

## INTISARI

Tanah longsor adalah salah satu bencana alam yang paling sering terjadi di daerah tropis pada musim hujan. Seperti longsor di Kabupaten Bone Bolango, Provinsi Gorontalo. Bencana ini menimbulkan kerugian material maupun immaterial. Untuk penanggulangan tanah longsor ini, perlu dilakukan suatu metode perbaikan dan perkuatan lereng yang tepat dan efisien. Penelitian ini bertujuan untuk mengidentifikasi faktor-faktor penyebab dan karakteristik longsor di Kabupaten Bone Bolango, serta menganalisis perilaku dan kestabilan lereng tanpa dan dengan modifikasi perkuatan dinding krib bambu/kayu.

Dalam penelitian ini, data diperoleh dari hasil survei lokasi, survei geologi permukaan dan penyelidikan geoteknik. Sampel tanah/batuan yang diperoleh dari hasil pemboran di lokasi penelitian berupa sampel tak terganggu dan sampel terganggu. Sifat fisis dan mekanis tanah/batuan serta material lokal (bambu dan kayu kelapa) diperoleh dari hasil uji di laboratorium berdasarkan ASTM dan SNI. Analisis 2D dan 3D dilakukan secara numeris dengan menggunakan metode keseimbangan batas dan metode elemen hingga, dengan menggunakan perangkat lunak *Slide* dan *Rock Soil*. Stabilitas lereng alam dianalisis pada saat musim kemarau dan musim hujan, sedangkan perkuatan dinding krib bambu/kayu dianalisis pada saat musim kemarau.

Pada umumnya kemiringan lereng di Kabupaten Bone Bolango sangat curam. Batuannya telah mengalami pelapukan akibat kekar intensif dan diskontinuitas. Faktor internal ini membuat lereng rawan longsor. Sementara itu, faktor eksternal yang memicu longsor adalah curah hujan yang tinggi, >100 mm/hari, dan aktivitas manusia memotong kaki lereng. Secara umum, jenis tanah longsor di daerah penelitian adalah aliran rombakan, gelinciran rotasi, dan jatuhnya batuan. Pada saat curah hujan tinggi, terjadi penurunan tekanan geser sedangkan tekanan air pori berubah menjadi positif. Hal ini menyebabkan lereng menjadi tidak stabil. Hasil analisis menggambarkan lereng alam dalam keadaan tidak aman,  $FS < 1,5$ . Perkuatan dinding krib bambu dan kayu, memberikan peningkatan nilai faktor aman yang cukup signifikan,  $FS > 1,5$ . Analisis stabilitas eksternal dinding krib menggambarkan nilai keamanan rerata terhadap keruntuhan kapasitas dukung, bahaya guling, dan bahaya geser secara berurutan adalah 1,85; 1,78; dan 4,97. Hasil analisis stabilitas internal dengan metode keseimbangan batas menggambarkan nilai faktor aman rerata terhadap kegagalan geser dinding krib bambu/kayu adalah 4,86. Nilai rerata keamanan terhadap gaya angkat elemen krib pada sisi dalam, dari gaya horisontal dan vertikal,  $F_{LC}$  adalah 4,39. Nilai rerata keamanan terhadap gaya angkat elemen krib pada sisi dalam, dari gaya paralel ke kemiringan dinding,  $F_{LC}$  adalah 8,10. Nilai rerata keamanan terhadap patahnya sambungan berdasarkan teori monolitik,  $F_{CJA}$  sebesar 3,65, dan  $F_{CJB}$  sebesar 2,12. Nilai rerata keamanan terhadap patahnya sambungan berdasarkan teori silo,  $F_{CJA}$  sebesar 8,96, dan  $F_{CJB}$  sebesar 8,39. Diharapkan model perkuatan dinding krib bambu dan kayu kelapa ini menjadi salah satu alternatif dalam pemilihan tipe perkuatan lereng. Selain material bambu/kayu mudah diperoleh, pelaksanaan struktur ini mudah dilakukan.

Kata kunci: longsor, dinding krib, stabilitas lereng

## ABSTRACT

*Landslide is one of the natural disasters that frequently occurs in tropical regions during the rainy season. For example, the landslide in Bone Bolango, Gorontalo Province. Material and immaterial losses may occur as a result of this disaster can result in. An appropriate and efficient method for repairing and reinforcing slopes is required to prevent landslides. This study aims to identify causal factors and characteristics of landslides in Bone Bolango Regency and to analyze the behavior and stability of the slopes with and without reinforcement modifications using timber/bamboo crib walls.*

*Data were obtained from the results of site surveys, surface geological surveys, and geotechnical investigations. Soil/rock samples were collected by drilling at the study area in the form of undisturbed and disturbed samples. Physical and mechanical properties of soil, rock, bamboo, and coconut wood were determined from laboratory tests based on ASTM and SNI standard. Two-dimensional and three-dimensional analyses were performed numerically using limit equilibrium method and finite element method, using Slide and Rock Soil software. The natural slope stability was analyzed both during the dry and rainy season while the timber and bamboo crib wall reinforcement was analyzed during the dry season.*

*In general slope in Bone Bolango Regency very steep. The rocks have experienced weathering and discontinuities due to intense joints. These internal factors make the slopes prone to landslides. Meanwhile, the external factors that trigger the landslides are high rainfall, >100 mm/day, and human activity i.e. excavation of slope or its toe. The types of landslides in the study area are debris flows, rotation slides, and rock falls. During periods of high rainfall, the shear stress decrease while pore water pressure turn into positive. This causes the slope to become unstable. The results of analysis demonstrate the natural slopes in unstable state,  $FS < 1.5$ . The reinforcement using wooden and bamboo crib walls can significantly increase the factor of safety. The external stability analysis of the crib walls which represents the average factor of safety towards bearing capacity failure, overturning, and sliding were 1.85, 1.78, and 4.97 respectively. The result of internal stability analysis using the limit equilibrium methods indicated that the average factor of safety towards sliding failure of timber and bamboo crib walls was 4.86. The average factor of safety towards the lift forces of the crib elements on the inner side, from the horizontal and vertical forces,  $F_{LC}$  was 4.39. The average factor of safety towards the lift forces on the inner side, from the force parallel to the slope of the wall,  $F_{LC}$  was 8.10. The factor of safety value towards the breaking of the joints based on the monolithic theory,  $F_{CJA}$  was 3.65, and  $F_{CJB}$  was 2.12. The factor of safety value towards the breaking of the joints based on the silo theory,  $F_{CJA}$  was 3.65, and  $F_{CJB}$  was 2.12. The factor of safety value towards the breaking of the joints based on the silo theory,  $F_{CJA}$  was 8.96, and  $F_{CJB}$  was 8.39. It is expected that the models of timber and bamboo crib walls can be one of alternatives in selecting the type of slope reinforcement. In additions, it is easy to obtain and to implement.*

*Keywords: landslide, crib walls, slope stability*