

INTISARI

Terowongan Jalan Tol Yogyakarta - Bawen Seksi 5 merupakan infrastruktur yang mendukung kepentingan nasional untuk meningkatkan konektivitas dan pertumbuhan wisata nasional seperti Ambarawa, Magelang, Borobudur, dan Yogyakarta. Secara administrasi, lokasi rencana terowongan terletak di Kecamatan Grabag, Kabupaten Magelang, Provinsi Jawa Tengah. Berdasarkan perencanaan yang telah dilaksanakan, kondisi geologi teknik hanya didasarkan oleh kondisi geologi regional serta masih terbatasnya pengujian sifat properties dan mekanik. Mengingat konstruksi zona portal merupakan pekerjaan yang sulit serta belum dilakukannya penyelidikan geologi teknik yang lebih detail, evaluasi kondisi geologi teknik dan analisis kestabilan zona portal secara numerik diperlukan.

Pemetaan geologi dilakukan pada lokasi penelitian dengan skala 1 : 12.500 dengan luas area penelitian sebesar 4 km². Berdasarkan hasil analisis kondisi geologi dan tingkat pelapukan, zona portal terowongan berada pada satuan tuf dan breksi tuf lapuk sangat tinggi. Namun, berdasarkan evaluasi penampang geologi, andesit hadir sebagai satuan tambahan yang berada di bawah elevasi terendah terowongan. Berdasarkan hasil analisis geomorfologi, zona portal terletak di satuan perbukitan vulkanik berlereng curam. Zona portal Outlet Terowongan A, yang mempunyai kemiringan 19⁰, merupakan zona portal yang mempunyai *overburden* yang paling tipis dan dapat mewakili zona geologi paling lemah dalam analisis kestabilan zona portal. Selain itu, berdasarkan kondisi air tanah, zona portal outlet Terowongan A berada pada kedalaman 6 - 18 m dari permukaan.

Berdasarkan hasil analisis empiris dan numerik, terowongan membutuhkan perkuatan *arch* dengan tebal 40 cm dan mutu beton K350; *side wall* dengan tebal 40 cm dan mutu beton K350, *invert* dengan tebal 50 cm dan mutu beton K350; *steel support* H-Beam 200 x 200 dengan jarak antara *steel support* sebesar 1 m; beton semprot dengan tebal 25 cm; *long face bolt* GFRP dengan panjang 12,5 m; *long forepiling* dengan panjang 12,5 m, dan *dewatering*. *Secant piles* dibutuhkan pada awal konstruksi zona portal.

Kata kunci: terowongan jalan, kestabilan zona portal, analisis empiris, analisis numerik, sistem perkuatan.

ABSTRACT

Yogyakarta - Bawen Toll Road Tunnel Section 5 is an infrastructure that supports national interests to improve connectivity and growth of national tourism such as Ambarawa, Magelang, Borobudur, and Yogyakarta. The road tunnel was planned in Grabag District, Magelang Regency, Central Java Province. Based on the detailed engineering design report, geological conditions were designed based on consideration of regional geological conditions. Moreover, testing of properties and mechanical properties was not detailed. Since construction of the portal zones were difficult, this research was needed to give detailed and comprehensive geological condition resulting more precise stability analysis.

Geological mapping was carried out at the research location with a scale of 1: 12,500 with a research area of 4 km². Based on geological condition, the portal zone of the tunnel consisted of extremely weathered tuff and tuff breccia. Moreover, andesite was identified as an additional which placed below the lowest elevation of the tunnel. Based on geomorphological analysis, the portal zone was located at steep-sloped volcanic hills. The portal zone of outlet Tunnel A, which had a slope of 19°, had the lowest overburden and can represent the weakest geological zone in the portal zone stability analysis. In addition, the outlet portal zone of Tunnel A had the ground water table at a depth of 6 - 18 m from the surface.

Based on the results of empirical and numerical analysis, the tunnel required arch reinforcement with a thickness of 40 cm; side wall with a thickness of 40 cm; invert with a thickness of 50 cm; steel support H-Beam 200 x 200 with a distance between steel supports of 1 m; shotcrete with a thickness of 25 cm; 12,5 m-long face bolt; 12,5 m-long forepiling, and dewatering. Secant piles are needed at the beginning of the construction of the portal zone.

Keywords: *road tunnel, portal zone stability, empirical analysis, numerical analysis, support system, auxiliary methods.*