

Optimized Design of Piled Embankment Using a Multi-Effect Coupling Model on a Coastal Highway

Aobo Zhang^{1,2} Hong Pan³ Haitao Yu^{1,2} Zhen Liu⁴ Cuiying Zhou⁴

(1. Guangdong Provincial Academy of Building Research Group Co.,Ltd. Guangzhou 510500;

2. Guangdong Construction Engineering Quality & Safety Testing Head Station Co.,Ltd. Guangzhou 510500;

3. School of Civil Engineering and Transportation, South China University of Technology, Guangzhou, Guangdong 510640, China

4. School of Civil Engineering, Sun Yat-sen University, Guangzhou 510275, China)

Abstract: In the design and calculation of geosynthetic reinforced pile-supported embankment (GRPSE), most of them only consider the arching effect or membrane effect to calculate the settlement stability. It is difficult to truly reflect the actual situation of the project, resulting in inaccurate results. In the process of design and construction, measures such as reducing the distance between piles are usually used to control the settlement stability, resulting in high project cost. In this paper, three-dimensional soil arching effect, membrane effect and pile-soil interaction effect are coupled together to establish a multi-effect coupling settlement calculation model, which provides evaluation standard for optimal design. On this basis, the objective cost function with structural parameters as variables is established, and the influence of structural parameters on settlement is analyzed by three-dimensional numerical simulation. Finally, the design optimization method of GRPSEs is put forward, and the method is applied in practical engineering to verify. The results show that the settlement calculation model based on multi-effect coupling can accurately reflect the actual settlement of the project under the comprehensive consideration of arching effect, membrane effect and pile-soil interaction effect. It can provide a reasonable evaluation standard for the design optimization method. The engineering cost was reduced by 25.4%, and the settlement calculation method of the optimized plan improved the calculation accuracy by 6%. The proposed optimization method can save project cost to the maximum under the premise of reducing the amount of engineering settlement, and provide a new optimization method for engineering design.

Keywords: geosynthetic-reinforced pile-supported embankment; arching effect; membrane effect; multi-effect coupling; geosynthetics