Comparative Analysis of Midas GTS NX and SLOPE/W Numerical Simulation Softwares

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Abstract

There are many kinds of numerical simulation software used in geotechnical engineering, and different softwares have different characteristics and scope of application. In specific engineering applications, appropriate software should be selected for simulation analysis according to the characteristics and scope of application of the software. At present, the commonly used numerical simulation software are Midas GTS NX and SLOPE/W. This paper makes a comparative study of these two finite element analysis software, which can help experts and scholars to better grasp their respective characteristics. In the actual project in the future, a more reasonable software will be used for modeling and analysis.

Keywords

Finite element analysis; Comparison of numerical simulation software; Subway tunnel; Foundation pit slope.

1. Introduction

With the rapid development of urbanization in China, it has resulted in the accelerated increase of urban population and the continuous expansion of urban scale, which is bound to consume a certain amount of natural resources. As the basis of human survival and development, because of its limited quantity, fixed location and irreplaceability, the contradiction between land supply and land demand in the process of urbanization has become increasingly prominent. Therefore, it promotes the vigorous development of high-rise buildings and the full use of underground space, and improves the requirements for the stability and safety of building engineering. However, there are still many safety accidents in specific engineering cases. Once the overlying building is damaged by the deformation of the foundation project, the consequences are difficult to estimate. At the same time, due to the instability of some slopes, the utilization rate of land will be reduced.

Therefore, in order to reduce the occurrence of safety accidents, improve the space utilization rate, study the influence of foundation pit engineering on the overlying buildings and the surrounding environment, predict the engineering risk of foundation pit engineering to the surrounding existing buildings, and evaluate the stability of the slope, it is of great help to the actual engineering through accurate modeling and analysis with the help of numerical simulation software. For example, Ren Weidong [1] in view of the situation that the slope angle is small and the open-pit slope covers more resources in an open-pit, the generation model is established by the coupling of CAD and finite element software, and the representative profile is selected by Mohr-Coulomb constitutive relation. Combined with the displacement changes of different steps in the process of excavation, stability analysis is carried out. Hu Haiying et al. [2] comprehensively analyzed the influence of foundation pit excavation on subway tunnel by using Midas/GTS finite element software for numerical

simulation and tunnel measurement, so as to provide useful reference for engineering optimization design and construction. Chen Hui et al. [3] use MIDAS GTS NX software and ABAQUS software to simulate the deep foundation pit excavation process, compare the simulated data with the measured data, and summarize the respective characteristics of MIDAS GTS NX software and ABAQUS software in the simulation of foundation pit excavation process. Li Yangqiu et al [4] use Midas/GTS finite element software to establish a three-dimensional model to simulate the whole process of tunnel construction, deep foundation pit excavation and building group loading, analyze the impact of project construction on the tunnel in many aspects, and draw useful conclusions. To sum up, it can be seen that most experts and scholars often use a certain numerical analysis software as a research method to analyze the impact of foundation pit excavation on the surrounding environment or slope stability, and to make a risk assessment of the project. Few experts and scholars compare and study the similarities and differences between different numerical simulation software. This paper studies the similarities and differences between Midas GTS NX and SLOPE/W numerical simulation software, which is beneficial to better grasp the respective characteristics of different numerical analysis methods and choose more reasonable numerical analysis software in practical engineering application.

2. Comparative analysis of two kinds of software

2.1 Software introduction

Midas GTS NX is a general finite element analysis software developed for geotechnical field. SLOPE/W is a sub-module software of GeoStudio geotechnical engineering simulation analysis software, and it is one of the most advanced geotechnical slope stability analysis software in the world.

2.1.1 Application range

Midas GTS NX has a wide range of applications, which is suitable for accurate modeling and analysis of various practical projects, such as subway, tunnel, slope, foundation pit, pile foundation, hydraulic engineering, mine and so on, and provides professional modeling assistant and database. The application range of SLOPE/W is relatively small. It mainly analyzes and evaluates almost all the slope stability problems encountered in the fields of geotechnical engineering, water conservancy and hydropower, municipal engineering, civil engineering, mining engineering and so on. It is typically used in natural geotechnical slope, slope formed by excavation, excavation foundation pit retaining wall and so on.

2.1.2 Analytical method

Midas GTS NX can consider the most important material nonlinearity and the initial stress state of rock and soil in geotechnical analysis to reflect the actual field situation as much as possible. Under different loads and boundary conditions, the analysis that can be carried out includes static analysis, seepage analysis, stress-seepage coupling analysis, consolidation analysis, construction stage analysis, dynamic analysis, slope stability analysis and so on. SLOPE/W uses limit equilibrium theory, software built-in a variety of slip surface search methods, pore water pressure conditions, soil strength constitutive, reinforcement components and load conditions, etc., can analyze the stability of the slope, can carry out slope failure probability analysis and parameter sensitivity analysis, but also can use the finite element method to effectively analyze and calculate most of the slope stability problems.

2.1.3 Constitutive model

In terms of constitutive models, both, Midas GTS NX and SLOPE/W contain a variety of models, and they contain some of the same constitutive models. The constitutive models provided by Midas GTS NX include wired elasticity, transversely isotropic elasticity, Mohr-Coulomb, Hawk-Brown and generalized Hawk-Brown models. The constitutive models provided by SLOPE/W include Mohr-Coulomb, impermeable, bilinear, anisotropic, Hawk-Brown and friction-undrained composite models. Two of the software provide the same constitutive model, including Mohr-Coulomb model and Hawk-Brown model.

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