岩石力学与工程学报 2007 26 (2007-S2): 3704 ISSN: 1000-6915 CN: 42-1397/O3

双连拱隧道偏压段管棚效应分析（英文）

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收稿日期 2007-6-12 修回日期 2007-7-9 网络版发布日期 2008-1-30 接受日期 2007-7-15

摘要 在海床复杂的地质条件下，海底双连拱隧道与陆地连接的浅埋软岩段容易形成偏压，从而影响围岩的稳定性。采用三维弹塑性有限差分法对双连拱隧道进口偏压段管棚的预支护作用进行分析，并分析了不同管棚参数下的计算结果。研究的主要内容包括：(1) 计算了隧道在有管棚支护和无管棚支护条件下的拱顶下沉和塑性区分布；(2) 给出了管棚设计参数和优化参数下不同的变形和弯矩变化；(3) 分析了拱顶下沉和水平收敛的FEM计算结果和实际测量结果。 计算结果表明，管棚支护和注浆加固围岩能有效减小隧道周围由偏压引起的塑性区，软岩中双连拱隧道偏压段采用管棚支护是很必要的；偏压通常会使连拱隧道侧洞的应力状态不同从而造成围岩变形的不同，为了更有效地控制围岩变形在管棚支护的设计中应该采用不均衡设计；数值计算结果与实测结果的一致性进一步说明了管棚优化设计的合理性。

关键词 隧道工程；双连拱隧道；偏压；管棚；有限差分法

分类号

PIPE SHIELD EFFECT ANALYSIS OF DOUBLE-ARCHED TUNNEL UNDER UNSYMMETRICAL PRESSURES

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Abstract

Under the complex geological conditions of seabed，the pressure on surrounding rock of shallow double-arched tunnel is usually unsymmetrical，especially when the tunnel is connected to land and surrounded by soft rock. Consequently，the stability of the surrounding rock will be affected by the unsymmetrical pressures. In this paper，the pre-support function of pipe shield on unsymmetrical pressure section of double-arched tunnel was analyzed by using three-dimensional elasto-plastic contact finite difference method. The calculation results with different parameters of the pipe shield or tunnels were compared to analyze the effect of pipe shield. The mainly numerical results include：(1) the plastic zone and crown subsidence of the tunnel with/without pipe shield were simulated，respectively；(2) comparison of the deformation and moment of pipe shield according to design parameters or optimized parameters of pipe shield is conducted；and (3) comparison of crown subsidence and horizontal convergence displacement of FEM results with the corresponding item of actual measured results is performed. Pipe shield and grouting-reinforced rock can reduce the plastic zone around tunnel caused by unsymmetrical pressures effectively and it is necessary for double-arched tunnel in soft rock under unsymmetrical pressures to adopt pipe shield pre-support. Unsymmetrical pressures usually bring different stresses to lateral cavities of tunnel and the deformation of surrounding rock is uniform. Unbalanced design should be adopted for pipe shield in order that the deformation and stress can be controlled effectively. The result of numerical simulation is in accordance with the actually measured data，and it is proven that optical design of pipe shield is reasonable.

Key words tunneling engineering；double-arched tunnel；unsymmetrical pressures；pipe shield；finite-difference method

DOI:

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