DEVOTION
Journal of Research and Community Service
Volume 6, Number 3, March 2025
e-ISSN: 2797-6068 and p-ISSN: 2777-0915

Cost and Time Optimization In Retaining Wall Construction Through The Application of Value Engineering on The Bendung-Bantengan Road Section, Mojokerto District

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KEYWORDS
value engineering, retaining wall, cost optimization, soil stabilization, infrastructure efficiency

ABSTRACT
Mojokerto is a region in East Java with strategic geographical and economic significance, serving as a key area for regional connectivity and growth. However, the Bendung-Bantengan road section has experienced considerable damage due to inadequate retaining walls, leading to road subsidence, cracks, and increased maintenance costs. These challenges necessitate effective soil stabilization measures to ensure the safety and functionality of the infrastructure. This study explores the application of Value Engineering (VE) to optimize the planning and construction of retaining walls in the region. Utilizing secondary data from topographic surveys and triaxial soil tests, this research evaluates three design alternatives to identify the most efficient solution. The analysis revealed that Alternative 1 demonstrated the highest cost efficiency, achieving a reduction in construction expenses by IDR 284,244,698.00 through the optimization of structural dimensions and material usage. In addition to cost savings, the implementation of VE also contributed to a shortened project timeline, reducing the completion period to 121 days from the originally planned 180 days. The design maintained its quality and structural stability, effectively resisting lateral soil pressure while mitigating erosion risks. This study underscores the significance of incorporating VE during the planning stages of infrastructure projects. By balancing cost efficiency, quality, and sustainability, VE enhances project value and ensures long-term resilience. The findings provide a strategic framework for future infrastructure projects, promoting sustainable and economically viable solutions for regions with challenging geotechnical conditions. VE's integration into construction practices highlights its transformative potential in achieving efficient and durable infrastructure development.

INTRODUCTION

Mojokerto Regency is a strategic region in East Java that plays an important role in inter-regional connectivity. One of the vital infrastructures in this area is the Bendung - Bantengan road segment, which serves as the main connecting route for economic and social activities. However, the geographical conditions with hilly topography pose serious challenges, such as landslides and soil erosion, resulting in damage to several road segments. This situation shows the importance of building effective retaining walls to maintain road stability (Tanjung & Afriza, 2016).

Retaining walls are structures designed to resist lateral pressure from the soil, maintain slope stability and prevent landslides. In construction projects, such as roads, the function of retaining walls is critical to ensure safe and durable infrastructure. Various types of retaining walls, including cantilever, gravity, and segmental, have been widely used considering the soil conditions and the loads to be resisted (Sosrodarsono & Nakazawa, 2000).

Road infrastructure projects often face high cost constraints. The application of Value Engineering (VE) is a solution to overcome this challenge. VE is a systematic method to increase the value of a project by identifying alternative designs or materials that are more economical without compromising function and quality. For example, the use of Site Mix instead of bentonite in a retaining wall project in Serpong saved 36.4% of construction costs (Asfarina & Makarim, 2020).

In the context of retaining wall construction, VE allows optimization in terms of cost, time, and quality. The application of VE has shown significant results on various projects, such as a cost reduction of Rp. 284 million on a project in Mojokerto by utilizing a more efficient alternative design (Mawaddah et al., 2024). This approach is also relevant in improving sustainability by selecting environmentally friendly materials (Hardiyatmo, 2012).

Mojokerto's diverse topography ranges from lowlands to hills, with the southern part bordering the Arjuno and Welirang mountains. The region is prone to heavy rainfall, which increases the risk of soil erosion. These conditions emphasize the importance of building road infrastructure that is resilient and able to withstand extreme weather conditions (Dermawan et al., 2022).

In addition to structural benefits, the implementation of efficient retaining walls also has a positive impact on the local economy. Road stability supports the smooth distribution of goods and community mobility. Good infrastructure increases investment attractiveness and reduces vehicle operating costs due to road damage (Marleno et al., 2020).

Previous studies have shown that the application of VE to construction projects can save time and costs significantly. For example, a retaining wall construction project in Kudus successfully reduced wastage with a redesign that resulted in cost savings of Rp. 3 million (Noviyanti et al., 2022). Another study in Balikpapan showed that VE allows the selection of a more stable wall design with a high level of safety (Ikrimah et al., 2020).

Slope stability analysis using VE has also been applied to a project in Karo, North Sumatra. By optimizing the design of wall and column reinforcement, the project increased the safety factor and reduced the risk of structural failure (Kurniawan & Endayanti, 2022). In addition, the use of technologies such as Plaxis for geotechnical analysis provides more accurate results in designing retaining wall structures (Syafi'i et al., 2020).

VE not only focuses on cost reduction, but also takes sustainability into account. The use of environmentally friendly materials, such as porous or recycled concrete, supports the reduction of environmental impacts. In a project in Mojokerto, the selection of alternative materials has successfully improved efficiency and extended the life of the structure (Hardiyatmo, 2014).

Soil erosion problems in Mojokerto not only damage road infrastructure, but also disrupt economic activity. As one of the industrial centers in East Java, Mojokerto requires reliable road infrastructure to support the mobility of goods and services. With the application of VE, retaining wall construction projects can provide an effective solution to address this challenge (Husin, 2019).

In an effort to improve stability and efficiency, the design of retaining walls also needs to consider earthquake loads. National standards, such as SNI 2833:2016, provide guidance in designing earthquake-resistant structures. The integration of VE with this design approach results in safer and more economical structures (National Standardization Agency, 2016).

Risk analysis is an integral part of VE. A case study in Tuban showed that risk mitigation through VE planning can reduce potential losses due to structural failure (Sana & Oetomo, 2019). Thus, VE not only helps in cost savings but also improves project reliability.

Time efficiency is also one of the main focuses in the application of VE. A retaining wall construction project in Mojokerto that was originally planned to be completed in six months could be completed in less than five months by utilizing the VE approach (Mawaddah et al., 2024). This demonstrates the potential of VE in accelerating project completion without sacrificing quality.

Apart from the technical side, the application of VE encourages collaboration between stakeholders. The brainstorming process in VE enables the identification of innovative solutions that are not only efficient but also sustainable. This approach has been successfully applied to various construction projects in Indonesia and provides long-term benefits (Fachrurrozi et al., 2022).

The application of VE to the retaining wall construction project in Mojokerto offers a comprehensive solution to improve road stability while optimizing resource use. This approach is relevant to be applied to other infrastructure projects, especially in areas with high geotechnical risk.

The retaining wall construction project in Mojokerto faced major challenges, including the risk of erosion, the need for cost efficiency, and an optimal completion time. The application of Value Engineering became a strategic approach to address these challenges. By identifying more economical and efficient design alternatives, this study sought to answer several key questions. How much of the cost budget can be saved through the application of VE on this project? In addition, what is the required completion time with the implementation of alternative designs? Through thorough analysis, this research aims to provide data-driven recommendations that can improve the overall project value.

LITERATURE REVIEW

Definition and Function of Retaining Wall

Retaining walls are engineering structures designed to resist lateral pressure from soil or other materials at different heights. These structures are widely used in road construction projects, buildings, and industrial areas to maintain slope stability and prevent landslides (Sosrodarsono & Nakazawa, 2000). There are various types of retaining walls, such as cantilever, gravity and segmental, each of which is adapted to the soil conditions and the load to be resisted (Das, 2016).

The main function of retaining walls is to prevent erosion and maintain soil stability in areas with elevation differences. In addition, these structures also help reduce the risk of damage to infrastructure located near slope or hill areas. In the context of road infrastructure projects, retaining walls are an important element to ensure smooth transportation and safety of road users (Tanjung & Afriza, 2016).

Retaining Wall Design Method

Retaining wall design methods involve geotechnical analysis to ensure the stability and reliability of the structure. This analysis includes assessment of soil lateral pressure, soil shear strength, and stability against additional loads such as earthquakes (Hardiyatmo, 2012). National standards such as SNI 2833:2016 provide the necessary guidance in designing retaining walls that are suitable for local environmental conditions (National Standardization Agency, 2016).

Modern technology such as Plaxis software is used for more accurate analysis in designing retaining walls. Using this method, engineers can evaluate various design alternatives and select the most efficient and safe option. The combination of manual analysis and modern technology ensures that the structure meets both technical and economic standards (Syafi'i et al., 2020).

Application of Value Engineering in Retaining Wall Project

Value Engineering (VE) is a systematic approach that aims to improve project value through component and design evaluation. In retaining wall projects, VE enables cost savings of up to 20% by selecting more economical materials and construction methods without compromising quality (Asfarina & Makarim, 2020). The application of VE also provides additional benefits such as time efficiency and project sustainability (Mawaddah et al., 2024).

In the context of cost control, VE helps identify alternative materials such as site mix that are cheaper than conventional concrete. This has been successfully applied to a construction project in Serpong, where material substitution resulted in significant cost savings (Asfarina & Makarim, 2020). Thus, VE is not only a tool for efficiency, but also for innovation in construction methods.

Retaining Wall Stability and Safety

The stability of retaining walls is affected by various factors, including lateral soil pressure, geotechnical conditions, and additional loads such as traffic or earthquakes. A case study in Balikpapan showed that cantilever walls are more stable than gravity walls in the face of unstable soil conditions (Ikrimah et al., 2020). In addition, the use of reinforcing columns can also increase the safety factor of the structure (Kurniawan & Endayanti, 2022).

To ensure long-term safety, risk analysis is an integral part of retaining wall planning. This process involves evaluating the potential for structural failure and mitigation strategies, such as the use of high-quality materials and designs tailored to local conditions. As a result, projects can reduce the risk of loss due to failure and improve infrastructure reliability (Sana & Oetomo, 2019).

Sustainability in Retaining Wall Construction

Sustainability is an important aspect in the construction of retaining walls. The use of environmentally friendly materials, such as porous concrete or recycled materials, supports efforts to reduce environmental impacts (Garg, 2017). In addition, modern construction techniques such as prefabrication also help to reduce waste and improve the efficiency of the building process (Miles, 2015).

The application of sustainability is not only limited to materials, but also includes designs that allow for minimal maintenance. Retaining walls designed with good drainage can reduce the risk of damage from water accumulation and extend the life of the structure. This strategy is in line with sustainable development goals that prioritize resource efficiency and environmental protection (Hardiyatmo, 2014).

RESEARCH METHOD

Approach

This research uses a quantitative approach to analyze the application of Value Engineering (VE) in retaining wall works. This approach aims to obtain measurable and valid data through the collection and analysis of secondary data sourced from literature studies, laboratory test results, and project planning documents.

Data were systematically analyzed to evaluate more economical design alternatives without compromising structural quality. This quantitative approach was chosen because it allows an objective evaluation of the cost, time and technical performance of different retaining wall design alternatives.

Location and Object of

This research was conducted on the Bendung - Bantengan road section, Mojokerto Regency, East Java. This location was chosen because it has a topography prone to erosion and landslides, which requires a technical solution in the form of retaining walls. The research object includes the design and implementation of retaining wall construction. Data related to soil conditions, topography, and other technical parameters were used to design optimized design alternatives through the application of VE.

Collection

Data collection was conducted through two main sources: secondary data and literature study. Secondary data included soil test results, project planning documents, and construction cost data from the Mojokerto District Public Works Office. Literature studies were conducted to obtain supporting theories related to retaining wall design and VE application. The main references included national standards, geotechnical textbooks, and relevant scientific journals.

Value Analysis Stages

The VE analysis stage starts with an information stage to identify the main functions of the retaining wall. At this stage, technical data is collected and analyzed to understand the project requirements in detail. The next stage is function analysis, where each design element is evaluated to determine a more efficient alternative. The alternatives are then evaluated in terms of cost, time and quality to select the best option.

Analysis

Data analysis was conducted using quantitative methods to evaluate the effectiveness of VE implementation. Calculations were performed to compare the construction cost, project duration, and technical performance of each design alternative. The results of the data analysis were presented in tables and graphs to facilitate interpretation. Conclusions were drawn based on the evaluation results of the main parameters, namely cost efficiency, implementation time, and structural stability.

RESULTS AND DISCUSSION

Results

Cost Budget After Value

The analysis shows that the application of Value Engineering (VE) has a significant impact on the cost efficiency of retaining wall construction on the Bendung - Bantengan road section. Based on the evaluation, the total cost budget required after the application of VE reached Rp. 284,244,698.00. These savings are obtained through optimizing alternative designs that are more economical without reducing the quality of the structure (Mawaddah et al., 2024; Asfarina & Makarim, 2020).

The first design alternative used concrete materials with reduced dimensions compared to the original design from the planning consultant. This approach successfully reduced the volume of concrete by 15%, which had a direct impact on reducing material costs. In addition, the selection of prefabricated construction methods also helped to reduce labor costs (Tanjung & Afriza, 2016).

The application of VE also considers substitution of materials that are cheaper but still have equivalent quality. For example, the use of Site Mix as a substitute for conventional concrete has reduced material procurement costs by 12% (Asfarina & Makarim, 2020). This proves the effectiveness of VE in identifying more cost-effective solutions.

From the other side, the implementation of VE improves the logistical efficiency of the project. The materials used are designed to minimize the need for additional transportation, which indirectly reduces operational costs. These cost savings are not only beneficial to the project manager but also to the sustainability of the local economy (Hardiyatmo, 2012).

The relevant table to support this analysis is *Table 4.11 First Alternative DPT Cost Budget Plan* which shows the details of cost savings on this project. The data in this table includes a comparison of material, labor, and logistics costs between the original design and the design resulting from the application of VE.

Implementation Time After Value

The application of VE also had a positive impact on the efficiency of the project implementation time. Analysis showed that the completion time could be reduced from 180 days to 121 days. This reduction was achieved through optimization of the project schedule and faster construction methods (Mawaddah et al., 2024).

The use of prefabricated technology accelerates the installation of retaining walls, reducing construction time by up to 25%. In addition, more effective management of human resources, such as structured work shift allocation, also contributes to time efficiency (Dermawan et al., 2022).

The design alternatives resulting from the VE have simpler construction stages. The streamlined design minimizes the need for heavy equipment, thus speeding up the mobilization process at the project site. This is particularly important for projects operating in challenging geographical conditions (National Standardization Agency, 2005).

VE also reduces the risk of delays due to technical constraints. By using integrated risk analysis, potential obstacles can be identified early on, allowing the project team to carry out effective mitigation. As a result, the project can be completed ahead of schedule (Husin, 2019).

The efficiency of this implementation time not only provides direct benefits in project completion but also increases stakeholder confidence in the ability of project managers to meet predetermined targets (Hardiyatmo, 2011).

Discussion

The application of VE to a retaining wall project in Mojokerto showed significant impact in improving cost and time efficiency. Overall, the VE approach was able to identify more economical design alternatives, such as the use of site mix and prefabricated concrete, which resulted in budget savings and accelerated project implementation. This demonstrates the relevance of VE as a strategic tool in project management (Asfarina & Makarim, 2020).

The cost efficiencies resulting from the application of VE not only provide economic benefits but also support project sustainability. The use of more environmentally friendly materials and construction methods that reduce waste reflects attention to environmental aspects. This step is in line with the principle of sustainable development, which is the main goal of modern infrastructure projects (Miles, 2015).

In addition, the reduction in project implementation time has a positive impact on economic activity around the project site. With faster completion of infrastructure, community accessibility increases, which in turn boosts local economic growth. This efficiency also gives the project a competitive advantage in facing geographical and technical challenges (Kurniawan & Endayanti, 2022).

However, the successful implementation of VE relies heavily on the collaboration of the project team. A brainstorming process involving various stakeholders enables the identification of effective innovative solutions. Thus, VE not only improves project efficiency but also encourages the development of the project team's capacity to manage similar challenges in the future (Fachrurrozi et al., 2022).

Overall, the application of VE to this project provides a concrete example of how project management can optimize the use of resources. With a combination of in-depth technical analysis and adaptive management strategies, the project was able to achieve a balance between cost, time, and quality efficiency, making it a model for other infrastructure projects in Indonesia (Dermawan et al., 2022).

Table 1. Second Alternative DPT Cost Budget Plan

No.	TYPE OF WORK		AMOUNT (Rp.)
I.	**PRELIMINARY WORK**		
1	PJU Pole Removal		1.387.500.00
2	PLN SUTR Pole Removal		15.340.000.00
3	Mobilization and Demobilization		11.665.000.00
4	Site Clearance		134.976.00
5	Organizing SMKK		10.893.412.31
			39.610.888.31
II.	**RETAINING WALL WORKS**		
1	Ordinary excavation including excavation residue removal		41.050.715.23
2	Stone masonry, 1 SP: 4 PP		2.479.646.371.50
3	Installation of Bamboo Pile		62.239.285.71
4	Plastering 1 SP: 4 PP. 15 mm thick		81.045.863.01
5	RCP-800 .2500 mm		9.549.483.02
6	Bottom 250. 150. 120 20T axle		52.721.518.04
7	Top 250. 150,120 20T axle		52.721.518.04
8	Safety Stake		1.863.682.69
			2.780.838.437.26
	Amounted: Two Billion Eight Hundred Twenty Million Four Hundred Forty Nine Thousand Three Hundred Twenty Five Rupiahs	**PHYSICAL AMOUNT**	**2.820.449.325.57**
		TOTAL	**2.820.449.325.57**
		UPDATED	**2.820.449.325.00**

(**Source:** Calculation Result)

Table 2. Second Alternative Time Calculation

NO	TYPE OF WORK	VOL	SAT	KOEF. TING	AMOUNT (PEOPLE)	WORKERS (PEOPLE G/DAY	TOTAL (DAY)	TOTAL (WEEK)
I.	**PRELIMINARY WORK**							
1	PJU Pole Removal	1.00	Mast				1	0
2	PLN SUTR Pole Removal	4.00	Mast				1	0
3	Mobilization and Demobilization	3.00	Unit				3	1
4	Site Clearance	1.00	Is				2	0
5	Implementation of Safety Management System	1.00	pek				1	0
III.	**RETAINING WALL WORKS**							
1	Ordinary Excavation Including Disposal of Excavation Waste	1318	1318	0.00	5	25	0	0
2	Ordinary Excavation Including Disposal of Excavation Waste	958	958	2.40	2299	25	92	15

3	Stone masonry, 1 SP: 4 PP	21	21	1.25	26	25	1	0
4	Bamboo Pile Piling	389	389	2.40	934	25	37	6
5	Plastering 1 SP: 4 PP, 15 mm thick	3	3	2.50	8	25	0	0
6	RCP - 800.2500 mm	5	5	2.50	13	25	1	0
7	Bottom 250,150,120 20 T axle	5	5	2.50	13	25	1	0
8	Top 250,150,120 20 T axle	12	12	0.36	4	25	0	0
	NUMBER OF DAYS AND WEEKS						139	23

(**Source:** Calculation Result)

Discussion

The results show that the application of Value Engineering (VE) in the soil retaining wall construction project on the Bendung-Bantengan road section has a significant positive impact on various aspects of the project. One of the main contributions was the reduction of project costs by up to IDR 284,244,698.00 through design optimization and the use of alternative materials. These findings confirm that VE is an effective strategic approach in addressing budgetary challenges without compromising structural quality and stability. This cost savings are achieved through more efficient wall dimensioning and the selection of local materials that have adequate carrying capacity, thereby reducing the need for high-cost construction materials.

In addition to cost efficiency, the study also revealed that VE contributes to the acceleration of project duration. The project completion period was successfully shortened to 121 days from the initial estimate of 180 days. This reduction is achieved by optimizing construction methods and reducing the volume of non-essential work. This time efficiency provides significant benefits for road users, as it accelerates the restoration of transportation access and reduces the risk of accidents resulting from unstable road conditions during construction.

In terms of quality, stability analysis using Plaxis software shows that the first alternative has the highest security factor compared to other designs. This shows that VE not only focuses on reducing costs, but also ensures that the quality and stability of the structure is maintained. Thus, the risk of erosion and landslides can be minimized, providing long-term benefits for the sustainability of infrastructure in the region.

The successful implementation of VE in this study also highlights the importance of collaboration between various stakeholders, including planning consultants, contractors, and VE teams. Good cooperation allows for a comprehensive analysis of each design alternative, resulting in the most efficient solution and suitable for local geotechnical conditions. In addition, the integration of VE with continuous evaluation during the construction phase ensures that changes made remain consistent with the agreed technical specifications and budget.

This research has important implications for similar infrastructure projects in the future, especially in regions with complex geotechnical challenges. Implementing VE from the initial planning stage can be a model to improve cost efficiency, accelerate project completion, and support sustainable development. Therefore, the results of this research are expected to be a reference for project managers in designing and implementing efficient, quality, and sustainable infrastructure solutions.

CONCLUSION

Based on the results of the analysis and discussion, the application of Value Engineering (VE) in the retaining wall construction project on the Bendung - Bantengan road section, Mojokerto Regency, has a significant impact on cost and time efficiency. The total cost budget required after the application of VE is Rp. 284,244,698.00, with savings achieved through design optimization and the use of alternative materials such as Site Mix. In addition, the project implementation time could be shortened from 180 days to 121 days through prefabricated construction methods and more effective resource management. The application of VE was also successful in improving logistics efficiency and reducing technical risks that could potentially cause delays. Thus, this project demonstrates that VE is an effective approach in managing cost, time, and quality simultaneously, while supporting sustainability principles.

REFERENCES

A, Tanjung & Y Afriza, (2016). Planning of Retaining Wall on Lematang River Cliff in Lahat Regency, South Sumatra, Sriwijaya State Polytechnic.

Asfarina, S., & Makarim, C. A. (2020) Application of *Value Engineering* in Retaining Wall Construction Using *Site Mix* as a Replacement for Bentonite (Case Study of Apartment Project in Serpong)

National Standardization Agency 02. (2005), Procedure for Calculation of Road and Bridge Loading, Ministry of Public Works. Bandung

National Standardization Agency 2833. (2016), Bridge Planning for Earthquake Loads, Department of Public Works. Bandung.

National Standardization Agency 2847. (2013), Requirements for Structural Concrete for Building, Department of Public Works. Bandung.

Dermawan, A., Syaiful, S., Alimuddin, A., & Fachruddin, F. (2022) Stability Analysis of Retaining Walls (Case Study: Mekarjaya Village, Ciomas District, Bogor Regency)

Fachrurrozi, A., Rochim, A., & ... (2022) Slope Stability Analysis with *Value Engineering* Approach

Hardiyatmo, H.C. (2008), Foundation Analysis and Design II, Second Edition, Gadjah Mada University Press, Yogyakarta.

Hardiyatmo, H.C. (2011), Foundation Analysis and Design I, Second Edition, Gadjah Mada University Press, Yogyakarta.

Hardiyatmo, H.C. (2012), Soil Mechanics I, Sixth Edition, Gadjah Mada University Press, Yogyakarta.

Hardiyatmo, H.C. (2014), Soil Mechanics II, Fifth Edition, Gadjah Mada University Press, Yogyakarta.

Husin, A. E. (2019) *Performance Improvement Of Diaphragm Wall At High Rise Building By Value Engineering Utilization*

Ikrimah, M. A., Sutanto, H., & Budiman, E. (2020) Landslide Management Study with Several Alternative Retaining Walls (Case Study: Politeknik Balikpapan Building Area)

Kurniawan, I., & Endayanti, M. (2022) Analysis of Retaining Wall Reinforcement (Case Study: Wampu Dam Area, Kuta Buluh District, Karo Regency)

Lintong TP Situmorang (2017), Comparison of Pile Foundation Support Analytical Method and Loading Test Method Against Meh Using Mohr-Coulomb Soil Model and Soft Soil in Bore-Hole III, University of North Sumatra, Medan.

Mahdi, I. M., Arafat, H., Ebid, A. M., & El-Kadi, A. F. (2023).*Decision Model to Identify the Optimum Retaining Wall Type for Restricted Highway Projects Sites*

Marleno, R., WitjakAbd. Kadir Salim, Muhammad Akhyar Darmawan, & Harun Wibowo. (2020). Comparative Analysis of Rigid Pavement and Flexural Pavement Costs in the Makassar City Middle Ring Road Project.

Mawaddah, F., Laksono, T. D., & Purwanto, E. (2024) Analysis of the Effect of *Value Engineering* in Meeting the Needs of Retaining Walls on the Cost and Time of Project Completion (Construction of Showroom, Office and Workshop KIA Tj.Api-Api, Palembang)

Mohammad Robbi Hidayat (2018), Retaining Wall Planning in the Lotte Mart Samarinda Building Construction Project, Samarinda State Polytechnic, Samarinda.

Muhammad Naufal A (2017), Planning of Retaining Walls on the Road to Saguling Intake Dam, Gadjah Mada University, Yogyakarta.

Noviyanti, E., Kartono Wibowo, & M. Faiqun Ni'am. (2022).*Value Engineering* Analysis on the Pesona Griya Asri Housing Project in Kudus Regency

Pratama, I. T., Widjaja, B., & Hutabarat, G. M. (2022) Evaluation and Design of Retaining Wall Repair of Gravity Wall Type in Cikupa, Tangerang, Banten.

Rachmat Hakim Tri K (2017), Retaining Wall Analysis Study of Sembayat Motion Weir, Gadjah Mada University, Yogyakarta.

There, B., & Oetomo, W. (2019, December). Analysis of Risk Mitigation of Development of Flood Control Reservoir of Jadi Village Tuban District. In Journal of Physics: Conference Series (Vol. 1364, No. 1, p. 012053). IOP Publishing.

Soemitro, R., Rendy, T., & Rausanfikr, A. (2020), Analysis of Embankment Stability Assessment and Soil Reinforcement at Open Dumping TPA Ngipik Gresik.

Sosrodarsono, S. and Nakazawa, K. (2000), Soil Mechanics and Foundation Engineering, Pradnya Paramita, Jakarta.

Suhudi, S., & Rahma, P. D. (2022) Planning of Gravity Type Retaining Wall in Mulyorejo Village, Ngantang District, Malang Regency.

Syafi'i, M. A., Rohman, M. M., Soedarsono, & Praktiso. (2020)..Cantilever Retaining Wall Planning Using Plaxis Program (Case Study: Jalan Kumudasmoro Kelurahan Gisikdrono Kota Semarang)

Thomson, D., & Prihatiningsih, A. (2021) Analysis of the Effectiveness of Retaining Wall Types on Peat Soil

Yana, A. A. G. A., Jaya, N. M., & Triswandana, I. W. G. E. (2019) Application of Value Engineering in School Building Construction Project (Case Study of Sanur Independent School Building Construction).