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Construction Planning Design Of A 5-Storey Building With SAP 2000 v14.0.0 Program In Central Java

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ABSTRACT
The structure of multi- storey buildings basically refers to SNI 1726-2012, SNI 03-1726-2019, SNI 03-2847-2019 and PPPURG 1987. This research aims to determine the calculation of beams and columns using SAP 2000 v14.0.0 and taking into account Earthquake spectrum in Central Java. Central Java is included in the moderate earthquake category, so to avoid structural failure, it is necessary to take into account beam-column connections, and structure modeling as well as calculating the forces acting on the structure with the SAP 2000 v14.0.0 application. The type of material used is concrete f'c = 25 MPa, and reinforcing steel is fy 400 MPa and 240 MPa.

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INTRODUCTION

Indonesia is a vulnerable region with disaster natural like earthquake Earthquakes and tsunamis. Java Island is one of the areas that is vulnerable earthquake, thing This because Java Island is close by meeting between Indo-Austrian plate and Eurasian plate. Building construction tiered must consider factor earthquake in building area That planned. Irregularity building Alone divided into 2, namely direction vertical and horizontal direction. Because That required analysis performance buildings located in disaster-prone areas earthquake. Research This aiming For designing building 5- storey building with earthquake resistant structure. Building design This designed in a way in a way vertical, so that need knowledge adequate knowledge as well as supported with mastery application Civil Engineering Computer Software so that it can design and build with good, strong and economical. In designing a building building tiered, of course No off from aesthetics building said, so that various type form from the regular until with the not regular.

Literature Review

Draft Planning Structure

Design Against *Lateral* Loads (Earthquakes)

Earth's crust not static and always move constant. So that according to theory geology about tectonic plate, surface earth consists of from a number of slab rock thick floating on matel molten earth. Plates tectonic newly formed continously throughout steep valley at the bottom sea Where material liquid from the interior of the earth pushed to on so

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that ocean new to form edge slab the ocean that causes *continental drift,* namely plates ocean driven to slab *continental, (Indranto Himawan. 2009).*

Selection of Analysis Method

Election method analysis For planning structure determined based on configuration structure and function planned and related buildings with land base and seismic area. For structure building small and not tiered, elements structural and non- structural No need designed special to earthquake, but good structural detail is required. For structure building regular used method analysis burden *static equivalent.*

Loads – Loads on Structures

a. Static Load

Static Load is working load in a way Keep going continuously on a structure buildings. Static loads are also associated with loads that are slowly arise as well as have variable magnitude of nature still *(steady states).* So if a burden have change running intensity Enough slowly such that appearance so that influence time No dominant, so that burden the can categorized as static load and deformation from A structure consequence static load will reach the peak If burden This reach mark maximum.

b. Burden of Life

Live load is all the loads in the building that occur due to occupancy or use of a building.

Table 1. Live Load On Building Floors

Burden Life Floor Building	Big Burden
Floor office, shop	250 kg/ m^2
Floor And ladder House stay	200 kg/ m^2
Floor For room meeting	400 kg/ m^2
Balcony – balcony Which jutting out free go out	300 kg/ m^2
Ladder And border For office, shop	300 kg/ m^2
Burden life on roof	100 kg/ m^2

Burden life on part roof Which No can achieved And burdenedby people, the most decisive of the two must be taken type the following loads:

a. distributed load per m ^{2} flat areas come from rain loadof (40-0.8α) kg/m ^{2,} with α = roof slope angle (º). The load does not need to be taken ≥20 kg/m ^{2} and no need reviewed whenα ≥50º.
b. Burden centralized from a worker fire extinguisher fire with the equipment minimum 100 kg.

Source: Indonesian Loading Planning Guidelines for Houses and Buildings (PPPURG)-1987

c. Dynamic oad

Dynamic load is a load that has change varying intensity and variation the in a way appropriate to time. So that burden dynamic This Work in a way suddenly on the structure building. In general, the load This No nature still *(unsteady-state)* and has characteristics changing magnitude and direction with fast. Deformation that occurs in the structure

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consequence burden dynamic this will also changeable in a way fast., therefore That burden dynamic consists of from burden earthquake and load wind.

d. Earthquake Load

Earthquake plan set as earthquake with possibility missed the magnitude during age structure 50 year old building is by 2%. Earthquake plan will cause structure building building reach condition on the verge collapse but Still can stand up, so that can prevent loss of life. Various Category risk building buildings and structures other For burden earthquake according to SNI 03-1726-2019. Depending on the probability the occurrence collapse structure building During age plan that is expected. The influence earthquake plan against him must multiplied with a factor priority earthquake according to SNI 03-1726-2019.

Site Classification for Seismic Design (SNI 03-1726-2019)

In the formulation criteria *design seismic* a building on the surface land or determination amplification magnitude acceleration earthquake peak from rock base to surface land For a site must classify moreover formerly with formulation as following :

$$N = \frac{\Sigma_{i=1}^{N} di}{\Sigma_{i=1}^{N} \frac{di}{Ni}}$$

in : Thickness of each layer between depth 0 to 30 meters

This: Prisoner penetration standard 60% measured energy (N) in the field.

Earthquake Region and Response Spectrum (SNI 03-1726-2019)

In determining the maximum earthquake acceleration *spectral response,* a seismic amplification factor is required at a period of 0.2 seconds (S_s) and a period of 1 second (S_1) to determine the *spectral response acceleration* determined based on the earthquake zoning as shown in the figure below.

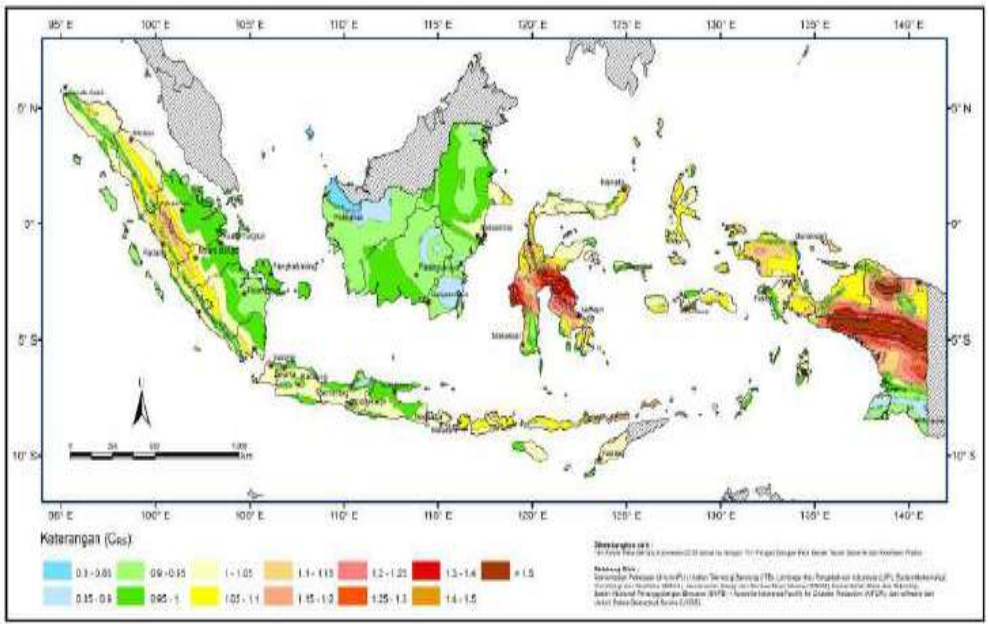

Figure 1. Spectral Response Acceleration Map for Period 0.2 seconds (Ss) (SNI 03-1726- 2019)

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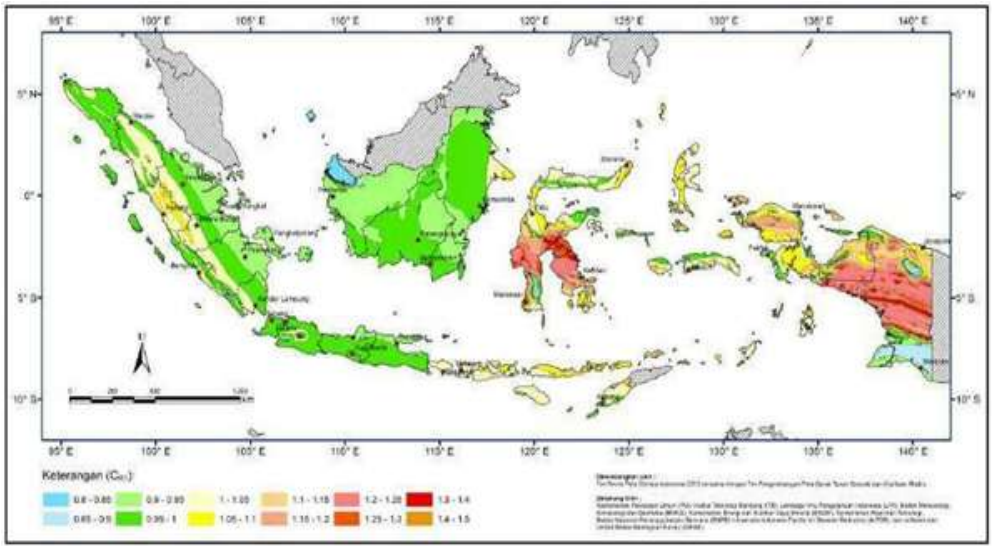

Figure 2. Spectral Response Acceleration Map for 1 second Period (S1) (SNI 03-1726-2019)

The vibration amplification factor related to the acceleration of short-period vibration (Fa) and the acceleration amplification factor representing 1-second period vibration (Fv). The acceleration response spectrum parameters for short periods (S_{ms}) and 1-second periods (S_{ml}) adjusted for the influence of site classification must be determined by the following formula:

$S_{ms} = F_a \times S_s$

$S_{MI} = F_v \times S_1$

Where :

S_s: Mapped MCER earthquake acceleration spectral response parameters for short periods.

S_1: MCER earthquake acceleration spectral response parameters mapped for a period of 1 second.

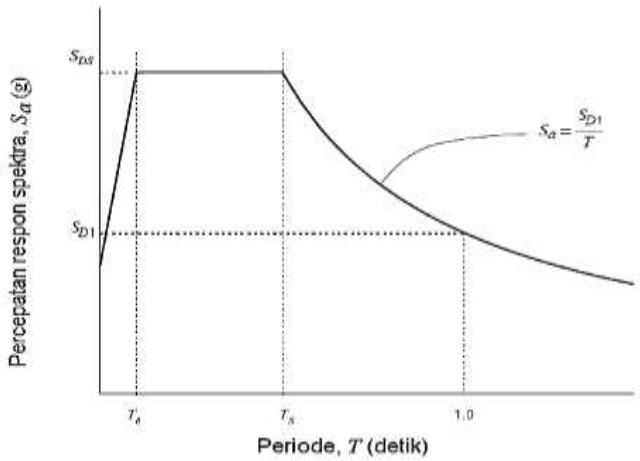

Figure 3. Design Acceleration Response Spectrum (SNI 03-1726- 2019)

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METHOD

Analysis Method

Stages – stages in planning five (5) storey building in study This as following :

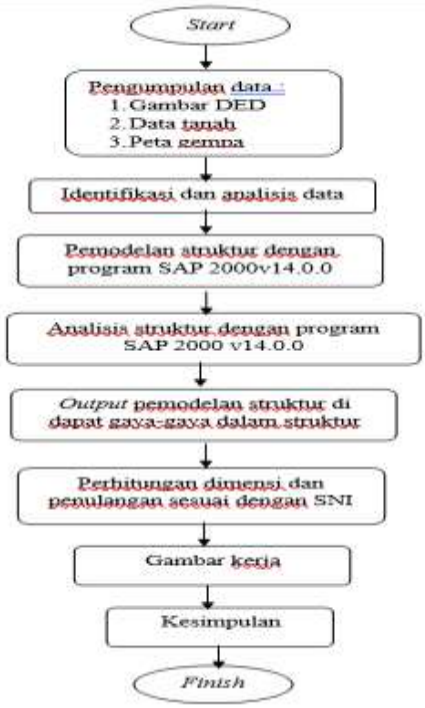

Figure 4. Research Stages

Secondary Data

Secondary data used in line consists of from :

a. Plan drawing Work
b. Building data between other : Earthquake zone for the Central Java earthquake zone area, Amount floor building with total 5 floors, Material specifications

RESULTS AND DISCUSSION

Planning beams and columns in study This with use guidelines as following : Guidelines Planning Loading For Houses and Buildings (PPPURG 1987), SNI 03-1726-2019. Planning Procedures Resilience Earthquake For Structure Building and Non-Building Structures, and SNI 03-2847-2019. Calculation Procedures Concrete Structures for Building Construction. For determine moment, then done calculation with use SAP2000.v14.0.0 application program help.

Guidelines Beam Calculation

Calculation beam (B1) with planning data like following :

b = 400 mm; h = 600 mm; f'c = 25 MPa
fy = 400 MPa (thread); fy = 240 MPa (plain)
Reinforcement main D19 mm ; Reinforcement stirrup ∅10mm
Thickness of blanket (s) = 40 mm

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d' = Blanket concrete + Ø $_{stirrups}$ + ½ D →= 40 + 10 + (19/2) = 60 mm
d = h – d' = 600 – 60 = 540 mm
ϕ flex = 0.9 ; ϕtorque = 0.85
So that mark moment ultimate part focus block B1 (400 x 600) then counted with SAP 2000 v14.0.0 with results like following :

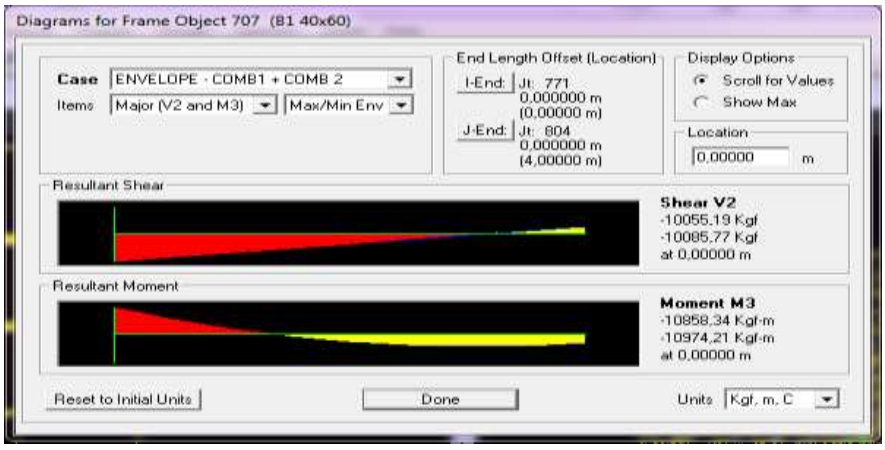

Figure 5. Support Moment Output

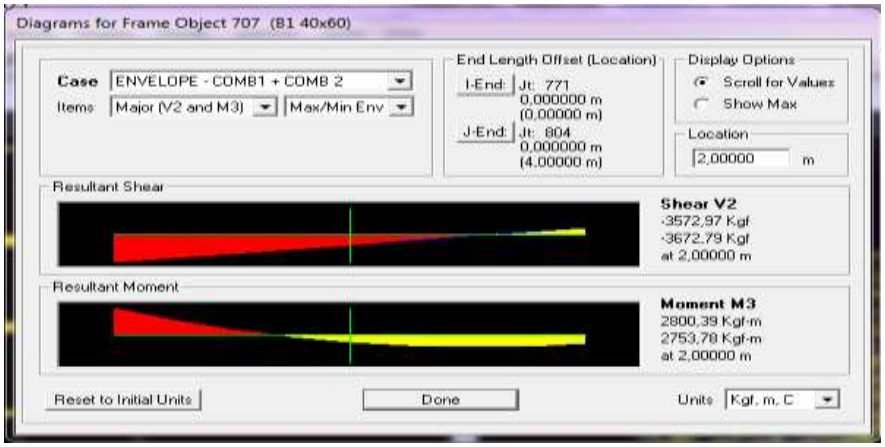

Figure 6. Field Moment Output

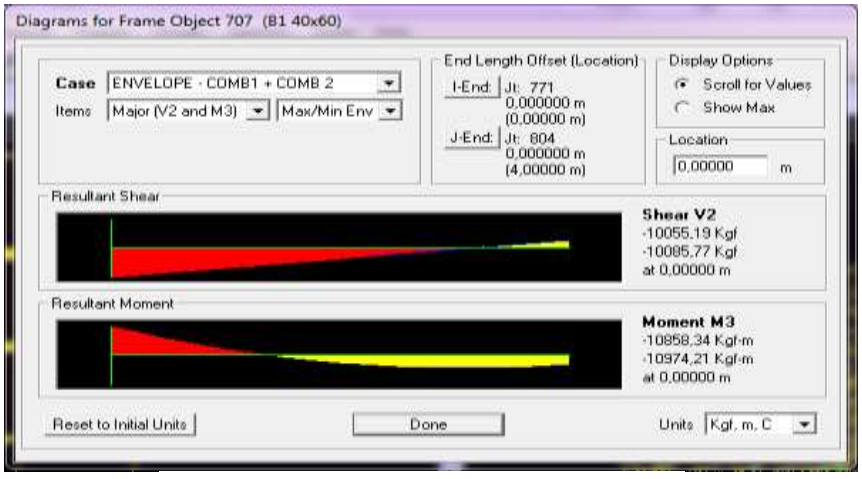

Figure 7. Ultimate Shear Force Output

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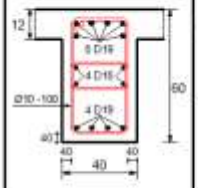
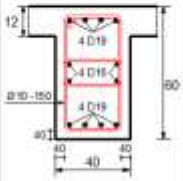
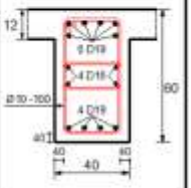
BAGIAN	TYPE BALOK B1 40 x 60 cm		
POSISI	TUMPUAN	LAPANGAN	TUMPUAN
POTONGAN			
TUL. ATAS	6 D19	4 D19	4 D19
TUL. TENGAH	4 D16	4 D16	4 D16
TUL. BAWAH	4 D 19	4 D 19	4 D 19
TUL. GESER	Ø 10 - 100	Ø 10 - 150	Ø 10 - 100

Figure 8. Flexural Reinforcement of Beam B1 400 x 600

Calculation beam (B2) with planning data like following :

b = 300 mm; h = 500 mm ; f'c = 25 MPa

fy = 400 MPa (thread); fy = 240 MPa (plain)

Reinforcement main D19 mm ; Reinforcement stirrup ∅10mm

Thickness of blanket (s) = 30 mm

d' = Blanket concrete + $\emptyset_{stirrups}$ + ½ D →= 30 + 10 + (19/2) = 50 mm

d = h – d' = 500 – 50 = 450 mm

ϕ flex = 0.9 ; ϕtorque = 0.85

So that mark moment ultimate part focus block B2 (300 x 500) then counted with SAP 2000 v14.0.0 with results like following :

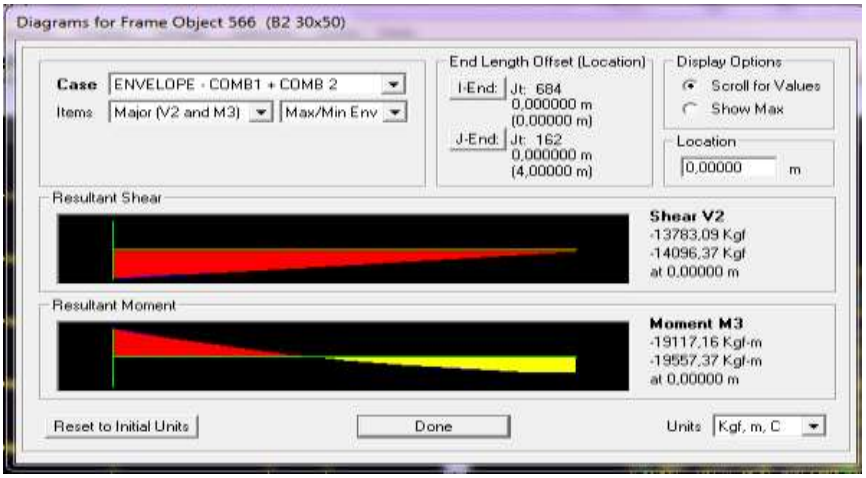


Figure 9. Support Moment Output

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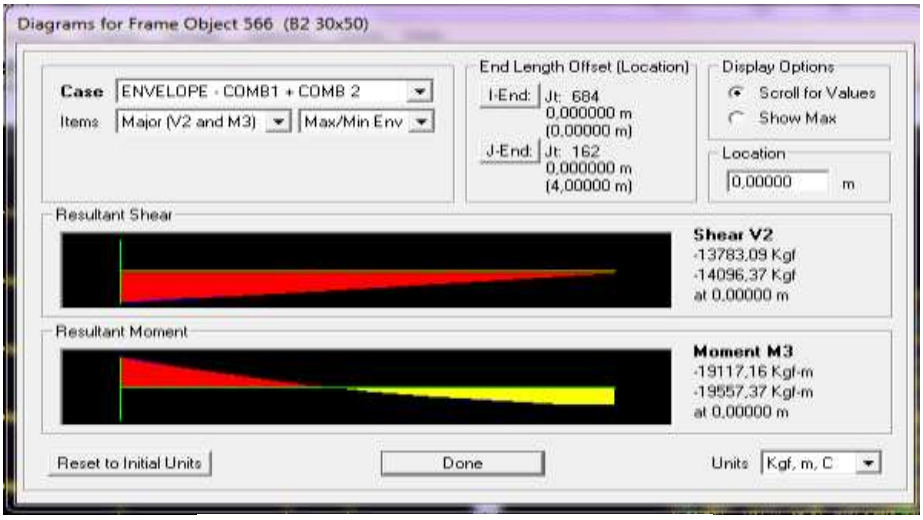


Figure 10. Field Moment Output

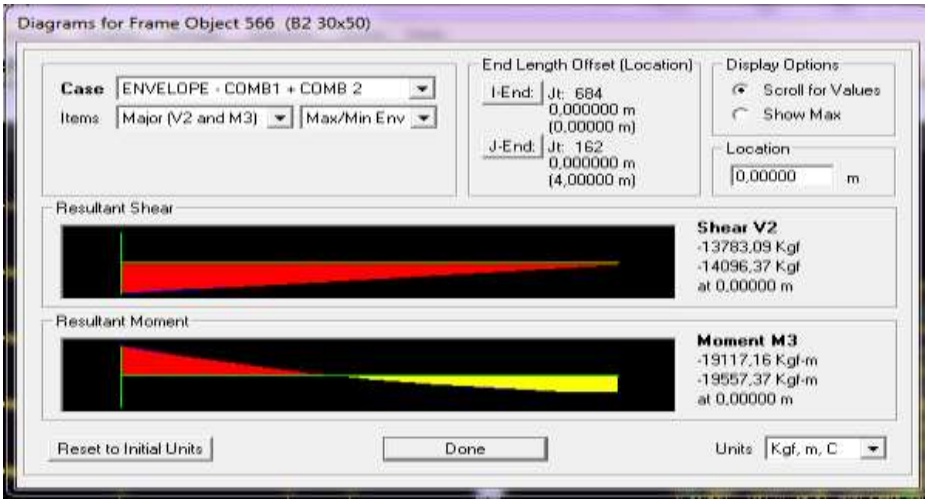


Figure 11. Ultimate Shear Force Output

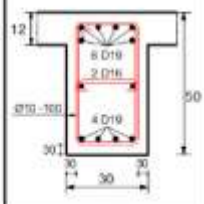
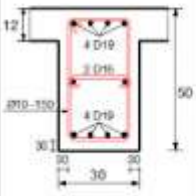
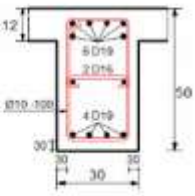
BAGIAN	TYPE BALOK B2 30 x 50 cm		
POSISI	TUMPUAN	LAPANGAN	TUMPUAN
POTONGAN			
TUL. ATAS	6 D19	4 D19	4 D19
TUL. TENGAH	4 D16	4 D16	4 D16
TUL. BAWAH	4 D 19	4 D 19	4 D 19
TUL. GESER	Ø 10 - 100	Ø 10 - 150	Ø 10 - 100

Figure 12. Flexural Reinforcement of Beam B2 300 x 500

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Column Calculation

Calculation reinforcement main column K1 600 x 600 mm, with planning data like following : b = 600 mm; h = 600 mm; f'c = 25 MPa

fy = 400 MPa (thread); fy = 240 MPa (plain)

Reinforcement main D19 mm ; Reinforcement shift ∅10mm

Blanket concrete = 40 mm

d' = Blanket concrete + $\emptyset_{stirrups}$ + ½ D →= 40 + 10 + (19/2) = 60 mm

d = h – d' = 600 – 60 = 540 mm

ϕ shift = 0.7 (stirrups rectangle)

β = 0.85

Load value axial factored and ultimate torque For column K1 discussed in calculation This taken from SAP 2000 v14.0.0 results, shown in the image below.

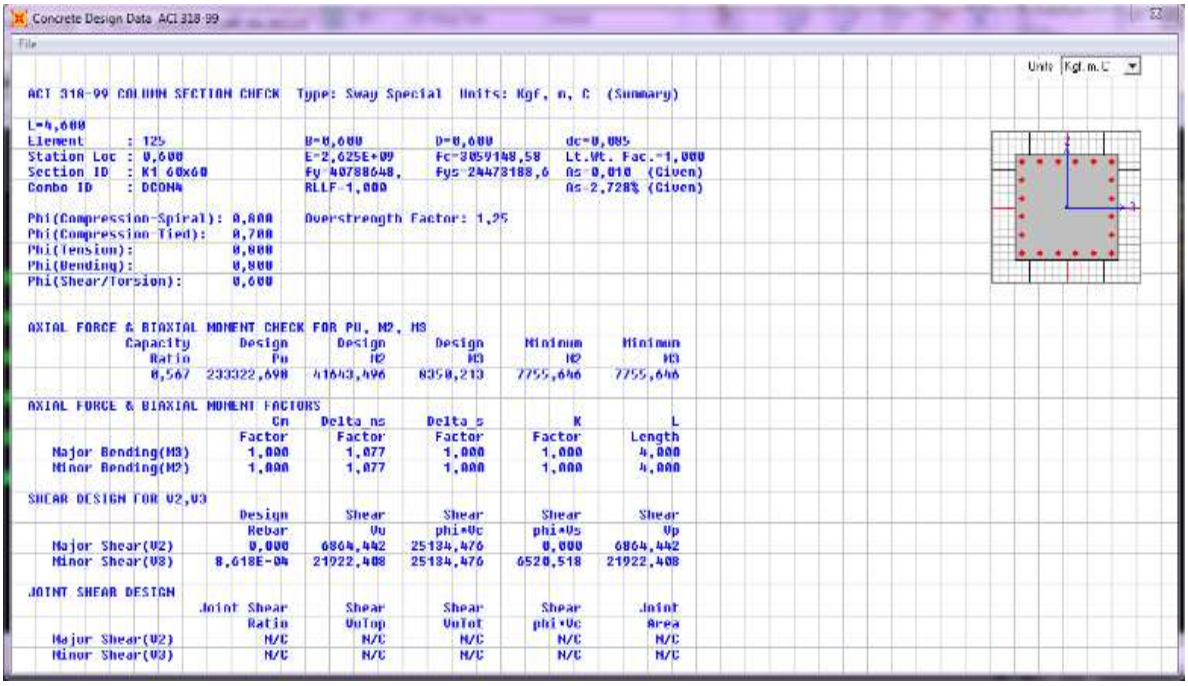

Figure 13. Pu and Mu values for Column K1.60x60 SAP 2000v14

Calculation reinforcement shift

Style value shift factored For column K1 (element 125) is discussed in calculation This taken from SAP 2000 v14.0.0 results such as following This :

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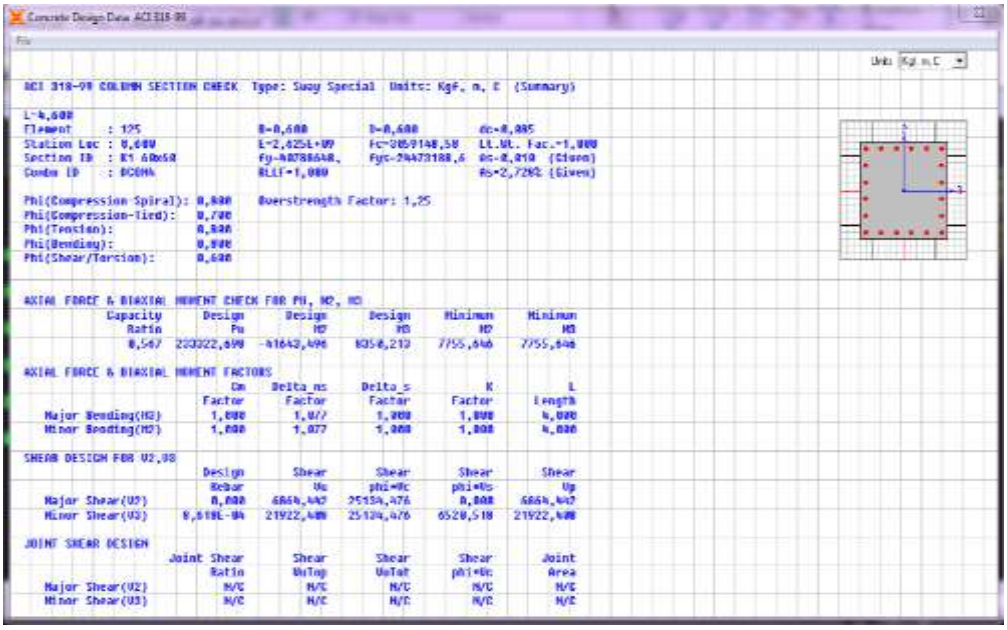

Figure 14. Column Ultimate Shear Force Output K1.60 x 60

With calculation and application of SAP 2000v 14.0.0 then you can get the reinforcement details as following :

Figure 15. Details of K1 60 x 60 Column

CONCLUSION

From the calculation above so can concluded as following : Calculation reinforcement beams and columns are obtained from mark style moment, style different latitudes and torques, so that For make it easier calculation so grouped from values maximum. Repetition flexible beams, such as beams (B1) 400 x 600 mm and (B2) 300 x 500 mm with span 4 m, with reinforcement details :

Block (B1) 400 x 600 mm	Focus	Field
Tul. Top	6D19	4D19
Tul. Side	4D16	4D16
Tul. Down	4D19	6D19
Tul. Sengkang	∅8 – 100	∅8 – 150

Beam (B2) 300 x 500 mm	Focus	Field
Tul. Top	6D19	4D19
Tul. Side	4D16	4D16
Tul. Down	4D19	4D19
Tul. Sengkang	∅10 – 100	∅10 – 150

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Repetition column as in (K1) 600 x 600 mm, with repetition main 28D22, stirrup ∅10 -100 along the way and stirrups ∅10-150 outside of you. Repetition column as in (K2) 500 x 500 mm, with repetition main 24D19, stirrup ∅10 -100 along the way and stirrups ∅10-150 outside *r* lo.

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The authors declare no conflict of interest. This research was conducted independently without any financial or non-financial relationship that could be construed as a potential conflict of interest. The selection of candidates, methodology, and analysis were performed objectively based on scientific principles. The findings and conclusions presented in this study are solely based on the data analysis and are not influenced by any political affiliations or external interests.

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