A simplified testing method for stress-induced of tunnel surrounding rock *

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Abstract A simple testing method for secondary or induced stress of surrounding rock was presented by laboratory experiment, numerical simulation and in situ testing based on the basic principle of the historical stress restoring method. First, stress equivalent coefficient, which key coefficient of stress restored testing, was obtained by laboratory experiment. Second, experimental results were examined using 3D finite element numerical analysis and the influence factors were analyzed by 2D finite element numerical analysis. The correctness of induced stress measuring results in situ for highway tunnel were proved by elastic mechanics theory solution and single-hole stress rescission method. The new simple method of induced stress measuring has important practical value for underground engineering induced stress field analysis.

Keywords stress-induced, stress measurement, numerical analysis, experiment

Introduction

The knowledge of induced stress of surrounding rock has to be one of key issues in underground engineering stability analysis. As early as the 1930s, the method of testing cavern wall's strain had been used to account in situ stress of rock. After the 50s, people researched emphatically the undisturbed stress state of deep rock. Then Lehmann's 'portal plug' strain gauge, Hast's piezomagnetism stress gage and three-direction stress gage etc. Since the 50s, China began the research of rock testing. Until now we have a relative mature method of stress testing.

Site testing of rock stress includes initial stress testing and testing of surrounding rock for tunnel. There are many methods, but each has its own advantages and disadvantages. Nowadays, general methods are classified as two main kinds: stress relief method

and stress restoring method, of which stress relief method is comparatively mature and widely applied. Stress restoring method is commonly used for tunnel wall surface measurement of the induced stress field influenced by excavation disturbance.

After installing a measuring element on the selected test point, a flat groove to burry hydraulic pillow or jack in rock is excavated. Compression is used to make it recover to the reading before cutting. The pressure reading of the hydraulic steel pillow or jack is just the rock stress in that direction. The advantage is that we can directly get the rock stress without considering the relation between stress and strain of rock. While its limits lies in: First, flat jack method is only a one-dimension stress testing method. Testing of a flat groove can only assure the stress component that is vertical with the flat jack at the test point. In order to determine these stress components of the test point,