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基于有限差分法的隧道新型支护结构稳定性分析

华 渊1，朱赞成1，周太全1，连俊英1，宋卫东2

(1. 江南大学 土木工程系，江苏 无锡 214063；2. 北京科技大学 土木工程系，北京 100083)

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摘要　聚丙烯纤维混凝土具有良好的变形性能，可以很好地适应隧道施工过程中围岩应力释放而产生的围岩压力；混凝土湿喷技术的引入可有效地改善隧道内工作环境，提高混凝土喷射质量。将湿喷聚丙烯纤维混凝土和锚杆应用于隧道支护结构，可起到良好的经济效益和支护效果。为了确保隧道施工过程的安全性和稳定性，采用FLAC有限差分计算软件对该支护结构性能和隧道的稳定性进行了计算和分析。分析模型中考虑围岩材料的非线性特性，以及围岩－支护结构体系位移场、塑性区和锚杆轴力的分布特征。分析结果表明：这种支护结构可有效地降低拱顶下沉，底板上鼓，提高成洞空间；围岩和支护结构体系协同工作，极大地发挥围岩的自承载能力。

关键词　隧道工程；聚丙烯纤维混凝土；铁路隧道；支护结构；稳定性；数值分析

分类号

NUMERICAL ANALYSIS OF STABILITY USING FINITE DIFFERENCE METHOD FOR NEW-TYPE SUPPORTING STRUCTURE TUNNEL

HUA Yuan1，ZHU Zan-cheng1，ZHOU Tai-quan1，LIAN Jun-ying1，SONG Wei-dong2

(1. Department of Civil Engineering，Southern Yangtze University，Wuxi 214063，China；
2. Department of Civil Engineering，University of Science and Technology Beijing，Beijing 100083，China)

Abstract

The polypropylene fiber reinforced concrete has higher flexibility and is suitable for supporting structure to adapt the rock mass pressure involved in tunnel rock mass stress relaxation during tunnel construction process. The wet sprayed technology introduced in tunnel engineering can effectively improve the working conditions in tunnel and improve the sprayed concrete quality. The wet-sprayed polypropylene fiber reinforced concrete and anchor system introduced in tunnel supporting structure can achieve good economy effect with better supporting structure compared with the dry-sprayed common concrete. For the safety and stability of tunnel construction process，the numerical analysis of the new-type supporting structure stability and the mechanical characteristics is performed using FLAC (fast Lagrangian analysis of continua). The nonlinear properties of material for rock mass is considered in detail. The

distribution of displacement，plastic zone of the rock mass and supporting structure and the axial force distribution of anchor bolt are obtained using the numerical analysis. The results show that the supporting structure can effectively reduce the vault downward displacement and the bottom floor upward displacement enlarging the cavity headroom. The rock mass with the supporting structure works well with each other utilizing the utmost self-bearing capacity of the rock mass.

Key words tunneling engineering；polypropylene fiber reinforced concrete；railway tunnel；lining structure；stability；numerical analysis

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通讯作者