Construction Technology of TBM Mode for Full-Face Rock Section in Triple-Mode TBM: Post-print

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Abstract

To investigate the construction technology of triple-mode tunnel boring machines (TBMs) operating in TBM mode through full-face rock strata, the shield tunnel section between Luogang Station and Shuixi Station on Guangzhou Metro Line 7 Phase II was selected as the research background. The construction technology of triple-mode TBMs in TBM mode is systematically summarized from four key aspects: muck removal methods, excavation parameter control, cutter management, and stabilizer application. The results demonstrate that: 1) The use of insert-tooth disc cutters in this project resulted in lower consumption and reduced cutterhead torque compared to smooth disc cutters; 2) The dual-channel muck removal system, combining slurry circulation and screw conveyor, significantly reduced the probability of slurry pipe blockage and improved muck removal efficiency; 3) The installation of stabilizers and gripper shoes on the front and middle shields effectively prevented shield body roll during excavation in full-face hard rock strata while enhancing overall shield stability; 4) When excavating tunnels in full-face rock strata using the triple-mode TBM in TBM mode, the operational parameters were as follows: cutterhead rotation speed of 3.0 r/min, total thrust of approximately 15000 kN, torque controlled within 1300 kN · m, and advance rate of 8–12 mm/min.

Full Text

Preamble

Tunneling Technology of Three-Mode Tunnel Boring Machine in TBM Mode for Full-Section Hard Rock

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Abstract

To investigate the construction technology of three-mode tunnel boring machines (TBMs) operating in TBM mode within full-section rock strata, this study examines the Luogang Station–Shuixi Station shield tunnel interval of Guangzhou Metro Line 7 Phase II as a case study. The tunneling technology is systematically reviewed from four key aspects: muck removal methods, excavation parameter control, cutter management, and stabilizer application. The results demonstrate that: (1) the use of button cutters, as opposed to smooth cutters, leads to reduced cutter consumption and lower cutterhead torque; (2) the dual-channel muck removal system, combining slurry circulation with a screw conveyor, significantly reduces the probability of slurry pipe blockage and enhances muck removal efficiency; (3) the installation of stabilizers and gripper shoes on the front and middle shields prevents shield rolling during excavation in full-face hard rock formations while simultaneously enhancing overall shield stability; and (4) when excavating tunnels in full-section rock strata using three-mode TBMs in TBM mode, optimal operating parameters include a cutterhead rotation speed of 3.0 r/min, a total thrust of approximately 15,000 kN, torque controlled at 1,300 kN · m, and an advance rate of 8–12 mm/min.

Keywords: rail transit; three-mode TBM; hard rock section; excavation efficiency; full-section rock stratum

Note: Figure translations are in progress. See original paper for figures.