

## INTISARI

Terowongan pengelak merupakan salah satu konstruksi bangunan sipil yang digunakan untuk memindah aliran sungai. Pada proyek pembangunan Bendungan Bener di Purworejo, terowongan pengelak dibangun untuk memindah aliran Sungai Bogowonto sehingga pembangunan bendungan dapat dilakukan dengan mudah. Selain sebagai pemindah aliran sungai, saat operasional bendungan, terowongan digunakan sebagai bangunan outlet PLTA di Bendungan Bener. Konstruksi terowongan dilakukan menggunakan metode *New Austrian Tunneling Method* (NATM). Kondisi bawah permukaan tanah yang sangat variatif ditambah ketidakmampuan uji bor menggambarkan seluruh lapisan bawah permukaan tanah dapat menyebabkan deformasi yang berlebih pada perkuatan terowongan dengan struktur batuan lemah. Berdasarkan permasalahan tersebut, perlu dilakukan analisis mengenai pengaruh variasi kualitas massa batuan terhadap deformasi yang terjadi pada perkuatan terowongan pengelak Bendungan Bener.

Analisis numeris dilakukan di STA 820 – STA 850 dengan kondisi eksisting, variasi nilai GSI, dan variasi *disturbance factor* batuan di sekitar terowongan menggunakan permodelan 3D dengan perangkat lunak Rocscience 3D. Simulasi konstruksi terowongan dimulai dengan ekskavasi batuan, pemasangan perkuatan sementara, dan perkuatan akhir. Pengecekan *displacement* dan tegangan dilakukan pada perkuatan akhir terowongan.

Berdasarkan analisis diperoleh *displacement* maksimum pada terowongan pada kondisi eksisting 0,984 mm dan tegangan efektif sebesar 4,036 MPa. Pada kondisi variasi nilai GSI diperoleh *displacement* sebesar 0,984mm dan tegangan efektif maksimum sebesar 4,366 MPa. Variasi nilai *disturbance factor* memberikan *displacement* maksimum sebesar 0,984 mm dan tegangan efektif yang terjadi sebesar 4,209 MPa. Struktur *lining* terowongan dalam kondisi aman terhadap variasi kualitas massa batuan di sekitar terowongan berdasarkan simulasi menggunakan perangkat lunak Rocscience 3D.

Kata kunci : terowongan pengelak, variasi kualitas massa batuan, GSI, *displacement* maksimum

### **ABSTRACT**

*Diversion tunnel is an underground passageway used to divert flowing river around a construction site. In the construction project of Bener Dam in Purworejo, a diversion tunnel was built to diverse the flow of Bogowonto River, so to ease the construction of the dam. Furthermore, apart from being utilized as flow control during the construction phase, the diversion channel was subsequently used as a hydropower plant outlet during the operational phase of the dam. To construct the tunnel, New Austrian Tunnelling Method was utilized. However, a very variative subsurface condition, in addition to inadequacy of the bore test to completely portray all levels of subsurface soils have been proven to cause an excess deformation in reinforcement of the tunnel with relatively weak rock structure. Considering those problems, an analysis regarding the influence of rock quality variation on such deformation in Bener Dam diverse channel is needed.*

*Numerical analysis was carried out at STA 820 - STA 850 with scenarios of existing conditions, GSI values that are varied, and rock disturbance factors that are varied around the tunnel using 3D modelling with Rocscience 3D software. The tunnel construction simulation begins with rock excavation, temporary reinforcement, and final reinforcement. Displacement and stress checks were carried out at the end of the tunnel's reinforcement.*

*Based on the analysis, it was obtained that the maximum displacement at the tunnel in the current condition was 0.984 mm and the effective stress is 4.036 MPa. In the condition of a varied GSI value, the displacement was 0.984 mm and the maximum effective as is 4.366 MPa. Further, providing a variation to the value of disturbance factor gave a maximum displacement of 0.984 mm and the effective stress of 4.209 MPa. In conclusion, the lining structure of the channel is in a safe condition to the variation of rock quality around the channel, according to the simulation that have been conducted using Rocscience 3D.*

*Key words: diversion tunnel, rock mass quality variation, GSI, maximum displacement*