THREE-DIMENSIONAL SOIL PROFILE IMAGEMENT IN THE MANDALIKA CIRCUIT AREA WITH ROCKWORKS SOFTWARE AS FOUNDATION DESIGN CONSIDERATIONS

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Abstract: Soil investigation work is considered less important in the project because it lacks added value in the short term, therefore it will be kept to a minimum in order to reduce costs. In the implementation of the construction of the international Mandalika circuit project, there was a problem that became a reference for research, namely when the development process was running the owner asked for a new supporting building to be made. This requires the contractor to conduct a soil investigation to obtain a Soil Profile in the area. As an effort to make work efficiency and accuracy, the use of Rockworks software is very appropriate to be used in supporting soil investigation work to obtain soil profiles in the project. The data used in this study is data from field tests in the form of sondir and SPT drill data in the Mandalika circuit area. The data serves as input material for the Rockworks software in processing the data so that the overall soil profile is obtained through the interpolation method by the Rockworks software. In this study, there were 20 sondir and drill data points scattered in the Mandalika circuit area. From this data, it is processed using Rockworks software so that the overall soil profile input obtained can then be selected and presented in the area where the new supporting building will be built. In the presentation of the results of the software output, it can be divided into two parts, namely the three-dimensional model of the state of the soil profile below the surface and the cross-section generated from the three-dimensional model. The results of this study indicate that there are seven types of stratigraphy or layers produced using Rockworks software interpolation in the Mandalika circuit area. The layer consists of Silt-Hard, Clay-Stiff, Clay-Hard, Sand-Medium Dense, Sand-Dense, Sand-Very Dense, and Andesite soils which are scattered and form a subsurface profile in the Mandalika circuit area. The dominant layer is sand or sand, considering that the Mandalika circuit area is located on the shoreline, the rest can be found in layers of clay or clay and silt or silt. The building area shows that there are 5 types of soil, namely Clay-Stiff, Clay-Hard, Sand-Medium Dense, Sand-Dense, and Sand-Very Dense. In the track lane area, there are 4 types of soil, namely Clay-Stiff, Clay-Hard, Sand-Dense, and Sand-Very Dense.

Keywords: soil investigation, soil profile, Rockworks software, Mandalika circuit project, three-dimensional model.

1. PRELIMINARY

Soil is a basic layer element that has an important role in a development project in the construction sector. The function of the land in question is as a supporting medium for the foundation of the building that will stand on it. Soil has several characteristics and different properties that will affect the level of strength and durability of the construction building being built. According to (Jayanggala, 2020), soil has an important role as a foundation supporter so that to ensure the condition of the soil to be built is stable, before construction work begins, a soil investigation must be carried out to determine the characteristics of the soil and its geological conditions.

Soil investigation is an activity in the geotechnical field carried out to obtain soil properties and characteristics for the benefit of engineering design (Simorangkir, 2021). Processing of data from the soil investigation that has been carried out will produce a picture of information that is justified by the engineer regarding the soil structure below the surface (soil profile). Soil profiles are soil layers contained in an area that need to be classified and distinguished from each other where each layer has predetermined soil parameters. The classification in question is a way to determine the type of soil into a group or subgroup so that it can obtain soil parameters or a description of the nature and behavior of the soil (Bella et al., 2015). Soil parameters are geotechnical parameters obtained from statistical calculations from the results of laboratory tests and from the correlation approach in the soil layer. The method of making soil profiles can be made from insitu test data such as borehole with N-SPT and sondir data (Estikhamah & Solin, 2021).

Soil investigation work is considered less important in the project because it lacks added value in the short term, therefore it will be kept to a minimum in order to reduce costs and time in the initial phase (Nugroho et al., 2019). From one of these problems, a geotechnical software has emerged, namely Rockworks, this software is used for the management, analysis, and visualization of geological data. This software provides several methods of gridding and interpolating well log data to build 3D spatial models (Trabelsi et al., 2013). Rockworks can be used as a database for identification of each borehole sample, where each borehole input can be filled with lab test results at a certain depth. The next function is to visualize the results of in situ tests such as SPT, CPT, CPTu, and so on through interpolation and extrapolation techniques at each input borehole point. Then it is possible to perform geostatistical analysis, for example processing laboratory test results from borehole samples that are entered into the 3D model so that geostatistics can be carried out in a soil layer in the 3D model automatically.

The international project of the Mandalika circuit, located in Lombok, West Nusa Tenggara, is a large-scale fast-paced project, consisting of the construction of a racing circuit with high-specification supporting buildings used in international events. In the implementation of development, there is a problem that becomes a reference for research, namely when the development process is running, the owner asks to make a new supporting building. This requires the contractor to conduct a soil investigation in the area where the new supporting building will be erected, considering that this project is built in an area close to the shoreline so that land investigation is very mandatory for the smooth running of the project. According to (Nasrullah, 2021) soil profile data in additional projects is to utilize the results of soil investigations at the closest point,

In an effort to make work efficiency and accuracy, the use of Rockworks software is very appropriate to be used in supporting soil investigation work to obtain soil profiles in the project. This research is very important to do in order to provide an easier and more efficient comparison reference in soil investigation work. After getting the results from the modeling and exposure of the subsurface conditions in the area, then the results obtained can be used as a reference for the implementing contractor. According to (Prayogo & Saptowati, 2016) from the results of this soil investigation, the most economical but safe alternative or type, depth and dimension of the foundation will be chosen.

2. METHOD

This research method is a numerical method, where this study aims to explain the problem solving that is formulated mathematically using arithmetic operations, namely the operations of addition, subtraction, times, and division. By analyzing data from research variables and comparing them with standards to be concluded. Quantitative research is widely used to develop theory in a discipline but can also only be used to find out certain circumstances. The method of data analysis in this study was carried out with the steps of the infinite planning method.

In calculating the value of the soil SPT at the point around the borehole, the author takes into account using the interpolation method obtained from the two closest borehole points using the Rockworks17 software, through the following steps:

1. Start the Rockworks17 program to create a database by clicking the folder-new project button and setting the name, file storage, project coordinates accordingly.
2. Input borehole and sondir control point data according to the data obtained in the field on the location tab.
3. Scan the inputted control point data by clicking the settings-dimentions-scan boreholes-process button.
4. Input Lithology (soil type) contained in the control point. For each new borehole that has been inputted with the name and position of the borehole, the next step is to enter all types of soil that exist in the results of all boreholes into the project database.
5. Stratigraphy data input, stratigraphy data is data in the form of formations or layers that you have determined to create a soil model (soil profile). A layer or formation can consist of one or more lithology, in other words, the formation is a grouping of 1 or more soil types into 1-layer soil.
6. Specific data input
   Specific data that needs to be input is special data which has 3 different types, namely P-Data, I-Data and T-Data. These data are useful for analysis using the built-in features of Rockworks. Each data has its own characteristics. The laboratory test results taken from can be categorized as I-Data. In borehole execution, generally measurement of the N-SPT value is also carried out. The presentation of the N-SPT value on Rockworks can be input as I-Data. As for the sondir results, it must be inputted as P-Data because of the nature of the measurement results of the end cone resistance (qc) and friction ratio (fr) which are continuous throughout the depth. T-Data, is rarely used in its applications in civil engineering and geotechnical engineering in general.
7. Input stratigraphy, input stratigraphy is done by pick stratigraphy contact method. With this method, it is mandatory to define all soil stratigraphic layers at each point (borehole or CPT). This means that if a borehole does not have a certain layer, then that layer must still be defined in the borehole even though it is "0" m thick. After the input stratigraphy is done, before the rendering process must turn off the "insert missing units" feature.
8. Rendering the model and creating a Cross Section. Rendering can be done by clicking the stratigraphy button and then you can perform the process by selecting one of the Models, Profiles, or Sections because the results of rendering grid models will be integrated with one another. In this case we will create a cross section, so to perform the rendering process can be started by pressing the Section button. Make sure that the interpolate surface button is checked and that the insert missing unit is unchecked. Select the cross section points then click process for rendering.
9. Analyzing and adjusting the interpolation results. After the rendering is complete, it is necessary to justify whether the cross section has met expectations or not. After that the results can be exported to the desired format (PNG, JPG)
10. After getting the rendering results and describing the stratigraphy that has been obtained, an adjustment analysis is carried out to determine the type of foundation that is suitable for use through a secondary data approach to the suitability of the foundation to soil characteristics.

3. RESULTS

This chapter presents data from three-dimensional soil profile imaging in the Mandalika circuit area using Rockworks software. The three-dimensional imaging data includes a three-dimensional image of the results of the Rockworks Stratigraphy in the Mandalika Circuit area as well as a cross-sectional image of the soil profile used in the building and track lane of the circuit. So that in this chapter, we will present the results of all the areas and special areas reviewed, including three-dimensional maps and cross-sections.

1. Results of Three Dimensional Stratigraphy Rockworks in the Mandalika Circuit Area

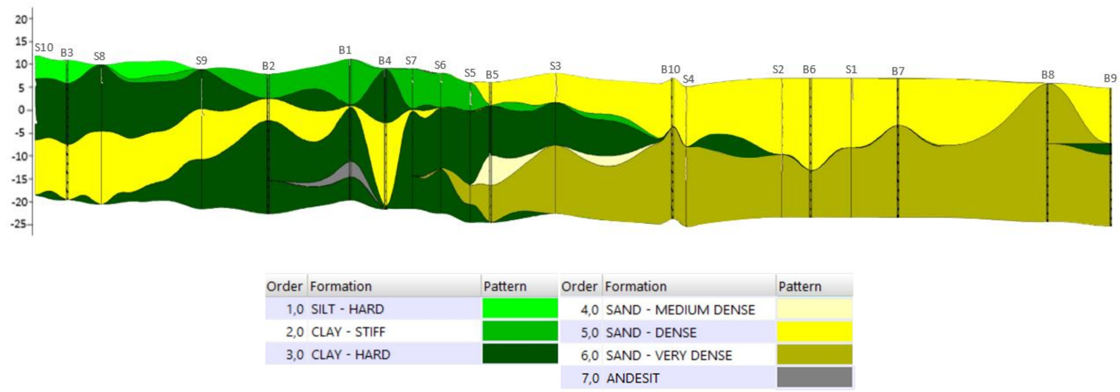

Figure 1. Cross Section of the Soil Profile of the entire Mandalika Circuit

2. Results of Cross-sectional Building Area and Track Lane

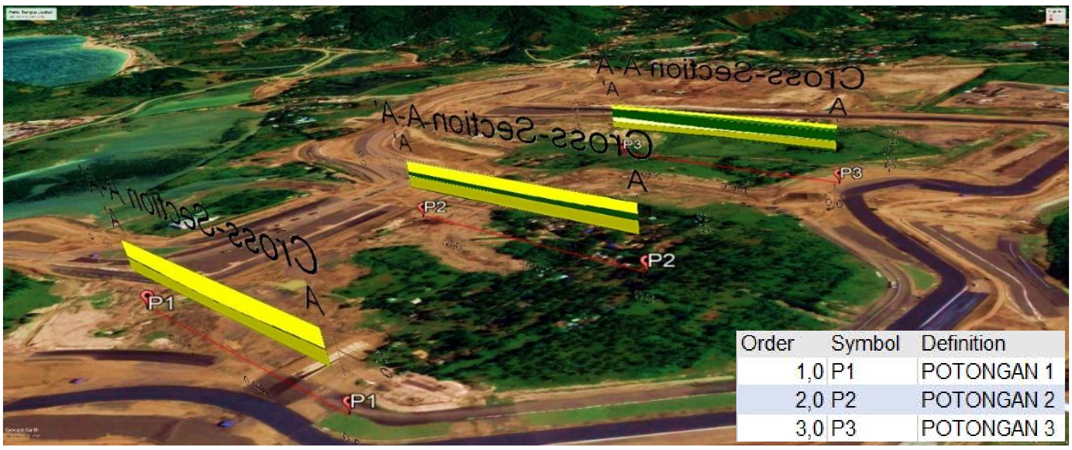

Figure 2. Cross-sectional section of the Mandalika Circuit Building Area

Figure 3. Cross-sectional section of the Mandalika Circuit Track Lane Area

3. Foundation Results Suitable for Use in Building Areas and Track Lanes

This result is a follow-up analysis after obtaining soil stratigraphy data which aims to give consideration to the contractor regarding the construction method used. The selection of this foundation is based on the parameters of the shear angle (Ø), cohesion (c), and soil volume weight (γ) based on the correlation with the N-SPT value in the stratigraphy obtained. In the building area and track lane whose stratigraphy is known, the type of foundation that is suitable for use in the area is then determined. The foundation is divided into two, namely the type of foundation for the building area (P1) and the type of foundation for the track lane area (P2) as shown in the following figure.

Figure 4. Map of Determining the Type of Foundation

In the results of the stratigraphic conditions of the building area and track lane, it was found that these two areas were dominated by a layer of sand or sand type and for the depth of the groundwater table it was far below the drill layer with the following criteria:

Table 4.11 Location of Hard Soil Layers (SPT>50)

Building Area		Track Lane Area	
Piece	Hard Soil Depth (m)	Piece	Hard Soil Depth (m)
1	10 m	1	5 m
2	10 m	2	11 m
3	12 m	3	8 m

Source: Rockworks17

Table 4.12 Typical Values of Soil Volume

Type of soil	sat (kN/m3)	dry (kN/m3)
Gravel	20-22	15-17
Sand	18-20	13-16
Silt	18-20	14-18
Clay	16-22	14-21

Source: Bowles, 1986.

Table 4.13 Relationship between density and relative density, N-SPT, qc and values in sand

Density	Relative Density (γd)	Value of N SPT	Conus Pressure qc (kg/cm2)	Sliding Angle (Ø)
Very Loose (very loose)	< 0.2	< 4	< 20	< 30
Loose	0.2 – 0.4	4 – 10	20 – 40	30 – 35
Medium Dense (rather compact)	0.4 – 0.6	10 – 30	40.0 – 120	35 – 40
Dense (compact)	0.6 – 0.8	30 – 50	120 – 200	40 – 45
Very Dense (very compact)	0.8 – 1.0	> 50	> 200	> 45

Source: GG Mayerhoff

Table 4.14 Physical and Mechanical Properties of Native Soil

Index Properties	Clay	Sand
Specific Gravity, GS	2,727	2,664
Atterberg Limit		
Liquid Limit, LL	49.78%	-
Plastic Limit, PL	28.02%	-
Plasticity Index, IP	21.76%	-
Shear strength		
Sliding angle in	18,880	31,630
Cohesion, c(kPa)	13.14	5.00

Source: Bowles, 1986.

From some of these value indicators, it can be concluded that the type of sand or sand has low shear angle (Ø), soil volume (γ), and low cohesion (c) parameters. The value of this parameter determines the resistance of the soil to deformation due to the stress acting on the soil in this case the lateral movement of the soil. So that the type of foundation that is suitable for use in the building area is the type of deep foundation.

4. DISCUSSION

In this chapter, a discussion of the results of the research in the previous chapter will be described in order to answer the formulation of the problems that have been put forward.

1. Three-dimensional Stratigraphy of Rockworks in the Mandalika Circuit Area

The results of imaging the condition of the Stratigraphy soil profile in the Mandalika circuit area will describe the types of soil layers that are arranged underground. The type of soil layer (stratigraphy) is formed from elements of the SPT value which is correlated with sondir data which is then interpolated and forms a soil layer. In Figure 4.1 it can be concluded that there are 7 types of stratigraphy or soil layers arranged.

The type 1 layer is a Silt-Hard soil layer, this layer is found in the Sondir 10 to Sondir 9 areas in one layer. Silt-Hard soil type is silt soil with an SPT value of more than 30.

Type 2 layer is a layer of Clay-Stiff soil, this layer is found in the Sondir 8 to 10 Borehole area in one layer. Clay-Stiff soil type is clay soil with SPT values in the range of 8-15.

Type 3 layer is a clay-hard soil layer, this layer is found in the area of Sondir 10 to Borehole 9 in three layers. Clay-hard soil type is clay soil with an SPT value of more than 30.

Type 4 layer is a Sand-Medium Dense soil layer, this layer is found in the Sondir 5 to 10 Borehole area in one layer. Sand-Medium Dense soil type is sandy soil with SPT values in the range of 10-30.

Type 5 layer is a Sand-Dense soil layer, this layer is found in the Sondir 10 to Borehole 9 area in two layers. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50.

Type 6 layer is a Sand-Very Dense soil layer, this layer is found in the Sondir 7 to Borehole 9 area in two layers. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50.

Type 7 layer is a layer of Andesite or Rock soil, this layer is found in the area of Borehole 2 to Borehole 4 in one layer and is dominated by a thin thickness at a depth of 15 meters below sea level.

2. Cross Sections of Building Areas and Circuit Track Lanes

The results of the cross-section of the building area and track lane in the Mandalika circuit area will describe in more detail the condition of the soil profile in the area where the building and track lane will be erected. This cross section is generated from a three-dimensional modeling of the overall soil profile which is then drawn three lines from two free points so as to produce a cross section in the particular area under consideration.

a. Cross Section of Building Area

This three-line cross section is located in the building area in the middle of the circuit where in the developer's plan, this area will be developed to build resorts and lodging for visitors who come to the Mandalika Circuit. The area obtained is drawn three parallel lines on the two sides and the middle, the three lines are P1, P2 and P3 according to Photo 4.7. Each point has coordinate data that is in accordance with the conditions in the field to match the position on Google Earth as listed in Table 4.3. The results of the soil profile are presented in each section as follows.

The soil profile obtained in the P1 cut area consists of the first layer, namely Sand-Dense soil with a thickness of 16 m which is found at a depth of 6 msl to -10 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the second layer there is a Sand-Very Dense soil type with a thickness of 14 m which is found at a depth of -10 msl to -24 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50.

The soil profile obtained in the P2 cut area consists of the first layer, namely Sand-Dense soil with a thickness of 11 m which is found at a depth of 6 msl to -5 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the second layer there is Clay-Hard soil type with a thickness of 5 m which is found at a depth of -5 msl to -10 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the third layer there is a Sand-Very Dense soil type with a thickness of 13 m which is found at a depth of -10 msl to -23 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50.

The soil profile obtained in the P3 cut area consists of the first layer, namely Sand-Dense soil with a thickness of 5 m which is found at a depth of 7 msl to 2 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the second layer there is Clay-Stiff soil type with a thickness of 2 m which is found at a depth of 2 msl to 0 msl. Clay-Stiff soil type is clay with SPT values in the range of 8-15. In the third layer there is Clay-Hard soil type with a thickness of 10 m which is found at a depth of 0 msl to -10 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the fourth layer there is a Sand-Medium Dense soil type with a thickness of 2 m which is found at a depth of -10 msl to -12 msl. Sand-Medium Dense soil type is sandy soil with SPT values in the range of 10-30. In the fifth layer there is a Sand-Very Dense soil type with a thickness of 8 m which is found at a depth of -12 msl to -20 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50. In the sixth layer there is a Clay-Hard soil type with a thickness of 2 m which is found at a depth of -20 msl to -22 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. In the sixth layer there is Clay-Hard soil type with a thickness of 2 m which is found at a depth of -20 msl to -22 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. In the sixth layer there is a clay-hard soil type with a thickness of 2 m which is found at a depth of -20 msl to -22 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30.

b. Cross Section of Track Lane Area

This cross-section of three lines is located in the northwest area of the circuit, this area was chosen based on information about the condition of the soil profile of this area which is very little due to the rare occurrence of drill points. The exposure of the soil profile in this area will greatly assist the developer contractor in obtaining soil condition data before starting construction. Similar to the cross-section of the building, the area obtained in this area is drawn three parallel lines on the two sides and the middle, the three lines are P1, P2 and P3 according to Photo 4.10. Each point has coordinate data that corresponds to the conditions in the field to match the position on Google Earth as listed in Table 4.4. The results of the soil profile are presented in each section as follows.

The soil profile obtained in the P1 cut area consists of the first layer, namely Sand-Dense soil with a thickness of 8 m, which is found at a depth of 7 msl to -1 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the second layer there is Clay-Hard soil type with a thickness of 1 m which is found at a depth of -1 msl to -2 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the third layer, namely Sand-Dense soil with a thickness of 1 m, which is found at a depth of -2 msl to -3 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the fourth layer there is Clay-Hard soil type with a thickness of 2 m which is found at a depth of -3 msl to -5 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the fifth layer there is a Sand-Very Dense soil type with a thickness of 12 m which is found at a depth of -5 msl to -22 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50. In the sixth layer there is a Clay-Hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30.

The soil profile obtained in the P2 cut area consists of the first layer, namely Sand-Dense soil with a thickness of 3 m found at a depth of 10 msl to 7 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the second layer there is Clay-Stiff soil type with a thickness of 2 m which is found at a depth of 7 msl to 5 msl. Clay-Stiff soil type is clay soil with SPT values in the range of 8-15. In the third layer there is a clay-hard soil type with a thickness of 3 m which is found at a depth of 5 msl to 2 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the fourth layer there is a Sand-Dense soil type with a thickness of 6 m which is found at a depth of -2 msl to 4 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the fifth layer there is Clay-Hard soil type with a thickness of 2 m which is found at a depth of -3 msl to -5 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the sixth layer there is a Sand-Very Dense soil type with a thickness of 12 m which is found at a depth of -5 msl to -22 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50. In the seventh layer there is a Clay-Hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. Clay-Hard soil type is clay with an SPT value of more than 30. In the sixth layer there is a Sand-Very Dense soil type with a thickness of 12 m which is found at a depth of -5 msl to -22 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50. In the seventh layer there is a Clay-Hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. Clay-Hard soil type is clay with an SPT value of more than 30. In the sixth layer there is a Sand-Very Dense soil type with a thickness of 12 m which is found at a depth of -5 msl to -22 msl. Sand-Very Dense soil type is sandy soil with an SPT value of more than 50. In the seventh layer there is a Clay-Hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. In the seventh layer there is a clay-hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30. In the seventh layer there is a clay-hard soil type with a thickness of 1 m which is found at a depth of -22 msl to -23 msl. Clay-Hard soil type is clay soil with an SPT value of more than 30.

The soil profile obtained in the P3 cut area consists of the first layer of clay-Stiff soil with a thickness of 2 m found at a depth of 9 msl to 7 msl. Clay-Stiff soil type is clay soil with SPT values in the range of 8-15. In the second layer there is Clay-Hard soil type with a thickness of 7 m which is found at a depth of 7 msl to 0 msl. Clay-Hard soil type is clay with an SPT value of more than 30. In the third layer there is a Sand-Dense soil type with a thickness of 8 m which is found at a depth of 0 msl to -8 msl. Sand-Dense soil type is sandy soil with SPT values in the range of 30-50. In the fourth layer there is Clay-Hard soil type with a thickness of 13 m which is found at a depth of -8 msl to -21 msl.

3. Types of Foundations that are Suitable for Use

This result is a follow-up analysis after obtaining soil stratigraphy data which aims to give consideration to the contractor regarding the construction method used. The selection of this foundation is based on the parameters of the shear angle (Ø), cohesion (c), and soil volume weight (γ) based on the correlation with the N-SPT value in the stratigraphy obtained. In the building area and track lane whose stratigraphy is known, the type of foundation that is suitable for use in the area is then determined.

From the stratigraphy results obtained from the two areas, it shows the same stratigraphy results where the dominant soil type is sand or sand and the groundwater level is far below the drill layer. Sand soil is a non-cohesive soil that is not plastic for all values of water content and surface tension is apparent cohesion, meaning that it sticks as long as the sand is wet and will disappear when the sand is completely dry or completely saturated (Bowles, 2007). 1986). From several indicators of shear angle (Ø), cohesion (c), and soil volume weight (γ) sand or sand type has low shear angle (Ø), soil volume (γ), and low cohesion (c) parameters. . The value of this parameter determines the resistance of the soil to deformation due to the stress acting on the soil in this case the lateral movement of the soil. Then in the building area the depth of hard soil with SPT values above 50 is at a depth of -10m, -10m, and -12m, while in the track lane area it is at a depth of -5m, -11m, -8m on each cut.

Due to the low values of the shear angle (Ø), cohesion (c), and volume weight (γ) of sand or sand type and the location of the deep hard soil layer, the planning of the selected type of foundation must be carefully considered. The type of foundation must reach the depth of the hard soil in order to withstand the working stress, namely lateral soil stress to minimize excessive soil deformation. The type of foundation chosen must also be strong enough to distribute the load of the building to be built so that settlement or land subsidence can be controlled. From these various considerations, it refers to the technical guidelines for soil testing, article 4.2. (Ministry of PUPR & Ministry of Public Works, 2021) "If the hard soil is very deep (D>9m) deep foundations or pile foundations (piles and drills) are used".

5. CONCLUSION

From the results of data processing and discussion in this study, several conclusions can be drawn as follows:

1. The 3D image of the Rockworks Stratigraphy in the Mandalika Circuit area is the output of the analysis using Rockworks17 software which includes the state of the soil profile in the entire Mandalika circuit area. From the results obtained, it shows that there are 7 types of soil layers, namely Silt Hard, Clay-Stiff, Clay-Hard, Sand-Medium Dense, Sand-Dense, Sand-Very Dense, Andesite which are scattered and make up the subsurface profile in the Mandalika circuit area. The dominant layer is sand or sand, considering that the Mandalika circuit area is located on the shoreline, the rest can be found in layers of clay or clay and silt or silt.
2. DescriptionThe cross section of the soil profile used in buildings and track lane circuits is a further analysis of the 3D stratigraphy results of the entire area in order to describe in more detail the state of the soil profile in a more specific area using a cross section. The building area shows that there are 5 types of soil, namely Clay-Stiff, Clay-Hard, Sand-Medium Dense, Sand-Dense, and Sand-Very Dense which

are scattered and make up the subsurface profile of the area. The type of soil that dominates the soil profile of the building area is Sand-Dense soil type, namely sandy soil with SPT values in the range of 30-50. The track lane area shows that there are 4 types of soil, namely Clay-Stiff, Clay-Hard, Sand-Dense, and Sand-Very Dense which are scattered and make up the subsurface profile of the area.

3. The type of foundation that is suitable for use in the building area and track lane is the result of further analysis after knowing the type of stratigraphy of the area being reviewed. From the analysis of the type of sandy soil in the area under review, it shows the results of the values of the soil parameters and the location of the hard soil layer which are correlated with the suitability of the type of foundation. The value of this parameter determines the resistance of the soil to deformation due to the stress acting on the soil in this case the lateral movement of the soil. The parameter values are the shear angle (Ø), soil volume weight (γ), and cohesion (c). From several guidelines or reference correlations the value of the shear angle (Ø), cohesion (c), and soil volume weight (γ) of sand or sand type obtained shows low results.

In order to complete and improve the shortcomings in this study, there are several suggestions that can be taken as follows:

1. Further research is needed to combine the results of the Rockworks software output regarding the soil profile, with deformation analysis software or soil stability such as Plaxis to use more in-depth data.
2. It is recommended that if it is still in the early stages of the soil drilling test, to pay attention to the distance between drilled wells in order to get maximum results from interpolation of soil profiles from Rockworks software.
3. It is recommended that in the project under study there are other soil test data such as Direct Shear Test, Triaxial Test, Unconfined Compression Test and so on, they can be included in the Rockworks software output via the legend tab.

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