Construction Technology for the Intersection Section of Inclined Shaft and Main Tunnel in Dapanshan Tunnel (Postprint)

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Abstract

The construction of inclined shafts in extra-long highway tunnels constitutes a significant auxiliary construction measure that increases working faces, facilitates muck removal and material transportation, improves ventilation, and enhances construction efficiency, thereby playing a vital role in schedule assurance. The right line of the Dapanshan Tunnel extends 8678 m, with an inclined shaft length of 1498 m, a comprehensive slope of 9.99%, an intersection angle of 66°35 08 between the inclined shaft and main tunnel, and Class III surrounding rock. Drawing upon the Dapanshan extra-long tunnel project of the Hangzhou-Shaoxing-Taizhou Expressway, this paper presents a detailed description of technical measures for the intersection section, including the two-bench excavation method (with cycle advance of 2–3 m), I18 steel arch supports and lock-foot anchor bolts, installation of reinforced steel support rings, main tunnel roof-lifting and transition to bench method construction, as well as monitoring and measurement of crown settlement and clearance convergence. Monitoring results demonstrate cumulative crown settlement of 8.2 mm and cumulative peripheral convergence of 4.69–8 mm, both substantially below the $±$100 mm control standard. Construction from the inclined shaft intersection to completion of main tunnel roof-lifting required only 27 days, with safe operations and controllable deformation, which can serve as a reference for similar intersection sections in extra-long tunnel projects.

Full Text

Preamble

Construction Technology at the Intersection of Inclined Shaft and Main Tunnel in Dapanshan Tunnel

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Abstract

Inclined shaft construction serves as a crucial auxiliary measure in extra-long highway tunnel projects, providing additional working faces, facilitating muck removal and material transport, improving ventilation, and enhancing overall construction efficiency—thereby playing a vital role in ensuring project schedules. The right line of the Dapanshan Tunnel extends 8,678 meters, with its inclined shaft measuring 1,498 meters in length at an overall gradient of 9.99%. The intersection angle between the inclined shaft and main tunnel is 66°35 08 , traversing Grade III surrounding rock.

Drawing upon the Dapanshan extra-long tunnel project on the Hangzhou-Shaoxing-Taizhou Expressway, this paper presents a detailed account of key technical measures implemented at the intersection section. These include the two-bench excavation method (with a cycle advance of 2–3 meters), I18 steel arch support with lock-foot anchor bolts, installation of reinforced steel ring supports, main tunnel roof-lifting operations, transition to bench method construction, and monitoring of crown settlement and clearance convergence.

Monitoring results demonstrate a cumulative crown settlement of 8.2 mm and peripheral convergence ranging from 4.69 to 8 mm, both substantially below the control standard of $±$100 mm. The section progressed from inclined shaft intersection to main tunnel roof-lifting completion in a mere 27 days, achieving safe construction with controllable deformation. These practices can serve as a valuable reference for similar extra-long tunnel projects involving inclined shaft and main tunnel intersections.

Keywords: roof-lifting, intersection section, bench method, temporary shed support

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