Modeling The Pabelan Sabodam Tourism Access Road Using Civil 3D

Ahmad Zaki[1*], *Seplika* Yadi[1], *Tri* Wahyono[2], *Kharisma Wira* Nindhita[1], *Arfa Maulana Kusuma* Wijaya[1], and *Ahmad* Yasin[1]

[1] Department of Civil Engineering, Universitas Muhammadiyah Yogyakarta, Brawijaya Street, Geblagan, Tamantirto, Kasihan, 55183 Bantul, Special Region Yogyakarta, Indonesia
[2] Department of Mechanical Engineering, Universitas Muhammadiyah Yogyakarta, Brawijaya Street, Geblagan, Tamantirto, Kasihan, 55183 Bantul, Special Region Yogyakarta, Indonesia

Abstract. The international community views Indonesia as rich in natural tourism, like a tourist village. One of the tourism potentials that can be developed as part of a tourist village is Pabelan Sabodam, located in Magelang Regency, Central Java Province. The Pabelan River in Sabodam has the potential to serve the community as a tourist destination in addition to being a water system infrastructure for agricultural land. However, the current problem is that there is no supporting road access to this weir. Therefore, this research will model the design of the access road to the Pabelan Sabodam to support the acceleration of the tourism development of the Pabelan Sabodam. The modeling process begins with collecting data from Google Earth and processing it through the Global Mapper application. Road modeling is carried out using the Civil 3D application, and then the visualization process approaches the actual conditions using the SketchUp application. The modeling results show horizontal and vertical alignment, road, and cross sections. In addition, the estimated volume of excavation and embankment required from the Civil 3D application is also obtained.

1 Introduction

Indonesia is a large country with various natural landscapes and all-natural potential that the community can utilize. One of these uses is the development of tourism [1]. Tourism development has an excellent impact on protecting and conserving the inheritance of local culture [2]. The international community views Indonesia as a country rich in natural tourism. Natural tourism includes national parks, protected forests, and tourist village areas. Village or rural tourism has many categories, such as farming, outdoor activities, village lifestyle experience, handmade souvenirs, architectural heritage, etc. Rural tourism gives a different atmosphere for urban people to spend their free time in nature. Rural tourism also protects urban people from noise and pollution [3].

Based on the explanation above, Pabelan Village is a village located in Mungkid District, Magelang Regency, Central Java, that has the potential to be developed into a tourist village. Pabelan Village has a variety of natural and man-made landscapes, including sabodam,

[*] Corresponding author: ahmad.zaki@umy.ac.id

community forests, hills, rice fields, and a beautiful rural atmosphere. Based on these conditions, a sabodam area can be utilized as a potential tourist attraction. Thus, it is necessary to increase accessibility to educational tourism objects in the Sabodam area, which is part of sustainable tourism, to support economic development. Sustainable tourism is defined by the triangular interaction between host locations and their environments, people, tourists, and the tourism sector [4]. There are already several Sabodam tourism facilities, but they have not run optimally. The development of additional tourist infrastructure, such as access roads to tourist attractions, has not occurred after the construction of these facilities.

Along with the technological era's development, a lot of software can help road modeling be faster and more accurate. Some software that can be used is AutoCAD Civil 3D, Google Earth, Global Mapper, and SketchUp. AutoCAD Civil 3D allows designers to design a comprehensive road layout through surface editing, road grading, and other functions to achieve complex engineering modeling [5]. AutoCAD Civil also significantly reduces the time needed to evaluate multiple situations and implement design changes. A real-time update system for the entire project helps designers complete projects faster and more accurately [6].

Meanwhile, determining modeling coordinates uses Google Earth and Global Mapper. Google Earth can provide virtual visualizations of the Earth. The advantages of Google Earth not only show the Earth visually but also give data exploration, data collection, validation, data integration, simulation, and ease of use [7]. Conversely, Google Earth has many limitations, such as inconsistent image quality, a limited capability for making quantitative measurements, a lack of analytical functionality, and the inability to support precise global spatial simulations [8]. In addition, Global Mapper is a visualization tool to display elevation raster or vector data. This software could also convert, edit, print, and create GPS tracks to be used as spatial data [9]. Besides that, the function of SketchUp is to help a designer construct, modify, and combine 3D modeling images quickly [10]. This application also makes it easy to give other people a point of view regarding the designs created.

With a variety of today's technological assistance, it is hoped that it can solve the problem of utilizing the weir area and accessibility of roads for Pabelan Sabodam tourism by means of modeling. Therefore, this project will model the design of the access road to the Pabelan Sabodam tourist spot with the help of Google Earth, Global Mapper, AutoCAD 3D, and Google SketchUp software. With the hope that the modeling process can be done quickly and accurately. As a result, it is possible to realize the initial plan without making many changes to the design plan.

2 Methodology

2.1 Modeling flow

The flow of the access road modeling to the Pabelan Weir educational tourism site is modeled using the AutoCAD Civil 3D application. The modeling results will produce a design of road sections, cross sections, road pavements, and the volume of excavation or embankment. Then the results of Civil 3D modeling will be visualized like an actual situation using Google SketchUp. The modeling flowchart is shown in Figure 1 below.

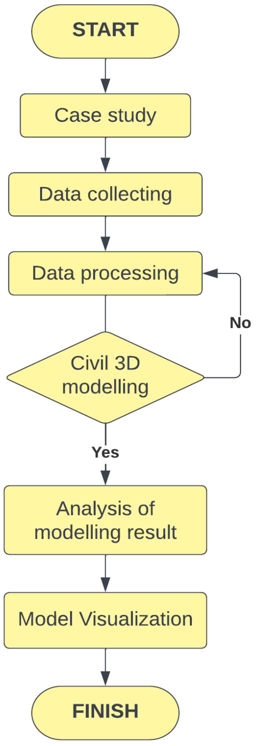

Fig. 1. Modeling flow

2.2 Location Planning

The planning location for the road model for access to the Pabelan Sabodam educational tour is in Pabelan Village, Muntilan District, Magelang Regency, Central Java Province, Indonesia. The length of the road to be made is about 200 meters, with a width of 1.5 meters. The previous condition of the road was a 0.5-meter-wide footpath overgrown with grass. This road will also be difficult to pass when it rains because the existing road is still made of dirt and prone to landslides on several sides. The following figure shows a road modeling location plan (Figure 2) and the existing condition of the access road to the Pabelan Sabodam (Figure 3).

Fig. 2. Location of the access road modeling plan to the Pabelan sabodam tourism

Fig. 3. The existing condition of the access road to the Pabelan sabodam tour

2.3 Modeling Data

Primary data is used to model the access road to the Pabelan Sabodam. The data taken comes from satellite imagery in the form of Google Earth contour data, which is then processed in the Global Mapper application [11]. The Google Earth application is used to determine coordinate points that will be used as a reference for Global Mapper processing [12]. The Google Earth application is used to determine coordinate points that will be used as a reference for Global Mapper processing. Furthermore, the coordinate and image data will be processed into elevation data in the Global Mapper application [13]. Figures 4 and 5 show the process of taking contour and coordinate data.

Fig. 4. Coordinate points and contour areas in Google Earth

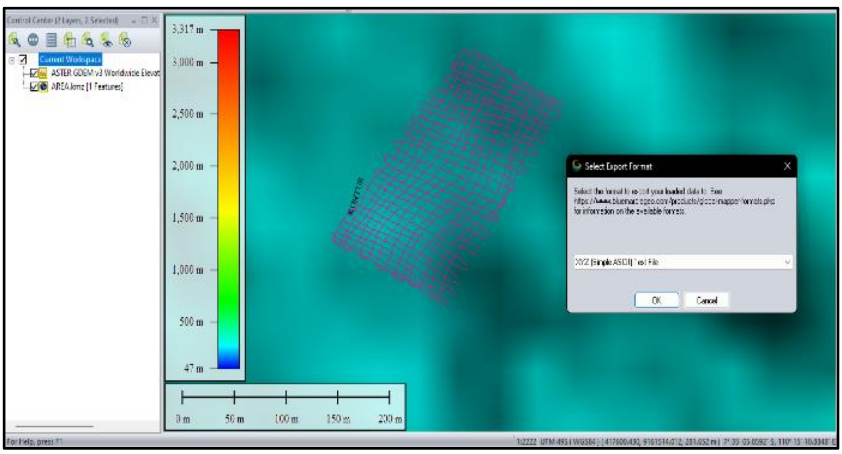

Fig. 5. Export coordinate data on Global Mapper

3 Modeling step

The steps for modeling the Pabelan Sabodam tourist access road using the Civil 3D application are as follows:

3.1 Edit drawing settings

The initial setting of the AutoCAD Civil 3D software is in the Edit Drawing Settings section with a scale of 1:1000, and the Coordinate System settings refer to the WGS 1984 datum. In this section, unit settings will also be used in modeling. Editing drawing settings are shown in Figure 6.

https://doi.org/10.1051/e3sconf/202342505006

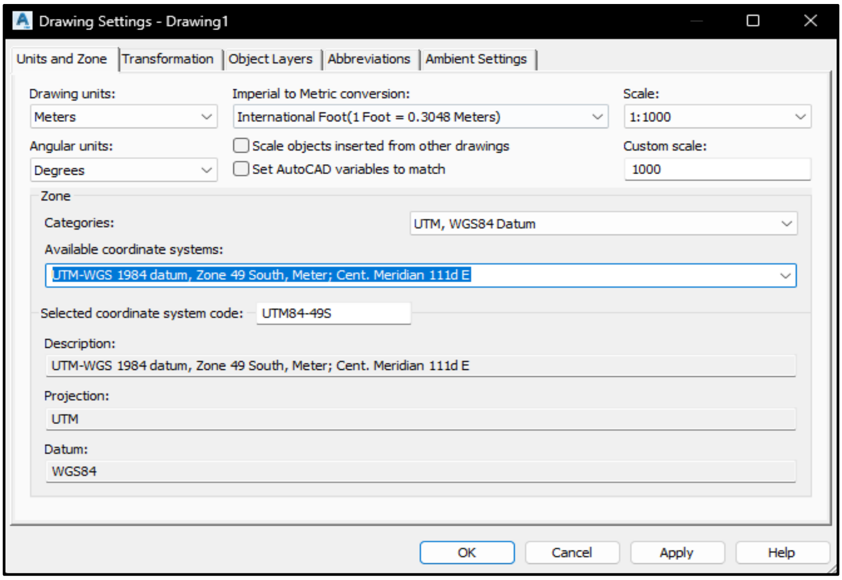

Fig. 6. Edit drawing settings

3.2 Insert point

Inserting Point from the File is done by Import Points as a Txt file from coordinate data. The import point results are shown in Figure 7.

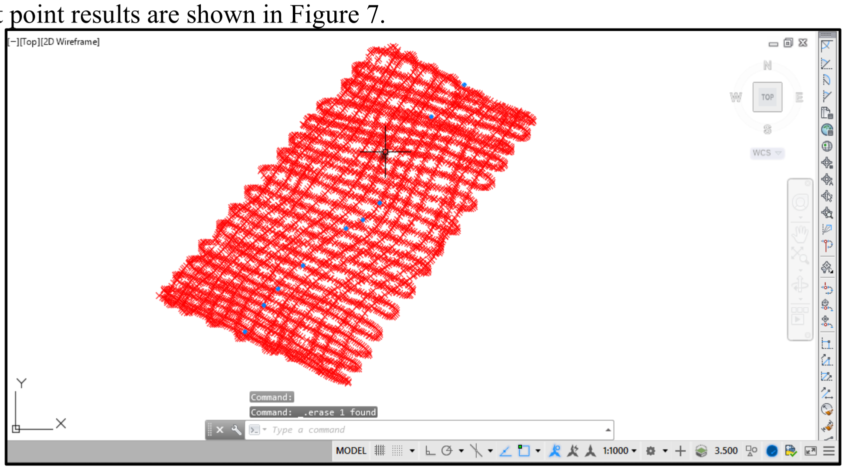

Fig. 7. Import point results

3.3 Surface making

The process of making a surface by entering contour data from Global Mapper Surface Style settings use contour intervals of 0.5 m minor and 2.5 m major. The results of the existing surface are shown in Figure 8.

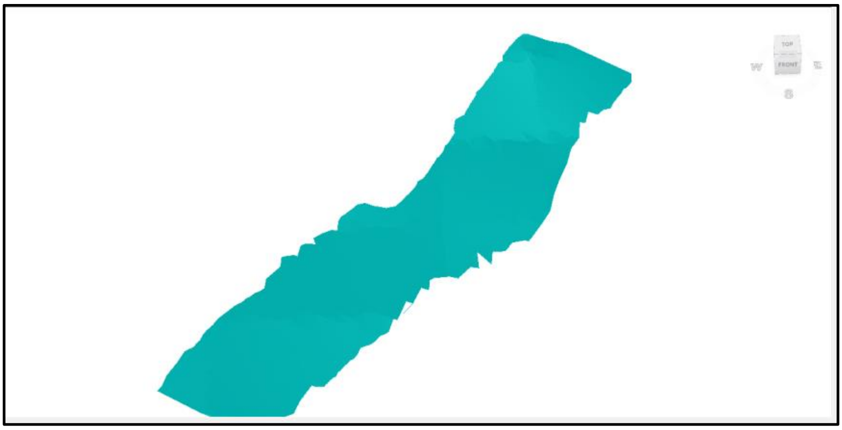

Fig. 8. Existing surface view

3.4 Alignment and profile-making

The horizontal alignment drawing refers to the existing coordinate points, followed by the Polyline tool for drawing. Then enter a design speed value of 20 km/h and a radius for a bend of 60 m. Meanwhile, profile creation is done by setting the appearance and band set you want to use.

Horizontal alignment describes the road in a horizontal plane and describes the road situation, or road alignment [14]. The horizontal alignment consists of 3 straight sections and 2 bends. The results of the horizontal alignment shown in Figures 9 Meanwhile, vertical alignment shows the elevation of the road to be built and can indicate the required volume of excavation and embankment [12]. The results of profile section and vertical alignment are shown in Figures 10 and 11, respectively.

Fig. 9. Horizontal alignment

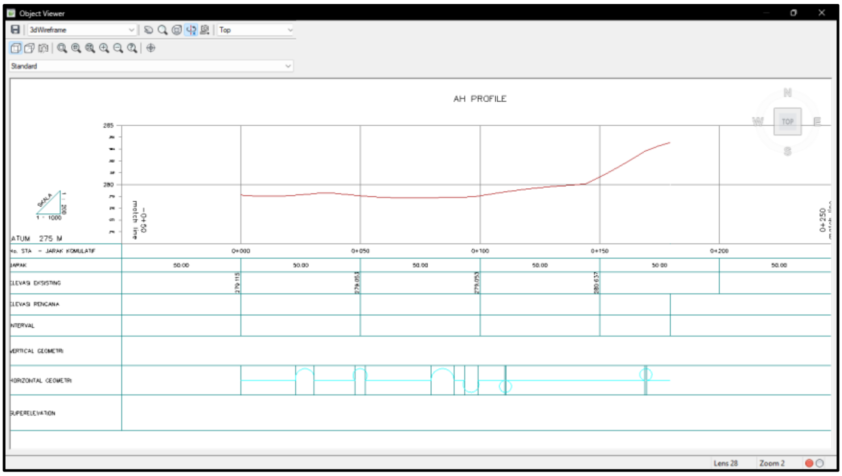

Fig. 10. Long section profile

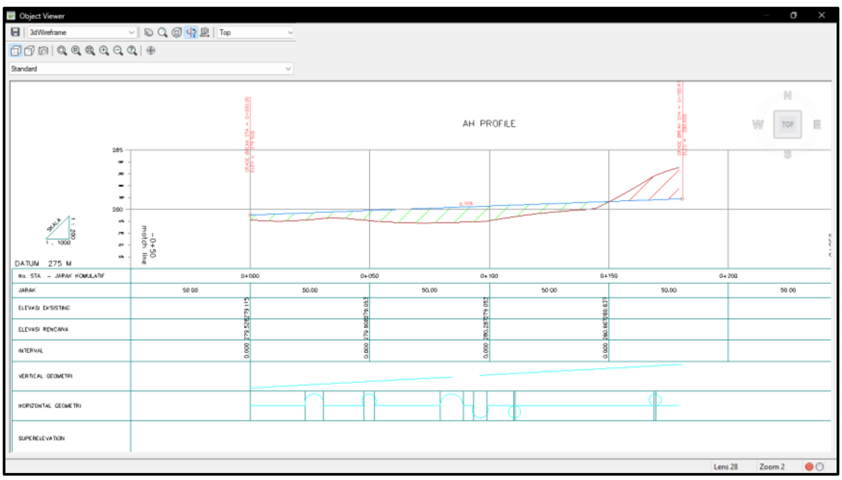

Fig. 11. Vertical alignment

3.5 Road section modeling

Modeling the road section starts with assembling and selecting the road type. Then set the lanes in the Lanes option with a lane width of 1.5 m. As well, there are additions on the left and right sides of the road, with the Basic curb option as wide as 0.225 m. In this section, the thickness and type of material to be used for each layer of the road are also described. The results of the road section modeling are shown in Figure 12.

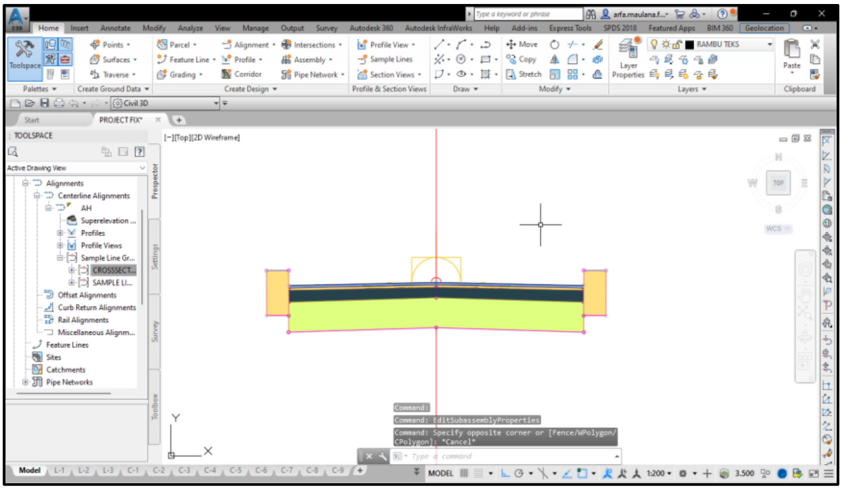

Fig. 12. Road section modeling

3.6 Corridor-making

They were making a corridor or road shape through the Corridor menu by selecting the target alignment, surface, and assembly to be formed. The results of the formation of the corridor are shown in Figure 13.

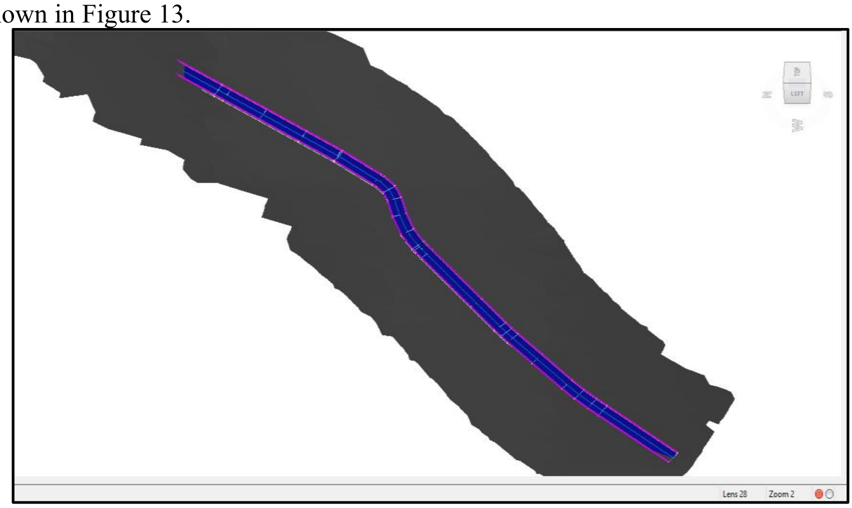

Fig. 13. Corridor shape

3.7 Surface corridor creation

Then make the Corridor Surface to calculate the Cut and Fill volume shown in Figure 14.

 https://doi.org/10.1051/e3sconf/202342505006

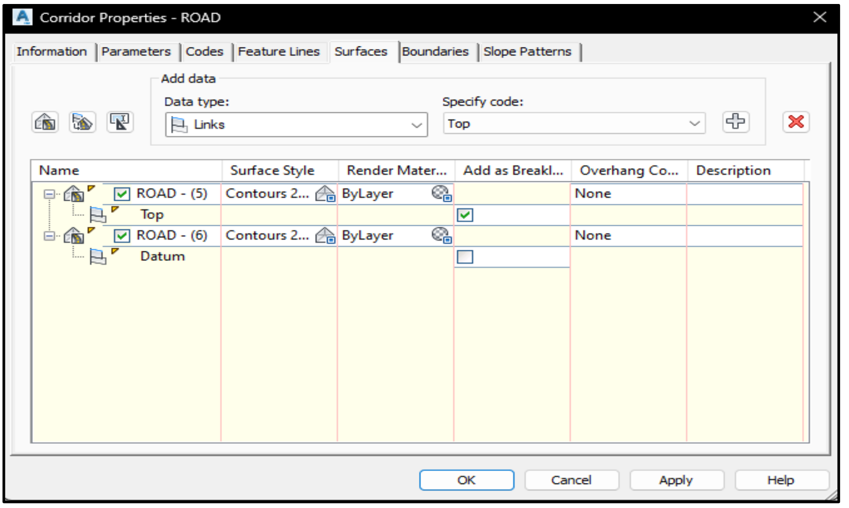

Fig. 14. Surface corridor

3.8 Creation of corridor boundaries

After that, setting the boundaries of the corridor is done to limit the shape of the road or corridor shown in Figure 15.

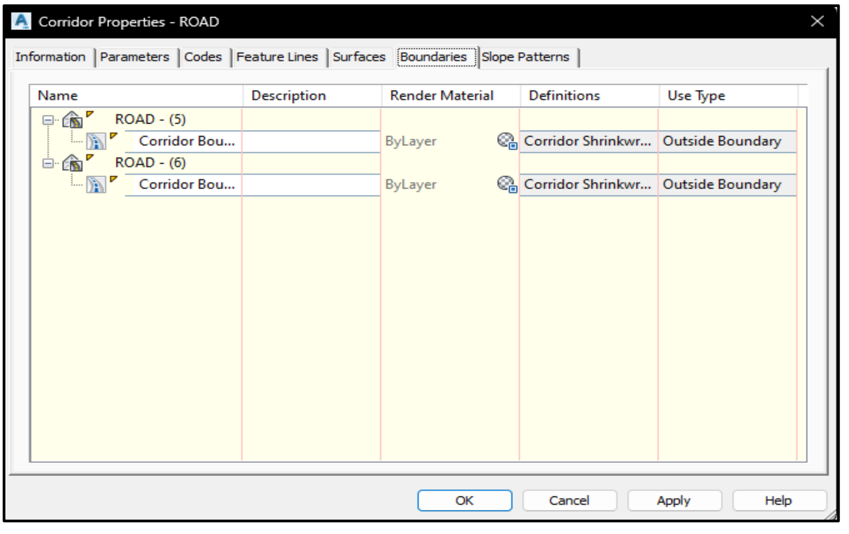

Fig. 15. Boundary corridors

3.9 Cross-section making

Cross sections are made with the Sample Line, setting the distance of the pieces every 20 meters. The results of the cross-section division are shown in Figure 16.

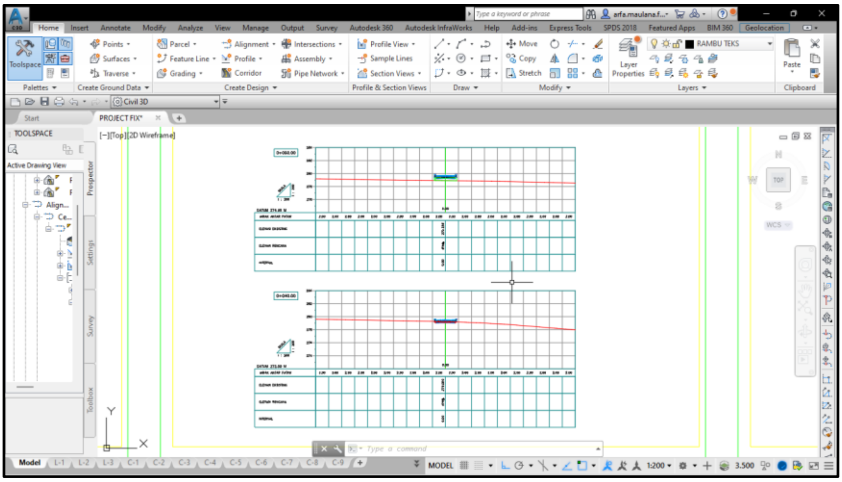

Fig. 16. Cross section

3.10 Cut-and-fill volume estimation

Estimated soil cut and fill volume can be shown via the Analyze menu and the Total Volume Table option shown in Figure 17.

Total Volume Table						
Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
0+000.00	0.00	1.35	0.00	0.00	0.00	0.00
0+020.00	0.00	0.50	0.01	18.55	0.01	18.55
0+040.00	0.00	0.42	0.01	9.23	0.02	27.78
0+060.00	1.37	0.00	13.67	4.19	13.69	31.97
0+080.00	2.19	0.00	35.54	0.00	49.23	31.97
0+100.00	2.54	0.00	47.33	0.00	96.56	31.97
0+120.00	1.47	0.00	40.10	0.00	136.66	31.97
0+140.00	1.12	0.00	25.88	0.00	162.54	31.97
0+160.00	0.00	4.42	11.22	44.18	173.76	76.16
0+179.46	0.00	10.14	0.00	141.72	173.76	217.88

Fig. 17. Cut and Fill Total Volume

4 modeling and Rendering Results

Modeling data from the Civil 3D application is then visualized using the SketchUp application. The results of the SketchUp visualization depict the situation around the access road to the Pabelan Sabodam educational tour. Visualization also describes the desired road modeling plan so that it can better describe the state of the road when it is realized [15]. The SketchUp visualization shown in Figure 18

Meanwhile, the results of the access road rendering are shown in Figure 19. Some road conditions, such as the entrance area, are depicted in Figure 20, the middle area with a water gate is illustrated in Figure 21, and an overview of the end of the road that is directly connected to the main part of the Sabodam tour is shown in Figure 22.

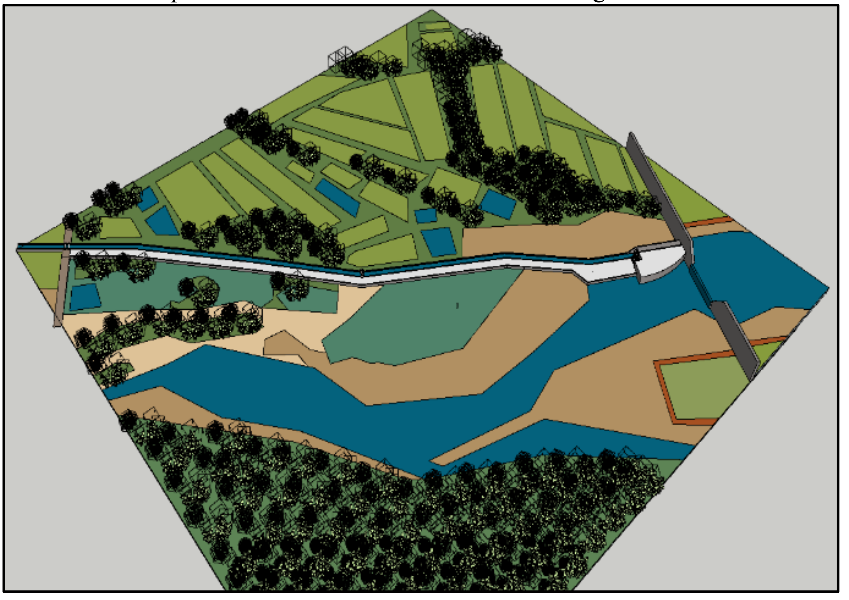

Fig. 18. SketchUp visualization

Fig. 19. Rendering results

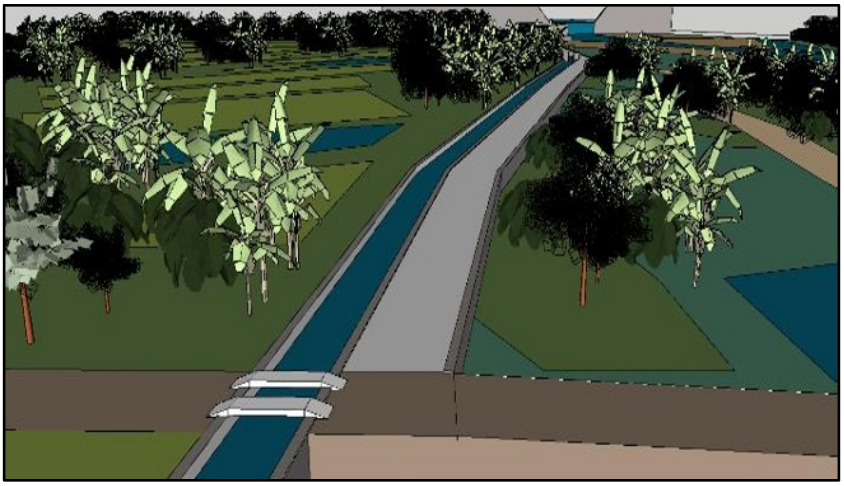

Fig. 20. Visualization of driveway sections

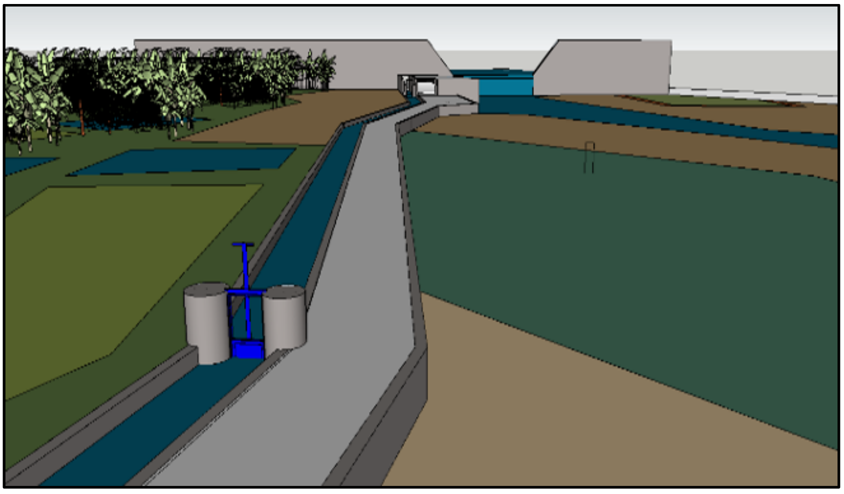

Fig. 21. Visualization of the middle section of the road

Fig. 22. Visualization of road sections of the main tourist spots

5 Conclusion

In modeling the educational tourism access road to the Pabelan Sabodam, it starts with collecting contour and coordinate data from Google Earth. Then the data is processed using Global Mapper so that it can be entered into the Civil 3D application. In the Civil 3D application, modeling of alignment, road sections, and cross sections is carried out. For a more realistic visualization of the final modeling image and the surrounding area, Civil 3D modeling data is processed into visuals in the SketchUp application. From the modeling results, an estimate of the volume of excavated soil and the required embankment will be generated, as will a visualization of the final state after the access road construction process is complete. From this modeling, it can also be a reference and consideration for related stakeholders when wanting to realize the construction of an access road to educational tourism in the Pabelan Sabodam.

References

1. D. Kodaş, et al., *Relationships between Perceptions of Residents Toward Tourism Development, Benefits Derived from Tourism and Support to Tourism.* Journal of Tourismology. (2022)
2. Y. Yu, *The Existing Problems and Suggestions for the Ethnic Village Tourism: A Case Study of Dong Village in Zhaoxing.* Communications in Humanities Research. **4**(1): p. 478-485. (2023)
3. H.K. Alma and M. Halilovic, *The phenomenon of ethno villages in Bosnian rural tourism.* Heritage and Sustainable Development. **4**(2): p. 122-133. (2022)
4. N. Markose, *The Prospects and Challenges of Developing Hydel Tourism Destinations in Kerala: A Scope for Responsible Tourism Practices.* Tourism & Hospitality. **12**(1): p. 1-8. (2023)
5. Z. Liu, et al., *3D Visualization of Railway Development Using GIS and BIM Techniques*, in *Ismr 2020*. 2020.

6. H. Chakole and D.P.J. Wadhai, *A Review on The comparison of geometric design using Civil 3D software and manual method.* International Journal for Modern Trends in Science and Technology. **8**(6): p. 115-122. (2022)
7. H. Chen and Z. Shi, *A Spatial-Temporal Attention-Based Method and a New Dataset for Remote Sensing Image Change Detection.* Remote Sensing. **12**(10). (2020)
8. Q. Zhao, et al., *Progress and Trends in the Application of Google Earth and Google Earth Engine.* Remote Sensing. **13**(18). (2021)
9. Ș.E. Cătălin, *A Scanned Georeferencing Maps Using Global Mapper 15 Software.* Annals of the „Constantin Brancusi" University of Targu Jiu, Engineering Series **4**: p. 61-64. (2018)
10. S.d. Yong, Y. Kusumarini, and P.E.D. Tedjokoesoemo, *Interior design students' perception for AutoCAD, SketchUp and Rhinoceros software usability*, in *IOP Conf. Series: Earth and Environmental Science*.(2020)
11. J.G.d. Santos, K. Bento, and J.L. Txifunga, *Google Earth, Google SketchUp and GIS software; An interoperable work flow for generating elevation data.* Preprint.org. (2019)
12. M. Mandal, P. Pawade, and P. Sandel, *Geometric design of highway using Civil 3D.* International Journal of Advance Research, Ideas and Innovations in Technology. **5**(3): p. 215-217. (2019)
13. H. Jaafar and R. Mourad, *GYMEE: A Global Field-Scale Crop Yield and ET Mapper in Google Earth Engine Based on Landsat, Weather, and Soil Data.* Remote Sensing. **13**(4). (2021)
14. K. You, et al., *Safety-Based Optimization Model for Highway Horizontal Alignment Design.* Mathematical Problems in Engineering. **2022**: p. 1-15. (2022)
15. K. Vugule, A. Mengots, and I. Stokmane, *Road landscape modelling*. p. 163-168.(2018)