

SARI

Pembangunan terowongan 1 Jalan Tol Ruas Sigli – Banda Aceh merupakan bagian dari Jalan Tol Trans Sumatera yang akan menghubungkan Kota Banda Aceh, Kabupaten Aceh Besar, dan Kabupaten Pidie. Lokasi pembangunan terowongan 1 secara administrasi berada di Gampong Pulo Hagu, Kecamatan Padang Tiji, Kabupaten Pidie, Provinsi Aceh. Tahapan perencanaan pembangunan terowongan yang telah dilakukan yaitu berupa desain geometri, jalur trase, metode penggalian dan sistem perkuatan terowongan. Namun belum dilakukan penyelidikan geologi teknik permukaan meliputi karakterisasi morfologi, batuan dan tanah, struktur geologi, kualitas massa batuan permukaan, dan analisis kestabilan lereng portal terowongan.

Penelitian ini bertujuan untuk mengetahui karakteristik geologi teknik meliputi batuan dan tanah, geomorfologi, struktur geologi dan kondisi air tanah serta untuk mengetahui kondisi kestabilan lereng portal *inlet* dan *outlet* terowongan. Pengambilan data lapangan permukaan dilakukan dengan melakukan pemetaan geologi teknik menggunakan peta dengan skala 1:12.500. Pengujian laboratorium yang dilakukan berupa pengujian sifat fisik, sifat indeks dan sifat mekanika batuan dan tanah. Hasil dari pengujian laboratorium digunakan untuk menganalisis kondisi tingkat pelapukan batuan, penilaian kualitas massa batuan permukaan berdasarkan GSI, dan kondisi tingkat kestabilan lereng portal *inlet* dan *outlet* terowongan dengan metode kesetimbangan batas.

Litologi daerah penelitian tersusun oleh batupasir karbonatan, batulanau karbonatan dan batupasir dengan tingkat pelapukan lapuk tinggi dan lapuk sedang. Kualitas massa batuan ditentukan berdasarkan klasifikasi *Geological Strength Index* (GSI) dan kemudian didapatkan tiga kelas kualitas massa batuan yaitu kualitas sangat buruk (nilai GSI kurang dari 20), kualitas buruk (nilai GSI 25 – 40) dan kualitas sedang (nilai GSI 45 – 50). Kondisi kestabilan lereng ditentukan menggunakan analisis kesetimbangan batas dengan metode *Bishop's Simplified* dengan kriteria keruntuhan *Mohr-Coulomb* dan *Generalized Hoek-Brown*. Pemodelan dilakukan pada lereng portal *inlet* dan *outlet* terowongan. Tujuan analisis kestabilan lereng untuk mendapatkan nilai faktor keamanan (FK) pada masing-masing lereng. Pada lereng portal *inlet* terowongan didapatkan nilai faktor keamanan sebesar 2,574 (FK = 2,574) sedangkan pada lereng portal *outlet* terowongan didapatkan nilai faktor keamanan sebesar 1,692 (FK = 1,692). Berdasarkan hasil dari analisis kestabilan lereng tersebut dapat diketahui bahwa tingkat kestabilan lereng portal *inlet* dan *outlet* terowongan berada dalam kondisi stabil dan aman.

Kata kunci: Terowongan Sigli – Banda Aceh, karakteristik geologi teknik, *Geological Strength Index*, analisis kesetimbangan batas, faktor keamanan.

ABSTRACT

The construction of tunnel 1 for the Sigli – Banda Aceh Toll Road is part of the Trans Sumatra Toll Road which will connect Banda Aceh City, Aceh Besar District, and Pidie District. The location for the construction of tunnel 1 is administratively in Pulo Hagu Village, Padang Tiji District, Pidie Regency, Aceh Province. The planning stages of tunnel construction that have been carried out are in the form of geometric design, trace lines, excavation methods and tunnel reinforcement systems. However, geological investigations of surface engineering have not yet been carried out including characterization of morphology, rock and soil, geological structure, quality of surface rock mass, and analysis of tunnel portal slope stability.

This research aims to determine the characteristics of engineering geology including rock and soil, geomorphology, geological structure and groundwater conditions and to determine the stability condition of the inlet and outlet portal slopes. The surface field data was collected by performing engineering geological mapping using a map with a scale of 1:12.500. Laboratory tests carried out in the form of testing physical properties, index properties and mechanical properties of rocks and soil. The results from laboratory tests are used to analyze the weathering conditions of rocks, assess the quality of the surface rock mass based on GSI, and the condition of the stability level of the inlet and outlet portal slopes using the boundary equilibrium method.

The lithology of the study area is composed of carbonated sandstone, carbonated siltstone and sandstone with high weathering and moderate weathering. The rock mass quality is determined based on the Geological Strength Index (GSI) classification and then three rock mass quality classes are obtained, namely very poor quality (GSI value is less than 20), poor quality (GSI value is 25 – 40) and medium quality (GSI value is 45 – 50). Slope stability conditions were determined using boundary equilibrium analysis using the Bishop's Simplified method with Mohr-Coulomb and Generalized Hoek-Brown failure criteria. Modeling is carried out on the slopes of the inlet and outlet portals of the tunnel. The purpose of slope stability analysis is to obtain the value of the factor of safety (FS) on each slope. On the slope of the portal inlet tunnel, the safety factor value of 2,574 ($FS = 2,574$) while on the slope of the portal outlet tunnel the value of the safety factor of 1,692 ($FS = 1,692$) was obtained. Based on the results of the slope stability analysis, it can be seen that the level of stability of the portal inlet and outlet tunnel slopes is in a stable and safe condition.

Keywords: *The tunnel of Sigli – Banda Aceh, engineering geology characteristic, Geological Strength Index, limit equilibrium analysis, safety factor.*