基础类成果

西部高拱坝抗震安全前沿性基础科学问题研究及其工程应用

【创新性】

围绕重大工程遭遇最大可信地震时不发生次生灾变的战略目标，对我国西部强地震区高拱坝抗震中的场地相关地震动输入、大坝体系地震响应、大坝混凝土动态抗力等基础科学问题开展了全面研究。在合理确定设防水准框架、正确理解输入机制和选择地震动参数等方面，进行了全面系统深化研究。研发了可综合计入无限地基辐射阻尼、坝体横缝、近域地基控制性滑动块体的整体系统显式有限元非线性波动反应分析方法和软件，提出了以典型部位位移突变作为拱坝地基系统整体失稳极限状态判据的拱坝抗震安全评价新方法。首次系统进行大坝全级配混凝土动态性能的试验和细观力学分析。研发了基于高性能计算平台的拱坝动力分析软件，开创了高性能计算在大坝抗震领域应用的先例。

【影响力】

本项目被国家自然科学基金委员会评为“A”类优秀成果并追加资助。主要研究成果已在我国西部强震区高拱坝的抗震设计和复核中被应用，并被国家标准《水工建筑物抗震设计标准》（GB51247-2018）所采纳。溪洛渡拱坝并行有限元计算程序在天河一号计算机的应用，被中央电视台新闻联播节目及 CHINA DAILY 头版作为其应用实例报导。在国内外发表了学术论文共 151 篇（SCI 或 EI 收录 51 篇），出版了中、英文专著《高拱坝抗震安全》，在国内外产生广泛影响。获得 2010 年度首届水力发电科学技术特等奖。

主要完成人：陈厚群、吴胜兴、党发宁、马怀发、周继凯、丁卫华、张翠然、沈德建、刘云贺、李同春

受奖单位：抗震中心

FRONTIER BASIC SCIENCE RESEARCH OF SEISMIC RESISTANCE SAFETY OF HIGH ARCH DAMS IN WESTERN CHINA AND ENGINEERING APPLICATIONS

【Innovation】

To achieve the strategic goal of preventing the occurrence of secondary disasters when key projects encounter a maximum credible earthquake, it conducted all-around research on basic science issues, such as site-specific seismic motion input, seismic response of the dam system, dynamic resistance of concrete dams, etc., during seismic resistance of high arch dams in the meizoseismal area of western China. With regard to the rational determination of the fortification level framework, the proper understanding of input mechanisms and the selection of ground motion parameters, it carried out comprehensive, systematic and in-depth research. It also developed the integral and systematic explicit finite element method and software for nonlinear wave response analysis, which can be comprehensively integrated into the infinite foundation radiation damping, dam transverse joints and near-field ground-controlled sliding blocks, and put forward a new approach that regards the displacement and mutation of typical locations as a criterion for judging the limit state of the overall failure of the arch dam-foundation system to evaluate the seismic safety of arch dams. It initially carried out systematic experiments and mesomechanics analysis of dynamic performance of fully-graded dam concrete. It developed dynamic analysis software for arch dams based on high-performance computing platforms, which was applied in the seismic resistance sector for dams for the first time.

【Influence】

The project was rated as “Class A” outstanding achievements by the National Natural Science Foundation of China and received supplemental grants. Its major research results were applied in seismic design and review of high arch dams in the meizoseismal area of western China, and adopted by the national standard-Standards for Seismic Design of Hydraulic Structure (GB51247-2018). The application of the parallel finite element computing program of the Xiluodu arch dam in the Tianhe-1 computer was reported by CCTV’s News Broadcast program and the front page of China Daily as an application example. It has issued 151 (with 51 included into SCI or EI) academic papers at home and abroad, and published the monograph entitled Seismic Safety of High Arch Concrete Dams in Chinese and English versions, which has had widespread impacts at home and abroad. It won a special prize at the First China Hydropower Science and Technology Award in 2010.

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Award-winning Unit : Earthquake Engineering Research Center