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Planning for the Construction of School Building and School Facilities for SMPN 1 Padangan

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Abstract

Planning for high-rise buildings is an important aspect in the development of an area. As the rapid population growth continues, the need for housing and public facilities is increasing. Planning a high-rise building for a school is urgently needed today considering the increasing number of students and the need for school facilities in an area. Padangan Village is a village in the western part of Bojonegoro Regency and is the location of SMPN 1 Padangan which at this time is in dire need of a school building and facilities to meet and support the needs of students in the school. The results of the analysis with sap 2000 are planned Sloof (S1) is planned using the dimension of 25x50 with reinforcement 5D16 and the Main Beam (B1) is planned using the dimension of 30 x 55 with reinforcement 5D16, the column is planned using the dimension of 45x45 with reinforcement 12 D16 mm with a transverse reinforcement distance of 2 Ø10-100 mm. Floor plates are planned using two-way concrete plates with a thickness of 12 cm. For x-direction focal reinforcement use Ø10-85 mm, x-direction field reinforcement uses Ø10-130 mm, y-direction focal reinforcement uses Ø10-85 mm and y-direction field reinforcement uses Ø10-130 mm.

Keywords: *Building, Planning*

Abstract

Planning for high-rise buildings is an important aspect in the development of an area. As the rapid population growth continues, the need for housing and public facilities is increasing. Planning a high-rise building for a school is urgently needed today considering the increasing number of students and the need for school facilities in an area. Padangan Village is a village in the western part of Bojonegoro Regency and is the location of SMPN 1 Padangan which at this time is in dire need of a school building and facilities to meet and support the needs of students in the school. The results of the analysis with sap 2000 are planned Sloof (S1) is planned using the dimension of 25x50 with reinforcement 5D16 and the Main Beam (B1) is planned using the dimension of 30 x 55 with reinforcement 5D16, the column is planned using the dimension of 45x45 with reinforcement 12 D16 mm with a transverse reinforcement distance of 2 Ø10-100 mm. Floor plates are planned using two-way concrete plates with a thickness of 12 cm. For x-direction focal reinforcement use Ø10-85 mm, x-direction field reinforcement uses Ø10-130 mm, y-direction focal reinforcement uses Ø10-85 mm and y-direction field reinforcement uses Ø10-130 mm.
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Introduction

Planning for high-rise buildings is an important aspect in the development of an area. As the rapid population growth continues, the need for housing and public facilities is increasing. High-rise buildings offer an efficient solution to utilize limited land in urban areas, so that they can accommodate more people and activities in one location. This is also in line with efforts to create a more sustainable and integrated environment

Planning a high-rise building for a school is urgently needed today considering the increasing number of students and the need for school facilities in an area. Padangan District is a sub-district in the western part of Bojonegoro Regency and is the location of SMPN 1 Padangan which at this time is in dire need of a school building and facilities to meet and support the needs of students in the school considering that along with the increase in students at the school that continues to increase.

Method

TYPES AND APPROACHES OF RESEARCH

This study focuses on planning the structure of school buildings using existing data. The research uses qualitative calculations using structural analysis with the latest loading in Indonesia.

RESEARCH LOCATION

The research was conducted at State Junior High School 1 Padangan, Padangan District, Bojonegoro Regency.

DATA ANALYSIS METHODS

The data analysis method is an important method in this research where the data collected is processed or processed to draw conclusions from the analyzed problem. In this study, the author conducted a structural analysis method on the building of the upper structure of SMPN 1 PADANGAN.

Result and Discussion

The following are the results of the calculation and analysis of the Beam and Column Structure using the Sap 2000 Program:

Beam repetition design (B1) 30x55 cm

- Flexural rebar design

The flexural/longitudinal rebar area required by SAP 2000 after calculation is as follows:

689	222	687
527	527	527
Focus	Field	Focus

Used thread reinforcement diameter 16 (D16):

Axle = 1/4 x π x d2
= 1/4 x 3,14 x 162
= 200,96 mm2

As min = 1,4 x b x d / fy
= 1,4 x 300 x 492 / 400
= 516,6 mm2

Because in the above calculation the area of reinforcement AS needed from SAP 2000 is greater than the area of reinforcement As min, the value of the area of reinforcement as needed from the output of SAP 2000 is used.

Bending reinforcement of the pedestal area:

Upper reinforcement area = 689 / 200,96
= 3,429 (8 pieces of reinforcement used)

Check the number of rebar areas:

Worn > Serve = 8 x 200,96 > 689
= 1607,7 > 689
= (the area of the rebar used has been met)

Lower reinforcement area = 527 / 200,96
= 2,622 (5 pieces of reinforcement used)

Check the number of rebar areas:

Worn > Serve = 5 x 200,96 > 527
= 1004,8 > 527
= (the area of the rebar used has been met)

Bending reinforcement of the field area:

Upper reinforcement area = 516 / 200,96
= 2,568 (5 pieces of reinforcement used)

Check the number of rebar areas:

As pakai > As min = 5 x 200,96 > 516
= 1004,8 > 516
= (the area of the rebar used has been met)

Lower reinforcement area = 527 / 200,96
= 2,622 (8 pieces of reinforcement used)

Check the number of rebar areas:

Worn > Serve = 8 x 200,96 > 527
= 1607,7 > 527
= (the area of the rebar used has been met)

- Sliding rebar design (Sengkang)

The shear rebar area required by SAP 2000 after calculation is as follows:

1,18	0,96	1,67
0	0	0

Focus Field Focus

- Sliding reinforcement of the pedestal area:

Used P10 reinforcement = 2 x 1/4 x π x d2

= 2 x 1/4 x 3,14 x 102

= 157 mm2

Distance = 157 / 1,186 = 88 mm

The spacing if in accordance with SNI 2847:2019 is:

d/4 = 492 / 4

= 123 mm

6 x diameter tul = 6 x 16

= 96 mm

150 mm

So for the distance of the shear reinforcement (Sengkang) in the pedestal area, the smallest value of the necessary sengkang distance is used and also from the 3 SNI provisions, so that the smallest value is obtained is 88 mm or rounded to a distance of 90 mm.

- Field area shear reinforcement:

Used P8 reinforcement = 2 x 1/4 x π x d2

= 2 x 1/4 x 3,14 x 102

= 157 mm2

Sengkang Distance = 157 / 0.968 = 162,19 mm

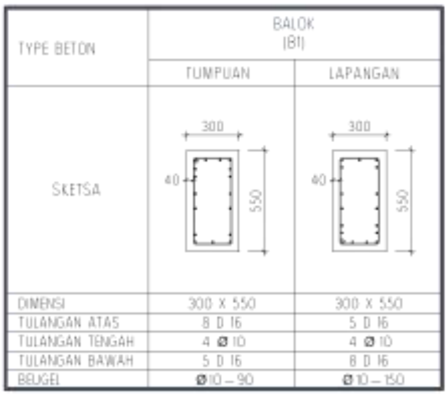
The spacing if in accordance with SNI 2847:2019 is:

d/2 = 492 / 2

= 246 mm

Therefore, for the distance of the shear reinforcement (Sengkang) in the field area, the smallest value of the necessary sengkang distance is used and also from the provisions of SNI, so that the smallest value is obtained is 162.19 mm or rounded to a distance of 150 mm.

Beam repetition image (B1)



TYPE BETON	BALOK (B1)	
	TUMPUAN	LAPANGAN
SKETSA		
DIMENSI	300 X 550	300 X 550
TULANGAN ATAS	8 D 16	5 D 16
TULANGAN TENGAH	4 Ø 10	4 Ø 10
TULANGAN BAWAH	5 D 16	8 D 16
BEUGEL	Ø 10 – 90	Ø 10 – 150

Picture. 1 beam repetition details (B1)

Source : personal documents/AutoCAD program

B . Column Repetition Design 45 x 45 cm

- Main rebar design
  - Main reinforcement/bending calculation

From the results of the analysis using SAP 2000, it was obtained that the design of the main reinforcement area of the K1/K2 column is = 2025 mm2

Used thread reinforcement diameter 16 (D16)

As = 1/4 x π x d2

= 1/4 x 3,14 x 162

= 200.96 mm2

So that the number of reinforcement needed is = 2025/200.96 = 10.076, then the number of reinforcement 12 is taken. So the main reinforcement for the K1/K2 column is 12 D16.

Check the number of rebar areas:

Worn > Serve = 12 x 200.96 > 2025

= 2411.52 > 2025

= (the area of the rebar used has been met)

Main rebar requirements

The main reinforcement/bending of the installed column must meet the requirements of SNI 2847:2019 article 21.6.3.2, which states that the repetition ratio (ρg) is limited to not less than 1% and not more than 6%.

rg = As/bxd x100

= (10 x 200.96)/(450 x 450) x100

= 1.19% (meet)

- Shear rebar design
  - Shear rebar calculation

From the results of the analysis using SAP 2000, it was obtained that the design area of the sliding reinforcement of the K1/K2 column was = 1,063 mm2

Used plain rebar diameter 10 (2 ø10) Axle
= 2 x 1/4 x π x d2

= 2 x 1/4 x 3.14 x 102

= 157 mm2

Sengkang rebar spacing = 157 / 1.063 = 147.70 mm

In the requirements of SNI 2847:2019 article 18.7.5.3 it is explained that:

1/4 cross section = 1/4 x 450

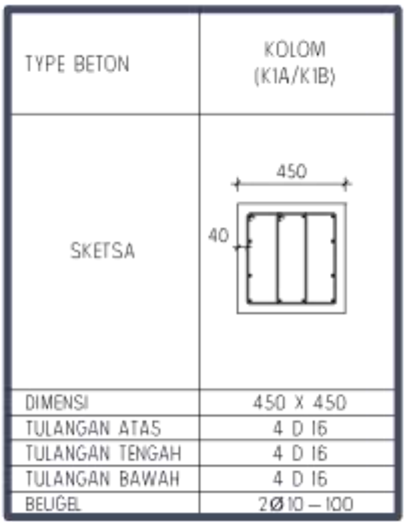
= 112.5

6d = 6 x 16

= 96

So for the distance of the shear reinforcement (Sengkang) on the K1A/K1B column, the smallest value of the necessary sengkang distance and also from the 2 SNI provisions, so that the smallest value is 96 mm or rounded to a distance of 100 mm. So that the results of the calculation of Sengkang use 2 P10 – 100 mm.

Column repetition image (K1A/K1B)



Picture. 2 Column Replay Details (K1A/K1B)

Source : personal documents/AutoCAD program

C . Floor Plate Repeating Design tb.12 cm

SAP 2000 Analysis Results

The output values used to calculate the plate reinforcement are M11 (for X-direction reinforcement) and M22 (for Y-direction reinforcement).

- Design of rebar of the pedestal area (x-direction)

From the results of SAP 2000 analysis, the value of Mu = 15.47 kN/m was obtained

Used plain reinforcement P10 - 85 mm

Used rebar area, US = 1/4 x π x d2 x b/85

= 1/4 x 3,14 x 102 x 1000/85

= 923,53 mm2

Height of the strain beam, a = (As x fy)/(0.85 x f^' c x b)

= (923,53 x 240)/(0,85 x 25 x 1000)

= 10,43 mm

Momen nominal, Mn= As x fy x (d – a/2) x 10-6

= 923,53 x 240 x (85 – 10,43/2) x 10-6

= 17,684 kNm

Requirement:

0,9 x Mn ≥ Mu

0.9 x 17,684 ≥ 15,47

15,916 ≥ 15.47 (meet)

So, for reinforcement in the focus area (x-direction) use plain iron reinforcement P10 – 85 mm.

- Field area reinforcement design (x direction)

From the results of SAP 2000 analysis, the value of Mu = 10.37 kN/m was obtained

Used plain reinforcement P10 - 130 mm

Used rebar area, US = 1/4 x π x d2 x b/130

= 1/4 x 3,14 x 102 x 1000/130

= 603,85 mm2

Height of the strain beam, a= (As x fy)/(0.85 x f^' c x b)

= (603,85 x 240)/(0,85 x 25 x 1000)

= 6,82 mm

Momen nominal, Mn = As x fy x (d – a/2) x 10-6

= 603,85 x 240 x (85 – 6,82/2) x 10-6

= 11,824 kNm

Requirement:

0,9 x Mn ≥ Mu

0,9 x 11,824 ≥ 10,37

10,642 ≥ 10.37 (meet)

So, for reinforcement in the field area (direction x) use plain iron reinforcement P10 – 130 mm.

- Design of rebar of the pedestal area (y-direction)

From the results of SAP 2000 analysis, the value of Mu = 10.52 kN/m was obtained

Used plain reinforcement P10 - 85 mm

Used rebar area, US = 1/4 x π x d2 x b/85

= 1/4 x 3,14 x 102 x 1000/85

= 923,53 mm2

Stretch beam height, a = (As x fy)/(0,85 x f^' c x b)

= (923,53 x 240)/(0,85 x 25 x 1000)

= 10,43 mm

Momen nominal, Mn = As x fy x (d – a/2) x 10-6

= 923,53 x 240 x (85 – 10,43/2) x 10-6

= 17,684 kNm

Requirement:

0,9 x Mn ≥ Mu

0,9 x 17,684 ≥ 10,52

15,916 ≥ 10.52 (meet)

So, for reinforcement in the focus area (y-direction) use plain iron reinforcement P10 – 85 mm.

- Field area reinforcement design (y-direction)

From the results of SAP 2000 analysis, the value of Mu = 8.26 kN/m

Used plain reinforcement P10 - 130 mm

Used rebar area, US = 1/4 x π x d2 x b/130

= 1/4 x 3,14 x 102 x 1000/130

= 603,85 mm2

Stretch beam height, a = (As x fy)/(0,85 x f^' c x b)

= (603,85 x 240)/(0,85 x 25 x 1000)

= 6,82 mm

Momen nominal, Mn = As x fy x (d – a/2) x 10-6

= 603.85 x 240 x (85 – 6.82/2) x 10-6

= 11,824 kNm

Requirement:

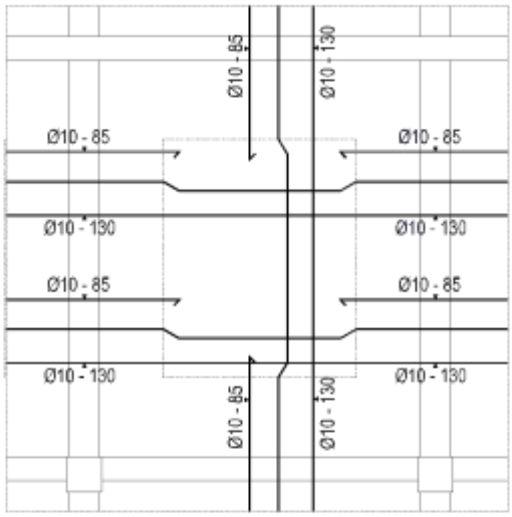
0.9 x Mn ≥ Mu

0.9 x 11,824 ≥ 8.26

10,642 ≥ 8.26 (meet)

So, for reinforcement in the field area (y-direction) use plain iron reinforcement P10 – 130 mm.

<u>Floor Plate reproduction picture tb. 12 cm</u>



Picture. 5 Floor plate repetition details

Source : personal documents/AutoCAD program

Conclusion

Based on the results of the discussion of the previous chapters regarding the Construction of School Buildings and School Facilities of SMP Negeri 1 Padangan with the help of the SAP 2000 application, it can be concluded that:
a. Beam (B1) is planned to use dimensions of 30x55 cm and for longitudinal reinforcement in the upper support area use 8 D16 mm, in the lower support area use 5 D16 mm, in the upper field area use 5 D16 mm and in the lower field area use 8 D16 mm. As for the transverse reinforcement in the pedestal area, Ø10-90 mm is installed and for the field area, Ø10-150 mm is installed, and for the torque reinforcement is 4 Ø10 mm.
b. Column (K1A/K1B) was planned to use the dimension of 40x40 cm, but at the analysis stage in SAP 2000 the column experienced Over Stressed (O/S) at several points, so that the dimension was enlarged to 45x45 cm. For the

main reinforcement use 12 D16 mm with a transverse reinforcement distance of 2 Ø10-100 mm.
c. Floor plates are planned using two-way concrete plates with a thickness of 12 cm. For x-direction focal reinforcement use Ø10-85 mm, x-direction field reinforcement uses Ø10-130 mm, y-direction focal reinforcement uses Ø10-85 mm and y-direction field reinforcement uses Ø10-130 mm.

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