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软土隧道纵向剪切传递效应的三维数值模拟分析

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摘要　采用三维空间模型对软弱地层中隧道衬砌结构进行数值模拟分析计算，针对隧道施工及使用阶段可能遇到的荷载及变形作用两类典型受荷状态，对比分析了这两种作用、不同作用方式下，隧道纵向剪切传递规律及其对纵横向内力的影响，找到了隧道纵向不均匀变形引起的纵向剪切传递的机理以及变形不同区段的隧道横向变形受力特征，证实了纵向剪切传递是导致隧道横向内力变化的关键因素，得到了纵向剪切传递对隧道横向结构及接头变形的抑制作用以及与隧道横断面最大附加内力的线性相关性、与隧道原始内力正负叠加效应等重要结论，对隧道横向设计中考虑纵向变形的影响具有重要参考价值。

关键词　隧道工程；纵向沉降；纵向剪切传递；三维数值模拟

分类号

3D MODELING OF LONGITUDINAL SHEAR TRANSFERENCE OF TUNNEL IN SOFT GROUND

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Abstract

With regard to the two typical states of loading and unloading actions of tunnel encountered in soft ground during construction and service stages，three-dimensional numerical method is applied to analyze the longitudinal shear transference of segment tunnel lining. The influence of the two types of actions on internal forces of tunnel cross-section and their characteristics are presented，which verify that the longitudinal shear transference is closely correlated with the key factor of influencing on the internal forces of tunnel cross-section caused by longitudinal loading and unloading action on the tunnel. It is concluded that the longitudinal shear transference restrains the unequal deformation of tunnel cross-section，and leads to more bearing load on tunnel lining and less bearing load on ground in the meanwhile. The additional internal forces of tunnel cross-section caused by longitudinal actions vary linearly with longitudinal shear transference and its superposition forms with significant original forces variation along the longitudinal axis of tunnel. The positive superposition occurs at the passive deformation part and is the critical control state of design. These results are obtained for the first time and will be benefit to the cross-section design of tunnel in soft soil while considering the effect of unequal longitudinal load and settlement.

Key words　tunneling engineering；longitudinal settlement；longitudinal shear transference；3D modeling

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