偏压富水软岩大断面隧道下穿建筑物地层变形及影响分析

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ANALYSIS OF STRATA DEFORMATION AND STRUCTURE IMPACT DUE TO LARGE SECTION WATER-ABUNDANT SOFT ROCK SHALLOW TUNNEL UNDER UNSYMMETRICAL PRESSURE PASSING THROUGH EXISTING STRUCTURE

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摘要 偏压富水软岩大断面隧道施工引起的地层变形是多方面影响因素叠加的结果。结合武广高铁尖峰顶隧道下穿地表高压输电线塔的工程实践，首先对隧道施工前后地层变形监测和分析提出控制大变形的工程措施，然后采用综合统计和理论分析，研究地形条件、地层产状、隧道和通道施工、地面荷载、地表坍塌造成的地层变形与建筑物位移的关系，最后以流固耦合数值分析为手段对影响地层变形的关键因素进行量化分析。结果表明：(1) 偏压富水软岩大断面隧道下穿工程，地表地形引起的地层变形是影响地表建筑物水平位移和倾斜的主要因素；(2) 地层变形叠加效应对建筑物倾斜的影响存在明显的方向性，当多重因素引起的地层变形产生互逆方向位移叠加时对控制建筑物倾斜有利；(3) 软岩顺层斜坡地面下的大断面偏压隧道施工，地层变形在垂直于隧道轴线两侧呈非对称分布，变形最大区域位于向山坡侧；(4) 从影响地层变形长期效应上看，因施工引起的地层变形增量波动大但收敛快，地表地形引起的地层变形在施工后仍持续发展，成为影响建筑物安全性的长期潜在因素。

关键词： 隧道工程 大断面偏压隧道 近接施工 地层变形 变形监测 流固耦合

Abstract： The strata deformation of large section water-abundant soft rock shallow tunnel under unsymmetrical pressure passing through existing structures would be effected by several factors. This article considers the Jianfengding tunnel on the Wuhan—Guangzhou high-speed railway when electricity pylons are present on the ground surface. First，the article describes the engineering measures needed as in-situ measured data to control large strata deformation. Second，statistical and theoretical analyses comprehensively studies the relationship between strata deformation and the impact of the existing building as affected by terrain condition，attitude of stratum，tunnelling construction，tunnel cross-hole construction，ground load，and ground collapse. Third，quantitative analysis is performed on strata deformation brought about by several critical factors and based on coupled fluid-mechanical numerical computation. The main results include：(1) the strata deformation result for the attitude of the stratum is a major factor that affects the horizontal displacement and obliquity of the buildings for these large-section，water-abundant tunnels shallow-buried through soft rock under unsymmetrical pressure；(2) the additive effects on strata deformation have directional properties so that the critical factors with inverse direction can control the obliquity of the structures or buildings well；(3) the strata deformation distributes disymmetrically along the tunnel central line and the regions of greatest deformation occur at the hillside where the unsymmetrical large-span tunnel is excavated under a slope with soft-rock bedding；and (4) in a longer time，the strata deformation change with large fluctuations brought about by the tunnel excavation rapidly converges. However，the strata deformation change brought about by the attitude of the stratum shows a more persistent oscillation after tunnel excavation，and this has a lasting effect on building safety.

Keywords： tunnelling engineering large section bias pressure tunnel nearby excavation strata deformation deformation monitoring coupled fluid-solid

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