Planning of Concrete Structure on the Upper Building of Air Traffic Tower with Special Moment Bearing Frame System Method in Pohuwato Airport Project, Gorontalo Province

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Abstract

Currently, the Pohuwato Airport Project does not have plans to build an Air Traffic Tower facility. The Air Traffic Tower facility has an important role in monitoring the security and safety of Air Traffic and Road Traffic when the Pohuwato airport is operating, because this requires an Air Traffic Tower Construction Plan at Pohuwato Airport, Gorontalo Province, which can withstand high earthquake conditions. .

Planning for the superstructure of an air traffic tower includes planning of plate, column and beam structures which will later be used for preliminary design planning, structural modeling, structural loading using the Special Moment Resisting Frame System (SRPMK) method using the SAP2000 application, work planning, and calculation of plans Cost Budget (RAB).

The preparation of this final project results obtained from the calculation of the structure of the building, namely the main beam reinforcement dimensions 50 x 70 cm, with 10 D 19 flexural reinforcement at positive moments, 12 D 19 flexural reinforcement at negative moments. Reinforcement of joists with dimensions of 20 x 30 cm, with 2 D 13 bending reinforcement at positive moments, 3 D 13 bending reinforcement at negative moments. Floor slab dimensions 300 cm x 300 cm, with 5 D19 flexural reinforcement at positive moments, 7 D19 flexural reinforcement at negative moments. Column dimensions 50 x 50 cm 12 D 19 flexural reinforcement and 2 P 10 – 150 mm stirrup reinforcement. As well as the calculation of the required Budget Plan (RAB) of Rp. 176.330.877.25 (spelled out One Hundred Seventy Six Million Three Hundred Thirty Thousand Eight Hundred Seventy Seven point Two Five Rupiah) for a concrete structure project in a building on the construction of a traffic tower.

Keywords: Air Traffic Tower 1, SRPMK 2, RAB 3, Building Strength 4, Building Structure 5.

1. INTRODUCTION

The Pohuwato Airport Development Project has a strategic role in supporting efforts to increase the role of air transportation in relation to regional development in particular and national development in general. The Pohuwato Airport Project currently does not have a plan to build an Air Traffic Tower facility.

The Special Moment Bearing Frame System (SRPMK) found in SNI 2847: 2019 (Structural concrete requirements for building buildings) is a portal frame system that is planned to be fully ductile with special detailing. In the planning of building structures, the main direction of influence of the Plan Earthquake must be determined in such a way that the greatest influence on the subsystem elements and the structural system as a whole. The transverse reinforcement along the specified region shall be designed to resist earthquake shear assuming Vc = 0, when:

a. The earthquake-induced shear force calculated in accordance with the plan force represents half or more of the maximum necessary shear strength along the area.

b. The factored compressive axial force, including that due to earthquake, is less than Agfc/20.

RAB (Cost Budget Plan) is used as a reference in procuring and spending funds during the construction process. SNI (Standar Nasional Indonesia): SNI 03-1732-2013 tentang Tata Cara Perhitungan Harga Satuan Pekerjaan Konstruksi and Harga Satuan Pokok Kegiatan di Lingkungan Pemerintah Kota Pohuwato, Gorontalo Tahun Anggaran 2022 is a reference in preparing the RAB. This standard provides guidance on the unit price of construction work, including the price of materials, labor, and tools used.

Based on this background, the following problems can be formulated:

1. How is the structure of the upper building of the Air Traffic Tower planned?
2. How is the structural design of plates, beams, and columns in the superstructure of the Air Traffic Tower with a Special Moment Bearing Frame System in the Pohuwato Airport Project?
3. How is the Budget Plan (RAB) for the superstructure of the Air Traffic Tower at the Pohuwato Airport Project?

METHOD

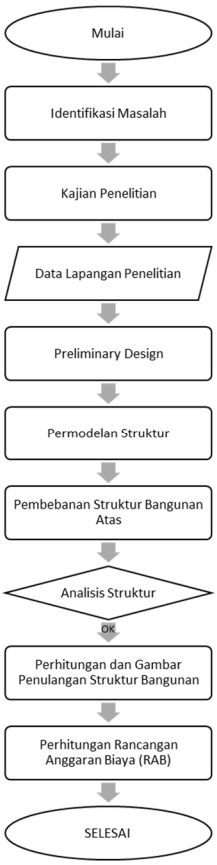


Figure 1 *Research flowchart*

Problem Identification

The structural planning of the Air Traffic building at the Pohuwato Airport Work Unit is located next to the PKP - PK building plan. The planned Air Traffic Tower with an area of 6 m x 6 m, 23 m floor height, contains 5 floors, with each floor 4 m high and the top floor 3 m high. Has technical data, includes the following:

2. Building length : 6 m
3. Building width : 6 m
4. Building construction : Concrete
5. Quality of flexural reinforcing steel : 390 Mpa
6. Shear reinforcing steel quality: 240 Mpa
7. Beam Span : 6 M
8. Column Height:
   a) H1 : 4 M (1st Floor)
   b) H2 : 4 M (2nd Floor)
   c) H3 : 4 M (3rd Floor)
   d) H4 : 4 M (4th Floor)
   e) H5 : 4 M (5th Floor)

f) H6 : 3M (6th Floor)

9. Thickness of Floor Plate : 0,12 M

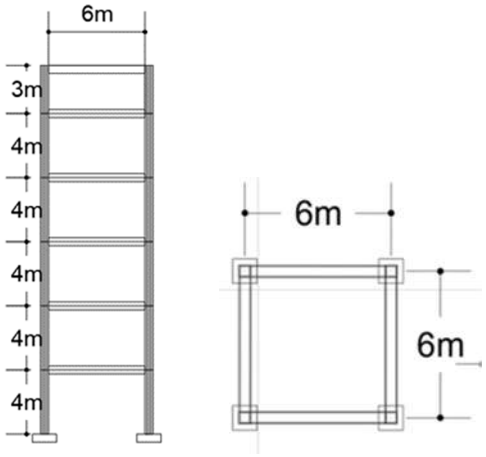


Figure 2 *Structure Model*

Data Analysis

Perhitungan Calculation of forces in the main structure using the help of the SAP2000 program. The things that are considered in analyzing this structure include:

a.The shape of the Air Traffic Tower.

b.Dimensions of structural elements from preliminary design.

c.Risk of earthquake region.

d.Structural loading and loading combinations.

Reinforcement Calculations and Drawings

The structural components are designed in accordance with the rules contained in SNI 2847: 2019. Calculations include:

a. SAP 2000 output in the form of bending moments (M), axial forces (P) and shear forces (D).

b. Calculation of shear and flexural reinforcement on all main structural components.

c. Control of reinforcement calculations.

d. Detail drawing of reinforcement.

The results of structural calculations are realized into a detailed drawing of the main structural reinforcement, namely columns, beams, and plates.

Calculation of Draft Budget Cost (DBC)

After looking for the needs of the concrete structure on the upper building of the Air Traffic Tower, then make RAB adjusting to the Basic Unit Price of Activities using references from Harga Satuan Pokok Kegiatan menggunakan acuan dari Standarisasi Harga Barang and Jasa Daerah Kota Pohuwato Gorontalo Tahun 2022 dan Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 78 Tahun 2014 tentang Standar Biaya di Lingkungan Kementrian Perhubungan.

RESULTS AND DISCUSSION

Air Traffic Tower Observer Elevation Height

Trigonometric formula calculation can find the optimal location and height of the required air traffic tower. The following data is known: The runway length is 1700m and the runway width is 30m. The planned location of the air traffic tower is next to the PKP - PK building. With the elevation of observer personnel (Ee') = 20m = 521.2 msl, distance from the center of the runway axle (T) 300 m, distance from runway 09 (La) 820 m and Eas = 458 msl, and distance from runway 27 (Lb) 880 m and Eas = 483 msl.

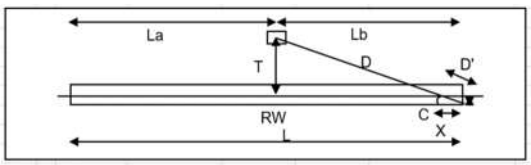


Figure 3 Air Traffic Tower Height

A. *Runway* 09

$$D = \sqrt{La^2 + T^2}\,(m)$$

$$D = \sqrt{(820)^2 + (300)^2}\,(m)$$

$$D = \sqrt{672{,}400 + 90{,}000}\,(m)$$

$$D = 27\,(m)$$

$$Ee = Eas + D.\,Tan.(35\,min \pm Gs)\,(msl)$$

$Ee = 458 + 27\ x\ Tan.\left(\frac{458}{27}\right)\ (msl)$

$Ee = 458 + 27\ x\ 0{,}3050\ (msl)$

$Ee = 466{,}235\ (msl)$

Ee' > Ee

521,2 > 466,235 (Meet the Elevation Needs of Observer Personnel)

B. *Runway* 27

$D = \sqrt{Lb^2 + T^2}\ (m)$

$D = \sqrt{(880)^2 + (300)^2}\ (m)$

$D = \sqrt{774{,}400 + 90{,}000}\ (m)$

$D = 29\ (m)$

$Ee = Eas + D.\ Tan.(35\ min \pm Gs)\ (msl)$

$Ee = 483 + 29\ x\ Tan.\left(\frac{483}{29}\right)\ (msl)$

$Ee = 483 + 29\ x\ 0.2991\ (msl)$

$Ee = 491.673\ (msl)$

Ee' > Ee

521,2 > 491.673 (Meet the Elevation Needs of Observer Personnel)

Preliminary Design

Preliminary design is an initial planning process that will be used to plan the dimensions of the building structure using the SAP2000 assistance application. Preliminary planning is carried out on primary structural components including beams, columns, and plates.

Material Data

A. Concrete Material

Concrete Quality K = 300

Concrete strength fc' = 25.00 MPa

Modulus of elasticity Ec =23500MPa

B. Steel Material

Modulus of elasticity sEs=200000MPa

BJTD 40 (Threaded)

Yield stress of steel fy =390.00MPa

Ultimate stress fu =560.00MPa

BJPT 24 (Plain)

Yield stress of steel fy =240.00MPa

Ultimate stress fu =360.00MPa

Load Calculation

a. Dead Load

The weight of all installed building construction materials, including walls, floors, roofs, ceilings, stairs, fixed partition walls, finishes and other architectural and structural components and other installed service equipment including the weight of cranes and material transport systems. The dead load/selfweight of such structural elements will be calculated automatically.

b. Live Load

Loads caused by users and occupants of buildings or other structures that do not include construction loads and environmental loads, such as wind loads, earthquake loads, flood loads or dead loads.

c. Earthquake Load

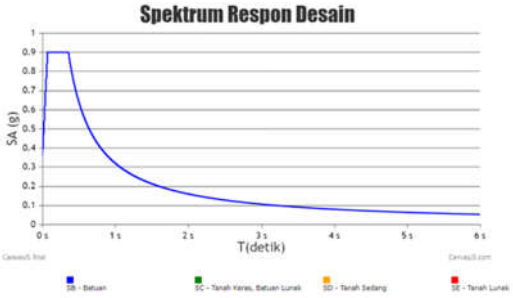


Figure 4 *Response Spectrum Graph*

Based on soil data, the site class = E is obtained so that the following data is obtained through RSA Puskim::

SS = 1.414

S1 = 0.613

SDS = 0.885

SD1 = 0.958

Structure Modeling

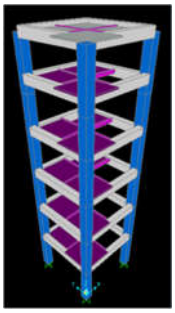
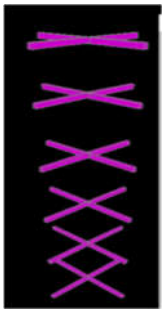
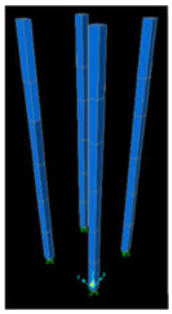


Figure 5 *Air Traffic Tower Modeling*

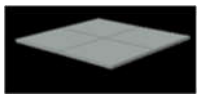
Figure 6 Beam Frame Section 50/70



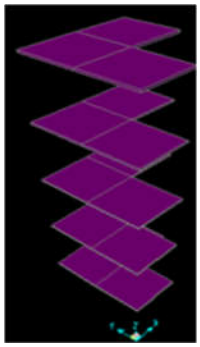
Gambar 7 *Beam Section Frame 20/30*



Gambar 8 *Column Section Frame 50/50*



Gambar 9 *Roof Plate Area Section 10 cm*



Gambar 10 *Floor Plate Area Section 12 cm*

Calculation of Budget Plan Cost (RAB)

The Budget Plan Cost (RAB) required is Rp. 176,330,877.25 (One Hundred Seventy Six Million Three Hundred Thirty Thousand Eight Hundred Seventy Seven point Two Five Rupiah) for the concrete structure project on the top building of the traffic tower construction according to the reference price of the Pohuwato Regional Basic Unit, Gorontalo in 2022.

CONCLUSION

Based on the planning of the upper building structure of the air traffic tower at the Pohuwato Airport Project using a special moment bearing frame system (SRPMK) based on SNI 1726-2019 and SNI 2847-2019 using the SAP2000 auxiliary program, the following conclusions can be obtained:

1. Planning an air traffic tower with a height of 23 m and a long - wide floor of 6m x 6m. So as to plan the preliminary design of the structure of plates, beams, and columns in accordance with the design plan of the air traffic tower.
2. This research uses SAP2000 auxiliary application to analyze the impact of input - output dead load, live load, and earthquake load on the safe superstructure in accordance with the Special Moment Bearing Frame System (SRPMK). The results of the structural analysis obtained, among others;
   a. Preliminary main beam with dimensions of 50 x 70 cm, with 10 D 19 flexural reinforcement at positive moment, 12 D 19 flexural reinforcement at negative moment and 2 P 10-250 stirrups.
   b. Preliminary sub-beams with dimensions of 20 x 30 cm, with 2 D 13 flexural reinforcement at positive moment, 3 D 13 flexural reinforcement at negative moment and 2 P 10-150 stirrup reinforcement.

c. Preliminary concrete slab with dimension 300 x 300 cm, with 5 D 19 flexural reinforcement at positive moment, 7 D 19 flexural reinforcement at negative moment and 2 P 10-200 stirrups.
d. Preliminary columns with dimensions of 70 x 70 cm with 12 D 19 flexural reinforcement and 2 P 10-150 mm stirrups in the shear reinforcement area.

3. The required Budget Plan (RAB) is Rp. 176,330,877.25 (One Hundred Seventy Six Million Three Hundred Thirty Thousand Eight Hundred Seventy Seven point Two Five Rupiah) for the concrete structure project on the superstructure of the traffic tower construction in accordance with the reference price of the Basic Unit of Pohuwato Region, Gorontalo in 2022.

ACKNOWLEDGEMENTS

Some suggestions related to the construction of the air traffic tower are as follows:

1. Judging from the condition of the area entering the high earthquake zone, it is recommended to build an anti-earthquake building with a Special Moment Bearing Frame System (SRMK).
2. In planning the construction of a project in addition to taking into account the strength of the upper structure, the airport should also plan the lower structure or foundation so as to get a sturdy building.
3. Data - the data needed in development can be collected as complete as possible so that development is in accordance with the calculation and design.

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