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考虑参数分布特征的隧道围岩稳定失效概率计算

Failure probability calculation for surrounding rock stability of tunnel considering random parameter distribution characteristics

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中文关键词： 计算力学 隧道变形 抽样方法 失效概率 响应面法

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中文摘要:

基于围岩变形破坏原理,建立了围岩稳定极限状态方程的普遍形式,研究了响应面方法求解该方程的过程,得出经典响应面方法仅仅适用于围岩物理力学参数随机分布曲线偏度系数为零的情况。针对围岩物理力学参数统计分布曲线的复杂性,利用统计矩参数对随机变量分布曲线形态特征的控制作用,提出了抽样样本修正方法和具体计算公式,归纳了修正后响应面算法的运行程序。以某公路隧道为例,分别采用经典算法和修正后算法计算了围岩稳定可靠度,然后与蒙特卡洛模拟结果进行了对照,经典方法计算结果与准精确解的绝对误差为1.017%,修正方法的计算结果与准精确解的绝对误差为0.388%。

英文摘要:

A general expression of limit state equation for surrounding rock stability was established based on its deformation failure principle. A procedure of resolving this equation was investigated through response surface method (RSM), which deduced that the classical RSM was only suitable for the circumstance that the skewness coefficient of distribution curve for physical and mechanical parameter of surrounding rock is zero. Subsequently, aiming at the complexity of statistical distribution curve for these physical and mechanical parameters of surrounding rock and according to the effects of statistics moment parameters on the configuration of distribution curve for random variables, a modified method and its corresponding calculation formulae for samples were proposed. An algorithm for the improved RSM was further summarized. Taking a certain highway tunnel as an example, the reliability of surrounding rock stability was calculated by the classical RSM and the improved RSM, respectively. The computed results were compared with those obtained by Monte Carlo Simulation (MCS) method, which reveals that the absolute error of calculated results between the classical RSM and MCS method is approximate to 1.017%, whereas the absolute error of computational results between the improved RSM and MCS method is found to be 0.388%.

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