Analysis of the Structure of the Existing Administration Building into Two Floors at the Class III Naha Airport Operator Unit, Tahuna - North Sulawesi

Olsyah Juhal Ramadhan*, Siti Fatimah, Bambang Wasito

Politeknik Penerbangan Surabaya, Jalan Jemur Andayani I No 73, Kota Surabaya, 60236
**Corresponding Author. Email: olsyahpacee@gmail.com*

Abstract
The administration building is a land-side facility that aims to organize airport administration and also control services in the airport work environment area. The administration building at Naha Airport needs to be expanded to two floors and improvements to the building construction to improve the safety of the building construction and also the safety of workers. There are several things in this planning, one of which is redesigning plates, beams, and columns. From the results of the analysis, the location of the construction of the administration building is in risk category E so that the structural analysis uses the SRPMK (Special Moment Bearing Frame System) method. In planning the building structure, SNI 2847: 2019 concerning reinforced concrete and SNI 1727: 2018 for loading are used. In this final project, the SAP 2000 auxiliary program is used for 3D building modeling, PCAColumn for calculating column interaction diagrams, and Autocad 2018 for reinforcement details. In this final project, the calculation of the Cost Budget Plan is also needed to determine the estimated cost of rebuilding the administration building into two floors. From the structural design results, the dimensions of the main beam (B1 25/40), child beam (B2 15/30), column (K1 25/25) and plate thickness of 12 cm and structural reinforcement details are included in the engineering drawings. In addition, the design control check of the administration building structure based on SNI 1726: 2019 has met the requirements.

Keywords: Structure Planning, SRPMK, Spectrum Response, Earthquake, Cost Budget Plan

INTRODUCTION

In Indonesia, transportation is necessary and very much needed to meet the needs of the Indonesian people in order to facilitate travel, one of which is air transportation. Air transportation is very important for archipelagic countries like Indonesia because it can facilitate and speed up the travel of feeders and can also distribute needs in remote areas. This is related to the airport which functions as a place for flight services.

Naha Tahuna Airport is located in Tahuna District, Sangihe Regency, North Sulawesi. Naha Tahuna Airport itself was originally called Pelud NAHA, the initial construction of this airport was carried out by the local government which was carried out when the regent Yudha Tindas, and was completed in 1972. Naha Airport itself began operating in 1980. UPBU Naha has Runway dimensions of 1600m x 30m in 2015. The airport also has facilities to conduct flight operations, one of which is the Administration Building which has been established since the beginning of the construction of this airport. We can pay attention to this building in terms of the feasibility of building construction to prevent damage to buildings such as cracked walls, damp walls, or even can cause the building to collapse.

Site Coefficients and Maximum Earthquake Acceleration Spectral Response Parameters For the determination of the MCER earthquake acceleration spectral response at the top of the ground, a seismic amplification factor at periods of 0.2 seconds & 1 second is required. The acceleration spectral response parameters at periods of 0.2 s and 1 s, adjusted for the effect of site classification, are determined by the following equations:

SMS = Fa Ss ......(2.14)

SM1 = Fv S1 ......(2.15)

Tabel 1 Koefisien Situs Fa

Kelas situs	Parameter respon spektral percepatan gempa maksimum yang dipertimbangkan risiko-tertarget (MCER) terpetakan pada periode pendek, T=0,2 detik,					
	$S_s \leq 0,25$	$S_s = 0,5$	$S_s = 0,75$	$S_s = 1,0$	$S_s = 1,25$	$S_s \geq 1,5$
SA	0,8	0,8	0,8	0,8	0,8	0,8
SB	0,9	0,9	0,9	0,9	0,9	0,9
SC	1,3	1,3	1,2	1,2	1,2	1,2
SD	1,6	1,4	1,2	1,1	1	1
SE	2,4	1,7	1,3	1,1	0,9	0,8
SF	SS					

Tabel 2 Koefisien Situs Fv

Kelas situs	Parameter respon spektral percepatan gempa maksimum yang dipertimbangkan risiko-tertarget (MCER) terpetakan pada periode pendek, T= 1 detik,					
	$S1 \leq 0,1$	$S1 = 0,2$	$Ss = 0,3$	$Ss = 0,4$	$Ss = 0,5$	$Ss \geq 0,6$
SA	0,8	0,8	0,8	0,8	0,8	0,8
SB	0,8	0,8	0,8	0,8	0,8	0,8
SC	1,5	1,5	1,5	1,5	1,5	1,4
SD	2,4	2,2	2	1,9	1,8	1,7
SE	4,2	3,3	2,8	2,4	2,2	2
SF	SS					

Description:
SA: Ape rock
SB: Rocks
SC : hard soil, very dense and soft rock
SD : Medium soil
SE : Soft soil
SF : Special soil

According to SNI 247:2019 Concrete is a mixture of Portland cement or other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without admixture. Concrete has high compressive strength but low tensile strength. Therefore, the compressive strength of concrete is very influential on other properties.

Table 3 Concrete according to its compressive strength

Jenis Beton	Kuat Tekan (Mpa)
Beton sederhana	Sampai 10 Mpa
Beton Normal	15 – 30 Mpa
Beton Pra tegang	30 – 40 Mpa
Beton Kuat tekan tinggi	40 – 80 Mpa
Beton Kuat tekan sangat tinggi	> 80 Mpa

SRPMK or Special Truss System is a reinforced concrete frame designed to produce maximum structural ductility. Based on SNI 2847:2019 for KDS D, E or F structures, the structure must be designed in accordance with Article 18.6 (beams), Article 18.7 (columns) and Article 18.8 (connections) subjected to flexural and axial loads, therefore SRPMK (Truss System) requirements are required.) Plan for Appropriate Special Moment Carriers.

The structure must have high ductility, i.e. be able to withstand large continuous post-elastic displacements due to earthquakes, while maintaining its strength so that the structure can remain upright even when it is about to collapse. This principle includes three:

1. Strong-colum weak-beam that works across most floors.
2. No shear failure of column beams.
3. Provides details that give the structure decay behavior.

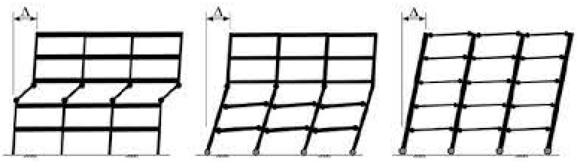


Figure 1 The SPRMK design prevents inter-story drift (a) by making the columns strong so that the drift is spread evenly along the floor (C) or most of the floor (b).

Class III Naha Airport, Tahuna has land side facilities, one of which is the administration building. In this case, the administration building needs to plan the improvement of the existing one-story building structure to become a two-story building. This requires structural analysis in order to determine the strength of the designed structure.

With the problems described above, the authors are interested in raising these problems to be used as research writing with the title,

"ANALYSIS OF THE STRUCTURE OF THE EXISTING ADMINISTRATION BUILDING INTO TWO FLOORS AT THE CLASS III NAHA AIRPORT OPERATOR UNIT, TAHUNA - NORTH SULAWESI".

The problem formulation of this research is how to plan the administration building at UPBU Class III Naha, Tahuna with the following formulations:

1. How to redesign the Administration Building into 2 floors?
2. How to plan the structure of the Administration Building?
3. How much does it cost to rebuild the Administration Building?

METHODS

To work on the research report, data is needed on everything related to the project. To obtain this data, several methods were used, as follows:

1. Literature Study, namely by theoretical studies and other references and studying literature books that have the same relationship to the matters discussed in compiling the research. Thus it can add accurate information and also as a support to strengthen the argument.
2. Field analysis (Observation) is a form of collecting existing field data. This method is also a systematic, practical and accurate depiction.
3. The secondary data required is Field Condition Observation. At the time of observation of field conditions aims to find out directly the conditions in the field in order to find out the part of the damage that needs repair. With this, it can be seen which parts of the damage can be repaired.
4. General data
   a. Building Name: Administration Building
   b. Location: UPBU Class III Naha, Tahuna
   c. Function: Controlling services in the airport environment area.
   d. Number of Floors: 2 Floors
   e. Building Height : ± 7 m

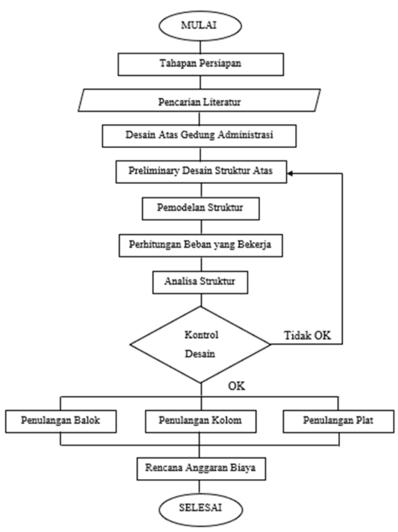


Figure 2 Flowchart

Cost Budget Plan (RAB) is to calculate the costs required for a building and with these costs, the building can be realized as planned. Given the size and importance of the building for which funding needs to be calculated, knowledge of the issues involved in costing is essential. Certain requirements must be met when planning the budget, namely construction drawings, construction material prices, and wages. The steps to calculate the RAB are as follows:

1. Collect data to be able to find out the work items to be carried out. This step is done before calculating the building volume.
2. Calculate the volume of work according to the work items for which data has been collected. Volume calculation is important to determine the work area, price analysis and total unit price later.
3. Determining the unit price list needs to be considered because each region throughout Indonesia has its own unit price.
4. Analyze the unit price of work based on work items. This is the calculation of material requirements, wages and tools based on work categories. To perform job analysis, the word can refer directly to SNI.
5. Cost Budget Plan This is done after a series of calculations above and can determine the Cost Budget Plan (RAB).

RESULTS AND DISCUSSION

1. Preliminary Cross Section Design

Preliminary design is the initial planning to determine the dimensions of the building structure. Preliminary design is carried out on primary and secondary structures including columns, beams and plates.

Material Data

a. Concrete Material
   Concrete Quality K = 300
   Concrete compressive strength fc' = 25.00 MPa
   Modulus of elasticity Ec = 23500MPa

b. Steel Material
   Elastic modulus ES=200000MPa
   BJTD 40 (Threaded Tul)
   Yield stress of steel fy =390.00MPa

Ultimate stress fu =560.00MPa
BJPT 24 (Plain Tul.)
Steel yield stress fy =240.00MPa
Ultimate stress fu =360.00MPa

2. Loading

a. Dead Load

The total weight of the installed building construction materials, including walls, floors, ceilings, roofs, partition walls, stairs, architectural and structural components and installed equipment.

b. Live Load

Loads caused by living beings or building occupants that do not include construction loads and environmental loads such as earthquake loads, wind loads, dead loads, and flood loads.

3. Earthquake Load

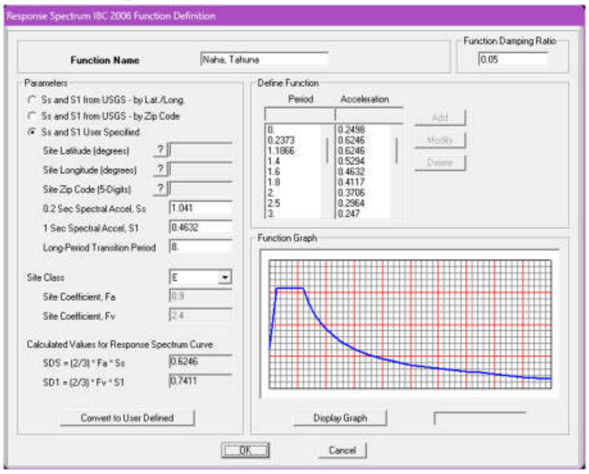


Figure 3 Spectrum Response Graph

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

SS = 1.1976
S1 = 0.5176
SDS = 0.7185
SD1 = 0.8281

4. Structure Modeling

For SAP2000 modeling which can be seen in Figure 4

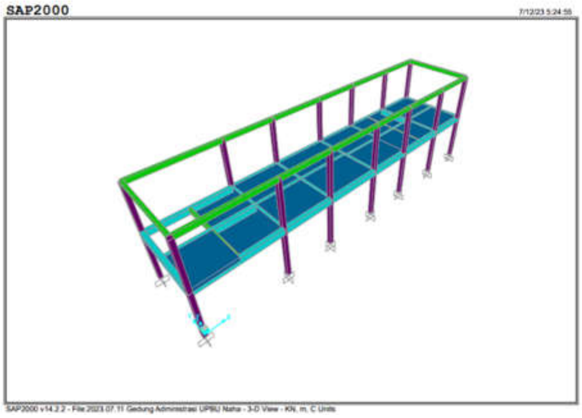


Figure 4 3D Structural Modeling

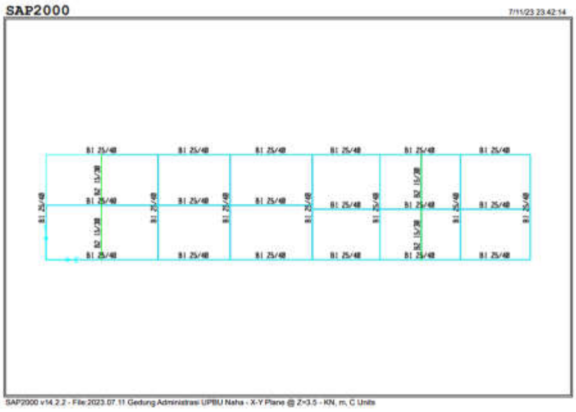


Figure 5 Modeling of 1st Floor Beams

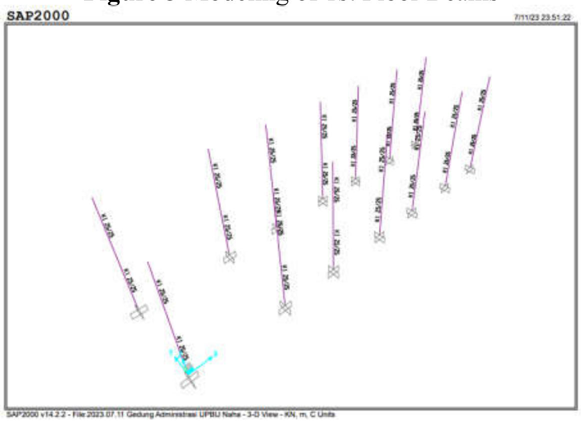


Figure 6 Modeling of Column K1 (25/25)

5. SRPMK Beam Design SNI 2847 2019

SRPMK beam design according to SNI 2847-2019 describes some general requirements. The main beam that will be designed is Beam B1 which measures 250 x 400 mm and B2 as a child beam which has a size of 150 x 300 mm.

KODE BALOK	B1		B2	
POTONGAN	TUMPUAN	LAPANGAN	TUMPUAN	LAPANGAN
DIMENSI (mm)	250 x 400	250 x 400	150 x 300	150 x 300
TUL. ATAS	2 - D16	2 - D16	2 - ⌀10	2 - ⌀10
TUL. BAWAH	2 - D16	2 - D16	2 - ⌀10	2 - ⌀10
TUL. SAMPING	-	-	-	-
BEUGEL	⌀10 - 120	⌀10 - 120	⌀8 - 100	⌀8 - 120
DECKING (mm)	40	40	40	40

Figure 7 Beam Reinforcement Detail

6. Column Design K1

The column cross-section dimension requirements are regulated by SNI 2847-2019. The column to be designed uses a column size of 250 x 250 mm.

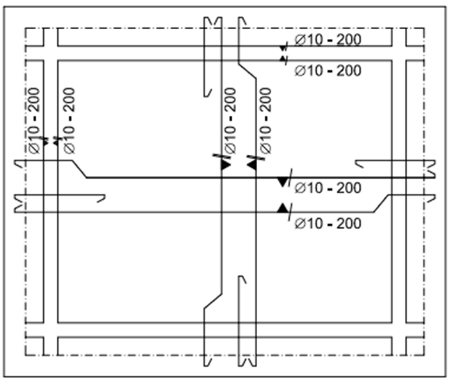
KODE KOLOM	K1	
KODE KOLOM	TUMPUAN	LAPANGAN
DIMENSI (mm)	250 x 250	250 x 250
TUL. LENTUR	8 - D13	18 - D13
BEUGEL	⌀10 - 120	⌀10 - 1O0
DECKING (mm)	40	40

Figure 8 Column Reinforcement Detail

7. SRPMK Plate Design according to SNI 2847-2019

SRPMK plate design according to SNI 2847-2019. Then the plate to be designed uses a plate thickness of 120 mm.

PLAT TIPE 1 (P1)



TEBAL PELAT = 12 cm	
Tul. Utama	⌀10 - 200
Tul. Susut	⌀10 - 200

Figure 9 Floor Plate Reinforcement Detail

8. Cost Budget Planning

Cost Budget Planning refers to the unit price of SNI and the Manado City Region, the cost required is IDR 269,403,000.00 (Two Hundred Sixty Nine Million Four Hundred Three Rupiah).

Conclusion

Based on the results of the structural planning analysis of the administration building at UPBU Class III Naha, Tahuna using the SRPMK method, the following conclusions can be obtained:

1. Redesign the structure using the SAP 2000 application by entering analysis data such as concrete quality, plate dimensions, beam dimensions, and column dimensions into SAP 2000. With the building plan, the placement of coordinate points can be determined accurately.
2. In this structural analysis planning is obtained qualified by using K-300 concrete quality with column sizes (K1 25/25), beams (B1 25/40 and B2 15/30), and 12 cm thick plates. Therefore, if you want to develop the administration building from the existing 1 floor to 2 floors, the size of the structure that has been analyzed is needed.
3. Structural planning requires a cost budget that aims to find out the Budget Plan (RAB) so that the costs incurred can be used optimally. This RAB is based on the Minister of PUPR for General Affairs in 2022 and Manado Mayor Regulation No. 32 of 2021. This structural planning costs Rp. 269,403,000 (Two Hundred Sixty Million Four Hundred Three Thousand Rupiah).

Suggestions

From the results of the analysis during the process of working on this research, there are several suggestions that are conveyed, among others:

1. Planning the structural analysis of the administration building at Naha Airport, it is necessary to re-plan the building

structure by using K-300 concrete quality and using 25/25 dimensioned columns, 25/40 main beams, 15/30 child beams, and 25/40 sloofs.

2. Future researchers are expected to pay more attention to the feasibility of constructing administrative buildings if there is damage, it is necessary to review the building to be repaired immediately.

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