Vol. 2

HSS NEWS

August 2009

IAHR Hydraulic Structures Section NEWSLETTER

Scale model (1:80) of the spillway for the Tocoma Hydroelectric Project, Venezuela, with downstream wing walls and concrete protection of the upstream slope of the pre-excavated plunge pool

In This Issue

HSS ACTIVITIES

A Vision for the HSS

By Jorge Matos and Hubert Chanson, HSS Executive Committee

The IAHR Hydraulic Structures Section aims to foster engineering and research activities in the development of hydraulic structures, encompassing:

- to champion the area of hydraulic structures in an era of increasing specialization;
- to provide a solid knowledge and experience base for design of hydraulic structures;
- to bridge the gap between researchers and practitioners;
- to identify knowledge gaps where hydraulic research can be applied;
- to address the subtle changes in the use of hydraulic structures to manage water in an environmentally sound manner;
- to encourage continuing education in hydraulic structures through specialty conferences, workshops, short courses and educational curriculum;
- to collaborate with other organizations in the advancement and understanding of hydraulic structures in the natural environment.

The IAHR Hydraulic Structures Section (IAHR-HSS) actively participates to a broad range of IAHR activities, including contributions to the biennial congresses and the organization of specialized symposia, workshops and seminars on topics related to hydraulic structures.

The involvement of the IAHR-HSS was particularly relevant for the International Symposia on Hydraulic Structures. The first one was held in Teheran, Iran, in April 2004, where some 600 people attended the event with around 50 foreign delegates. The second one was held in Ciudad Guayana, Venezuela, in October 2006, in conjunction with the XXII IAHR Latin American Congress, where more than 650 people attended the events with around 100 foreign delegates. The third International Symposium in Hydraulic Structures was held in Nanjing, China, October 2008, in conjunction with the 16th Congress of the Asia and Pacific Division of IAHR. It was attended by more than 400 participants from 28 countries including some 150 foreign delegates. In addition, an impressively large number of enthusiastic Ph.D. students (150), as well as over 130 graduate students – the emblematic *volunteers* – were very helpful in the organization of both events! This was indeed a singular feature of the 16th APD Congress and 3rd ISHS.

In This Issue (Cont.)

The International Junior Researcher and Engineer Workshop on Hydraulic Structures (IJREWHS) series is another key activity of the Hydraulic Structures Section aimed to young engineers and researchers. The first international workshop was organized in Montemor-o-Novo, Portugal in 2006, and attracted 36 participants from 8 countries. The 2nd International Junior Researcher and Engineer Workshop on Hydraulic Structures (IJREWHS'08) was held in Pisa, Italy where 50 participants from about 20 countries attended. The 3rd international workshop will take place in May 2010 in Edinburgh, Scotland, in conjunction with the 1st IAHR European Division Congress. We consider this International Junior Researcher and Engineer Workshop on Hydraulic Structures series as a key initiative to foster interest for hydraulic structures among young and dynamic engineers, researchers and students who form the future backbone of our associative activities.

This 2nd IAHR-HSS Newsletter illustrates the intensifying activities of the section, and its editors Robert Janssen, Corrado Gisonni and Fabián Bombardelli must be acknowledged for their continuing efforts. We would like to thank all colleagues who contribute actively to the IAHR Hydraulic Structures Section. We look forward to strengthen the cooperation with you all in 2009 and 2010, to foster active collaboration between researchers and practitioners, and to encourage the participation of young professionals working in the field of hydraulic structures or related areas of interest.

Changing of the Guard at HSS Executive

In accordance with the bylaws of the IAHR and HSS, the XXXIII IAHR Congress in Vancouver will see the end of the 4-year term of Jorge Matos as Chair of the HSS. The following two articles capture the contribution made by Jorge not only during his term as Chair, but from the very inception of the HSS. The new Chair and Secretary for the HSS will be elected at the HSS section meeting in Vancouver.

Jorge Matos and the history of the Hydraulic Structures Section

By Christopher George, IAHR Executive Director and Phil Burgi ex-Chair and Founder HSS

Dear HSS members!

I am delighted to have the chance to thank HSS Chair Jorge Matos in print (so to speak) for his quiet dedication and leadership of the IAHR Hydraulic Structures Section during the last four years. The Section was established as our newest section thanks to the efforts of Phil Burgi when I joined IAHR in 1999, and it is thanks to the efforts of Jorge that the "bird" has taken wing and flown!

Phil informs me that Jorge Matos helped him draft the proposal to form the new Hydraulic Structures Section as early as May 1996, that he was present and participated in the meeting to organize the HSS during the 1997 27th IAHR Congress in San Francisco, and is a charter member of the HSS having joined in the first official meeting at the 28th IAHR Congress in Graz, Austria in 1999. Some momentum was lost when many HSS supporters missed the Beijing meeting due to the 9/11 tragedy in the US! The Section voted to have Jorge Matos serve as the new Chair and Hubert Chanson serve as Section Secretary at the 2005 Seoul, Korea Congress.

Jorge was closely involved in the International Conference on Hydraulics of Dams and River Structures, in April 2004 Teheran, Iran - the first HSS event – which he in fact chaired as Phil had broken a leg!

After taking over from Phil Burgi as Chair in 2005 in Seoul, Jorge helped organize, with HSS member Arturo Marcano, the 2nd International Symposium on Hydraulic Structures, held jointly with the XXII IAHR-LAD Congress in October 2006; and last year he worked hard to ensure the success of the 3rd International Symposium on Hydraulic Structures, held in

conjunction with the 16th IAHR-APD Congress, in October in Nanjing, China.

All of these events were successful and have strengthened the Section: If IAHR had a prize for the "best Section" then HSS would be a contender!

During his tenure Jorge was also a prime motivator and had the vision to ensure Section support for instigating the *International Junior Researcher and Engineer Workshop on Hydraulic Structures* series. He was intimately involved in the organization of the first with Section Secretary Hubert Chanson in Montemor-o-Novo, Portugal, in September 2006, and of the second with Prof. Stefano Pagliara in Pisa, Italy, in September 2008.

I have recently been working with Jorge to bring the third Workshop alongside our 1st IAHR Europe Congress which will be held next May in Edinburgh!

I wish every success to Jorge's successor as Chair, and am ready to help keep things moving!

Christopher George

Jorge Matos

A personal and committed leadership of the HSS
By Hubert Chanson, HSS Secretary and IAHR member since 1990

Jorge Matos is serving in the Department of Civil Engineering and Architecture at the Instituto Superior Técnico (IST), Technical University of Lisbon, Portugal. In parallel with his professorship at IST, he served also as invited professor of Mathematics and Numerical Analysis at the Military Academy, as well as of Hydraulics at the Escola Superior de Tecnologia do Barreiro - Polytechnic Institute of Setúbal, for limited periods. His research interests include hydraulic structures, spillway hydraulics, energy dissipation, air-water flows, physical modeling, and wastewater hydraulics. He was the recipient of the APRH - Portuguese Water Resources Association Award for his scientific work in the field of water resources, 2001/02. In 2002, the American Society of Civil Engineers presented him with the J. C. Stevens Award for the best discussion paper published by the Society in the field of hydraulics, fluid mechanics and hydrology. He is currently the President of the APRH - Portuguese Water Resources Association.

Jorge Matos joined the IAHR Hydraulic Structures Section at its inception in 1997. He has been an active member since. He became the Secretary of the section in 2003, and the chairman of the section in 2005. His contribution to the Hydraulic Structures Section has been considerable and he has been instrumental to the development of many initiatives. Among these, one must include the initiation of the Hydraulic Structures Symposium series (2004 Iran, 2006 Venezuela, 2008 China) and the International Junior Researcher and Engineer Workshop on Hydraulic Structures IJREWHS series (2006 Portugal, 2008 Italy, 2010 UK).

Beyond these major achievements, Jorge has had a tremendous personal input into the section, its committee and its membership. I remember very well to have met Jorge at Lisbon airport in 2006, and been welcomed by his family as they took me to Montemor-o-Novo for the first International Junior Researcher and Engineer Workshop on Hydraulic Structures. That event was a tremendous achievement and it demonstrates the commitment of Jorge to young engineers and researchers. In my opinion, I regard the organization of the International Junior Researcher and Engineer Workshop series as the most significant contribution of Jorge to the Hydraulic Structures section and beyond to the IAHR.

Well done, Jorge!

Hubert Chanson

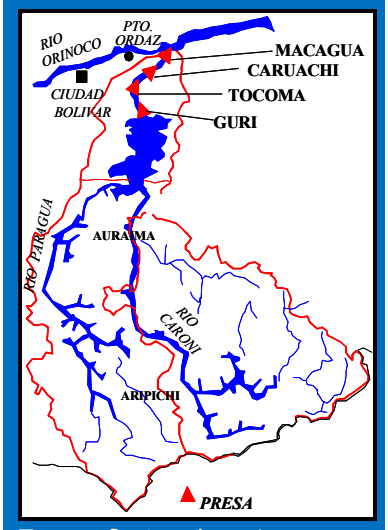
SPOTLIGHT

Tocoma Hydroelectric Project, Venezuela

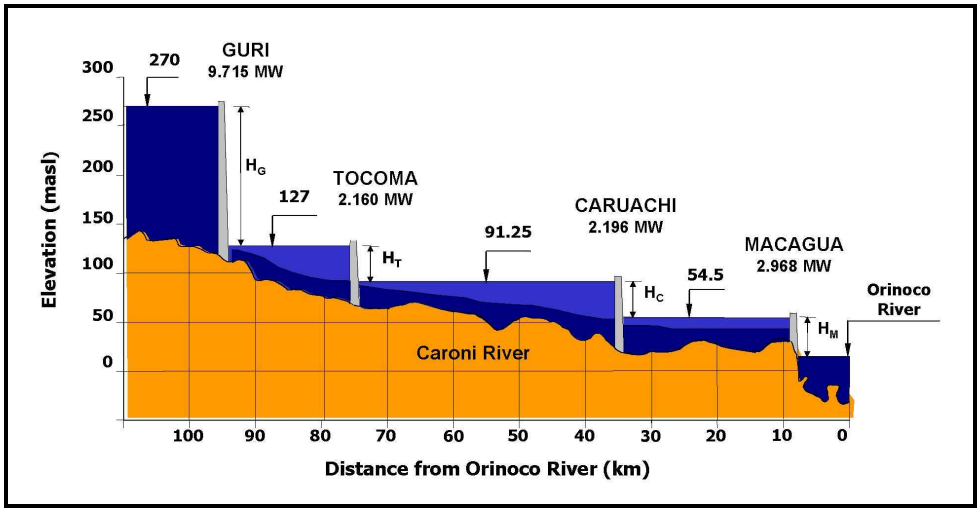
Contributors: Gonzalo Montilla and Emilio Martinez, Hydraulic Department, EDELCA
Arturo Marcano, IAHR Member 4794, Formerly Head of Hydraulic Department, EDELCA

INTRODUCTION

The Tocoma Project, together with Guri, Macagua and Caruachi Projects, form the Hydroelectric Development of the Lower Caroni River Basin in south-eastern Venezuela. The 2,160 MW project is located 15 Km downstream from Guri Dam and will add 12,060 GWh of annual average energy to the existing production of 76,440 GWh. These figures rank this hydro development as the largest in Venezuela and one of the largest of the planet.

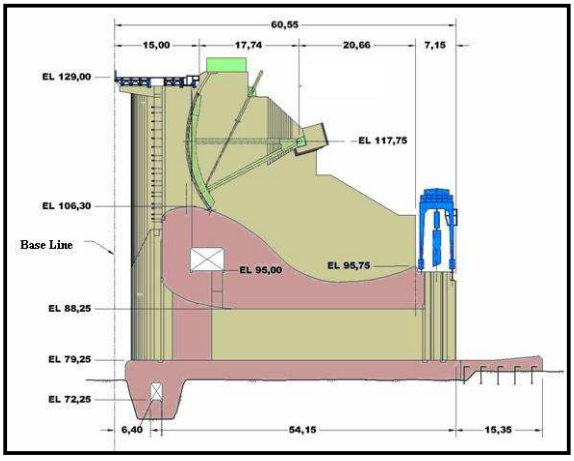


Tocoma Project Location



Hydroelectric Development of the Lower Caroni River Basin in south-eastern Venezuela

At the Tocoma site the Caroni River expands to a width of approximately 3,000m. Average, maximum, and minimum recorded flows are 4,824, 17,576 and 188 m^3/s, respectively. The Pao fault zone located nearby is one of most important geological aspects considered during the planning and design of the project. It is associated with the Imataca formation found at the dam site, which consists mainly of granitic gneiss. The Tocoma project will include two dams, a 3760 m-long, 50 m-high concrete-faced rockfill dam (CFRD) left dam and an 1835 m-long, 70 m-high rock fill right dam.



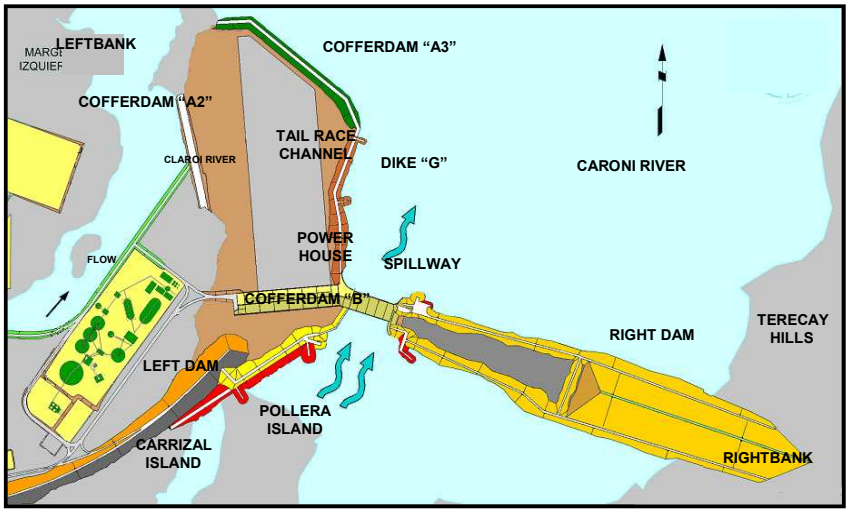
Tocoma Project – Two- body spillway

A 30,000 m^3/s capacity surface spillway will be equipped with nine 15.24m x 21.96m radial gates, and a lower body for diversion purposes consisting of 18 sluices 5.5m x 9m that operate under pressure flow.

Vol. 2

HSS NEWS

August 2009



Tocoma Project- Layout of main works

CONSTRUCTION PROGRAM

Presently, progress of construction includes all first stage river diversion works completed in 2002, total excavation of the main structure foundations, and partial concrete works. The second stage of the river diversion is scheduled for 2010, and commissioning of the first generating unit for 2012. The first stage cofferdams have been in operation since 2002 for annual diversion flows between 5,000 and 14,000 m^3/s, these being particularly large to maintain firm energy supply by the three existing hydro powerplants to the Venezuelan electricity network, where the Caroni input represents 72% of the country's demand. The 3,400 m horseshoe-shaped first stage cofferdam permits excavation in the dry the foundation of the spillway and its pre-excavated 325,000 m^3 plunge pool, powerhouse and tailrace channel, the construction of the main concrete structures, the erection of the CFRD left dam and, partially, the right rock fill dam.

Tocoma Project - Key Data

Power Generation 2,160 MW

Two dams:

3760 m long, 50 m high CFRD

1835 m long, 70 m high rock fill

Spillway capacity 30,000 m^3/s

Tocoma Project-First Stage of River Diversion (Oct 2008)

The second stage of River Diversion will start when the river is diverted through the 5.5m x 9m diversion sluices, followed by channel river closure, and finally by closure of the sluice gates and construction of the concrete plugs in the 18 sluices. The latter will allow reservoir initial filling and subsequent tests of the first generator.

Vol. 2

HSS NEWS

August 2009

PHYSICAL MODEL STUDIES

The performance of all hydraulic structures of the Tocoma Project operating at the varied conditions whether normal operation or during the diversion stages, have been optimized by extensive laboratory investigations at Electrificación del Caroní's (EDELCA`s) Hydraulic Laboratory located in Macagua. In a comprehensive 1:80-scale 3D physical model the optimal alignment of the temporary cofferdams, crest elevations and required protection were defined. The geometries of both the free surface and pressure flow section of the two body spillways were carefully investigated in a 1:40-scale partial physical model. The influence of the Tocoma Project backwater reservoir levels for very large flows from the Guri structure, were investigated in a large 3D physical model.

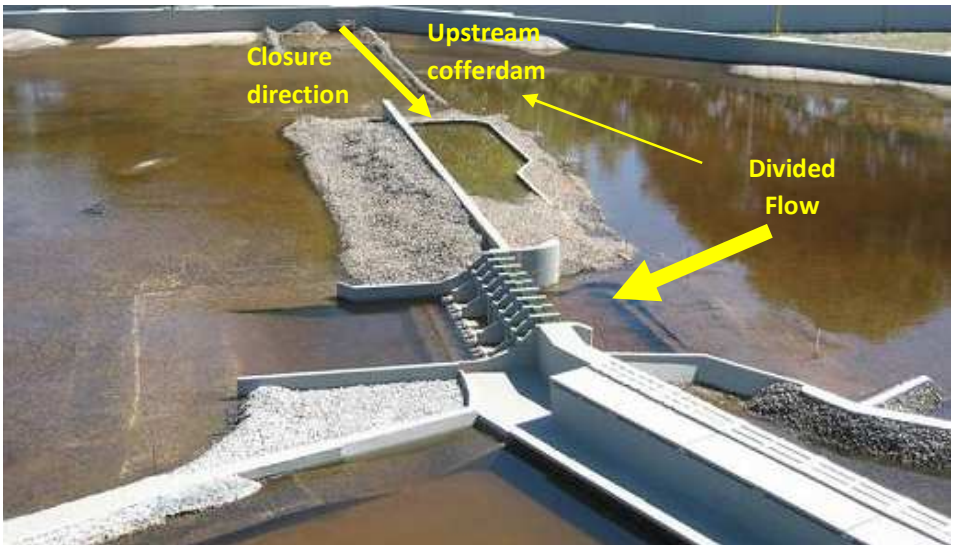
Considering the moderate geologic conditions close to the spillway structure, recent model tests have indicated the need to include lateral concrete wing walls and a concrete protection of the upstream slope of the pre-excavated plunge pool.

Tocoma Project - Milestones

2002 - First stage diversion completed

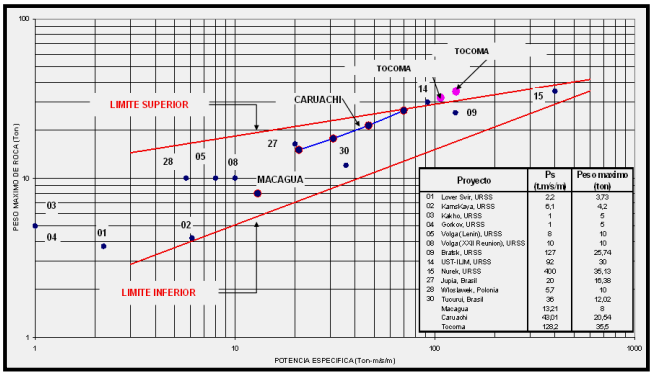
2010 – Second stage river diversion

2012 – Commissioning of first generating unit



Hydraulic Physical Scale Model (1:80) - Model tests of river closure

Following the construction plan of the contractor, model results have indicated that the river closure should be performed using a single upstream cofferdam, from the right bank to the middle reach of the river section. For such an arrangement, flow velocities at the cofferdam end tip reach values as high as 7.5 m/s with a head difference of 3.5m.



River closure data including Tocoma (model) measurements

The resulting computed specific power of the flow was as high as 128 tonne-m/s/m, requiring rock elements of 35 tonnes in the last 20 m of the closure, one of the most severe documented operations of this type.

Vol. 2

HSS NEWS

August 2009

OTHER FUTURE EVENTS

XXXIV IAHR Congress
Brisbane, Australia
26 June to 1 July 2011
http://www.iahr2011.org
Contact: **Hubert Chanson**
h.chanson@uq.edu.au

4th International Symposium on Hydraulic Structures
To be announced shortly

FUTURE EVENTS

3rd International Junior Researcher and Engineer Workshop on Hydraulic Structures

Edinburgh, Scotland, May 2010
http://www.iahreurope.info/edinburgh2010/home/index.asp

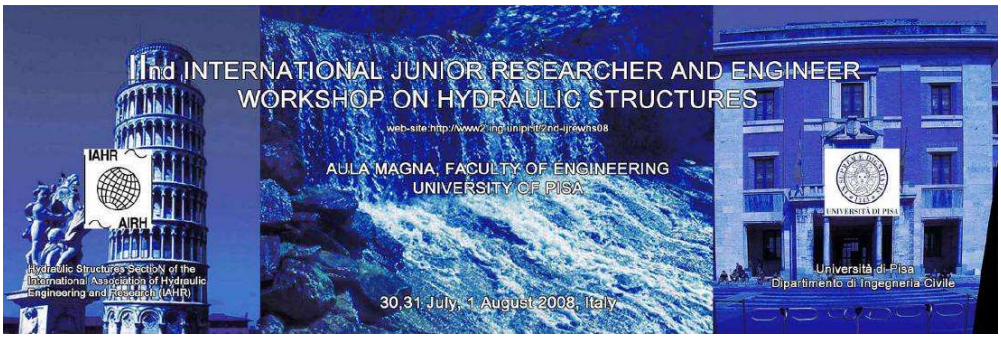
It has recently been agreed that the 3rd International Junior Researcher and Engineer Workshop on Hydraulic Structures will be held in conjunction with the 1st IAHR European Division Congress in Edinburgh, Scotland, in May of 2010. More details will be announced shortly.

XXXIII IAHR Congress

Vancouver, Canada, August 9-14 2009
http://www.iahr2009.org

The Hydraulic Structures Section executive committee has been active in the organisation of events for the upcoming 33rd IAHR Congress to be held in Vancouver, Canada. A general meeting of the Hydraulic Structures Section will be held on Sunday August 9th from 2:00 – 4:00 PM in the Constable Room, and all are welcome to attend.

PAST EVENTS



2nd International Junior Researcher and Engineer Workshop on Hydraulic Structures

University of Pisa, Italy: July 30 – August 1, 2008
http://www2.ing.unipi.it/2nd-ijrewhs08/
By Stefano Pagliara s.pagliara@ing.unipi.it

The Second International Junior Researcher and Engineer Workshop on Hydraulic Structures (IJREWHS'08) was held in the University of Pisa, Pisa, Italy, from July 30 to August 1, 2008. Around 50 junior researchers and senior experts from 18 different countries and 5 continents attended the conference.

The main themes of the IJREWHS'08 embraced different aspects of hydraulic structures like river structures and hydraulics of dams with papers on urban drainage structures, bridge scour, labyrinth weirs, jet scour, stepped spillways, hydraulic jump, air-water flow, fishways, block ramps etc. Both classical and new themes have been presented by junior researchers and engineers.

Prof. Stefano Pagliara of University of Pisa organized the event and together with Prof. J. Matos (Chairman of IAHR Hydraulic Structure Section) and Prof. H. Chanson (Secretary of IAHR Hydraulic Structure Section) formed the executive committee with the assistance of Dr. Christopher George (IAHR Executive Director).

IJREWHS '08

50 participants
18 countries
5 continents

Keynote Lectures
Prof. Hubert Chanson
Prof. John Fenton

Chair of organizing committee:
Prof. Stefano Pagliara

Attendees of the 2nd International Junior Researcher and Engineer Workshop on Hydraulic Structures

Prof. H. Chanson delivered a captivating lecture on digital revolution, which brings new tools for professionals and scholars. Prof. Chanson quoted that "digital revolution is progressing very rapidly like a tidal bore in a eulerian system of reference". Another invited lecture was of Prof. J. D. Fenton (University of Karlsruhe, Germany), who discussed obstacles in streams, such as bridge piers, and their roles as hydraulic structures. Prof. Fenton tentatively suggested that a new type of hydraulic structure could be developed, one that minimizes the overall force on the obstacle and resultant upstream flooding. Junior researchers from 18 countries and 5 continents also contributed with new ideas, findings and suggestions on the above mentioned topics, and they handled the roles of Chairman, Rapporteur and Advocatus diaboli of each session. Their active participation was ensured by playing a major role in presenting the paper and also by preparing reports, including all the scientific elements and the queries and solutions of each session.

"Sabo" check dam in the Cardoso river Basin, near Pisa, Italy

The technical visit on the Apuan Alps to see recent "sabo" works was very fruitful for young researchers and engineers.

The IJREWHS'08 was held under the support of the International Association of Hydraulic Engineering and Research (IAHR) and the University of Pisa.

The proceedings papers were examined by expert-reviewers and they are published in a proceedings book (EDIZIONI PLUS, University of Pisa, Italy- ISBN: 978-88-8492-568-8) that regroups 31 peer reviewed papers including 2 keynote lectures.

16th Congress of IAHR Asia and Pacific Division
3rd IAHR International Symposium on Hydraulic Structures

Hohai University, Nanjing, China: October 20-23, 2008
http://apd-iahr2008.hhu.edu.cn/

By Helmut Knoblauch and Robert Janssen

The 3rd IAHR International Symposium on Hydraulic Structures (ISHS) was held in conjunction with the 16th Congress of the IAHR Asia and Pacific Division. The overall event was attended by more than 400 participants from 28 countries including some 150 foreign delegates. The ISHS consisted of 2 out of a total of 6 technical sessions, namely "Hydraulic Structures for Water Projects" and "Hydropower Hydraulics". There were six keynote lectures, with three of these being from the ISHS. The 6-volume proceedings have been published by Tsinghua University Press, ISBN: 978-7-302-18662-5.

Session V / Topic B1 – Hydraulic Structures for Water Projects
This session consisted of topics on new developments in design, construction, and operation of hydraulic structures, numerical and physical modeling, risk and safety assessment, instrumentation and technology in laboratory experiments and field tests, sustainable design of hydraulic structures. For this topic a total of 86 papers were published in the conference proceedings. Approximately 30 presentations were delivered during the 4-day session, including 3 invited lectures by HSS members Stefano Pagliara (state of the art in block ramp design), Corrado Gisonni (high speed flows in hydraulic engineering) and Y. Yasuda (eco-hydraulics of fishways). The submitted papers presented the latest developments in hydraulic structures design and research, including vortex drop shafts; stilling basins and hydraulic jump behavior; pump stations; pipelines and hydraulic transient issues; stepped spillways; and bottom outlets.

Session VI / Topic B2 – Hydropower Hydraulics
The scope of this session consisted of topics on intakes and outlets, spillways, fish ways and energy dissipating structures, two-phase flow, pipe flow, cavitation, vibration and aeration, hydraulic machinery, environmental and ecological impact of hydraulic structures. A total of 44 papers were published in the conference proceedings under this session heading. Approximately 30 presentations were delivered during the 4-day session, including an invited lecture by HSS member Cai Fulin (impact of geometric factors on flow characteristics of pumped storage intakes). The presentations reflected the wide target scope, and included a study of the use of transmitted light and air bubbles to avoid fish from the intake gate; an investigation on the change in scour depth downstream of rock chutes for different ramp toe conditions; dimensional and numerical analyses conducted to investigate the efficiency of orifice energy dissipation; design of a micro-hydro scheme in a water supply system; and physical modeling and scale correction for morning glory spillways.

In addition, the contribution of the HSS was also extended to the 16th IAHR-APD. Topic A3, which focused on Fluvial Processes and River Engineering, included an invited lecture given by HSS member Helmut Knoblauch on reservoir sedimentation and desilting methods.

JUNIOR RESEARCHER AND ENGINEER FORUM

Introduction and welcome

As those of you following the recent activities of the Hydraulic Structures Section may have noticed, the International Junior Researcher and Engineer Workshop on Hydraulic Structures has become a key highlight in the calendar of the section. With this in mind, and recognising that the future of the section lies with the efforts of our "junior" members, the Junior Researcher and Engineer Forum has been included in this issue of *HSS News* for the first time. The first article below provides a unique participant perspective of the recent workshop in Pisa. Article submissions for future issues of *HSS News* will be very welcome, and nomination of a co-editor specifically for the Junior Researcher and Engineering Forum will be discussed at the next HSS general meeting to be held in Vancouver in August.

"It was a suitable mixture of young, semi-senior and senior researchers which made the workshop a fruitful event in a friendly and productive atmosphere."

Participant perspective of the 2nd International Junior Researcher and Engineer Workshop on Hydraulic Structures

By Stefan Felder

The temperature was convenient in the "aula magna" at the University of Pisa, a member of the local organisation team passed cold water and a woman in her mid-twenties gave a speech about her current research project. She had to fight with some clicking noises from the microphone and with the interruption of her power point presentation by a computer virus alert. But her presentation was excellent, as were most of the talks given by more than 30 junior researchers and engineers from around the world. It was summer and they did not come to Italy for holidays, they came to participate in the 2nd International Junior Researcher and Engineer Workshop on Hydraulic Structures. During the three days of the workshop the young researchers presented the outcomes of their current research projects, discussed in small round tables their findings and received some advice and feedback from senior experts and researchers in the IAHR HSS. These experts were highly motivated and played an important role for the success of the workshop. There were the chairman of the workshop, Prof. Pagliara, the chairman of the HSS, Prof. Matos, the secretary of the HSS and keynote speaker Prof. Chanson, and the second keynote speaker, Prof. Fenton, to name just a few.

"The diversity of the contributions was particularly interesting and it seems to be impossible that somebody left the workshop without having learned something new."

It was a suitable mixture of young, semi-senior and senior researchers which made the workshop a fruitful event in a friendly and productive atmosphere. The workshop was well organized and some outdoor activities made sure that the participants were able to see some spots of Pisa and its surrounding scenery. There was the small reception in the hydraulics laboratory of the University of Pisa with the unique option to climb on the water tower of the laboratory. The climbing was a bit dangerous but the view over Pisa and the surrounding mountains was excellent. Then there was the field visit to the river Cardoso basin and a series of hydraulic structures such as check dams were visited. Some hiking required to reach the structures was especially worthwhile to see the beautiful nature and the surrounding scenery; a special highlight was the short visit of a small Italian mountain village. And then there was the Gala dinner on the last night with countless courses in a club next to the beach; it took hours until the dinner finished and there was sufficient time for interesting discussions.

After three days the workshop ended, it was an event with focus upon the newest research projects from young researchers in the field related to hydraulic structures. There were presentations of physical experiments on labyrinth weirs; stepped spillways; scour effects on hydraulic structures; numerical studies of complex flow processes; and ecological impacts of hydraulic structures. The diversity of the contributions was particularly interesting and it seems to be impossible that somebody left the workshop without having learned something new. It was a worthwhile event for young researchers to gain first experiences with a conference, to present their research and to participate in the publication/review process. It would be good to maintain the workshop for young researchers and engineers to give them the chance to get a first comfortable and friendly exposure to the conference business.

FINAL NOTES

Looking for future articles for SPOTLIGHT

The *SPOTLIGHT* section is intended to be the focus of this newsletter. For future editions, we are keen to receive contributions that shine a spotlight on recent developments or projects of interest in research, design, construction or operation of hydraulic structures. Please contact the editors listed below should you have ideas for suitable articles, or should you be willing to submit an article.

HSS Email List

The HSS email list is for those interested in receiving future editions of this newsletter, and other communications of interest related to hydraulic structures. In the interest of avoiding excessive emails, the communications issued to the HSS email list will be controlled by the HSS Committee. If you are interested in being on the mailing list, please send an email with the subject "HSS Subscribe" to Fabián Bombardelli: fabombardelli@ucdavis.edu

Feedback

We welcome any feedback that readers may have regarding this newsletter. Please contact any of the editors below should you have any suggestions or comments.

Quick Links

IAHR Home
Home page of the IAHR
http://www.iahr.net

IAHR Media Library
Electronic material relating to hydraulics, hydrology and water resources
http://www.iahrmedialibrary.net

HSS Contacts

IAHR - HSS
For queries about the IAHR Hydraulics Structures Section activities, please contact:
Hubert Chanson
h.chanson@uq.edu.au

Newsletter
For queries about this newsletter, or to submit articles, please contact:
Robert Janssen
rjanssen@bechtel.com

HSS Email List
To request being added to the HSS email list, please send an email with the subject "HSS Subscribe" to:
Fabián Bombardelli
fabombardelli@ucdavis.edu

Editor
Robert Janssen
Bechtel, Chile
rjanssen@bechtel.com

Co-Editor
Fabián Bombardelli
Univ. of California, Davis, U.S.A.
fabombardelli@ucdavis.edu

Co-Editor
Corrado Gisonni
Seconda Università di Napoli, Italy
corrado.gisonni@unina2.it