JICE Journal Innovation of Civil Engineering

Vol. 6, No. 1, pp. 97-113
Submit: 6-06-2025 |
Accepted: 25-10-2025 |
Publish: 30-11-2025 |

Stability Analysis of Henes-Motamasin Slope STA 105+250 Using Geosynthetics and Gabions with Plaxis

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ABSTRACT
The slope at STA 105+250 on the Henes–Motamasin road is susceptible to instability due to geological conditions and external loads, necessitating slope reinforcement. This study aims to evaluate the stability of this slope using numerical analysis with Plaxis 2D and analytical calculations based on the Fellenius method, one of the earliest techniques in slope stability analysis. This method calculates the factor of safety (FK) of the slope, assuming failure along a circular slip surface. The Fellenius method will be used to compare the two types of reinforcement analyzed: geosynthetics and gabions. The factor of safety (SF) before reinforcement is 1.403 (Plaxis) and 1.406 (Fellenius), indicating a critical stability condition. After reinforcement, the SF increases to 2.291 with geosynthetics and 2.083 with gabions. The difference in SF values between methods is caused by parameter variations, such as the inclusion of the soil elastic modulus and Poisson's ratio in the Plaxis model. The results show that both reinforcement methods effectively improve slope safety against sliding, overturning, support failure, and seismic loads. This study highlights the importance of considering not only safety factors but also cost and construction efficiency in slope stabilization planning.

Keywords: *Slope stability; Geotextile; Gabion; Plaxis 2D; Safety Factor.*

1. Introduction

Slope failures remain a major geotechnical issue in tropical [1], high-rainfall regions, especially in areas with steep terrain and weak soil formations. The Henes–Motamasin road at STA 105+250, located near the Indonesia–Timor Leste border, exhibits these exact characteristics, making it highly prone to instability. Excess pore-water pressures during rainy seasons, combined with weathered soil layers, significantly increase the likelihood of shallow and deep landslides. Similar conditions have been widely documented in tropical countries, where intense rainfall is the dominant trigger for slope failures [2][3]. A landslide that occurred in 2021 along this road segment, resulting in a 25.5-meter-long failure on an 8-meter-high slope, demonstrates the urgency of implementing appropriate stabilization measures to protect infrastructure and ensure road safety [4].

Retaining structures and engineered reinforcements are essential in improving slope stability, particularly in areas with limited natural resistance to shear failure [5]. Various stabilization methods—such as cast-in-place retaining walls, geosynthetic reinforcements, and gabion systems—have been widely studied for their ability to increase slope safety factors by improving shear resistance and controlling surface deformation [6]. Geosynthetics, for example, provide tensile strength and soil confinement, effectively enhancing stability in weak ground conditions [7]. Meanwhile, gabions offer flexibility, permeability, and construction efficiency, making them suitable for mountainous and riverine areas with dynamic hydrological conditions [8]. The selection of an appropriate reinforcement method depends on several factors, including soil type, water conditions, construction constraints, and economic considerations [9].

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Advanced numerical modeling has become an indispensable tool for evaluating slope stability and the performance of reinforcement systems. Software such as Plaxis 2D enables simulation of soil–structure interaction through finite-element analysis, incorporating parameters that cannot be captured in simplified analytical approaches [1]. Nonetheless, classical methods such as the Fellenius (Swedish Circle) method remain relevant for validation and comparative assessment due to their simplicity and clarity in determining circular slip surfaces [10]. This study contributes to current geotechnical knowledge by comparing the effectiveness of geosynthetic and gabion reinforcements using both numerical modeling and traditional limit-equilibrium analysis under high-moisture soil conditions in a border region that has rarely been examined in previous research.

2. Material and Method

2.1 Slope Stability Analysis Methods

2.1.1 Fellenius

The Fellenius Method (Ordinary Method of Slice), first introduced by Fellenius, assumes that the forces acting on the right and left sides of any slice have zero resultant in the direction perpendicular to the landslide plane [10].

Fellenius proposed his method by assuming that collapse occurs through the rotation of a block of soil on a circular landslide surface, with point O as the center of rotation [11]. This method also assumes that the normal force P acts at the center of the slice. It is also thought that the resultant forces between slices on each slice are equal to zero, or it can also be stated that the resultant forces between slices are negligible. So, the total assumptions made by this method are:

- The position of the normal force P is located at the center of the base of the wedge: n
- The resultant force between the wedges is equal to zero: n - 1 Total: 2n - 1

An illustration of the modeling of the fellenius method can be seen in the following figure:
With these assumptions, the moment balance equation for all wedges with respect to the center of rotation can be tested and a Safety Factor value obtained [12]. With this assumption, the balance of the vertical direction and the forces acting is:

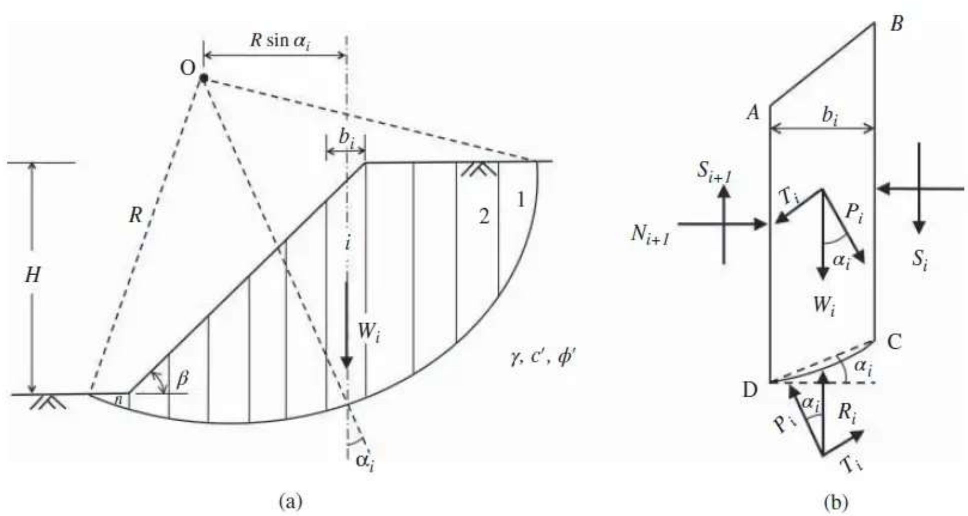

Figure 1. Fellenius's Slices Method

Where:
Ni + Ui = Wi cos θi Or,
Ni = Wi cos θi - Ui
= Wi cos θi – ui.ai (2.13)
The safety factor is defined as,
SF = ΣMr/ΣMd

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The moment arm of the weight of the soil mass of each slice is R sin θ, hence:

$$\sum \text{Md} = R\Sigma_{n=1}^{i=n} Wi \sin\theta i$$

With:

R = radius of the landslide plane circle
n = number of slices
Wi = weight of soil mass of ke-1 slice
Ni = resultant of the effective normal force acting along the base of the wedge
θi = angle defined

In the same way, the moment that restrains the soil from landslide is:

$$\sum \text{Mr} = \Sigma_{n=1}^{i=n}(\text{cai} + \text{Ni tg } \emptyset)$$

Then the equation for the factor of safety becomes,

$$\text{SF}= \frac{\Sigma_{n=1}^{i=n}(\text{cai}+ \quad \text{tg } \emptyset)}{\Sigma_{n=1}^{i=n} Wi \sin\theta i}$$

When water is present on the slope, the pore water pressure in the landslide plane does not increase the moment due to the landslide (Md), because the resultant force due to pore water pressure passes through the center of the circle.

$$\text{SF}= \frac{\Sigma_{n=1}^{i=n}\text{ca} \quad (\text{Wi}\cos\theta i - uia\ ) \text{ tg } \emptyset}{\Sigma_{n=1}^{i=n} Wi \sin\theta i}$$

with:

SF = safety factor
C = soil cohesion (kN/m^2)
∅ = angle of friction in soil
ai = length of curved circle at the ke-1 wedge (m)
Wi = weight of Ith soil slice (kN)
ui = pore water pressure at the ke-1 wedge (kN/m^2)
θi = angle defined

If there are forces other than the soil's weight, such as buildings on the slope, the moment due to these loads is calculated as Md.

2.1.2 Plaxis

Plaxis is a geotechnical analysis program chosen because it can analyze soil stability using the finite element method, which can approach actual behavior. Plaxis provides various analyses of soil displacements, soil stresses, slope safety factors, and more.

The field conditions simulated with the Plaxis program are intended to be applied from program work through to the implementation stage in the field. So that the program's results make it easier to process data, which is expected to save time, and that the results are in accordance with manual calculations [13].

Slope stability analysis using PLAXIS 8.2

From the existing data, processed by entering the slope data into the program for processing, it will be known whether the slope needs to be reinforced [14]. This program can also be used to control the safety factor (SF) against the slope with reinforcement using geotextiles or gabions. In operating the PLAXIS 8.2 program [15], the following steps are required:

1. Open the Plaxis 8.2 program, then enter the dimension data and title of the program to be created
2. Draw the cross-section of the slope to be analyzed, then click Standard Fixities.

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3. Create the type of material properties that will be used on the slope, and fill in the slope data such as ɣd, ɣb, φ, and so on. Then apply the prepared material to each soil layer.
4. Create a geotextile profile according to the required specifications by clicking the geometry button, then selecting the geogrid option.
5. Then change the mesh generating setup according to the mesh, and then generate.
6. Create the groundwater table layer in the cross-section using the initial conditions.
7. Then, calculate and fill in each phase that will be analyzed.
8. Then create the displacement curve, and then calculate.
9. After the calculation process is complete, the following output is obtained.

2.2 Reinforcement Materials

2.2.1 Geotextiles

Geotextiles are widely used for reinforcement of subgrade soil in pavement structures and slopes. Geotextiles have also been frequently used for stabilization of road embankments located on soft soil foundations. A significant beneficial effect of the various uses of geotextiles for embankment reinforcement is that, primarily functioning as separators, geotextiles also function as reinforcement or reinforcements that increase the bearing capacity of the subgrade by the composite strength of the soil with the geotextile [16].

Table 1. Data Properties

Soil Classification	Depth (m)	N-SPT (blow/feet)	γ_sat (kN/m³)	γ_dry (kN/m³)	k_x, k_y (cm/s)	E (kN/m²)	ν	c' (kN/m²)	ϕ' (°)
Soft black clay	1–2.45	19	25	23	10^{-4}	18,17	0.30	12.667	20
Brown and white clay soil	2.45–4.45	60	25	23	10^{-4}	33,51	0.20	40	21
Green claystone and stiff green clay	4.45–6.45	57	24	22	10^{-4}	32,5	0.25	38	21
Hard claystone and claystone	6.45–8.45	60	24	22	10^{-4}	35,9	0.35	43.33	35
Green claystone	8.45–10.0	65	24	22	10^{-4}	35,8	0.35	43.33	35

Table 1 explain that the soil profile at the Henes–Motamasin slope consists of five layers with progressively increasing strength and stiffness, ranging from soft black clay in the upper 2.45 m (N-SPT 19; E = 18,170 kN/m²) to hard claystone and green claystone at depths of 6.45–10.0 m, which exhibit high shear strength (c′ = 43.33 kN/m²; φ′ = 35°) and stiffness (E ≈ 35,800–35,900 kN/m²). Intermediate layers of brown–white clay and green claystone show moderate to high strength with N-SPT values of 57–60. All layers have low permeability (10^{-4} cm/s) and unit weights of 24–25 kN/m³ (saturated), indicating fine-grained soils with poor drainage. These geotechnical parameters are essential for evaluating slope stability and modeling reinforcement performance.

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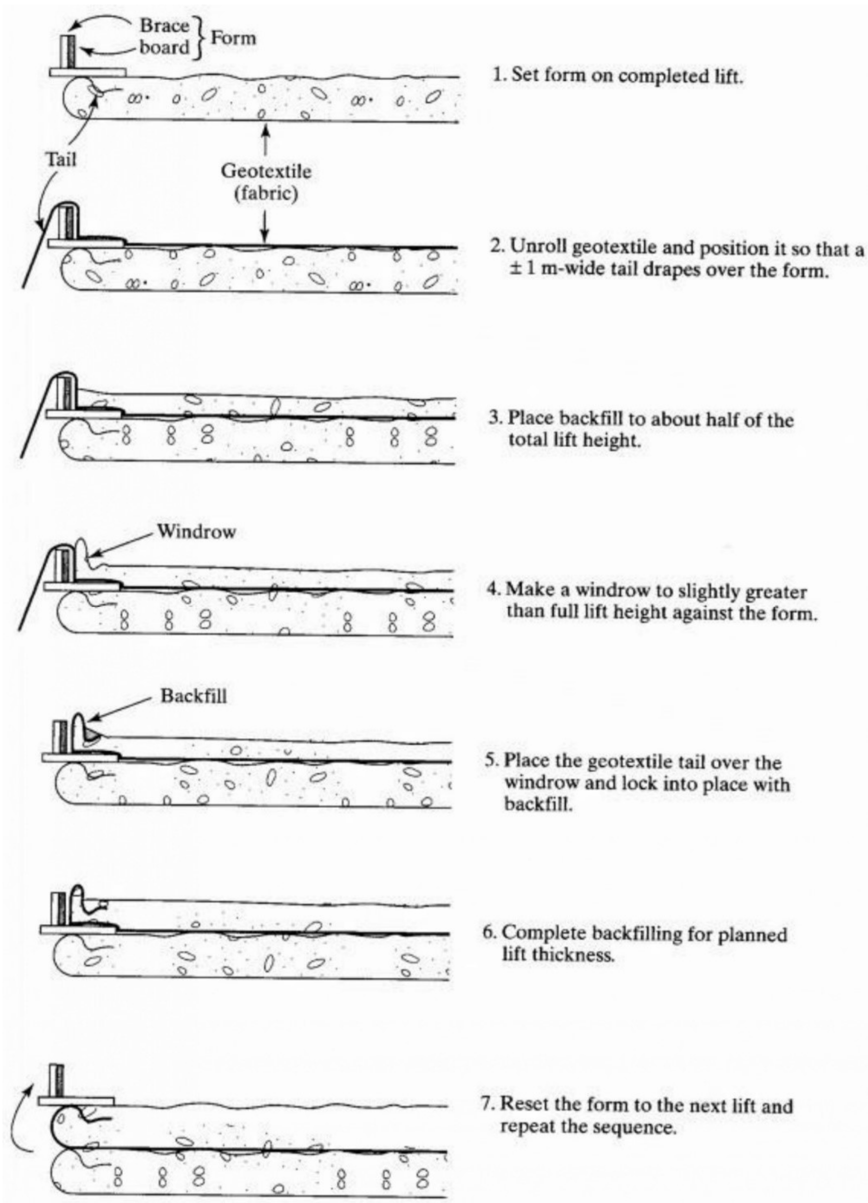

Figure 2. Sequence of geotextile retaining wall construction

Geotextiles include woven and non-woven. Interlacing yarns produces woven fabric through a weaving process, while non-woven is made by several methods, such as heat bonding (with heat), needle punching (with needles), and chemical bonding (with chemicals). Both woven and non-woven materials are primarily produced from polymer yarns and fibers, including polypropylene, polyester, polyethylene, and polyamide.

2.2.2 Gabions

Gabions are woven steel wire structures that are neither galvanized nor coated, shaped into box- or block-like forms and filled with large stones [17]. These units serve as protective elements in various geotechnical applications, particularly for mitigating erosion and preventing slope failures. The primary material used for gabion construction is gabion wire, manufactured in accordance with SNI 03-6154-1999. In practice, gabions are widely utilized to stabilize inclined slopes, reduce

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erosion, and protect areas exposed to abrasion. They are also commonly applied as soil-retaining structures and as protective barriers for bridge piers against scour caused by flowing water.

The use of gabions offers several technical and economic advantages. Their inherent flexibility allows the structure to accommodate ground movement without experiencing significant damage. In addition, their permeability enables water to pass through the stone infill, thereby reducing active earth pressure generated by pore water [18]. Gabions are considered cost-effective and can be installed without the need for advanced machinery, making them suitable for diverse site conditions, including both wet and dry environments. Their environmentally friendly characteristics, lightweight nature, ease of transport, and the possibility of producing customized dimensions further enhance their applicability as an efficient and adaptable solution for slope stabilization and structural protection.

Gabions serve a wide range of functions across various engineering fields due to their versatility and ease of installation. In emergency situations, gabions are frequently employed as rapid countermeasures for conditions requiring immediate intervention. Their simple construction and quick assembly make them suitable for addressing urgent issues such as sudden erosion, slope instability, or structural threats along rivers and roadways [19].

In the field of irrigation engineering, gabions play a critical role in supporting hydraulic structures and protecting water conveyance systems. They are commonly used in the construction of irrigation weirs, check dams, and energy dissipation structures such as drop structures or chute outlets [19]. Gabions are also widely applied for protecting the slopes and bases of irrigation canals, reinforcing riverbanks, constructing gabion groynes (kribs) for flow regulation, and forming toe drains at the base of embankments or dams to enhance stability and drainage efficiency.

Gabions are also valuable in road and bridge infrastructure. Their applications include the construction of retaining walls to stabilize surrounding soil masses, the use of gabion walls as temporary or emergency foundations for bridge structures, and the formation of embankments to contain volcanic debris or sediment flow [20]. Additionally, gabion units can be arranged as foundation layers for road construction, providing stability and improving load distribution on weak subgrade soils.

Wire Gabions according to Bina Marga 2018 specification. Wire gabions must meet one of the following SNI standards: SNI 03-6154-1999, SNI 03-0090-1999, or SNI 03-3046-1992.

The characteristics of gabion wire are:

Edge reinforcement, diameter	: min. 3.4 mm
Network, diameter	: min. 2.7 mm
Binder, diameter	: min. 2.0 mm
Tensile Strength	: 41 kg/mm^2
Diameter elongation	: 10% (min)

Figure 3. Gabions

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The webbing shall be evenly spaced hexagons of three windings, with approximately 80 m x 100 mm holes, designed to prevent loosening and to provide the required flexibility and strength. The perimeter of the woven wire mesh shall be fastened to the gabion frame so that the joints attached to the frame shall be as strong as those of the woven body.

The baskets shall be single units, provided with the dimensions required in the Drawings or as directed by the superintendent of works, and so constructed that they can be delivered to the site before being filled with stone.

Stone for blank masonry and gabions shall consist of rugged and durable stone with the following properties:

- Aggregate wear by Los Angeles machine shall be less than 40%.
- Dry specific gravity greater than 2.3.
- Water absorption not greater than 4%.

Consistency of aggregate form to sodium sulfate or magnesium sulfate in the S cycle test shall be less than 12% or 18% respectively.

Stone blanks shall be sharp-angled, with a minimum dimension of 200mm. The Works Supervisor may substitute larger stones if the river flow velocity is high enough.

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2.3 Flowchart

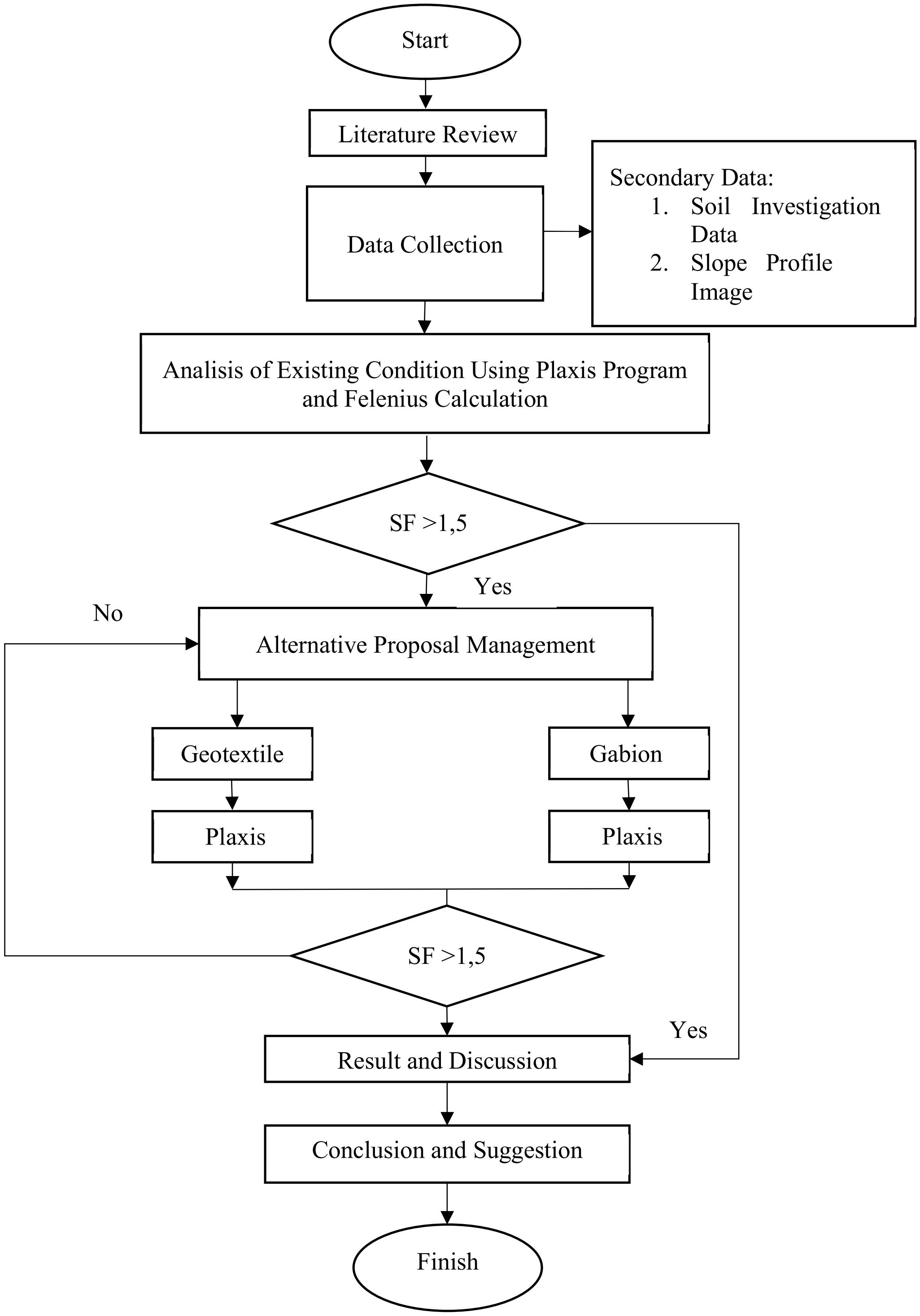

Figure 3. Steps research

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3. Results and Discussion

This study discusses slope stability analysis using geotextiles and gabions. This analysis was conducted to determine the safety factors of existing slopes and reinforced slopes. According to Fellenius, this method assumes that slope failure occurs along the surface of a circular arc slip plane [21].

The Plaxis application was used as a tool to calculate and compare the results obtained through manual calculations using Fellenius' formula. The Plaxis output data image will serve as a validation and reference tool for calculations. This research is also in line with previous studies that show positive results for the use of slope reinforcement materials such as geotextiles and gabions [22][23].

Table 2. Calculation of Existing Slope STA 105+250

Slice	a (m)	θ (°)	Slice Area (A) (m^2)	$\gamma_{Lap}.\tau_1$ (kN/m^3)	c′ (kN/m^2)	ϕ′ (°)	W = A·γ (kN/m)	P = W cosθ (kN/m)	W sin a (kN/m)	c′·l+Ptanϕ′ (kN/m)
1	3.10	49.58	2.01	23.00	12.67	20.00	46.23	29.97	35.20	50.18
2	2.05	43.57	3.74	23.00	12.67	20.00	86.02	62.32	59.29	48.65
3	1.86	36.22	4.86	23.00	12.67	20.00	111.78	90.02	66.09	56.38
4	1.73	29.53	4.77	23.00	12.67	20.00	109.71	95.46	54.07	56.66
5	1.64	23.35	4.27	23.00	12.67	20.00	98.99	90.82	40.62	49.82
6	1.58	18.16	3.52	23.00	12.67	20.00	80.96	76.98	30.23	40.21
7	1.54	15.52	2.91	23.00	12.67	20.00	66.93	64.89	15.40	34.49
8	1.51	7.19	2.20	23.00	12.67	20.00	50.60	50.03	9.63	37.29
9	1.66	3.23	0.99	23.00	12.67	20.00	22.77	22.73	1.28	29.30
								Total (Σ)	301,10	423,33
$SF = \frac{\sum[c'l + (Wcos\ a - u.a)\tan\emptyset]}{\sum Wsin\ a}$									1,406	

Stability analysis is to determine the safety factor of a potential landslide field. The theoretical basis used to solve the problem of slope stability and soil bearing capacity uses the theory of the method of slices (Method of Slice), the Fellinius Method [1].
Retaining Walls.

The Geotextile Soil Retaining Wall Calculation shown below.

Backfill load	q	= 25 kN/m^2
Volume weight of backfill soil	γ_{sat}	= 18 kN/m^3
Shear angle of embankment soil	∅	= 35°
Cohesion of embankment soil	c	= 0 kN/m^3
Horizontal earthquake acceleration	ah	= 0,5 g
Vertical earthquake acceleration	av	= 0,167 g
Soil cohesion	c	= 12.667 kN/m^3
Back face slope of DPT	θ	= 0°
Shear angle between soil and geotextile	δ	= 33,25°
Slope of the soil surface	β	= 0°
Adhesion between soil and geotextile	ca	= 0 kN/m2
Geosynthetic limit tensile stress	Tult	= 100 kN/mm

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Partial factor for installation damage during construction	FSID = 1,1
Partial factor due to creep	FSCR = 1,6
Partial factor due to chemical degradation	FSCD = 1,1
Partial factor due to biological degradation	FSBD = 1,1
Safety factor	FS = 1,5
Slope height	H = 8m
Slope	$\alpha = 31°$

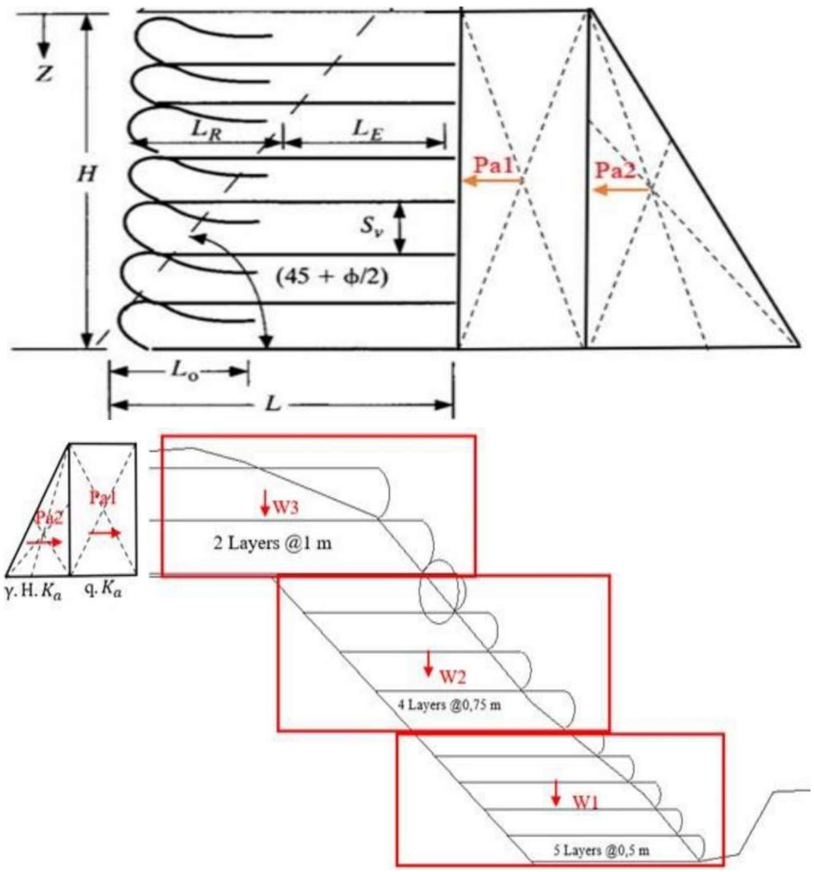

Figure 4. Geosynthetic retaining wall design

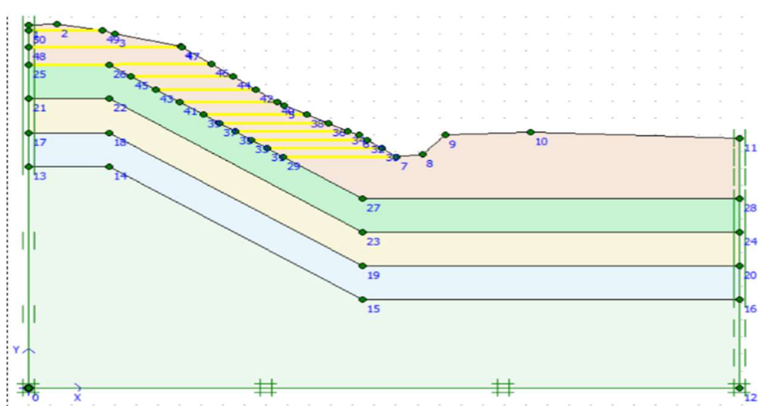

Figure 5. Slope reinforcement with variation of Geotextile thickness

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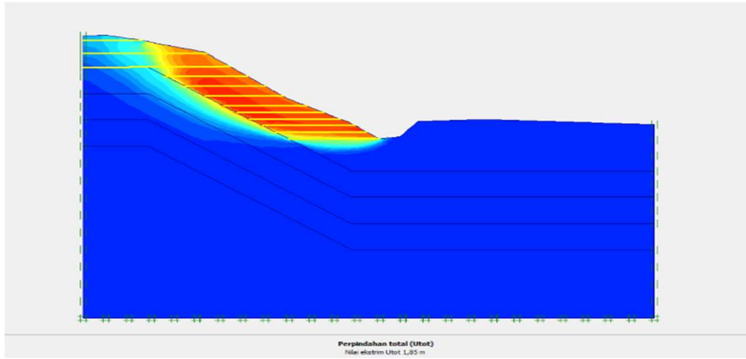

Figure 6. Total displacement of slope with Geotextile reinforcement

This image shows the numerical analysis of total displacement on a slope [2], with an extreme displacement of 1.85 m. The colors in the image indicate brightness levels: red and yellow indicate areas with the most significant displacement, while blue indicates stable regions.

1. Interpreting the Image
   - Displacement Pattern (Total Deformation, Utot)
     - Red & orange zones → Indicate the slope sections experiencing the greatest displacement, particularly in the upper soil layer.
     - Blue zones → More stable soil sections with minimal displacement.
     - The pattern above indicates the potential for upper slope failure with a sliding failure mode.
   - Effect of Geotextile Reinforcement
     - When geotextiles have been applied, the displacement is reduced compared to without reinforcement (compared to the previous image, which showed greater displacement).
     - The application of geotextiles in multiple layers has helped reduce soil displacement and improve slope stability.
2. Additional Recommendations for Stability Improvement

Based on the analysis, which is still quite large (1.85 m), the following are suggested for further improvements:

   - Adding Geotextile Layers
     - If only a few layers are currently used, consider increasing the number of layers and reducing the layer spacing.
     - The installation spacing can be shortened to 0.5 – 1 meter between layers, depending on soil conditions.
   - Using Geogrids as a Supplement
     - If significant movement remains, combining geotextiles with geogrids can provide additional tensile strength to the soil.
   - Adding Retaining Walls or Soil Nailing
     - If the elevation remains high despite the use of geotextiles, additional reinforcement, such as soil nails or lightweight retaining walls, should be considered.
   - Improving the Drainage System
     - Installing drainage pipes or geodrains can help reduce pore air pressure and accelerate slope stabilization.

3. Discussion
   - The results of geotextile installation have been consistent with the theory and function of geotextiles themselves, whereby geotextiles in slope reinforcement are based on their ability to improve the mechanical properties of soil [2]. When geotextiles are installed within a soil slope, they interact with the soil to resist tensile forces (tensile stress) that the soil itself

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cannot withstand, thereby creating a stronger composite structure and also helping to reduce soil settlement. However, the total displacement is still quite large (1.85 m), requiring further evaluation. A combination of geotextiles, drainage systems, and soil nails is needed to significantly improve slope stability.

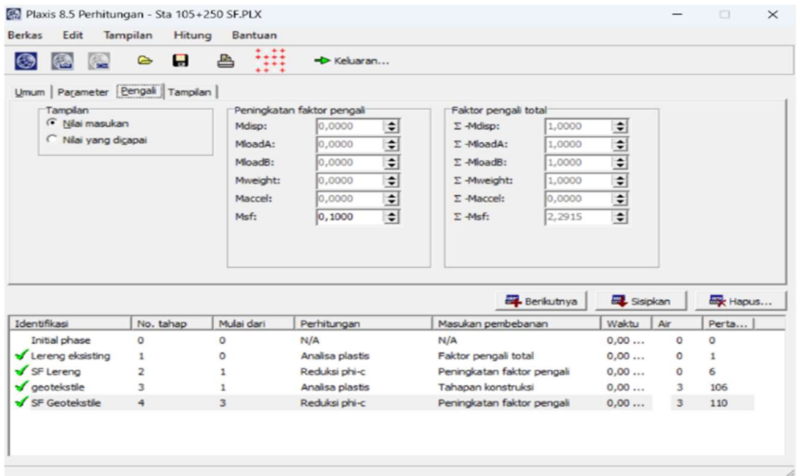

Figure 7. SF value of slope with Geotextile reinforcement

Analysis of slope stability after reinforcement using geotextile materials shows a significant increase in safety factors. The Safety Factor (SF) value obtained is 2.29, indicating that the slope structure is in a very stable condition. This value shows a surplus of retaining force of 129% compared to the collapse driving force, and far exceeds the minimum SF criteria required in geotechnical engineering standards.

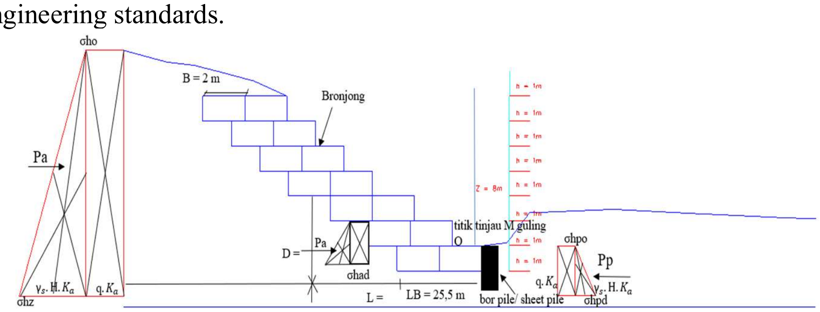

Figure 8. Calculation of Gabions

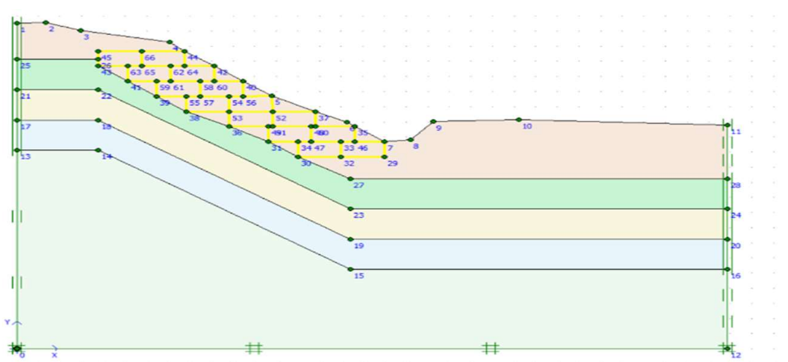

Figure 9. Slope modeling with gabion reinforcement

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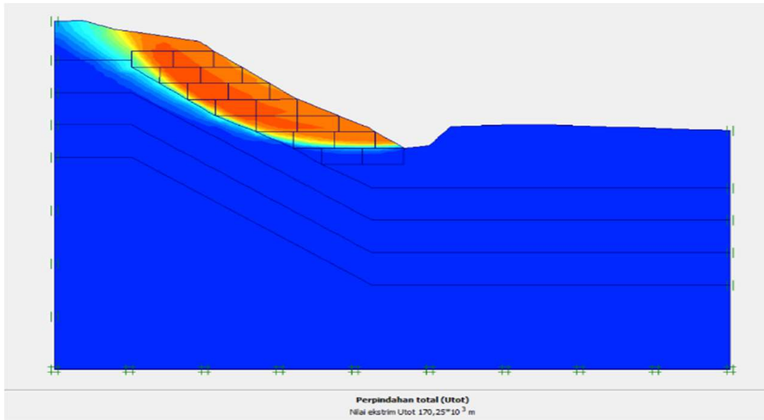

Figure 10. Total displacement of slope with gabion reinforcement

This image shows that the slope has experienced a significant cessation at the top, indicating movement leading to instability.

1. Interpretation of Colors in the Image
   - Blue → Indicates areas with very little or no displacement.
   - Green to Yellow → Indicates areas with moderate displacement.
   - Orange to Red → Indicates areas with the most significant movement, indicating a critical zone with the possibility of landslides or reaching their highest point.
2. Total Displacement (Utot)
   - The extreme value of the total displacement shown is 170.25×10^{-3} m or approximately 17 cm.
   - This indicates significant ground movement at the top of the slope, particularly in the red and orange areas.
3. Ground Movement Pattern
   - From the color and movement pattern, it appears that the critical landslide zone is located at the top of the slope, following a typical curvilinear pattern in slope failure.
   - The most significant displacement occurs in areas with block geometry (possibly slope reinforcement or additional material).
4. Boundary Conditions and Reinforcement Elements
   - The bottom of the slope and the right side are shown in blue, indicating that these areas are considered stable and not subject to significant movement.
   - Green symbols on the bottom and side edges indicate fixed boundary conditions that prevent movement in these areas.

Gabion comes from the Italian word "gabbione," which means "large cage." Technically, a gabion is a structure consisting of rectangular baskets made of thick galvanized steel wire mesh (or PVC-coated for extra corrosion resistance). These baskets are filled with fill material such as rocks, gravel, or recycled concrete at the project site.

The basic theory of gabions involves the following principles:

- Gravity Structure: Gabion walls function as gravity retaining walls, relying on their own weight and the compactness of the infill stones to resist lateral soil pressure and hydraulic forces.
- Flexibility: One of the main advantages of gabions is their flexibility. This structure can adapt to minor subsidence or soil movement without compromising its structural integrity, unlike rigid structures such as concrete.
- Permeability: Gabions are permeable, meaning water can easily seep through them. This prevents the buildup of hydrostatic water pressure behind the wall, which is a common cause of failure in conventional retaining walls.

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Erosion Control: Gabion structures help stabilize the soil and prevent erosion by slowing water flow and encouraging natural vegetation growth between the rocks over time.

In practice, gabions are often used as part of a more comprehensive soil reinforcement system, especially to stabilize steep slopes or landslide-prone areas.

- Reinforced Gabion Walls: Gabion walls can be combined with reinforcement materials, such as geogrids or geotextiles installed in the soil layer behind the wall.
- Combination Mechanism: Gabions function as a flexible retaining wall facade that allows water to flow through, while geosynthetics embedded in the soil fill resist lateral soil pressure and increase the internal stability of the soil mass, creating a mechanically stabilized earth (MSEW) structure.
- Stability analysis of gabion structures and reinforcements typically uses standard geotechnical engineering methods, such as Rankine's theory, and is often aided by slope stability analysis software to calculate the required safety factors.

This finding is consistent with [7], which found that Gabions reinforcement improved slope stability more significantly due to its tensile confinement of soil.

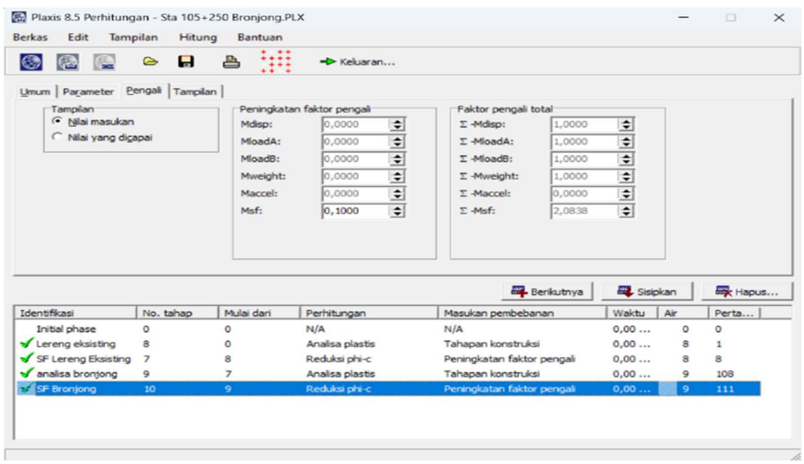

Figure 11. SF value of slope with gabion reinforcement

The SF obtained after reinforcement using Gabion is 2,08

- Strong stability: A value of 2.08 is well above the minimum safety standard threshold (1.5). This indicates that the gabion reinforcement you installed is highly effective in improving slope stability.
- Excess strength: This slope has more than twice the strength to resist the pressure pushing it to collapse. In other words, this safety factor provides a significant strength reserve.
- Resistance to additional loads: This high SF value indicates that the slope is capable of withstanding additional loads that may occur in the future, such as increased rainfall, traffic loads on the slope, or vibrations caused by earthquakes, without reaching the point of failure.
- Effective and conservative design: The value of 2.08 may be the result of a conservative design, in which the gabions are installed with strong specifications to provide a very high level of safety. Some studies also show a significant increase in SF when gabions are combined with other reinforcements.
- Comparison with unreinforced conditions: If you compare these results with slope calculations without gabions (before reinforcement), the SF value is likely to be much lower, possibly even less than 1.5 or 1.0. The increase from a low SF to 2.08 demonstrates the success of using gabions as a reinforcement solution.

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4. Conclusions

This study analyzes the performance of slope reinforcement using two methods: geotextiles and gabions. The results of these two methods will be compared, and the preferred method will be determined for field use and design.

Modeling with Plaxis resulted in the following SF values. From the table above, the results of modeling using Plaxis obtained the SF value of the existing slope of 1,4031 < 1,5 [8]SF plan, reinforcement with Geotextile of 2,2915 > 1,5 SF plan, and reinforcement with Gabions of 2.0838 > 1.5 SF plan. Geotextiles provide a higher safety factor because they strengthen the slope body internally, while gabions act more as local or external protection of the slope, depending on their weight and installation position. From the table above, there is a difference of 0.89 for Geotextile reinforcement and 0.68 for Gabion reinforcement with existing slopes with SF of 1.4031.

The analysis of the SF value of the slope shows a difference of 0.21 between reinforcement with Geotextiles and Gabions, with Geotextile reinforcement slightly superior, increasing by 63.32%, while Gabion reinforcement increases by 48.51%.

The slope on the Henes-Motamasin road section Sta. 105+250 is at risk of landslides. Based on the results of the SF analysis using Plaxis, the SF value of the slope is 1.4031. The SF value of the analysis results indicates that the slope is in an unstable condition, requiring reinforcement.

The slope on the Henes-Motamasin road section Sta. After being reinforced with Geotextile and Gabions, the SF values obtained are 2.2915 and 2.0838 based on the analysis using Plaxis, showing a Safety Factor difference of 0.21 between Geotextile and Gabion reinforcement.

From both results of slope stability analysis using Fellenius and Plaxis v.8.2 methods there is a difference in the value of different safety factors, the safety factor with [1]Fellenius tends to have a smaller value than using Plaxis, this is because the analysis using Fellenius does not include the parameters of the modulus of elasticity of the soil and Poisson's number and the review of the slope is only reviewed in the landslide plane area. The slope can be declared safe if the Safety Factor value, FS > 1.5 [8], results of slope stability analysis using Fellenius and Plaxis:

- Fellenius Safety Factor Analysis and plaxis v.8.2 program
  SF of existing slope with Fellenius method = 1.406 < 1.5 (Critical slope)
  SF slope with Plaxis = 1.403 < 1.5 (Critical slope)
- Analysis results after Geotextile installation in unsaturated soil conditions:
  Safe factor against shear = 1.7 > 1.5 (safe slope)
  Safe factor against overturning 2.28 > 2 (safe slope)
  Safe factor against earthquake force = 2.28 > 1.1 (safe slope)
  Safe factor against soil bearing capacity = 8.011 > 3 (safe slope)
  Safe factor using plaxis 2.291 > 1.5 (safe slope)
- Analysis results after installation of gabions in unsaturated soil conditions:
  Safe factor against shear = 4.354 > 1.5 (safe slope)
  Safe factor against rolling = 11.67 > 1.5 (safe slope)
  Safe factor against subgrade bearing capacity = 6.141 > 3 (safe slope)
  Safe factor against earthquake force = 11.67 > 1.1 (safe slope)
  Safe factor using plaxis = 2.083 > 1.5 (safe slope).

Acknowledgements

The author would like to thank God Almighty for all His gifts and blessings, which enabled the author to complete this journal. The author would also like to thank the Civil Engineering Study Program at Udayana University for the knowledge, guidance, and facilities provided during the study period. The NTT National Road Implementation Agency has supported this research by providing valuable data and information.

Vol. 6, No. 1, pp. 97-113
Submit: 6-06-2025 |
Accepted: 25-10-2025 |
Publish: 30-11-2025 |

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Accepted: 25-10-2025 |
Publish: 30-11-2025 |

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