

基础类成果

岩土力学极限分析的二、三维理论和方法

【创新性】

滑坡是自然界和基本工程建设中经常遭遇的重大灾害。自上世纪八十年代以来，课题组在多项国家级项目的支持下，结合小湾、三峡和洪家渡等世界级工程，应用塑性力学上下限原理，建立了具有更为严格理论基础和数学力学内涵，边坡稳定、地基承载力和土压力三个领域统一的二、三维极限分析理论体系，包括在边坡领域占重要地位的 Morgenstern-Price 改进方法、基于斜条分的二、三维上限解方法以及对“潘家铮最大最小原理”的严格理论证明等。研究成果已成功应用于三峡、小浪底、紫坪铺、锦屏一级、洪家渡、小湾等重大工程。以此分析方法为主要工具设计建设的紫坪铺右岸高边坡在 5.12 汶川地震中经受了 11 度强震考验，保证了电站输水洞、泄洪洞和溢洪道的安全，已成为边坡抗震工程中罕见的成功案例。

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【影响力】

项目完成人发表与本项目有关的高水平论文 120 余篇（16 篇被 SCI 收录），2 篇代表性专著《土质边坡稳定分析—理论·方法·程序》和《岩质边坡稳定分析—理论·方法·程序》在《中国引文数据库》中分别被引用 2244 次和 955 次。对 Morgenstern-Price 法和 Sarma 法的改进计算公式已被碾压式土石坝和边坡工程等 4 个设计规范列为指定计算方法。依据本研究成果编制的边坡稳定分析软件 STAB 和 EMU 遍及于水利水电、工业和民用建筑等行业 260 余家单位，并入选中国水利水电勘测设计协会颁发的水利水电勘测设计计算机软件名录（2017）。研究工作解决了漫湾、天生桥、龙滩、三峡、小浪底、锦屏一级、小湾、洪家渡等多个工程的关键技术问题，相关成果获得国家科技进步奖 2 项，省部级科技进步奖 12 项。

TWO-AND THREE-DIMENSIONAL THEORY AND METHOD FOR THE LIMIT ANALYSIS OF GEOTECHNICAL MECHANICS

【Innovation】

Landslide is a key disaster that is frequently encountered in the natural world and during basic engineering construction. Since 1980s, supported by various national programs and combined with world-class projects such as the Xiaowan, Three Gorges and Hongjiadu Hydropower Stations, the research group had applied the upper and lower bound theorems of plasticity mechanics to establish a general two- and three-dimensional limit analysis methodology for slope stability, bearing capacity and earth pressure, that boasts a rigorous theoretical basis and integration of mathematics and mechanics. The system includes the improved Morgenstern-price method that plays an important role in the slope stability analysis field, the two-and three-dimensional upper-bound method based on inclined slices, the rigorous theory proof for Pan Jiazheng's maximum and minimum principle, etc.

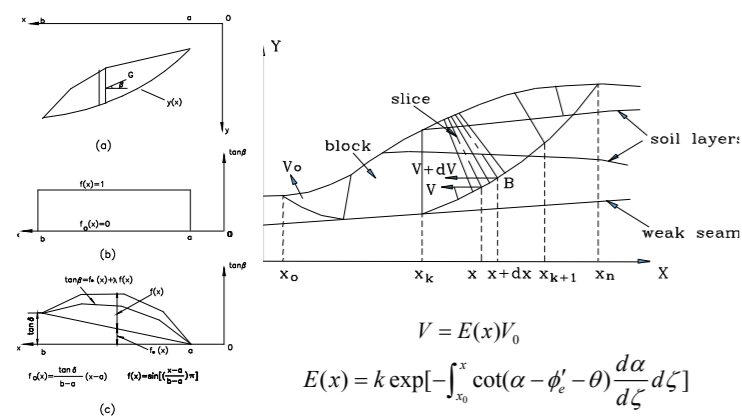
Major research achievements have been successfully applied in Three Gorges, Xiaolangdi, Zipingpu, Jinping First Stage, Hongjiadu, Xiaowan and other key engineering projects. The Right Bank High Slope of the Zipingpu Hydropower Station that was designed and built with the analytic method of this project as a key tool had undergone the test of 11-degree strong shock in the 5.12 Wenchuan Earthquake, and ensured the safety of conveyance tunnels, flood discharge tunnels and spillways of the hydropower station, making it a successful case history of engineered slope projects undergone with a strong seismicity.

【Influence】

The project principal has issued nearly 120 high-level papers (with 16 included into SCI) relating to this project and two representative monographs—Soil Slope Stability Analysis—Theory, Method and Program and Rock Slope Stability Analysis—Theory, Method and Program, which have been cited for 2,244 and 955 times respectively in the Chinese Citation Database. The improved calculation formulas for the Morgenstern-Price and Sarma methods have been classified as designated calculation methods by four design specifications for rolled earth-rock dams, slope projects, etc. The slope stability analysis software STAB and EMU that were compiled based on the achievements of this project have been applied by nearly 260 users, including water conservancy and hydropower, industrial and civil buildings, etc., and listed into the directory of computer software for the investigation and design of water conservancy

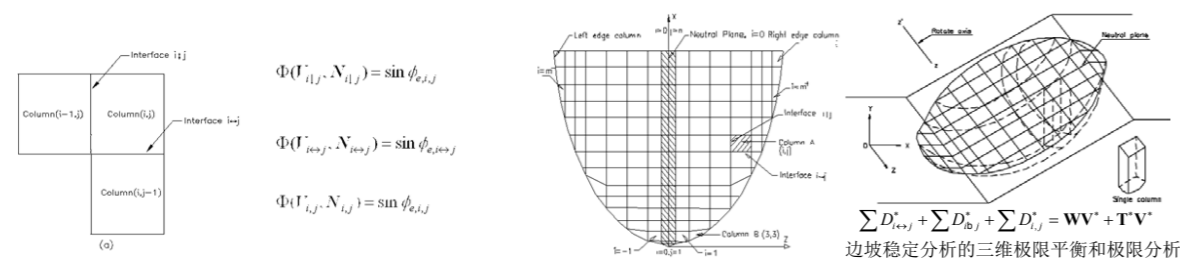
and hydropower projects (2017), which was conferred by the China Water Conservancy and Hydropower Investigation and Design Association (CWHIDA). The research work has solved key technical issues for a number of projects, such as Manwan, Tianshengqiao, Longtan, Three Gorges, Xiaolangdi, Jinping First Stage, Xiaowan, Hongjiadu, etc., and relevant results have won two prizes of the National Science and Technology Progress Award as well as 12 scientific and technological progress awards at provincial and ministerial levels.

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边坡稳定分析的下限解：垂直条分法

边坡稳定分析的上限解：斜条分法



边坡稳定分析的三维极限平衡和极限分析