

Main Influence Factors for Penetration Rate in Tunnelling

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Extended Abstract

The target of this study is to establish the influence factors for penetration rate of soft rock in EPB shield TBM tunnel site. The tunnelling site is located at Kyoung-Ki province in South Korea. The bed rock is a banded gneiss of the Cenozoic Tertiary metamorphic rock. The depth of TBM lateral tunnel is about 50m from the ground surface, there is no underground water in this site. Total length of lateral tunnel is 2.26km, outside diameter of tunnel is 3.0m. TBM for excavation, which was made by KAWASAKI from Japan in 2013, has capabilities of maximum RPM 9, total thrust 9,600kN and curve radius 120m[3].

To analyse the main influence factor for the penetration rate in situ excavation data, stepwise regression analysis was conducted. The input data are total 15 factors, such as eight ground factors including TCR, RQD, Lugeon, Absorption, Elastic velocity, UCS and Young's modulus[1], and seven TBM factors including thrust, Jack pressure, RPM, Torque, cutter rotation pressure, screw torque and face earth pressure[2]. The machine raw data of TBM data acquisition system based on the excavation length of about 1,600m is used, ground conditions are obtained from the boring log data. Some characteristics of ground condition are that the extent of UCS of bed rock is 20 MPa to 97 MPa and the range of RQD is 53 to 96. Some operating conditions of TBM are that the average RPM is about 7.1 and the range of total thrust is 1,500kN to 3,000kN.

To begin with, basic statistical analysis is performed on the response variable which is penetration rate prior to statistical analysis. The results show the normal distribution with an average penetration rate of 31.2mm/min and a standard deviation of 8.8mm/min. And then stepwise regression analysis is performed to find the main influence factors among various factors. From the stepwise regression analysis, it is found that RQD, Young's modulus, RPM and total thrust are the main influence factors affecting penetration rate of the Shield TBM tunnel in this soft rock site. At this time R-sq is 99.6 and Mallows C-p is 3.6. Using the developed regression formula, the remaining excavation rate range is estimated as 21.4mm/min to 32.9mm/min. After excavation 400m length tunnel, real penetration rate is recorded to range 18.1mm/min to 31.0mm/min depending on the ground conditions in tunnel.

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References

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