

INTISARI

Penelitian ini dilakukan pada inlet terowongan pengelak Bendungan Pedes yang terletak di Kabupaten Lamongan, Provinsi Jawa Timur. Penelitian ini bertujuan untuk mengevaluasi kondisi geologi teknik sebagai dasar penentuan metode penggalian dan sistem penyangga terowongan, serta menganalisis kestabilan lereng portal. Metode penelitian meliputi pemetaan geologi teknik, analisis data pengeboran inti, pengujian laboratorium, penilaian kualitas massa batuan menggunakan klasifikasi *Rock Mass Rating* (RMR) dan *Geological Strength Index* (GSI), serta analisis stabilitas lereng menggunakan *Limit Equilibrium Method* (LEM) dengan metode *Bishop Simplified* dan *Morgenstern-Price*. Secara geomorfologi, lokasi penelitian tersusun atas dua satuan, yaitu lembah sinklin berlereng landai dan lembah sinklin berlereng miring. Litologi daerah penelitian terdiri atas batugamping, batupasir karbonatan dengan sisipan tuf, serta endapan pasir-kerakal, sedangkan berdasarkan data bawah permukaan trase terowongan didominasi oleh batupasir karbonatan dan batugamping. Struktur geologi yang berkembang didominasi oleh kekar berarah relatif utara-selatan yang memengaruhi potensi bidang gelincir dan aliran airtanah. Lokasi penelitian berada pada zona rawan gempa bumi rendah dengan nilai percepatan tanah maksimum (PGA) sebesar 0,219 g dan koefisien seismik horizontal sebesar 0,132. Berdasarkan klasifikasi RMR, kualitas massa batuan pada trase terowongan tergolong dalam kategori *poor rock*, sedangkan berdasarkan klasifikasi GSI menunjukkan variasi kualitas dari *fair* hingga *very poor*. Metode penggalian yang direkomendasikan berdasarkan RMR adalah metode *benching* dengan laju penggalian 1–1,5 m per tahapan, sedangkan berdasarkan GSI direkomendasikan metode *digging* dan *ripping* pada zona tertentu. Sistem penyangga terowongan yang direkomendasikan berupa *shotcrete* dengan ketebalan 50–100 mm yang diaplikasikan segera setelah penggalian serta pemasangan *rock bolt* sepanjang 3 m dengan jarak 1,5–2 m. Hasil analisis stabilitas lereng portal menunjukkan bahwa desain lereng dengan kemiringan 1,5:1 berada pada kondisi aman, dengan faktor keamanan sebesar 1,515-1,527 pada kondisi statik, dan 1,240-1.234 pada kondisi pseudostatik.

Kata Kunci: geologi teknik, kualitas massa batuan, metode penggalian, sistem penyangga, stabilitas lereng portal, terowongan pengelak, Bendungan Pedes

ABSTRACT

This study was conducted at the inlet of the diversion tunnel of Pedes Dam, located in Lamongan Regency, East Java Province, Indonesia. The objective of this study is to evaluate the engineering geological conditions as a basis for determining appropriate tunnel excavation methods and support systems, as well as to analyze the stability of the tunnel portal slope. The research methodology includes engineering geological mapping, analysis of core drilling data, laboratory testing, rock mass quality assessment using the Rock Mass Rating (RMR) and Geological Strength Index (GSI) classifications, and slope stability analysis using the Limit Equilibrium Method (LEM) with the Bishop Simplified and Morgenstern–Price methods. Geomorphologically, the study area consists of two units, namely gently sloping synclinal valleys and moderately sloping synclinal valleys. The lithology of the study area comprises limestone, tuff-intercalated carbonate sandstone, and sand–gravel deposits, while subsurface data indicate that the tunnel alignment is predominantly composed of carbonate sandstone and limestone. Geological structures in the study area are dominated by joints with a general north–south orientation, which influence potential slip surfaces and groundwater flow patterns. The groundwater table depth around the tunnel ranges from 0.3 to 5.2 m. The study area is located in a low seismic hazard zone with a peak ground acceleration (PGA) of 0.219 g and a horizontal seismic coefficient of 0.132. Based on the RMR classification, the rock mass quality along the tunnel alignment is classified as poor rock, whereas the GSI classification indicates a range of rock mass quality from very poor to good. The excavation method recommended based on the RMR classification is benching with an advance rate of 1.0–1.5 m per stage, while the GSI-based classification recommends digging and ripping for specific zones. The proposed tunnel support system consists of shotcrete with a thickness of 50–100 mm applied immediately after excavation and 3 m long rock bolts with a spacing of 1.5–2.0 m. The results of the slope stability analysis indicate that the portal slope with a gradient of 1.5:1 is in a stable condition, with safety factors ranging from 1.515 to 1.527 under static conditions and from 1.234 to 1.240 under pseudostatic conditions.

Keyword: *engineering geology, rock mass quality, excavation method, support system, portal slope stability, diversion tunnel, Pedes Dam, Lamongan*