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# ANALYSIS AND DESIGN STRUCTURE OF CIDERES HOSPITAL BUILDING

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**ABSTRACT**

A hospital is one of the important elements in the people of nation, especially in the medical sector. Cideres hospital is one of hospital in district Majalengka that has the best services. Healthy is important to make development of quality people sector. Cideres hospital has a target to make Majalengka become a healthy district in Indonesia.

As one of citizen needs, healthy is important to make development of quality people sector. Cideres hospital has a target to make Majalengka become a healthy district in Indonesia. After this building constructed, it make the service healthy to the people in Majalengka more increase.

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

With the special programs, the completion of structural analysis for various purposes can be performed quickly and accurately, when compared with the structural analysis is done manually including SAP2000 program.

**Keywords :** Analysis and design, SNI codes, SAP2000 Program

## 1. PRELIMINARY

### Background

Majalengka is one of the districts in West Java that has population who quite rapidly, because of that the government must take care the health of Majalengka people. A hospital is one of the important elements in the people of nation, especially in the medical sector. Cideres hospital is one of hospital in district Majalengka that has the best services, because of that Cideres hospital become a reference by people to check their healthy.

As one of citizen needs, healthy is important to make development of quality people sector. Cideres hospital has a target to make Majalengka become a healthy district in Indonesia. After this building constructed, it make the service healthy to the people in Majalengka more increase.

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

Belong the times and technological progress, computers become tools in resolving the problems of numerical and non-numerical in every aspect of science. With the special programs, the completion of structural analysis for various purposes can be performed quickly and accurately, when compared with the structural analysis is done manually including SAP2000 program.

## 2. Focus Problem

This focused research is designing and analyzing structure of Cideres hospital building with construction concrete method.

## 3. Formulation Problem

1. Designing the structure of Cideres hospital, according to the SNI - 2847 - 013 reinforced concrete, PPPURG 1987 and SNI - 1727 - 2013 for loading, and then calculate the seismic.
2. Does not design Mechanical Electrical and Plumbing.
3. Analysis structure with SAP2000.
4. Calculate the budget structure.

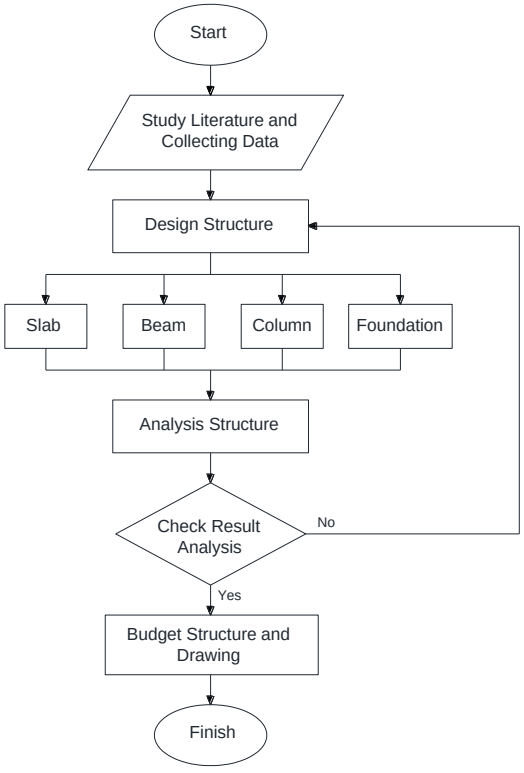
## 4. Research Purpose

1. Designing Slab, Beam, Column and Foundation in the structure of Cideres hospital.
2. Analyzing the structure of Cideres hospital with SAP2000.
3. How much the budgeting that spends just for the structure.

## 5. Research Boundaries

1. Calculating the main structure
2. For earthquake analysis, just calculating the static equivalent.
3. Calculating the budget of structure only, does not calculate the budget of architecture, mechanical electrical and plumbing.
4. Does not calculating the support structure

## 6. Framework Thinking




## 7. RESEARCH METHODOLOGY

### The Preparation Stage

The preparation stage is the stage preliminary, before doing the survey to research location in Cideres Hospital at Cideres – Kadipaten Street No. 180, Cideres Village, Dawuan Sub-district, district of Majalengka.

### Problem Identification Stage

1. Does the structure of Cideres hospital building safe or not according to the SNI rules?

2. The solutions are analysis and design the structure?

**Study Literature Stage**

1. Thesis literature
2. The rules of SNI and PPPURG 1987
3. Data collection from field

**Design Structure Stage**

1. Designing slab
2. Designing beam
3. Designing column
4. Designing foundation

**Analysis Structure Stage**

1. Check deflection of slab
2. Check deflection and shear of beam
3. Check axial force of column
4. Check the strength and quantity of pile foundation

**Calculation Budget of Structure**

The budget structure is volume of structure multiply by unit price.

## 8. ANALYSIS AND DESIGN

**Building Configuration**

| No | Building | Elevation ( m ) |
|---|---|---|
| 1 | 1st floor | +0,00 |
| 2 | 2nd floor | +4,00 |
| 3 | 3rd floor | +8,00 |
| 4 | 4th floor | +12,00 |
| 5 | Rooftop | +16,00 |

**Material Specification**

Concrete : K300 (fc = 24,9 MPa)
Rebar : D16 (BJTD40)
: D12 (BJTD40)
: Ø10 (BJTP24)

## 9. Frame Structure

**Slab**

- Slab : 1st – 4th = 12,5 cm
- Slab rooftop = 10 cm

**Sloof (tie beam)**

- SA = 30/20
- S1 = 40/30

**Beam**

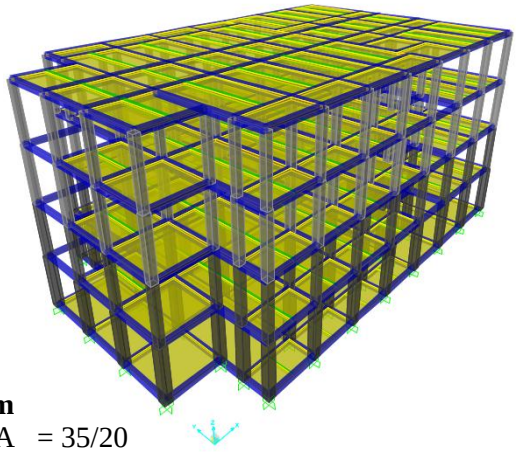
- BA = 35/20
- B1 = 45/30
- B2 = 55/30
- B3 = 55/30
- B4 = 55/30

**Column**

- K1 = 55/55
- K2 = 45/45
- K3 = 45/45
- K4 = 40/40

## 10. Modeling Structure

First step in modeling structure is setting the unit. The unit used is kN.mm.C



**Beam**

- BA = 35/20
- B1 = 45/30
- B2 = 55/30
- B3 = 55/30
- B4 = 55/30

## 11. Define Materials

**Concrete**

- Weight per unit volume = 2400 kg/m$^3$
- Concrete quality = 24,9 MPa

**Rebar**

- Weight per unit volume = 7850 kg/m$^3$
- Yield stress = 400 MPa

## 12. Define Section Properties

**Slab**

- Slab : 1st – 4th = 12,5 cm
- Slab rooftop = 10 cm

**Sloof (tie beam)**

- SA = 30/20
- S1 = 40/30

**Column**

- K1 = 55/55
- K2 = 45/45
- K3 = 45/45
- K4 = 40/40

**Define Loads**

1. Live load
2. Dead Load
3. Wall Load
4. Wind Load
5. Earthquake Load

## 13. Load Combination

Rules about load combination based on SNI-1727-2013. In the analysis, there is 6 (six) main combination that usual and commonly used in the structural analysis.

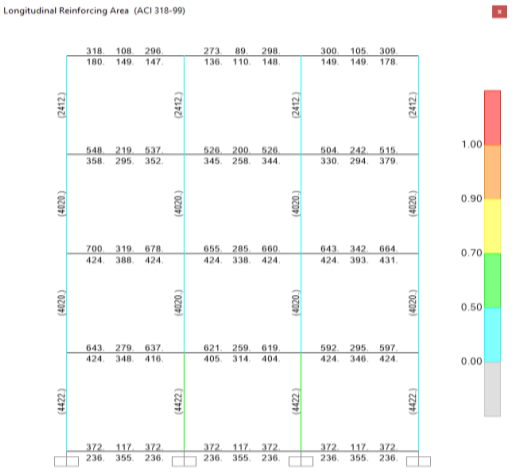
1. 1,6D
2. 1,2D + 1,4L
3. 1,2D + 1,0Wx + 1,0L
4. 1,2D + 1,0Wy + 1,0L
5. 1,2D + 1,0Ex + 1,0L
6. 1,2D + 1,0Ey + 1,0L

**Run Analysis SAP2000**

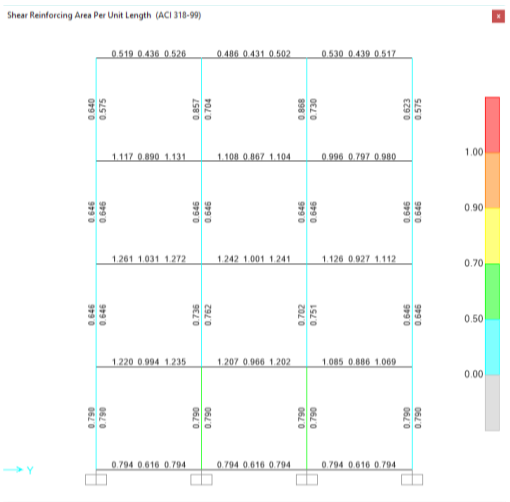
- Select the load combination.
- Edit the reduction factor based on design code from ACI-318-99.
- Choose the type of structure.
- Run Analysis.

## 14. Output Analysis SAP2000

- Output Design Rebar (Longitudinal reinforcing)




- Output Design Rebar (Shear reinforcing)




- Output Lateral Force

| No | Name | Self Weight (kN) |
|---|---|---|
| 1 | 1st floor | 7829.76 |
| 2 | 2nd floor | 4470.72 |
| 3 | 3rd floor | 4461.12 |
| 4 | 4th floor | 3940.56 |
| ∑ | | 20702.16 |

## 14. Check the Result of Analysis

- The result of analysis slab

| FRAME STRUCTURE | REINFORCEMENT | |
|---|---|---|
| | X Direction (mm) | Y Direction (mm) |
| SLAB A | Ø10 - 100 | Ø10 - 100 |
| SLAB B | Ø10 - 75 | Ø10 - 75 |
| SLAB C | Ø10 - 100 | Ø10 - 100 |
| SLAB D | Ø10 - 100 | Ø10 - 100 |
| SLAB E | Ø10 - 100 | Ø10 - 100 |
| SLAB F | Ø10 - 150 | Ø10 - 150 |
| SLAB G | Ø10 - 150 | Ø10 - 150 |

- Check deflection of beam

| FRAME STRUCTURE | RESULT OF DEFLECTION ANALYSIS (mm) | DEFLECTION PERMIT (L/480) (mm) |
|---|---|---|
| BA | 11.087 | 12.5 |
| B1 | 1.589 | 8.333 |
| B2 | 0.983 | 8.333 |
| B3 | 0.427 | 4.167 |
| B4 | 1.037 | 8.333 |

- Axial force on column 1st

| N0 | Axial Force (kN) | N0 | Axial Force (kN) | N0 | Axial Force (kN) |
|---|---|---|---|---|---|
| 1 | 352.91 | 21 | 899 | 41 | 1418.52 |
| 2 | 597.88 | 22 | 797.61 | 42 | 1428.02 |
| 3 | 517.94 | 23 | 1324.78 | 43 | 900.14 |
| 4 | 595.7 | 24 | 1580.98 | 44 | 385.29 |
| 5 | 481.94 | 25 | 1586.63 | 45 | 610.48 |
| 6 | 709.14 | 26 | 1575.31 | 46 | 643.26 |
| 7 | 1051.54 | 27 | 1128.94 | 47 | 1407.27 |
| 8 | 719.29 | 28 | 959.6 | 48 | 1408.56 |
| 9 | 653.89 | 29 | 1036.48 | 49 | 1413.86 |
| 10 | 1407.38 | 30 | 691.2 | 50 | 930.83 |
| 11 | 1409.14 | 31 | 620.98 | 51 | 354.17 |
| 12 | 1400.18 | 32 | 1147.82 | 52 | 598.41 |
| 13 | 586.99 | 33 | 1580.95 | 53 | 516.93 |
| 14 | 547.04 | 34 | 1586.62 | 54 | 589.26 |
| 15 | 637.9 | 35 | 1576.6 | 55 | 672.16 |
| 16 | 548.6 | 36 | 1135.02 | 56 | 1146.56 |
| 17 | 768.03 | 37 | 961.72 | 57 | 1163.27 |
| 18 | 654.85 | 38 | 1040.41 | 58 | 720.94 |
| 19 | 891.07 | 39 | 691.25 | | |
| 20 | 1240.9 | 40 | 948.7 | | |

- Summary the demand of foundation

| N0 | Axial Force (kN) | Type of Pile Cap | N0 | Axial Force (kN) | Type of Pile Cap | N0 | Axial Force (kN) | Type of Pile Cap |
|---|---|---|---|---|---|---|---|---|
| 1 | 352.91 | A = 1 P | 21 | 899 | B = 2 P | 41 | 1418.52 | C = 3 P |
| 2 | 597.88 | A = 1 P | 22 | 797.61 | B = 2 P | 42 | 1428.02 | C = 3 P |
| 3 | 517.94 | A = 1 P | 23 | 1324.78 | C = 3 P | 43 | 900.14 | B = 2 P |
| 4 | 595.7 | A = 1 P | 24 | 1580.98 | D = 4 P | 44 | 385.29 | A = 1 P |
| 5 | 481.94 | A = 1 P | 25 | 1586.63 | D = 4 P | 45 | 610.48 | A = 1 P |
| 6 | 709.14 | A = 1 P | 26 | 1575.31 | D = 4 P | 46 | 643.26 | A = 1 P |
| 7 | 1051.54 | B = 2 P | 27 | 1128.94 | B = 2 P | 47 | 1407.27 | C = 3 P |
| 8 | 719.29 | A = 1 P | 28 | 959.6 | B = 2 P | 48 | 1408.56 | C = 3 P |
| 9 | 653.89 | A = 1 P | 29 | 1036.48 | B = 2 P | 49 | 1413.86 | C = 3 P |
| 10 | 1407.38 | C = 3 P | 30 | 691.2 | A = 1 P | 50 | 930.83 | B = 2 P |
| 11 | 1409.14 | C = 3 P | 31 | 620.98 | A = 1 P | 51 | 354.17 | A = 1 P |
| 12 | 1400.18 | C = 3 P | 32 | 1147.82 | B = 2 P | 52 | 598.41 | A = 1 P |
| 13 | 586.99 | A = 1 P | 33 | 1580.95 | D = 4 P | 53 | 516.93 | A = 1 P |
| 14 | 547.04 | A = 1 P | 34 | 1586.62 | D = 4 P | 54 | 589.26 | A = 1 P |
| 15 | 637.9 | A = 1 P | 35 | 1576.6 | D = 4 P | 55 | 672.16 | A = 1 P |
| 16 | 548.6 | A = 1 P | 36 | 1135.02 | B = 2 P | 56 | 1146.56 | B = 2 P |
| 17 | 768.03 | A = 1 P | 37 | 961.72 | B = 2 P | 57 | 1163.27 | B = 2 P |
| 18 | 654.85 | A = 1 P | 38 | 1040.41 | B = 2 P | 58 | 720.94 | A = 1 P |
| 19 | 891.07 | B = 2 P | 39 | 691.25 | A = 1 P | | | |
| 20 | 1240.9 | B = 2 P | 40 | 948.7 | B = 2 P | | | |

**The Budget of Structure**

The calculation of the budget is with multiplied the volume with the unit price and the total budgeting is

Rp 5.338.524.770,-

## 15. CONCLUSION

1. In the analyzing and designing the structure, all of step should be done.
2. The step of analyzing and designing the structure are designing the dimension of frame (get the rebar design) and then analyzing the frame structure (check the rebar design)
3. The result of analysis and design of structure is internal forces (moment, shear and axial) that will be used to designing the rebar required in the every elements (frame) structure.
4. The total budgeting is
   Rp 5.338.524.770,-

## 16. RECOMENDATION

The recommendations for regarding on this journal thesis are :

1. In the analysis using SAP2000 program needed a preliminary design and must has an accurate when inputting data.
2. Regarding the design of structure is always according to the design rules (SNI in Indonesia) and should has a supporting data.
3. Pay attention to the structure that based on the required design. Including loading, frame and cost.

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