INTISARI

Terowongan 2 Daerah Irigasi Bintang Bano merupakan bagian dari jaringan irigasi Bintang Bano yang dibangun sebagai sarana untuk mengoptimalisasi pemanfaatan air dari Bendungan Bintang Bano, Sumbawa Barat, Nusa Tenggara Barat. Berdasarkan laporan investigasi bawah permukaan, terdapat perbedaan interpretasi litologi, sehingga diperlukan investigasi lanjutan kondisi geologi dan goelogi teknik di lokasi penelitian. Terowongan 2 didesain berdasarkan klasifikasi massa batuan *Rock Mass Rating* (RMR) tanpa adanya metode pembanding dan belum dilakukan analisis kestabilan lereng portal terowongan. Tujuan penelitian ini adalah untuk menganalisis sistem penyangga dan kestabilan lereng outlet terowongan berdasarkan kondisi geologi teknik. Analisis geologi teknik dilakukan dengan pemetaan geologi teknik permukaan dengan luasan kavling 0,57 km^2 berdasarkan peta topografi skala 1:4000 dan bawah permukaan. Penilaian kualitas massa batuan menggunakan metode *Rock Mass Rating* (RMR), *Geological Strength Index* (GSI), dan *Q-system*. Sistem penyangga terowongan ditentukan secara empiris berdasarkan hasil penilaian kualitas massa batuan RMR dan *Q-system*, metode penggalian terowongan dianalisis secara empiris berdasarkan RMR dan GSI. Kestabilan lereng outlet terowongan dianalisis secara 2 dimensi menggunakan perangkat lunak Slide 6.0 dengan prinsip kesetimbangan batas menggunakan metode Morgenstern-Price dan Bishop. Lokasi penelitian diidentifikasi sebagai punggungan aliran lava berlereng curam (54%) dan dataran fluvial berlereng sangat landai (46%). Struktur dominan dari lokasi ini memiliki orientasi barat laut – tenggara dan timur laut – barat daya sehingga arah gaya dominan diprediksi bekerja dari utara-selatan atau sebaliknya. Berdasarkan identifikasi arah gaya dominan dan kelurusan, terdapat sesar geser sinistral. Lokasi penelitian tersusun atas batuan homogen berupa satuan lava andesit teralterasi dan endapan pasir kerakalan. Sistem penyangga terowongan berdasarkan RMR berupa *rockbolt, shotcrete* dan *steel support* untuk kualitas massa batuan buruk dan *rockbolt* dan *shotcrete* untuk kualitas massa batuan sedang dan baik. Sistem penyangga terowongan menurut *Q-system* adalah *bolt* yang dipasang secara sistematis atau pemasangan *bolt* di beberapa titik tertentu dengan jarak yang disesuaikan dengan kualitas massa batuan disekitarnya serta penggunaan beton semprot untuk kualitas buruk. Metode penggalian yang direkomendasikan berdasarkan RMR adalah *full face* dengan kemajuan penggalian 1-1,5 meter untuk kualitas massa batuan baik, *top heading* dan *bench* dengan kemajuan penggalian 1,0-1,5 m untuk massa batuan kualitas buruk dan *top heading* dan *bench* dengan kemajuan penggalian 1,5-3 m untuk kualitas massa batuan sedang. Metode penggalian berdasarkan GSI adalah kombinasi antara *ripping, hammer* (dan *blasting*) serta blasting berturut-turut untuk kualitas massa batuan buruk hingga baik. Desain lereng outlet portal dengan kemiringan *bench* 64,21° dan kemiringan seluruhnya 57,44° dianggap aman (FK≥1,5), baik dalam kondisi statik tanpa beban tambahan (FK=2,771 berdasarkan Morgenstern-Price dan FK=2,592 berdasarkan Bishop) dan dengan beban tambahan 10 kN/m^2 (FK=2,528 berdasarkan Morgenstern-Price dan FK=2,527 berdasarkan Bishop) serta dalam keadaan pseudo-statik dianggap aman (FK>1,1), baik tanpa anpa beban tambahan (FK=1,922 berdasarkan Morgenstern-Price dan FK=1,926 berdasarkan Bishop) dan dengan beban tambahan 10 kN/m^2 (FK=1,832 berdasarkan Morgenstern-Price dan FK=1,839 berdasarkan Bishop).

Kata Kunci : geologi teknik; sistem penyangga terowongan; metode penggalian; kestabilan lereng portal; metode kesetimbangan batas; Bintang Bano; Sumbawa Barat; Nusa Tenggara Barat

ABSTRACT

Tunnel 2 of Bintang Bano Irrigation Area is part of the Bintang Bano irrigation network which was built to optimize the utilization of water from Bintang Bano Dam, West Sumbawa, West Nusa Tenggara. Based on the report of subsurface investigation, there were different interpretations of subsurface lithologies, therefore geology and engineering geology conditions need to be re-assesed. The tunnel was designed used Rock Mass Rating (RMR) assessment without any comparison method and the portal tunnel stability is not assess yet. The purpose of this research are to analyze the support system and the stability of the tunnel outlet slope based on the engineering geological conditions at the tunnel construction site. Engineering geology analysis was conducted by mapping surface and subsurface engineering geology. Rock mass quality assessment were used Rock Mass Rating (RMR), Geological Strength Index (GSI) and Q-system methods. The tunnel support system was determined empirically based on the results of the RMR and Q-system rock mass quality assessment, the tunnel excavation method was analyzed empirically based on RMR and GSI. The stability of the tunnel outlet slope was analyzed 2-dimensionally using Slide 6.0 software with the principle of limit equilibrium using the Morgenstern-Price and Bishop methods. The study site was identified as a steeply sloping lava flow ridge (54%) and a very gently sloping fluvial plain (46%). The dominant structure of the site has a northwest - southeast and northeast - southwest orientation, the dominant force direction is predicted works from north - south or vice versa. Based on the identification of the dominant force direction and alignment, a strike-slip fault identified as sinistral fault is predicted. The research location is composed of homogeneous rocks in the form of altered andesite lava unit and alluvium defined as pebble-sand deposit unit. The tunnel support system based on RMR is rockbolt, shotcrete and steel support for poor rock mass quality and rockbolt and shotcrete for medium and good rock mass quality. The tunnel support system according to the Q-system is systematically installed bolts and sprayed concrete for poor quality, and installation of bolts at several specific points with distances adjusted to the quality of the surrounding rock mass. The recommended excavation method based on RMR is full face advance 1-1.5 meters for good quality rock mass, top heading and bench 1.0-1.5 m for poor quality rock mass and top heading and bench 1.5-3 m for medium quality rock mass. Excavation method based on GSI is a combination of ripping, hammer (and blasting) and successive blasting for poor to good rock mass quality. The design of the portal outlet slope with a bench slope of 64.21ºand a full slope of 57.44º is considered safe, both under static conditions without additional load (FoS=2.771 based on Morgenstern-Price and FoS=2.592 based on Bishop) and with an additional load of 10 kN/m^2 (FoS=2.528 based on Morgenstern-Price and FoS=2.527 based on Bishop), and in pseudo-static condition without additional load (FoS=1.922 based on Morgenstern-Price and FoS=1.926 based on Bishop) and with additional load of 10 kN/m^2 (FoS=1.832 based on Morgenstern-Price and FoS=1.839 based on Bishop).

Keywords : engineering geology; tunnel support system; excavation method; stability of outlet portal tunnel; limit equilibrium; Bintang Bano; West Sumbawa; West Nusa Tenggara