INTISARI

Pembangunan perumahan di Sleman Barat terus meningkat pada 2025, termasuk di kawasan lereng seperti Gunung Gedang, Seyegan. Pembangunan perumahan di lereng batuan yang curam (80°, tinggi 7 m) memperbesar risiko keruntuhan (Wyllie & Mah, 2004). Untuk mitigasi, direkomendasikan penggunaan *soil nailing* dan *rock bolt* yang dikombinasikan dengan *shotcrete* yang tepat untuk meningkatkan keamanan dan kestabilan lereng.

Penelitian ini diawali dengan studi literatur terkait proyek perumahan dan kondisi geologi di lokasi penelitian. Data sekunder geologi teknik diolah untuk analisis stabilitas lereng menggunakan metode *finite element method* (FEM) dengan *software* Plaxis 2D. Pemodelan perkuatan menggunakan *soil nailing* dan *rock bolt* dilakukan dengan modifikasi dimensi dan konfigurasi tulangan baja untuk memperoleh desain optimal, yaitu jumlah tulangan minimal dengan nilai *safety factor* (SF) yang memenuhi SNI 8460:2017. Analisis ini juga mempertimbangkan stabilitas eksternal, internal perkuatan, *facing failure,* serta deformasi horizontal lereng.

Hasil pemodelan FEM pada lereng eksisting (*initial phase*) menunjukkan kondisi stabil dengan SF sebesar 3,27. Setelah pembangunan perumahan tanpa perkuatan, SF turun menjadi 1,20 pada kondisi statik (tidak memenuhi syarat minimum 1,5) dan mengalami runtuh (*collapse*) pada kondisi pseudostatik (tidak memenuhi syarat minimum 1,1) sesuai SNI 8460:2017, sehingga lereng dinyatakan rawan longsor. Untuk mengatasi hal tersebut, dilakukan perkuatan lereng dengan *soil nailing* dan *rock bolt* yang optimal. Desain perkuatan *soil nailing* menghasilkan SF 2,04 (statik) dan 1,50 (pseudostatik), sedangkan *rock bolt* menghasilkan SF 1,62 (statik) dan 1,17 (pseudostatik). Kedua desain optimal tersebut juga telah memenuhi kriteria stabilitas internal, *facing failure*, dan deformasi horizontal sesuai SNI 8460:2017.

Kata kunci: stabilitas lereng, *finite element method* (FEM), *safety factor* (SF), *soil nailing*, *rock bolt*

ABSTRACT

Housing development in West Sleman continues to increase in 2025, including in slope areas such as Mount Gedang, Seyegan. Housing development on steep slopes (80°, 7 m high) increases the risk of collapse (Wyllie & Mah, 2004). For mitigation, the use of soil nailing and rock bolts combined with appropriate shotcrete is recommended to increase slope safety and stability.

This study begins with a literature review on housing development projects and the geological conditions of the study area. Secondary geotechnical data were processed for slope stability analysis using the Finite Element Method (FEM) with Plaxis 2D software. Slope reinforcement modeling using soil nailing and rock bolts was conducted by modifying the dimensions and configurations of the steel bars to achieve an optimal design—minimizing the number of reinforcements while meeting the required safety factor (SF) in accordance with SNI 8460:2017. The analysis also considers external stability, internal reinforcement stability, facing failure, and horizontal deformation of the slope.

The results of FEM modeling on the existing slope (initial phase) showed a stable condition with an SF of 3.27. After the construction of unreinforced housing, the SF dropped to 1.20 in static conditions (not meeting the minimum requirement of 1.5) and collapsed in pseudostatic conditions (not meeting the minimum requirement of 1.1) according to SNI 8460:2017, so that the slope was declared prone to landslides. To overcome this, a slope reinforcement analysis was carried out to obtain an optimal design. The soil nailing reinforcement design produced an SF of 2.04 (static) and 1.50 (pseudostatic), while the rock bolt produced an SF of 1.62 (static) and 1.17 (pseudostatic). Both optimal designs have also met the criteria for internal stability, facing failure, and horizontal deformation according to SNI 8460:2017.

Keywords: *slope stability, finite element method (FEM), safety factor (SF), soil nailing, rock bolt*