

Long-term stability analysis of tunnel lining in weak rocks using data from tunnelling construction.

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1 INTRODUCTION

Time-dependent deformation of weak rocks has a significant effect on the stability of underground structures. Tunnel surrounding ground deformation in weak rocks may causes to gradual development of loading on the support system and threatens the tunnel stability. The host rock of Shibli tunnels are mainly composed of gray to black Shale, Marl and calcareous Shale. Geological maps and reports demonstrate a heavily jointed condition in the host rock through two orogenic phases. In this research, the time-dependent behavior of the Shibli tunnel host rock was numerically simulated considering Burger-creep viscoplastic model (CVISC). Displacement based direct back analysis using univariate optimization algorithm were applied and properties of the CVISC model and initial stress ratio were estimated for the rock mass.

Using back analysis results, creep behavior of the rock mass was modeled during tunnel service life. The assessments of the loading induced on the final lining due to creep behavior of rock mass were performed by means of support capacity diagrams.

Figure 1 represents the thrust–bending moment interaction diagram for spring line of the tunnel lining. Simulation results show that thrust force, bending moment and the resulting axial stresses will remarkably increase at the spring line of the final lining with time.

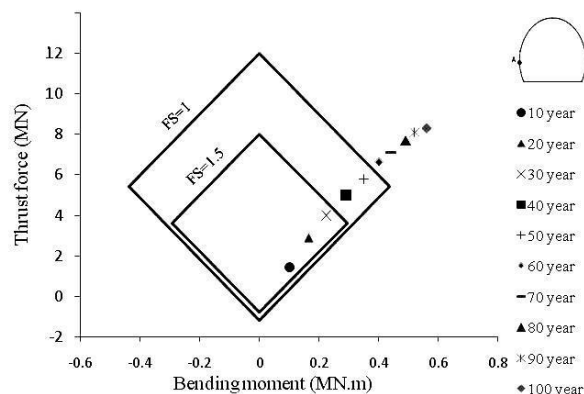


Figure 1. thrust–bending moment interaction diagram for spring line of the tunnel lining.

2 CONCLUSION

Based on the present work, the time-dependent features of weak rock mass should be taken into account in the long-term design and maintenance of tunnels.

After approximately 55 years, the compressive strengths of concrete lining are unable to withstand the induced-stresses by thrust force and bending moment. So, rehabilitation of tunnels was recommended.