987. *Pedoman Peraturan Pembebanan Untuk Rumah dan Gedung* (PPPURG 1987). Yayasan Lembaga Penyelidikan Masalah Bangunan , Bandung.

Departemen Pekerjaan Umum. 2013. *Beban Minimum Untuk Perancangan Bangunan Struktur Gedung* (SNI–1727–2013). Yayasan Lembaga Peyelidikan Masalah Bangunan, Bandung.

Departemen Pekerjaan Umum. 2013. *Persyaratan Beton Struktural Untuk Bangunan Gedung* (SNI –284 –2013). Yayasan Lembaga Peyelidikan Masalah Bangunan, Bandung.

Linda Widyastani dan Takhmid Ulya, 2010. *Perencanaan Bangunan Gedung Kuliah Diploma III Fakultas Teknik. Universitas Diponegoro"*. Semarang.

Nugraha, Sigit. 2016. *Analisis Perencanaan Gedung Kantor Samsat Kabupaten Kuningan Dengan Menggunaka SNI Beton 2013.* Universitas Swadaya Gunung Jati Cirebon.

Satyarno, Iman, Purbolaras Nawangalam, R. Indra Pratomo, (2011). *Belajar SAP2000 Seri 1 dan Seri 2. Zamil Publishing*, Jogjakarta.

Wahyudi, 2015. *Analisis Strutkur Portal Statis Tak Tentu Dengan SAP2000*. Universitas Muhammadiyah, Palangkaraya.

Yusuf, 2015. *Analisis Perencanaan Gedung Aula dan Rektorat. Universitas Swadaya Gunung Jati, Cirebon.*

http://www.ilmusipil.blogspot.co.id
http://www.purbolaras.wordpress.com
http://www.puskim.go.id/