



Studies on Modern Technologies and Long-term Behavior of Dams

Edited by: Jia Jinsheng
Zhang Shuguang
Xu Zeping
Xu Yao



中国水利水电出版社
www.waterpub.com.cn

Studies on Modern Technologies and Long-term Behavior of Dams

Edited by: Jia Jinsheng

Zhang Shuguang

Xu Zeping

Xu Yao



中国水利水电出版社
www.waterpub.com.cn

图书在版编目（C I P）数据

大坝技术及长效性能研究进展：英文 / 贾金生等主
编. — 北京：中国水利水电出版社，2011.9
ISBN 978-7-5084-9018-2

I. ①大… II. ①贾… III. ①大坝—水利工程—工程
技术—文集—英文 IV. ①TV649-53

中国版本图书馆CIP数据核字(2011)第190796号

书 名	Studies on Modern Technologies and Long-term Behavior of Dams
作 者	Edited by: Jia Jinsheng Zhang Shuguang Xu Zeping Xu Yao
出版发行	中国水利水电出版社 (北京市海淀区玉渊潭南路1号D座 100038) 网址: www.waterpub.com.cn E-mail: sales@waterpub.com.cn 电话: (010) 68367658 (发行部)
经 售	北京科水图书销售中心(零售) 电话: (010) 88383994、63202643 全国各地新华书店和相关出版物销售网点
排 版	中国水利水电出版社微机排版中心
印 刷	涿州市星河印刷有限公司
规 格	184mm×260mm 16开本 50.25印张 2876千字
版 次	2011年9月第1版 2011年9月第1次印刷
印 数	001—600册
定 价	120.00 美元

凡购买我社图书，如有缺页、倒页、脱页的，本社发行部负责调换
版权所有·侵权必究

Proceedings of International Symposium on Modern Technologies and
Long-term Behavior of Dams, Zhengzhou, China, Sep. 27-29, 2011

Studies on Modern Technologies and Long-term Behavior of Dams

Edited by:

Jia Jinsheng
Zhang Shuguang
Xu Zeping
Xu Yao



Sponsors:

Chinese National Committee on Large Dams (CHINCOLD)
Yellow River Conservancy Commission of Ministry of Water Resources (YRCC)
Department of Water Resources of Henan Province
China Three Gorges Corporation (CTGPC)
Xiaolangdi Dam Project Construction and Management Bureau

Organizers:

China Institute of Water Resources and Hydropower Research (IWHR)
Henan Provincial Water Conservancy Research Institute

Co-sponsors:

Japan Commission on Large Dams
Korean National Committee on Large Dams
United States Society on Dams
China Huaneng Group
China Huadian Corporation
Gezhouba Power Investment Co., Ltd.
Yellow River Institute of Hydraulic Research
Yellow River Engineering Consulting Co., Ltd.
Henan Water and Power Consulting Engineering Co., Ltd.
Sinohydro Bureau 7 Co., Ltd.
Hydrochina Kunming Engineering Corporation
Zhengzhou UT Geoengineering Technology Ltd.
Beijing CEEVIN New Materials Co., Ltd.
Beijing Research Institute of Construction Engineering Co., Ltd.
Department of Hydraulics and Hydropower Engineering of Tsinghua University
Zhengzhou University
China Three Gorges University
North China University of Water Resources and Electric Power
Graz University of Technology, Austria
University of Innsbruck, Austria
Vienna University of Technology, Austria
Technical Committee on Dams (TC210), ISSMGE
Georisk

Organizing Committee

Chairman

Wang Shucheng President of CHINCOLD
Vice Chairman of Financial and Economic Committee of the National
People's Congress, P. R. China

Vice – chairmen

Jiao Yong Vice Minister of Ministry of Water Resources, P. R. China (MWR)
Vice President of CHINCOLD
Liu Mancang Vice Governor of Henan Province, P. R. China
Cheng Niangao Deputy General Manager of China Huadian Corporation
Tadahiko Sakamoto President of Japan Commission on Large Dams (JCOLD)
Soontak Lee Vice President of Korean National Committee on Large Dams (KN-
COLD)

Members

(Name list in alphabet)
Chen Jun Deputy General Manager of Beijing CEEVIN New Materials Co. , Ltd.
Du Qingping Division Head of Xiaolangdi Dam Project Construction and Manag-
ement Bureau
E. Bauer Professor of Graz University of Technology, Austria
He Jie Deputy General Manager of Henan Water and Power Engineering
Consulting Co. , Ltd.
He Kui Vice President of Beijing Research Institute of Construction Engi-
neering Co. , Ltd.
Jiang Enhui Vice President of Yellow River Institute of Hydraulic Research
Li Faxiang Deputy Director of the Science and Technology and Education Sec-
tion of Department of Water Resources of Henan Province
Li Jianlin President of China Three Gorges University
Li Qingbin Vice Dean of School of Civil Engineering of Tsinghua University
Li Zongkun Vice Dean of School of Water Conservancy and Environmental Engi-
neering of Zhengzhou University
Liu Handong Vice President of North China University of Water Resources and E-
lectric Power

M. Aufleger	Professor of University of Innsbruck, Austria
P. Tschernutter	Professor of Vienna University of Technology, Austria
Peng Jing	Director of Division of International Cooperation of China Institute of Water Resources and Hydropower Research
Shang Hongqi	Director of Department of International Cooperation, Science and Technology, YRCC
Yan Xinchun	Deputy Division Head of China Huaneng Group
Zhang Jinliang	General Manager of Yellow River Engineering Consulting Co. , Ltd.

Advisory Committee

Chairman

Lu Youmei Honorary President of CHINCOLD
Academician of Chinese Academy of Engineering

Vice-chairmen

Gao Bo Director General of Department of International Cooperation, Science
and Technology, MWR

Kuang Shangfu President of IWHR
Vice President of CHINCOLD

Liao Yiwei Deputy Director General of YRCC
Vice President of CHINCOLD

Wang Shushan Director General of Department of Water Resources of Henan Province

Zhang Shuguang Assistant General Manager of CTGPC

Yin Baohe Director General of Xiaolangdi Dam Project Construction and Manage-
ment Bureau
Executive Director of CHINCOLD

Members

(Name list in alphabet)

Cao Yingchao Chief Economist of Xiaolangdi Dam Project Construction and Manage-
ment Bureau

Chen Houqun Academician of Chinese Academy of Engineering
Executive Director of CHINCOLD

Chen Zuyu Academician of Chinese Academy of Sciences
Executive Director of CHINCOLD

Feng Xinsheng Chairman of Gezhouba Power Investment Co. , Ltd.

Kyung-Taek Yum Vice President of Korean National Committee on Large Dams

Norihisa Matsumoto Executive Director of Japan Commission on Large Dams

Wang Hao Academician of Chinese Academy of Engineering
Executive Director of CHINCOLD

Xiang Jian Chief Engineer of Sinohydro Bureau 7 Co. , Ltd.
Director of CHINCOLD

Yan Dakao President of North China University of Water Resources and El-

	ectric Power
Zhang Chuhan	Academician of Chinese Academy of Sciences Executive Director of CHINCOLD
Zhu Bofang	Academician of Chinese Academy of Engineering Executive Director of CHINCOLD
Zou Lichun	Vice President of HydroChina Kunming Engineering Corporation Director of CHINCOLD

Technical Committee

Chairman

Pan Jiazheng	Honorary President of CHINCOLD Academician of Chinese Academy of Science Academician of Chinese Academy of Engineering
--------------	--

Vice-chairmen

Jia Jinsheng	President of International Commission on Large Dams (ICOLD) Vice President and Secretary General of CHINCOLD
Refaat Abdel-Malek	President of International Hydropower Association (IHA)
Xue Songgui	Chief Engineer of YRCC
Wang Jianwu	Deputy Director General of Department of Water Resources of Henan Province
Michael Rogers	President of United States Society on Dams

Members

(Name list in alphabet)

Ai Yongping	Chief Engineer of Hydrolancang Director of CHINCOLD
Chai Fangfu	Deputy Division Head of China Huadian Corporation
D. Adam	Professor of Vienna University of Technology, Austria
Fang Guoguang	Professor of National University of Singapore
Fu Jun	Chief Engineer of Gezhouba Power Investment Co. , Ltd.
G. Hofstetter	Professor of University of Innsbruck, Austria
Hae-Jin Yang	Secretary General of Korean National Committee on Large Dams
Jiang Naiqian	Vice President of Yellow River Institute of Hydraulic Research
Jin Feng	Head of Department of Hydraulics and Hydropower Engineering of Tsinghua University
Jing Laihong	Chief Engineer of Yellow River Engineering Consulting Co. , Ltd. Director of CHINCOLD
Li Yu'e	President of Henan Water and Power Engineering Consulting Co. , Ltd.
Lin Peng	Deputy Division Director of China Huaneng Group Director of CHINCOLD

Liu Jintang	Deputy Chief Engineer of HydroChina Kunming Engineering Corporation
Lu Yihui	General Manager of BEIJING IWHR-KHL Co. , Ltd. Director of CHINCOLD
Tatsuya Ohmachi	President of Japan Dam Engineering Center
Wang Fuming	Professor of Zhengzhou University
Wang Wanjin	Chief Engineer of Beijing Research Institute of Construction Engineering Co. , Ltd.
Wang Zigao	Deputy Chief Engineer HydroChina Kunming Engineering Corporation
Wei Wuji	President of the Research Institute of Beijing CEEVIN New Materials Co. , Ltd.
Yu Cunyang	President of Henan Provincial Water Conservancy Research Institute
Zhang Limin	Professor of The Hong Kong University of Science and Technology

Secretary General

Du Zhenkun	Chinese National Committee on Large Dams
------------	--

Deputy Secretaries General

Yuan Yulan	Chinese National Committee on Large Dams
Zheng Cuiying	Chinese National Committee on Large Dams
Xu Yao	Chinese National Committee on Large Dams

Secretaries

Ma Zhongli	Chinese National Committee on Large Dams
Zhang Yao	Chinese National Committee on Large Dams
Zhang Ju	Chinese National Committee on Large Dams
Yang Huichen	Chinese National Committee on Large Dams

Preface

In recent years, the global economic and social development has encountered many difficulties and problems, such as earthquakes, tsunamis, hurricanes, floods, severe droughts, climate changes, energy and economic crises. History of human development has demonstrated that dam has played and will continue to play an important role in addressing the difficulties and challenges. Dam, which has direct relationship to flood control, food security, water security and energy security, has already become an important part of modern social infrastructures. Therefore, nowadays the construction of dams is further strengthened in stead of weakened. In 2011, Chinese government has issued the “No. 1 document” on accelerating the reform and development of water resources. The document put water security to the high level of the strategic security of the country and takes water infrastructure as the prior area of national development. Recently Chinese government held the top-level meeting on water-related issues. All these actions of the government have signaled a new round of opportunities for China’s water resources and hydropower development and dam construction. As most of the potential projects are located in the southwestern mountainous regions, which have large-scale engineering, complicated geology, poor construction conditions, great challenges will be encountered in the construction. Besides, a lot of existing dams built in the 1950s and 1960s have been running for many years, resulting in a huge task of maintenance and reinforcement due to serious aging issues of disrepair. Under the new situations to meet the requirement of building a resource-saving, eco-friendly society, China’s dam construction has made a lot of useful exploration in playing ecological function of dams. In general, the practice of China’s dam construction has made great achievements while relevant theoretical studies and experience summary are lagging behind the engineering practices. Therefore, it is necessary to strengthen theoretical studies and absorb research results and engineering practices from both at home and abroad. By widely accepting expert wisdom and further improving construction quality and operation management, dam construction could bring better benefits to mankind.

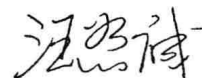
The International Symposium on Modern Technologies and Long-term Behavior of Dams is the continuity of the series conferences of East Asia Dam Conference (EADC) and Long Term Behavior of Dams (LTBD). Chinese National Committee on Large Dams (CHINCOLD), Japan Commission on Large Dams (JCOLD) and Korean National Committee on Large Dams (KN-COLD) have jointly hosted six rounds of EADC since 2004. Till now, LTBD has been jointly organized by universities from China and Austria, already going through for two consecutive terms.

To sum up the great achievements of concrete dam technology and identify those milestone projects in the field of dam engineering, with the support of the international experts, Chinese

National Committee on Large Dams (CHINCOLD) and United States Society on Dams (USSD) together initiated the International Milestone Project Award on Concrete Dams. This proposal gained the support of President of International Commission on Large Dams (ICOLD), Mr. Jin-sheng Jia, Honorary Presidents of ICOLD, Mr. L. Berga (Spain), Mr. G. Lombardi (Switzerland), Mr. CB Viotti (Brazil), CVJ Varma (India) and W. Pircher (Austria) as well as the positive responses from ICOLD National committees of relevant countries. Their support and participation has played an important role in recommending and determining the milestone projects. After nomination, preliminary evaluation and re-evaluation, the milestone projects of concrete dams have been finalized. Those selected milestone projects are not only the symbol of the achievements of concrete dam construction but also the basis for us to construct new dams, which shall remain important reference value in future's development of concrete dams.

The symposium has received about 120 papers from more than 20 countries, which, of wide-ranging contents, have displayed both the latest progress and the new challenges on dam design, construction, operation and management of each country. In order to better report the outcome of the symposium, the accepted representative papers are included in this proceedings. The papers in the proceedings cover the following fields: (1) Methods of Design and Analysis for Dams; (2) Environment-friendly Technologies for Dam construction; (3) Long-term Operation and Maintenance of Dams; (4) Dam Rehabilitation and Upgrade; (5) Dam Safety Assessment and Risk Management; and (6) Reservoir Management.

The symposium has gained strong support from the sponsors, organizers, and co-sponsors of this symposium, including the Yellow River Conservancy Commission of the Ministry of Water Resources of the People's Republic of China (MWR), Department of Water Resources of Henan Province, China Three Gorges Corporation, Xiaolangdi Dam Project Construction and Management Bureau, China Institute of Water Resources and Hydropower Research, Henan Provincial Water Conservancy Research Institute, ICOLD, KNCOLD, USSD, China Huangeng Group, China Huadian Corporation, etc. We would like to deliver our sincere gratitude to all of them.



WANG Shucheng

President of Chinese National Committee on Large Dams
Chairman of Organizing Committee of International Symposium on Modern
Technologies and Long-term Behavior of Dams

September 2011

Table of Contents

Preface

Theme 1: Methods of Design and Analysis for Dams

Seismic Damage Repair of Zipingpu CFRD and Progress in Study on Seismic Safety Evaluation of Rockfill Dam	3
<i>JIA Jinsheng, WEN Yanfeng, ZHAO Jianming</i>	
Theory and Method on Simulation of Actual Working Performance of High Arch Dams	11
<i>ZHANG Guoxin, LIU Yi, ZHU Bofang, WANG Renkun</i>	
Evaluation Method for Leakage State of CFRD	21
<i>JIA Jinsheng, HAO Jutao, XU Yao</i>	
The Optimal Design of Arch Dams with Regard to Safety and Economic Criteria-sensitivity Analysis a New Approach	29
<i>Alexsandro HOLZNER, Herbert LINSBAUER</i>	
Discussion on Some Problems of Temperature-control in Super-high Arch Dams During Construction Period	35
<i>HU Yu, LI Qingbin, ZHOU Shaowu, ZUO Zheng, GUAN Junfeng, LUO Danni</i>	
Seismic Assessment of Concrete Gravity Dams	41
<i>Furgani L., Imperatore S., Nuti C.</i>	
Study on Asphalt Concrete Core Rockfill Dam Built on Narrow and Unsymmetrical Valley	49
<i>WU Hao, DENG Gang, JI Hui, WANG Jingwu</i>	
New Solutions for New Dams	55
<i>François Lempérière, Michel Ho Ta Khanh</i>	
On One-dimensional Compression of Breakable Granular Materials	63
<i>FU Zhongzhi, GAO Junjun, LIU Sihong</i>	
Soil Improvement for Embankment Dams in Coastal Areas of Central Vietnam-Case Study of the Ta _ Trach Dam	71
<i>PHAM Hong Giang, Takashi TAKENAKA, NGUYEN Hoai Nam, PHAM Hong Nga</i>	
Study on the Influence of Joint Closure Temperature on the Stress of Masonry Arch Dam	75
<i>GONG Yangqing, WU Haizhen, WU Xiaobin</i>	
The Case of Dam Foundation Treatment for Grouting in Condition of Non-consolidation Sedimentary Layer	81
<i>Park Chal-Sook, Shin Jong-Iee, Cheung Sang-In, Hong Chung-Ki, Kim Hyung-Chan, Ahn Young-Sub, Kim Jong-Pil</i>	
Research and Design of Chemical Grouting of Foundations at Jinping-1 High Arch Dam, Sichuan	91
<i>JIANG Xuelin, Mike Richards</i>	

Seismic Analyses of a High Mexican Rock Fill Concrete Face Dam	99
<i>E. Botero, B. Mendez, M. P Romo, H. Marengo</i>	
Design and Study on Prestressed Anchorage of Xiaowan Arch Dam Abutment Resisting Rock Mass	107
<i>LI Yongming, WANG Guojin</i>	
Analysis of Foundation Sliding of an Arch Dam Considering the Hydromechanical Behaviour ...	117
<i>Braga Farinha M. L., Lemos J. V., Maranha das Neves E.</i>	
Efficient Method for Dam Inflow Estimation	125
<i>CHOO Tai Ho, CHOI Gye Woon, HUH Jae Yeong, LEE Chang Hae</i>	
The Design and Features of Guangzhao Roller Compacted Concrete Dam of 200 m High	133
<i>LONG Qihuang, CHEN Nengpin</i>	
Influences of Geometry of Inclined Core and Construction Procedure Progress on the Development of Negative Skin Friction in Cut off Wall of Earth Dams	143
<i>Mahmoud Ghazavi, Mohammad Vahdani</i>	
Analysis on Design Floods of Hekoucun Reservoir	151
<i>SONG Weihua, LI Baoguo, ZHANG Zhihong, MA Cuili</i>	
Impervious Elements for Rockfill Dams: Selection Criteria	157
<i>M. P Romo, E. Botero, B. Mendez</i>	
The Directivity Character of Strain of Earth Rockfill Material	169
<i>SUN Junshi, YUAN Youren, FENG Yelin, XIANG Biao</i>	
Comparison of Deformation Behavior of a CFRD Dam by Numerical Analyses and Instrumentation Results	179
<i>Dong-Hoon Shin, Hae-Jin Yang, Heui-Dae Lim, Han-Gyu Park</i>	
Study on Coupling of Seepage, Temperature and Stress Fields of Soft Rock	185
<i>XU Zenghui, LIU Guangting, WANG Yiming</i>	
Seismic Analyses of the Concrete Face of Rockfill Dams	195
<i>Miguel P. Romo, Neftali Sarmiento</i>	
Research and Demonstration on Compaction Tests of Earth Mixing Gravel in Different Compaction Apparatus	207
<i>XIANG Biao, FENG Ye-lin, YUAN You-ren</i>	
Analysis of Electrical Resistivity Changes in a Piping Simulation of a Fill Type Dam	215
<i>Hee-Bok Ahn, Heui-Dae Lim, Tae-Wan Moon, Jae-Young Ko</i>	
Theme 2 : Environment-friendly Technologies for Dam Construction	
Application of Multi-level Intake Technique in the Jinping-I Hydropower Project Construction	229
<i>WU Shiyong, WANG Hongmei, CAO Wei</i>	
Quantifying Sustainability: Roller Compacted Concrete Versus Zoned Earth Embankment Dams	235
<i>Dennis J. Hogan, Chi Fai Wan</i>	
Research on Mechanical Properties and Sectional Form of CGS Dams	243
<i>SUN Mingquan, CHAI Qihui, YANG Shifeng</i>	

Enlarging the Undersized Spillway of Höljes Dam	249
<i>Petter Stenström , James YANG , Patrik Andersson , Gunnar Henriksson</i>	
Discussion and Prediction on the Techniques of Dam Construction for 300 m Level Concrete CFRD	257
<i>ZHAN Zhenggang , CAI Dayong</i>	
Design and Construction of Asphalt Facing Adopting Foamed Asphalt Mixture	265
<i>Masanori Matsuura , Takehiko Okudera , Hiroyuki Seto</i>	
Design and Application of Bituminous Concrete Facing for Upper and Lower Reservoirs of Xilongchi Pumped Storage Power Station	275
<i>MENG Fanzhen , SHEN Anqi , LIU Haiyu</i>	
Environmental-friendly Dam Construction and the Effective Usage of the Floodplain Area	287
<i>Ock-jae Jang , Ki-chung Bae , Won-pyo Hong , Un-il Baek</i>	
Key Construction Technology of High Rockfill Dams	299
<i>DU Xingfa , WANG Yawen</i>	
Construction of Son La Dam, the Largest Roller-Compacted Concrete Dam in Vietnam	307
<i>Pham van Minh , Shigeru Tsuchida , Shisei Sakoda</i>	
Quality Control & Management of Gravel Core Wall Construction for Shuiniujia Project	317
<i>GANG Yongcai , ZHU Ping</i>	
Construction of Shahr-e-Bijar CFRD Dam	323
<i>Ramazan Moradi Kal Bolandi , Reza Ghaedi , Mohammad Ghamari Habashi , Amir Puria Ruhi</i>	
The Filling Construction of the Pankou Concrete Face Rockfill Dam	331
<i>LI Zhenlian , WANG Quanbin , JING Zenghu</i>	
Environmental Preservation of Downstream River of Dam by Sediment Bypass System	339
<i>H. Doi , T. Tada , K. Yamashita</i>	
Application Research on Low Heat and High Performance Hydraulic Concrete	349
<i>ZENG Zhengbin , ZHANG Xihe , YANG Jindi , TAN Jianjun</i>	
Modern Technologies in Dam Construction: Development of La Romaine Hep in Northern Quebec, Canada	357
<i>Vlad Alicescu , Jean-Pierre Tournier</i>	
A Study of Environmental-friendly Han-Tan River Dam with RCD Applied for the First Time in Korea	365
<i>Jung Sang-In , Lee Jong-yeon , Hong Chung-Ki</i>	
Concrete Production in the Required Quality, Temperature and Output Capacity, Considering the Different Climatic and Geographic Conditions	375
<i>Klaus Knoll</i>	
Theme 3 : Long-term Operation and Maintenance of Dams	
Operational Practices of the Three Gorges Project	385
<i>ZHANG Shuguang</i>	
Long-term Dam Safety Monitoring of Punt dal Gall Arch Dam in Switzerland	391
<i>Wieland M. , Kirchen G. F.</i>	

Lessons Learned from Monitoring the Behavior of Arch Dams	399
<i>Fabre. JP, Geffraye. G, Sausse. J</i>	
Study on Long-term Use of Large Reservoir and its Sediment Problems	409
<i>FAN Beilin, HUANG Renyong</i>	
Investigation of the Interaction between Pressure, Density and Rheological Properties of Rockfill Materials	417
<i>E. Bauer, Z. Z. FU, S. LIU</i>	
Application of Fractal Method in Landslide Interpretation of Remote Sensing Images in the Reservoir Area	425
<i>WANG Zhiwang, LI Duanyou</i>	
Long-Term Seepage Behaviour of an Embankment Dam Founded on Rock Strata under Artesian Pressure	429
<i>Messerklinger S. , Brenner R. P. , Zēg ele Z.</i>	
Evaluation and Research on Replacement Reinforcement Quality at Abutment of Ultra-high Arch Dam Based on Prototype Monitoring	439
<i>HU Bo, LIU Guanbiao</i>	
Frost Damage in Concrete in the Waterline of Porsi Hydro Power Plant	447
<i>Martin Rosenqvist, Mikael Persson, Manouchehr Hassanzadeh, Katja Fridh</i>	
Abnormal Results Adjustment of Non-Stress Strain Gauge in High Concrete Dam	455
<i>SHEN Hui, WANG Zhiyuan</i>	
Leakage Detection for Rockfill Dams with Asphaltic Central Core	461
<i>Markus Aufleger, Thomas Etzer, Jiirgen Dornstädter, Orce Mangarovski</i>	
Monitoring of Long Term Expansion (25 years) in Victoria Dam, Sri Lanka, Instrumentation Interpretation	467
<i>S. R. K. Aruppola, K. M. H. K. Kotagama</i>	
The Application of Crossing River Flexible Double Catenary Trash Rack System in Pubugou Hydropower Station	479
<i>HOU Yuanhang, HUANG Huibao, WEN Hao, BAI Wei</i>	
Methods of Analyzing and Investigating Sink Holes in Impounded Parts of Embankment Dams and Blankets	485
<i>Susanna Jannung, Carl-Anders Andersson, Ingvar Ekström</i>	
Behavior of Jegin RCC Dam Afiter Impounding	493
<i>Mohammad Esmaeilnia Omran, Hamed Mahdiloo Torkamani</i>	
Analysis on Displacement Monitoring Data of Lijiaxia Hydropower Station	505
<i>GONG Baocheng, QIAO Jiqing, JIANG Shaogang, LI Yuan, LIU Jingjie</i>	
Jarreh Embankment Dam Monitoring in End of Construction Stage Using Instrumentation Systems Results	513
<i>A. R. Majidi</i>	
Challenges in Reservoir Sediment Management the Case of Tarbela Dam Project	521
<i>Muhammad Siddique, Hazrat Umer</i>	