



# Value Engineering for Cost-Efficient Retaining Wall Construction to Support Sustainable Tourism in the Parisudha Ubud

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**Abstract.** A Retaining Wall (DPT) is a structural element designed to hold back soil and maintain land stability, particularly in hilly or landslide-prone areas. In Ubud, Bali, a region renowned for its cultural tourism and natural landscapes, retaining walls play a crucial role in ensuring land stability and infrastructure safety. The Parisudha Ubud, a guesthouse currently undergoing expansion, requires the construction of a DPT due to its sloping terrain and risk of soil displacement. However, the construction of DPTs often involves high costs, which can hinder project efficiency and timely completion. This study applies the Value Engineering (VE) approach as a method to optimize construction costs without compromising the structural integrity and function of the DPT. The research methodology includes field observations, technical data analysis, and cost simulations. Three alternatives were compared to the initial design: (1) Reinforced Concrete DPT, (2) Geotextile + Stone Gabions, and (3) Wire Gabion and Stones. The analysis results indicate that Alternative 3 is the most cost-efficient option, yielding savings of IDR 80,549,600. This alternative not only reduces costs but also aligns with sustainable tourism principles by using eco-friendly materials and minimizing construction waste. Therefore, the application of VE in this project offers tangible benefits in reducing costs while ensuring a more sustainable approach to infrastructure development for tourism.

**Keywords:** Cost-Effective, Retaining Wall, Sustainable Tourism, Value Engineering

## 1 Introduction

Construction projects are inherently complex, involving a range of technical and non-technical aspects that necessitate thorough planning and coordination. The three main aspects in construction planning are cost, quality, and time, which must be managed optimally to ensure that a project meets its targets. Effective project management and decision-making are crucial for managing resources, including labor, materials, implementation methods, equipment, and budgets. One approach that can be used to

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optimize cost and time efficiency without compromising quality is Value Engineering (VE) (Asfarina & Makarim, 2019).

The Parisudha Ubud is a tourist retreat currently undergoing expansion in the Tegalalang area of Ubud, Bali. Given the region's hilly terrain and susceptibility to landslides, the construction of a retaining wall (*Dinding Penahan Tanah*, DPT) is crucial to maintaining land stability and ensuring the safety of the infrastructure. However, the construction of retaining walls often presents challenges in terms of high costs and extended project timelines, particularly when traditional methods are used. This makes the application of Value Engineering (VE) in the planning and construction of the retaining wall a suitable solution to optimize resource utilization, reduce costs, and shorten the construction period (Mawaddah, 2024).

Value Engineering is a systematic approach aimed at identifying alternative designs, materials, and methods that are more cost-efficient while maintaining or even enhancing the core functions and quality of a construction element (Chaudhari, 2018). VE aims to eliminate unnecessary costs without compromising the project's structural integrity. In the case of The Parisudha Ubud, applying VE in the construction of retaining walls could involve the use of sustainable materials, such as precast concrete, gabions, or modular systems, alongside more efficient construction methods that reduce waste and minimize environmental impact.

In addition to improving cost and time efficiency, the application of VE aligns with the principles of sustainable tourism. Sustainable tourism emphasizes environmentally friendly infrastructure development that minimizes ecological impacts. By optimizing the use of materials and construction methods that are more sustainable, the project not only improves the safety and durability of the structures but also supports environmental conservation efforts—an essential feature for the tourism appeal of Ubud (Utami & Kurnia, 2022). The emphasis on eco-friendly and cost-efficient solutions demonstrates the potential of VE to contribute to the growth of sustainable tourism infrastructure in Bali.

Thus, this research aims to analyze the application of Value Engineering in the construction of retaining walls at The Parisudha Ubud, focusing on cost and time efficiency, as well as its alignment with sustainable tourism principles. The findings are expected to provide optimized, cost-effective, and environmentally friendly technical recommendations that can be applied to future similar projects, further contributing to the development of sustainable tourism infrastructure in the region.

## 2 Methodology

This research adopts a mixed-method approach that integrates field observation, documentation, interviews, secondary data collection, and technical analysis to systematically evaluate the application of Value Engineering (VE) in the construction of retaining walls (DPT) at The Parisudha Ubud. Each stage of the methodology is designed to complement the others, ensuring a comprehensive and reliable analysis. Field observation was conducted on-site to investigate construction practices, material application, and geotechnical conditions. This step provided first-hand data on land

stability, slope characteristics, and soil behavior, which are critical parameters in designing a retaining wall. Observations also included monitoring work sequence and identifying potential sources of inefficiency in the field. Documentation review supported the observations by collecting project-related records, including design drawings, project schedules, budget reports, and photographic evidence. This documentation provided a reference framework to validate field findings and trace any deviations between planned and actual construction activities.

Interviews were carried out with key stakeholders, including contractors, project managers, and geotechnical experts. These discussions aimed to capture professional perspectives on cost and time management, explore the feasibility of alternative materials and construction methods, and validate assumptions made during the analysis. Insights from interviews were also used to identify practical constraints and opportunities for implementing VE in the local context. Secondary data collection involved reviewing relevant literature, case studies, and industry standards. This provided a comparative basis to benchmark the proposed alternatives against established practices, while also identifying innovations from similar projects. Additional references were obtained from contractor databases and online technical resources to strengthen the relevance and applicability of the findings.

Finally, technical analysis was conducted using geotechnical engineering software and cost–time simulations. Several design alternatives were modeled to assess structural stability, durability, and efficiency. Each alternative was evaluated not only in terms of its technical feasibility but also in terms of its potential to reduce construction costs and duration. The integration of quantitative analysis with qualitative inputs from fieldwork and interviews enabled the formulation of optimized recommendations that balance cost-effectiveness, structural safety, and sustainability.

### **3 Result and Discussion**

#### **3.1 Result**

The expansion project of The Parisudha Ubud, which will be studied, covers a total land area of 1,329 m<sup>2</sup>, with the building expansion covering an area of 250 m<sup>2</sup>. This expansion is intended for public facilities, such as restaurants, public pools, and spas. Due to the hilly terrain, retaining walls (DPT) are necessary to ensure the stability of the land and infrastructure safety. However, the construction of DPT often faces challenges, particularly in terms of high costs and lengthy construction timelines, especially when using conventional methods. Therefore, the application of Value Engineering (VE) in the planning and construction of DPT is a suitable solution to optimize resource utilization, enhance budget efficiency, and expedite project completion. To conduct the analysis, the researcher uses the Five Phase Job Plan, which consists of the following stages: Information Phase, Analysis Phase, Creative Phase, Development Phase, and Recommendation Phase (Rani, 2022).

The project, located in the Ubud area, has a land characteristic that is quite hilly, which certainly presents challenges in structural planning and the selection of appropriate construction methods. Before proceeding to the functional analysis stage, it is crucial to understand the field conditions in detail, especially regarding the layout drawings and the Detailed Technical Calculations (DPT) used (Kurniawan & Hadimuljono, 2020). At this stage, this research will focus on the planned DPT, which has the potential for cost savings through more in-depth analysis.

The research findings indicate that this project utilizes a river rock retaining wall, equipped with reinforced concrete, as the primary soil retention structure. It can be seen that the initial DPT design is quite inefficient, which could still be optimized. The specifications of the existing DPT indicate that the river rock wall has a height of 2.4 meters, with a width of 0.5 meters. Above the river rock wall, there is reinforced concrete with a height of 3 meters and a width of 0.2 meters, while below the reinforced concrete, there is an additional dimension with a height of 0.2 meters and a width of 1 meter. Therefore, the next step is to explore alternative DPT designs that remain structurally strong but are more cost-effective and environmentally friendly, or sustainable.

In the creative phase of Value Engineering (VE), the next step is to generate alternative designs that are more efficient and potentially better than the existing design (Bendhari & Agustina, 2021). These alternative designs will be compared with the design provided by the contractor to determine which option is more optimal in terms of cost, functionality, and sustainability. In this case, the existing design is sourced from the contractor, while the alternative designs may involve environmentally friendly structures, cost-effective options, or more efficient execution methods.

Alternative I for the Retaining Wall (DPT) is the use of reinforced concrete (RC Wall). The dimensions of this DPT are adjusted according to field requirements and tested using engineering software to analyze stability against overturning, sliding, eccentricity, and soil bearing capacity. The analysis results show that the reinforced concrete retaining wall meets all safety criteria, including an overturning stability safety factor of 3.02 (greater than the 2.00 criterion), sliding stability with a safety factor of 2.68 (greater than 2.00), eccentricity of 0.08 meters (meeting the criterion limits), and soil bearing capacity with a safety factor of 5.88 (higher than the 3.00 criterion). Overall, this reinforced concrete retaining wall is safe and feasible for implementation.

Alternative II for the Retaining Wall (DPT) uses Geotextile Reinforced Earth and Wire Mesh Gabion with Stones. The dimensions of this DPT are adjusted according to field requirements and tested using engineering software to analyze stability against overturning, sliding, eccentricity, and soil bearing capacity. The analysis results show that this DPT meets all safety criteria, with overturning stability (SF 2.51) and sliding stability (SF 2.34) both meeting the  $\geq 2.00$  criterion, eccentricity of 0.1 m (still safe), and soil bearing capacity with a safety factor of 6.42 (higher than the minimum 3.00 criterion). While slightly lower in some parameters compared to Alternative I (Reinforced Concrete), Alternative II still meets safe and stable criteria.

Alternative III for the Retaining Wall (DPT) utilizes Wire Mesh Gabion with Stones. The dimensions of this DPT are adjusted according to field requirements and tested using engineering software to analyze stability against overturning, sliding,

eccentricity, and soil bearing capacity. The calculation results show that this DPT meets all safety criteria, with overturning stability (SF 2.17) and sliding stability (SF 2.06) both meeting the  $\geq 2.00$  criterion, eccentricity of 0.12 m (still safe), and soil bearing capacity with a safety factor of 4.75 (higher than the minimum criterion of 3.00). Although the calculation results are slightly lower compared to Alternatives I and II, all parameters are still within the safe range as per the set criteria.

### 3.2 Discussion

The evaluation phase is conducted to determine the best choice from the options generated in the creative phase (Thomson & Prihatiningsih, 2021). In this research, the evaluation focuses on comparing the cost and implementation time of the first, second, and third options.

Alternative, we utilize a Retaining Wall (DPT) with a Reinforced Concrete (RC) wall. The Cost Estimation Plan (RAB) is detailed, listing the costs for each type of work based on the unit prices specified in the project contract. The total cost for implementing DPT Alternative I is Rp 189,027,027. Alternative II, which uses DPT with Geotextile Reinforced Earth combined with Wire Mesh and Stone, has a total Budget Estimate (RAB) of IDR 124,747,166. This cost calculation encompasses various work items with unit prices based on the project contract, yielding a total cost for each type of work involved in the construction. Meanwhile, Alternative III, which uses DPT with Wire Mesh and Stone, shows a RAB of IDR 113,484,666. This budget is also calculated based on unit prices and work volume as per the agreed contract. Both alternatives show a difference in costs, which can be an important factor in selecting a more efficient and cost-effective method (Hansen, 2017).

Then, the next step is the development phase, which involves comparing the alternative conditions based on the analysis from the previous stages. Below is the comparison table for each alternative condition.

**Table 1.** Recap of Value Engineering Development Stages

Type of retaining wall (DPT)	Security level	Cost (Rp)	Cost fiffence (from Initial DPT) (Rp.)
Initial DPT (Stone + Reinforced Concrete)	Safe	194,034,266	-
Alternative I (Reinforced Concrete)	Safe	124,747,166	-69,287,100
Alternative II (Geotextile + Stone Gabion)	Safe	139,641,349	-54,392,917
Initial DPT (Stone + Reinforced Concrete)	Safe	113,484,666	-80,549,600

The comparison between the initial DPT design and three alternative designs focuses on safety, cost, and cost differences. The initial DPT and Alternative 1 (Reinforced Concrete) offer high safety levels due to the use of strong materials, such as reinforced concrete and river stones. Alternative 2 (Geotextile + Stone Gabion) and Alternative 3

(Wire Mesh Gabion with Stones) have moderate safety levels but remain safe for most site conditions. In terms of cost, Alternatives 1 and 2 offer significant savings compared to the initial DPT. At the same time, Alternative 3 provides the largest savings, being Rp 80,549,600 cheaper than the initial DPT, making it a highly cost-effective choice without compromising many technical aspects.

Based on the analysis, Alternative 3 (Wire Mesh Gabion with Stones) is the best choice for this project due to its cost efficiency. With lower costs compared to the initial DPT and Alternatives 1 and 2, Alternative 3 offers significant savings and a more efficient construction process. While its safety level is slightly lower, it is still sufficiently safe for most soil conditions and is more environmentally friendly, as it uses fewer materials and helps reduce the carbon footprint compared to reinforced concrete (Dermawan et al., 2022). Therefore, Alternative 3 is the optimal choice if the project prioritizes cost savings and sustainability.

Overall, applying value engineering in selecting an environmentally friendly DPT alternative will not only offer cost-efficiency benefits but also support sustainable tourism in Ubud. By using more eco-friendly materials, reducing construction impacts, and enhancing the appeal of the location for environmentally conscious tourists, this tourism cottage project will directly contribute to the development of green tourism, which is increasingly popular worldwide (Mensah, 2019).

## 4 Conclusion

The Parisudha Ubud expansion project required retaining walls (DPT) for land stability. Using Value Engineering (VE) to optimize resources, reduce costs, and improve efficiency, three DPT alternatives were evaluated. Alternative 3 (Wire Mesh Gabion with Stones) proved to be the most cost-effective choice, offering significant savings without compromising safety. Though slightly lower in safety compared to other options, it remains within acceptable limits for most conditions. Additionally, it is more environmentally friendly, as it uses fewer materials and reduces its carbon footprint. In conclusion, Alternative 3 is the optimal solution for the project, as it balances cost, safety, and sustainability. It also supports the development of sustainable tourism in Ubud, contributing to the growing demand for eco-friendly practices in the industry.

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