

Penelitian ini dilatarbelakangi oleh rencana pembangunan Terowongan Penghindar Bendungan Pedes di Kabupaten Lamongan yang mempunyai fungsi penting dalam mengalihkan aliran sungai pada saat pembangunan bendungan. Mengingat pekerjaan terowongan dan lereng outlet merupakan pekerjaan yang berisiko tinggi, maka diperlukan evaluasi geologi teknik yang komprehensif untuk meminimalkan potensi kegagalan konstruksi. Perbedaan antara kondisi geologi hasil perencanaan sebelumnya dan kondisi lapangan sebenarnya, serta kurangnya analisis metode penggalian, sistem perkuatan terowongan, dan stabilitas lereng outlet pada desain sebelumnya, menjadi dasar utama penelitian ini untuk mendukung perencanaan yang aman dan andal.

Metode penelitian yang digunakan meliputi studi literatur, pengumpulan data lapangan, uji laboratorium, dan analisis data. Data lapangan meliputi teknik pemetaan geologi, observasi geomorfologi, litologi, struktur geologi, kondisi airtanah, serta pengambilan contoh tanah dan batuan. Kualitas massa batuan dianalisis menggunakan klasifikasi Rock Mass Rating (RMR), Q-System, dan Geological Strength Index (GSI) untuk menentukan metode penggalian dan sistem perkuatan terowongan. Analisis kestabilan lereng outlet terowongan dilakukan dengan Metode Limit Equilibrium dengan software Slide2, baik pada kondisi pembebanan statis maupun gempa, serta mempertimbangkan pengaruh tinggi muka air tanah.

Hasil penelitian menunjukkan bahwa kondisi geologi teknik daerah penelitian didominasi oleh satuan batupasir tufa, batugamping, batulanau, dan batulumpur dengan tingkat pelapukan yang bervariasi, serta dipengaruhi oleh struktur geologi antara lain lipatan sinklinal dan sesar regional. Kualitas massa batuan di sepanjang alinyemen terowongan bervariasi dari sedang hingga buruk, seperti yang ditunjukkan oleh klasifikasi RMR, Q-System, dan GSI, sehingga direkomendasikan metode penggalian mekanis konvensional, namun setelah terjadi penurunan muka airtanah maka faktor keamanannya meningkat dan memenuhi kriteria rekomendasi baik pada kondisi statis maupun gempa.

Kata kunci: terowongan, kualitas massa batuan, metode penggalian, sistem perkuatan, kemiringan.

ABSTRACT

This research was motivated by the plan to build the Pedes Dam Avoidance Tunnel in Lamongan Regency, which has an essential function in diverting river flow during dam construction. Given that tunnel work and outlet slopes are high-risk work, a comprehensive engineering geology evaluation is needed to minimize the potential for construction failure. The differences between the geological conditions resulting from previous planning and actual field conditions, as well as the lack of analysis of excavation methods, tunnel reinforcement systems, and outlet slope stability in earlier designs, provide the primary basis for this research to support safe and reliable planning.

The research methods used include literature study, field data collection, laboratory testing, and data analysis. Field data includes engineering geological mapping, geomorphological observations, lithology, geological structure, groundwater conditions, and soil and rock sampling. The quality of the rock mass is analyzed using the Rock Mass Rating (RMR), Q-System, and Geological Strength Index (GSI) classifications to determine the excavation method and tunnel strengthening system. Tunnel outlet slope stability analysis was carried out using the Limit Equilibrium Method with the Slide2 software, under both static and earthquake loading conditions, and considering the influence of the groundwater level.

The research results show that the engineering geological conditions of the research area are dominated by tuff sandstone, limestone, siltstone, and mudstone units with varying levels of weathering, and are influenced by geological structures, including synclinal folds and regional faults. The quality of the rock mass along the tunnel alignment varies from medium to poor, as indicated by the RMR, Q-System, and GSI classifications, so conventional mechanical excavation methods are recommended, with a reinforcement system comprising shotcrete, rock bolts, and additional supports in certain zones. Analysis of outlet slope stability shows that the slope condition is relatively unsafe in its initial condition, but after lowering the groundwater level, the safety factor increases and meets the recommendation criteria in both static and earthquake conditions.

Keywords: tunnel, rock mass quality, excavation method, reinforcement system, slope.