

# 三峡永久船闸边坡岩体在复杂应力路径下的变形特性

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**摘要** 三峡永久船闸边坡开挖后, 岩体应力调整, 且其变化路径复杂。为研究三峡永久船闸边坡岩体在此状态下的变形特性, 在边坡勘探平洞进行复杂应力路径下的原位岩体真三轴试验, 试验荷载模拟边坡初始地应力场及其在边坡开挖过程中的变化情况, 按3种路径施加: s1卸载时, s2和s3保持不变; s1加载时, s2保持不变, 而s3同步卸载; s1卸载时, s2保持不变, 而s3同步加载。根据试验结果, 建立此3种应力路径下岩体切线弹性模量Et与主应力差间的经验关系式, 分析边坡岩体的变形特性。研究结果表明: 在一个主应力减小(卸荷)、另一主应力增加(加载)的应力路径下, 岩体变形具有非线性和各向异性; 在卸荷方向, 切线弹性模量随有效主应力差(负值)的减小而加速减小; 在加载方向, 切线弹性模量基本保持稳定。

**关键词** 岩石力学; 真三轴试验; 应力路径; 卸荷; 非线性变形; 切线弹性模量

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## DEFORMATION PROPERTIES OF ROCK MASS OF TGP PERMANENT SHIPLOCK SLOPES UNDER COMPLEX STRESS PATHS

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### Abstract

In the course of excavating permanent shiplock slopes of the Three Gorges Project(TGP), the rock mass stress in the slopes area adjusted along complex paths. Aiming at the deformation properties of the rock mass in that state, in-situ real triaxial tests are carried out on rock mass with complex loading paths. Simulating the initial stress field and its variation patterns, the experimental load is applied under the following three loading paths: (1) s1 decreases, s2 and s3 maintain constant in the same course; (2) s1 increases, s2 maintains constant and s3 decreases in the same course; (3) s1 decreases, s2 maintains constant and s3 increases in the same course. Based on the testing data, the relationships between the elastic modulus and the principal stress difference under such loading paths are acquired, and the deformation properties of the slope rock mass are analyzed. The result indicates that, when a principal stress decreases and another one increases in the same process, the deformation is nonlinear and anisotropic. The elastic modulus keeps approximately invariable in the loading direction and speed-up decreasing in the unloading direction in accordance with the decreasing of

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the effective principal stresses.

**Key words** [rock mechanics](#); [real triaxial test](#); [stress path](#); [unloading](#); [nonlinear deformation](#); [elastic modulus](#)

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