Planning for the Subgrade Preparation of the Inspection Road at Depati Parbo Kerinci Jambi Airport

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ABSTRACT

Depati Parbo Airport, located in Kerinci Regency, Jambi Province, is currently undergoing airside facility development to improve flight safety and operational efficiency. One of the essential supporting infrastructures that needs to be realized is the inspection road, which functions as a route for routine monitoring, perimeter surveillance, and facility maintenance access. This study aims to plan the subgrade preparation of the inspection road based on existing conditions, as the area consists of former rice fields with low bearing capacity soil, requiring ground improvement before pavement construction. The type of research used is applied research. Data were obtained through field observation during the On the Job Training 2 at the Airport Operator Unit of Depati Parbo Airport, and supported by secondary data such as topographic maps from DEMNAS, the airport master plan, and the 2024 Jambi Provincial Standard Unit Prices (HSPK). The population in this study includes the entire inspection road area of 4,437 meters in length, with samples taken at cross-sectional analysis points every 50 meters, totaling 92 points. Based on the results of the calculations, the cut volume is estimated at 44,303.49 m³, while the fill volume is approximately 22,814.37 m³. The estimated total cost for the subgrade preparation work reaches IDR 17,450,000,000.00. The outcome of this planning is expected to serve as a reference for field implementation and contribute to enhancing the safety and performance of airside infrastructure at Depati Parbo Airport.

Keywords: *Airport, check road , subgrade, cut and fill, civil 3D.*

1. INTRODUCTION

Depati Parbo Airport (IATA: KRC, ICAO: WIPH) is located in Kerinci Regency, Jambi Province, at coordinates 02°05’35”S and 101°27’55”E. The airport operates as a Class III Airport Management Unit, connecting Kerinci with tourist destinations such as Lake Kerinci and Mount Kerinci, and providing air transportation access to areas in Sumatra. Established in 1978, it was originally named UPBU Depati Parbo, inspired by the Kerinci hero, "Depati Parbo." The airport was built as a disaster evacuation route, considering Kerinci Regency's vulnerability to natural disasters. It features an 1800-meter long and 30-meter wide runway, along with other facilities such as a taxiway and an apron to support flight operations. The airport offers benefits to the people of Kerinci by shortening travel time to Jambi. The first aircraft to land was from SMAC, followed by Merpati and several other airlines. With the ATR 72-600 being the largest aircraft used, the airport continues to contribute to supporting transportation activities.

Infrastructure development is crucial, including the construction of an inspection road planned in the 2023 master plan. The inspection road supports airport operations and safety, but currently, it is not yet available, which means inspections are conducted on the runway. The challenge in building the inspection road lies in the existing soil conditions, which are predominantly former paddy fields with low bearing capacity. Therefore, soil compaction and subgrade improvement are necessary to ensure the inspection road is safe and strong. Thorough soil preparation is crucial to prevent structural failure and high repair costs.

2. BRIEF THEORY

According to SKEP 347/XII/1999 concerning the Design and Engineering Standards for Airport Facilities and Equipment, inspection roads are built in the area around the airport boundary and are used for routine inspections of basic airport facilities. In addition, inspection roads are also used for emergency vehicles such as fire trucks from the PKP-PK unit.[1]

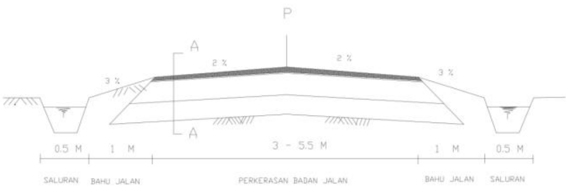

Figure 1 Inspection Road
(Source: SKEP 347/XII/1999)

It is stated in ICAO (International Civil Aviation Organization) ANNEX 14 Vol. 1 that an emergency access road or inspection road must be provided at airports where terrain conditions allow, to facilitate the achievement of a minimum response time. The emergency access road must be able to support the heaviest vehicles that will use it, and be usable in all weather conditions.

A contour line is a line connecting points of equal elevation. Contour lines are drawn on a map to show the undulations of the ground surface. The steeper the terrain, the closer the contour lines on the map, and conversely, the wider the distance between contour lines indicates that the area is considered relatively flat [2].

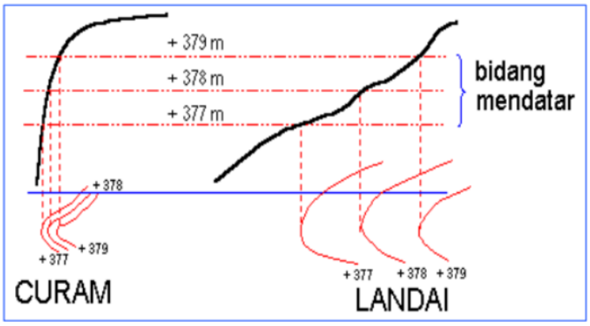

Figure 2 Contour line density in steep and flat areas
(Source: Surveying and Mapping Techniques, 2008)

Contour lines have the following properties:

a. They form a closed curve.
b. They do not branch.
c. They do not overlap.
d. They are not drawn if they intersect with a building.
e. Close contour lines indicate a steep terrain.
f. Wide contour lines indicate a gentle slope.
g. One contour line represents one specific elevation.
h. Two contour lines with the same elevation cannot be connected into one single contour line.
i. On terrain with a uniform slope, contour lines form a 'V' shape pointing towards the lower elevation. On a steep elevation, the contour lines form a 'V' shape pointing towards a higher elevation.
j. On a hill ridge that forms a 90° angle with the maximum slope, the contour lines will form a 'U' shape facing the higher part.

Subgrade preparation involves the condition of the original soil, fill, or excavation before the installation of the Subbase Course. This stage includes excavation, embankment, and compaction to achieve the planned surface. Embankment dimension tolerances regulate the elevation and slope, with limitations on the layer thickness. The calculation of excavation and embankment volume is usually done indirectly through line and area measurements. Contour lines connect points of equal elevation, and the volume is calculated using the end areas formula.

$$V = \left(\frac{A1 + A2 + \ldots + An}{n}\right) \times \left((n-1) \times d\right)$$

Information :

- **V** : Volume

- **A** : Area of the first cross-section
- **d** : Contour Interval

3. RESEARCH METHODS

This research plans the subgrade preparation for the inspection road using the cut and fill method with Autodesk Civil 3D for efficiency. The subgrade preparation for the inspection road will be completed

Figure 3 Flowchart
(Source: Author, 2025)

According to the following planning workflow:

- Data Collection Techniques

Data collection in this study was carried out through field observation during the On-the-Job Training 2 at Depati Parbo Kerinci Airport Management Unit. Visual observations were conducted on the inspection road planning area to determine the area's size and soil conditions. The necessary data for this research is secondary data obtained from various sources, including topographical data from DEMNAS, the Depati Parbo Airport masterplan data, and the Jambi Basic Activity Unit Price (HSPK) data used to estimate the cost of subgrade work for the inspection road.

- Data Processing Techniques

The data is processed using Autodesk Civil 3D to design the subgrade preparation for the inspection road, compare existing and planned conditions, calculate cut and fill volumes, and estimate costs based on unit prices. The results will be presented in tables and graphs.

- Population and sample

The research population is the 4437-meter inspection road construction site, with 92 elevation sample points for topographical modeling.

- Data Analysis

The data analysis stage includes modeling the contour map, determining the planned elevation, and calculating the cut and fill volumes for the inspection road at Depati Parbo Airport. This analysis supports the design and efficiency of the earthwork.

- Planned Area Conditions

Data analysis for inspection road modeling and soil efficiency.

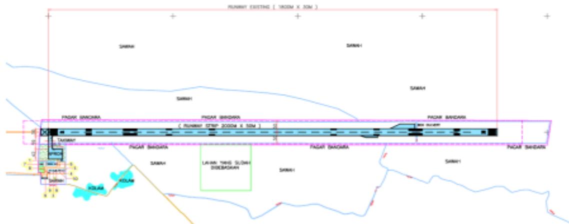

Figure 4 Layout Depati Parbo Airport
(Source: Aerodrome Manual Depati Parbo Airport)

- Planned Conditions

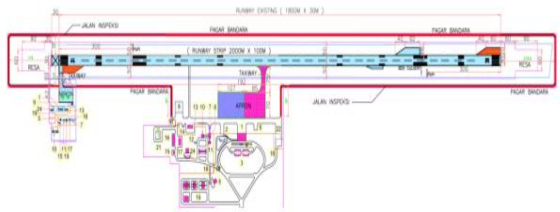

Figure 5 Masterplan Bandar Udara Depati Parbo
(Source: Aerodrome Manual Depati Parbo Airport)

Based on the image above, the subgrade preparation for an inspection road is planned along the airside of Depati Parbo Airport, with a length of 4437 meters and a road width of 5 meters.

- Research Timeline

The research was conducted during the On-the-Job Training, from October 1, 2024, to February 28, 2025.

4. RESULTS AND DISCUSSION

- Research Result

The subgrade preparation for the project is divided into two stages: preparation and implementation. The preparation stage includes land surveying, mobilization, demobilization, and the application of the Construction Safety and Health Management System (SMK3)[3]. Land surveying uses tools like a Total Station and a theodolite to establish contours, elevations, and work boundaries, aiming to support the implementation according to the inspection road design. Mobilization involves moving equipment and personnel to the project site, followed by demobilization after the work is completed. SMK3 controls risks and improves work safety by developing a Construction Safety and Health Work Plan. Land clearing work clears the area of materials, while cut and fill operations are carried out to create the ground elevation according to the design, involving a cut volume of 44,303.49 m^3 and a fill volume of 22,814.37 m^3. According to the Minister of Public Works and Housing Regulation No. 28/PRT/M/2016, the measurement of cut for payment purposes requires fill material to be divided by a shrinkage factor of 0.85.

Therefore, the soil requirement is as follows: Soil compaction for the inspection road is carried out in layers using heavy equipment to achieve a CBR (California Bearing Ratio) of ≥12%. Subsequently, a contour map is drawn using DEMNAS data from BIG and processed with Google Earth Pro, Global Mapper, and Autodesk Civil 3D[4]. This is the step-by-step approach used for the planning process.

1. Open the Google Earth Pro software. Right-click on My Places, then click Add New Folder. Right-click on the new folder, then click Add Polygon. Plot the polygon on the Depati Parbo Airport area. Then, save it in .kmz format.

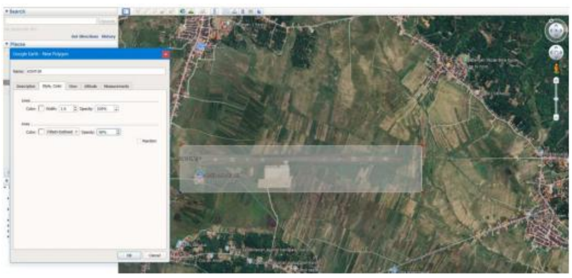

Figure 6 Plotting a contour Map
(Source: Author, 2025)

2. Go to the DEMNAS website (https://tanahair.indonesia.go.id/portal-web/). Click on the location of Depati Parbo Airport, then download the DEMNAS data.

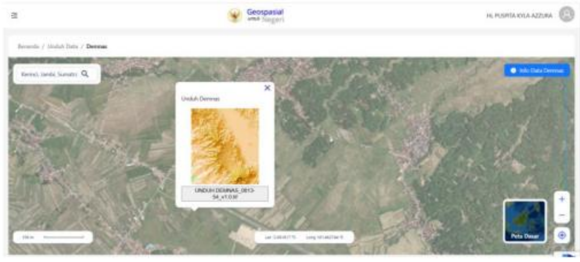

Figure 7 Data DEMNAS
(Source: Author, 2025)

3. Open Global Mapper. Open the .kmz file and DEMNAS file. Select the entire polygon area. Click Analysis, then Generate Contour (From Terrain Grid). In the Contour Options window, change the Contour interval to 0.5 meter. In the Contour Bounds section, choose crop to selected area.

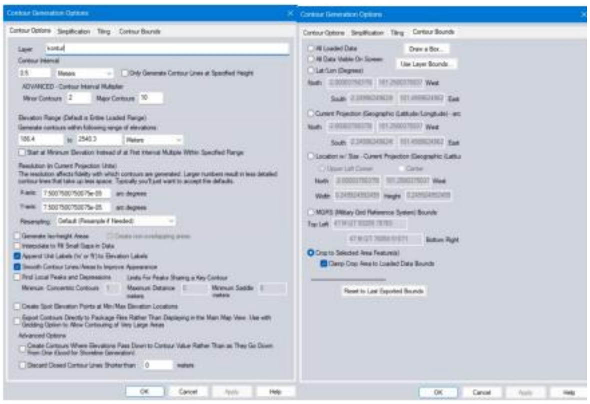

Figure 8 Generate Contour Window
(Source: Author, 2025)

Then, export it in vector/lidar and DWG formats.

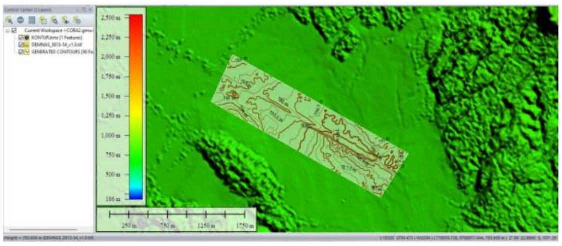

Figure 9 Export format Lidar
(Source: Author, 2025)

4. On the Toolspace tab, right-click on Surface. Select Create Surface to make the

contour lines. Change the surface name and adjust other settings.

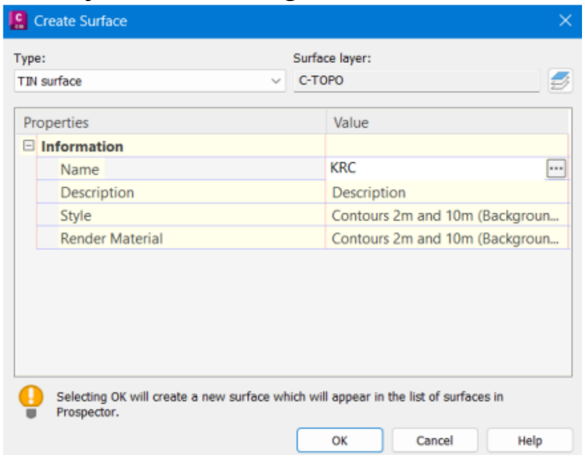

Figure 10 Create Surface Contour
(Source: Author, 2025)

5. On the Surface menu, click to expand "KRC", expand Definition, and then select Add Contours. Afterward, click Apply and OK.

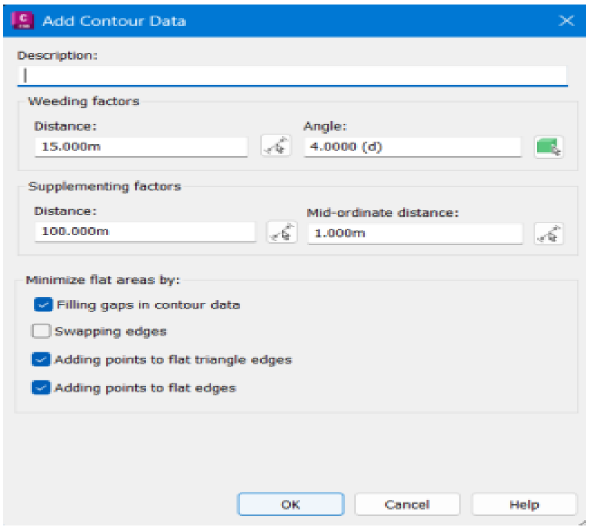

Figure 11 Contour Window
(Source: Author, 2025)

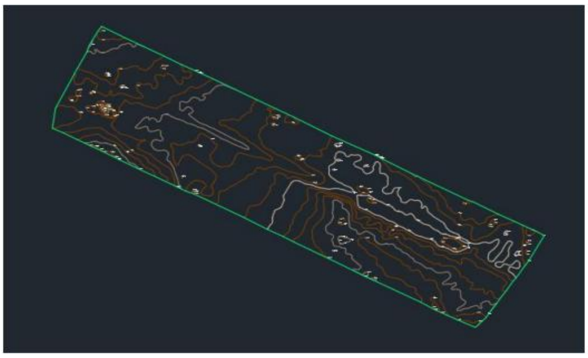

Figure 12 Contour Mapping Result
(Source: Author, 2025)

The author then designed the calculation of cut and fill volumes for the subgrade of the inspection road using Civil 3D. The planned elevation was set at 790.25 m to calculate the volume, with longitudinal and cross-sections taken to depict the existing conditions and the planned elevation[5]. The planning for the cut and fill volumes of the inspection road's subgrade was done using Civil 3D. The planned elevation was set at 790.25 m to calculate the volume. Longitudinal and cross-sections were taken to illustrate both the existing conditions and the planned elevation[6].

1. Draw the planned inspection road area on the previously created contour map, adjusting it to the UTM coordinate points. Draw the alignment and profile for the longitudinal section, and the assembly and corridor for the cross-sections.

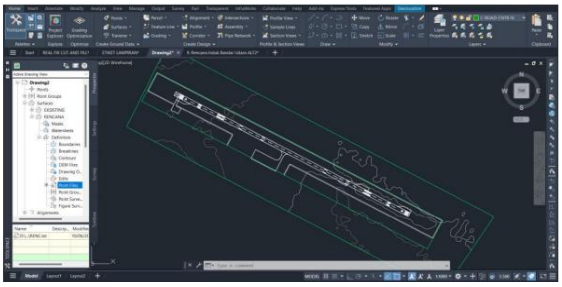

Figure 13 Planned Inspection Road Area
(Source: Author, 2025)

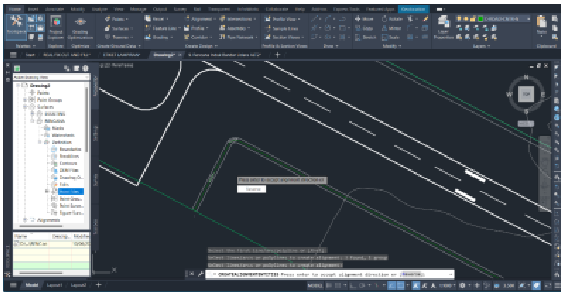

Figure 14 Alignment Images
(Source: Author, 2025)

2. Sample lines are used to take cross-section images from the existing and planned elevations. For this 4,437-meter-long inspection road plan, the sample lines are created at an interval of 50 meters."

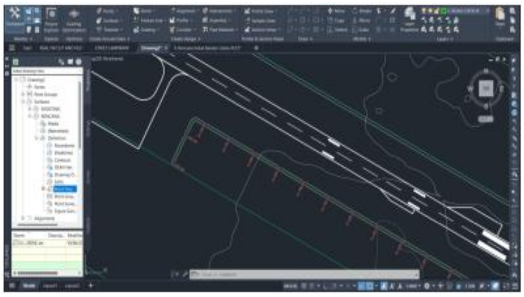

Figure 15 Sample Line Cross section
(Source: Author, 2025)

3. Creating section views. Click 'create multiple views', change the 'band set' as specified, and then click 'create section views' when finished. Click on any empty space to display the cross-section views.

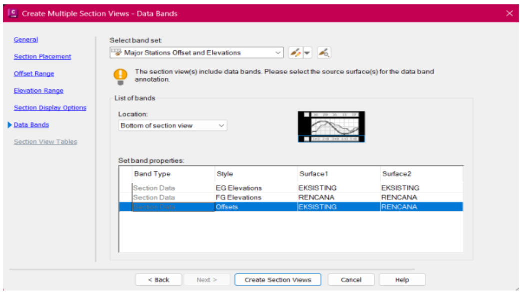

Figure 16 Section Views setting
(Source: Author, 2025)

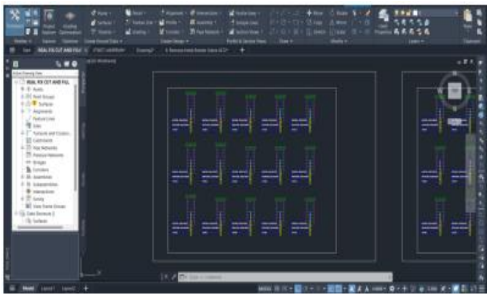

Figure 17 Cross Section display
(Source: Author, 2025)

4. Creating profile views. Profile views are used to display the long section of the alignment. Click 'create profile views', adjust the settings in the 'profile hatch option' section. Once finished, click 'OK'. Click on any empty space to display the long section views.

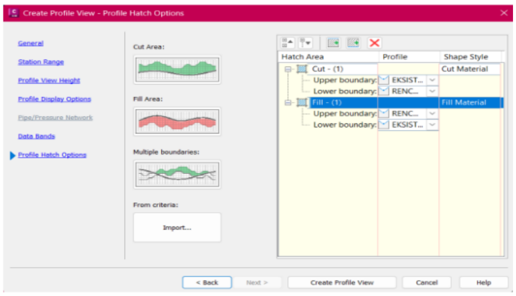

Figure 18 Profile Views Setting
(Source: Author, 2025)

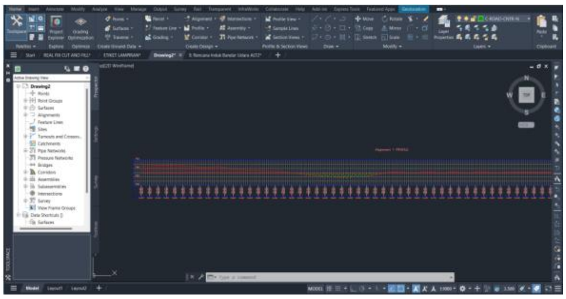

Figure 19 Long Section display
(Source: Author, 2025)

The calculation of cut and fill volume then proceeds, which requires existing and planned elevation data, alignment, profile, and sample lines. The following are the steps to calculate cut and fill volume using Civil 3D software.

1. Click the 'Analyze' tab, in the 'Volume and Materials' panel, select 'Compute Materials'. Select the alignment and sample lines for which the volume will be calculated, then click 'OK'. A new window will appear; change the volume calculation method to 'Prismoidal'. Edit the material according to the surface to be calculated

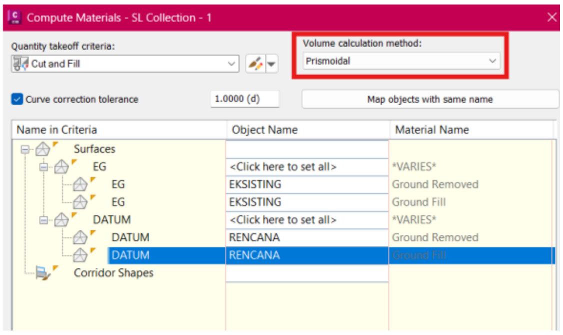

Figure 20 Compute Materials setting
(Source: Author, 2025)

2. Next, display the total volume of cut and fill. Click on 'Total Volume Table'. Select the alignment and sample lines for which you want to display the volume, then click on an

empty area to display the total cut and fill volume table.

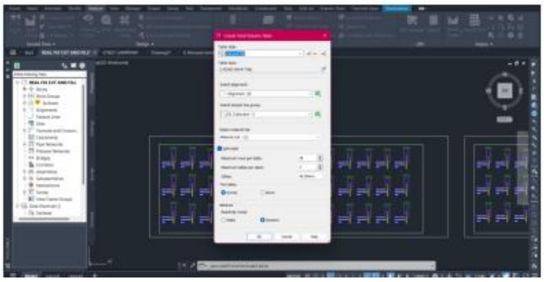

Figure 21 Create Total Volume Table window
(Source: Author, 2025)

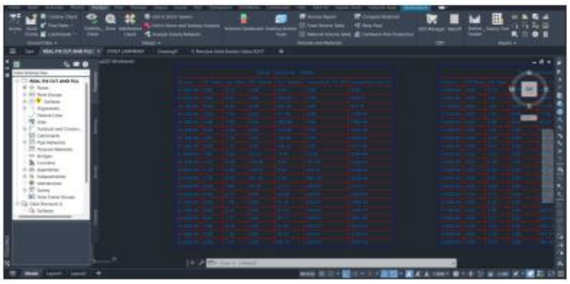

Figure 22 Table of cut and fill volumes
(Source: Author, 2025)

3. After obtaining the cut and fill volume table from the Civil 3D software calculation, the volume calculation is then continued with Microsoft Excel. The total cut volume was 44,303.49 m³ and the fill volume was 22,814.37 m³.

Lintasan 1	Cut Volume (m³)	Fill Volume (m³)
0+000.00	0.00	0.00
0+050.00	455.87	0.00
0+100.00	463.5	0.00
0+150.00	411.06	0.00
0+200.00	362	0.00
0+250.00	279.84	0.00
0+300.00	190.98	0.00
0+350.00	108.23	0.00
0+400.00	18.95	32.54
0+450.00	0.00	150.96
0+500.00	0.00	219.51
0+550.00	0.00	181.38
0+600.00	27.72	46.28
0+650.00	46.89	0.00
0+700.00	41.18	0.00
0+750.00	87.53	0.00
0+800.00	97.71	0.00
0+850.00	61.56	0.00
0+900.00	50.01	0.00
0+950.00	59.74	0.00
1+000.00	47.32	0.00
1+050.00	80.07	0.00
1+100.00	113.34	0.00
1+150.00	77.56	0.00
1+200.00	43.2	0.00
1+250.00	60.51	0.00
1+300.00	135.48	0.00
1+350.00	293.54	0.00
1+400.00	403.51	0.00
1+450.00	345.37	0.00
1+500.00	312.48	0.00
1+550.00	279.81	0.00
1+600.00	247.18	0.00
1+650.00	239.9	0.00
1+700.00	249.01	0.00
1+750.00	255.15	0.00
1+800.00	233.09	0.00
1+850.00	200.22	0.00
2+050.00	186.04	0.00
2+100.00	217.43	0.00
2+150.00	228.12	0.00
2+200.00	267.08	0.00
2+250.00	336.49	0.00
2+300.00	373.11	0.00
2+350.00	396.27	0.00
2+400.00	415.97	0.00
2+450.00	438.16	0.00
2+500.00	463.33	0.00
2+550.00	486.12	0.00
2+600.00	531.08	0.00
2+650.00	584.48	0.00
2+700.00	612.49	0.00
2+750.00	625.92	0.00
2+800.00	640.57	0.00
2+850.00	662.78	0.00
2+900.00	687.27	0.00
2+950.00	728.1	0.00
3+000.00	771.87	0.00
3+050.00	795.9	0.00
3+100.00	863.96	0.00
3+150.00	949.85	0.00
3+200.00	1007.92	0.00
3+250.00	1033.1	0.00
3+300.00	1059.72	0.00
3+350.00	1110.16	0.00
3+400.00	1148.4	0.00
3+450.00	1188.81	0.00
3+500.00	1197.53	0.00
3+550.00	1209.73	0.00
3+600.00	1223.61	0.00
3+650.00	1166.75	0.00
3+700.00	1085.23	0.00
3+750.00	1042.77	0.00
3+800.00	1022.12	0.00
3+850.00	1032	0.00
3+900.00	1044.95	0.00
3+914.69	300.14	0.00

Figure 23 Cut and fill volume STA 1
(Source: Author, 2025)

Lintasan 2	Cut Volume (m^3)	Fill Volume (m^3)
0+000.00	0.00	0.00
0+050.00	958.76	0.00
0+100.00	910.05	0.00
0+150.00	879.08	0.00
0+200.00	825.53	0.00
0+250.00	806.19	0.00
0+300.00	766.15	0.00
0+350.00	720	0.00
0+400.00	714.18	0.00
0+450.00	691.44	0.00
0+500.00	667.38	0.00
0+522.05	286.53	0.00
TOTAL	**44303.49**	**630.67**
TIMBUNAN (*Fill*) 1m		**22183.7**
TOTAL TIMBUNAN		**22814.37**

Figure 24 Cut and fill volume STA 2
(Source: Author, 2025)

After the calculation of cut and fill volumes, the next step is to calculate the budget plan for this project. A budget plan (RAB) was created to determine the estimated total cost required for the subgrade preparation work of the inspection road at Depati Parbo Airport[7]. This RAB was prepared based on the unit prices of the main activities in Jambi Province in 2024 and Ministerial Regulation No. 78 of 2014. The following are the details of the project's budget plan:

RENCANA ANGGARAN BIAYA (RAB)					
Pekerjaan : PERENCANAAN PENYIAPAN TANAH DASAR JALAN INSPEKSI					
Lokasi : BANDAR UDARA DEPATI PARBO KERINCI					
NO.	**ITEM PEKERJAAN**	**SATUAN**	**VOLUME**	**HARGA SATUAN**	**JUMLAH HARGA**
a	b	c	d	e	f = (d x e)
I	**PEKERJAAN PERSIAPAN**				
1	Pek. Papan Nama Proyek	Unit	1	Rp 2.882.353.46	Rp 2.882.353.46
2	Mobilisasi dan Demobilisasi	Ls	1	Rp 26.000.000.00	Rp 26.000.000.00
3	Kelengkapan K3	Ls	1	Rp 13.000.000.00	Rp 13.000.000.00
4	Pek. Pengukuran	m2	22183.7	Rp 4.526.65	Rp 100.417.867.79
				Jumlah I	Rp 142.300.221.25
II	**PEKERJAAN GALIAN DAN TIMBUNAN TANAH DASAR**				
1	Pek. Pembersihan (Clearing)	m2	66701.1	Rp 27.458.82	Rp 1.831.533.343.73
2	Pek. Galian Tanah	m3	44303.49	Rp 133.505.82	Rp 5.914.773.814.57
3	Pek. Timbunan Tanah	m3	26840.44	Rp 259.763.44	Rp 6.972.163.757.09
4	Pek. Pemadatan	m2	22183.7	Rp 38.697.29	Rp 858.449.073.43
				Jumlah II	Rp 15.576.919.988.82
JUMLAH (I+II)					Rp 15.719.220.210.07
PPN 11%					Rp 1.729.114.223.11
JUMLAH TOTAL					Rp 17.448.334.433.18
PEMBULATAN					Rp 17.450.000.000.00
TERBILANG : Tujuh Belas Milyar Empat Ratus Lima Puluh Juta Rupiah					

Figure 25 Budget plan for inspection road subgrade preparation
(Source: Author, 2025)

- Discussion of Research Findings

An analysis of the subgrade preparation work shows a total cut volume of 44,303.49 m³ and a fill volume of 22,814.37 m³, with the existing topography being higher than the planned elevation. The existing soil, which comes from rice fields, has a low bearing capacity, high moisture content, and a CBR value that does not meet the requirements. Therefore, all fill material, amounting to 22,814.37 m³, will be sourced from outside the site. The total requirement for fill material will be 26,722.79 m³. The Budget Plan (RAB) for this work totals Rp 17,450,000,000.00, covering various related cost components.

5. CONCLUSION AND SUGGESTION

- Conclusion

Based on the discussion in Chapter IV regarding the planning of subgrade preparation for the inspection road at Depati Parbo Airport, Kerinci, Jambi, it can be concluded that:

1. The planning for the subgrade preparation of the inspection road is divided into two stages: the preparation stage and the subgrade preparation stage. The preparation stage includes land surveying, mobilization and demobilization, and the Occupational Safety and Health Management System (SMK3). Meanwhile, the subgrade preparation stage includes land clearing, cut and fill work, and soil compaction.
2. The cut and fill work for the inspection road subgrade is planned with dimensions of 4,437 meters in length and 5 meters in width. The cut and fill volumes are calculated using Civil 3D software. From these calculations, the cut volume is 44,303.49 m³ and the fill volume is 22,814.37 m³.
3. The subgrade preparation work for the inspection road at Depati Parbo Airport, Kerinci, Jambi requires a budget of Rp 17,450,000,000.00 (Seventeen Billion Four Hundred Fifty Million Rupiah). The calculation of the Budget Plan (RAB) for this project is based on Ministerial Regulation No. 78 of 2014 and the 2022 Jambi Province Unit Price for Main Activities.

- Suggestions

Based on the discussion in Chapter IV regarding the planning of the subgrade preparation for the inspection road at Depati Parbo Airport, the author provides several suggestions that can be considered, as follows:

1. Suggestions for the Airport In the planning of the subgrade preparation for the inspection road in the airport area, it is recommended that the field implementers pay more comprehensive attention to the drainage system, given the high rainfall in the Kerinci region. Good drainage can

prevent subgrade settlement, which could cause damage to the road structure. According to the Minister of Transportation Regulation No. 77 of 2015 concerning Standardization and Certification of Airport Facilities, every new or modified airport facility is required to have operational-worthy facilities, including good drainage as part of the supporting infrastructure and facilities.

2. Suggestions for Future Research For future research, it is recommended to conduct further laboratory tests on the characteristics of the local soil, such as laboratory CBR tests, consolidation tests, and soil permeability tests. A more in-depth study of the variations in soil types at the project location is also important to determine the most appropriate stabilization method.

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