INTERNATIONAL ASSOCIATION FOR HYDRO-ENVIRONMENT ENGINEERING AND RESEARCH

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SPECIAL ISSUE ON LARGE HYDRAULIC INFRASTRUCTURE PROJECTS

IAHR AIRH

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LARGE HYDRAULIC INFRASTRUCTURE: WHY OUR LIFE DEPENDS ON LARGE PUBLIC WORKS FOR BETTER OF FOR WORSE

EDITORIAL BY PROF. MICHELE MOSSA

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Water infrastructure can be defined as a stock of facilities and installations needed to develop and manage water resources, including delivery, treatment, supply and distribution of water to its users as well as for the collection, removal, treatment and disposal of sewage and waste-water or coastal management and harbour works.
From a historical point of view, in Ancient Rome many different hydraulic applications were developed. We can remember the numerous aqueducts that the Romans constructed to bring water from distant sources into their cities and towns, supplying public baths, latrines, fountains and private households. During that time aqueducts moved water through gravity alone, being constructed along a slight downward gradient within conduits of stone, brick or concrete. Most were buried beneath the ground, and followed its contours and where valleys or lowlands intervened the conduit was carried on bridgework. One of the most impressive examples is the Aqueduct of Segovia that I had the opportunity to visit before an IAHR meeting in Madrid.

Themes linked with water infrastructure are ever more current and complex; they are linked to climate change and the social pressure on water quantity and quality and to the ever increasing demand for sources of energy. In fact, we should remember that above all in developing countries millions of people suffer from the lack or at the very least a bad supply of drinkable water and, sometimes, as in the case of huge dam constructions, the solution is worse than the original problem, becoming itself an environmental problem. Rapidly increasing international trade leads to a constantly increasing demand for port infrastructure, and climate change to increased pressure on coastal management. Furthermore, we try to solve energy shortages by designing large hydraulic infrastructure - whether by harnessing rivers or exploiting sea currents, waves or tides. We share our knowledge by organsing regular congresses, workshops, and partnerships.

Water has always played a central role in human society, but in order to sustain that role, it needs to be harnessed and managed to increase its productive impact and to reduce the risk of destruction, while protecting the aquatic ecosystems which is crucial for the environment. This could be achieved by developing adequate hydraulic infrastructure concomitantly with legal and institutional frameworks for water management.

We must consider that, generally speaking, hydraulics infrastructure, of which water infrastructure are only a part, are the facilities and installations whose role is also the environmental defense, such the defense of coasts or land reclamation. For example it is well known that the Netherlands is a geographically low-lying country, with about 20% of its area and 21% of its population located below sea level and 50% of its land lying less than one meter above sea level. In reality most of the areas below sea level are man-made. From the late 16th century land reclamation started and large polder areas are now preserved through elaborate drainage systems with dikes, canals and pumping stations. Another example is the particularly fascinating high water defense system of Venice, the so-called MOSE system (i.e., the *Modulo Sperimentale Elettromeccanico* or *Electromechanical Experimental Module system*). An article on this topic is published in this issue of Hydrolink. The fascinating defense system of Venice stimulates a lot of questions, such as the main features of the MOSE (for example if the MOSE system is more costly and invasive than other alternatives) or the reason of the choice of that system between many other hypotheses for protecting Venice, and many others. The above-mentioned article, provided by *Conzorzio Venezia Nuova* includes a brief introduction by prof. Giampaolo Di Silvio.

From the aforementioned it is clear why this issue of Hydrolink is mainly devoted to Large Hydraulics Infrastructure. Furthermore, as I promised to our readers when I presented the new guidelines of Hydrolink, with this issue of our magazine we have inaugurated a new column in which we provide updates on issues covered in past articles in our magazine. Particularly, in this issue we have published a follow-up report on the 2011 tsunami disaster in Japan. As our readers will remember the tragic event was related by prof. Hitoshi Tanaka (Tohoku University, Japan, and Chairman of the Asia Pacific Division of IAHR) in issue 3/2011 of Hydrolink where also my editorial entitled “Could David overpower Goliath (again)?” was published.

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Cover picture: Porto di Lido mouth. A stage in the transport of the second gate housing caisson. Credits: Ministry of Infrastructure and Transport – Magistrato alle Acque di Venezia, concessionary Consorzio Venezia Nuova.

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IN THIS ISSUE

LARGE HYDRAULIC INFRASTRUCTURE PROJECTS

CHALLENGES TO MANAGING WATER PROJECTS IN A CLIMA

BY KATIE MORRICE AND PETER GOODWIN

Katie Morrice is a California Sea Grant State Fellow working with the Delta Science Program at the Delta Stewardship Council California, USA. She holds a MS in physical oceanography and is interested in fluid dynamics and the effects of physical processes on marine ecosystems.

Peter Goodwin is currently the Lead Scientist with the Delta Science Program at the Delta Stewardship Council. He is the DeVlieg Presidential Professor in civil engineering at the University of Idaho and former Vice President of IAHR.

California is the most populous state in the USA and home to 1 in 8 Americans.

While most of California's precipitation originates in the northern half of the state, most of the state's population resides in the southern half. To serve that population, California has spent decades supplementing water supplies in the southern part of the state by constructing a complex water resource infrastructure. The Delta, which includes the Sacramento-San Joaquin Delta and Suisun Marsh, plays a key part in this water delivery system. Located at the intersection of the two largest rivers in California, the Sacramento and San Joaquin (Figure 1), this major water supply hub covers nearly 3300 km^2, with the greater watershed spanning over 116,500 km^2. The rivers that flow into the delta are fed by rainfall and snowpack melting from the Klamath Mountains and Sierra Nevada and drain nearly 40% of the land in California. Together with the San Francisco Bay, the Bay-Delta system is the largest estuary on the West Coast of North America. With both tidal and fluvial influences, the Delta is a complex system driven by seasonal variability and episodic flooding events (Figure 2). It is a rich habitat, home to 700 species, five of which are endangered. Many of California's important commercial fishery species (80 percent) live in the Bay-Delta or migrate through the system. In addition to being an important habitat for diverse flora and fauna, the Delta is a critical stop along the Pacific Flyway, the route that millions of birds use to migrate along North America, and home to a half million people spread out across the region.

The Delta has a long history of human modification throughout the last 160 years. Following the discovery of gold in 1848, significant hydraulic mining, which peaked in the 1860s, drove immense amounts of debris into channels and streams leading to severe flooding and causing mercury contamination in some areas. As the region became increasingly developed, levees were constructed to drain the wetlands for agriculture, and humans carved out more than fifty islands, completely altering the hydro-

Figure 1. California's Sacramento-San Joaquin Delta.

CALIFORNIA'S 20TH CENTURY TE OF CHANGE

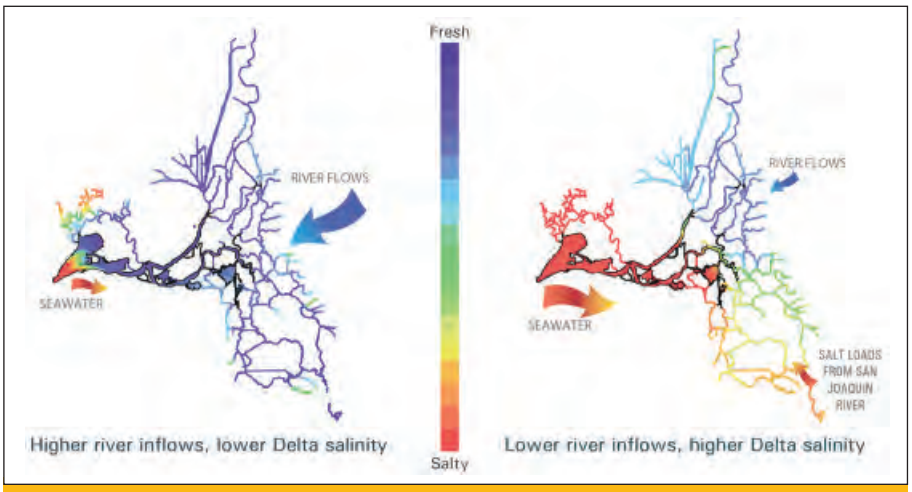

Figure 2. Tidal and river flows in the delta during wet and dry conditions. Source: Resource Management Associates, www.rmanet.com

logical characteristics of the system. Eventually, 95% of the historical tidal marsh in the Delta was lost. Sediment delivery to the Delta was also reduced in the 20th century due to the construction of dams along the rivers feeding into the Delta (Whipple et al. 2012).

As California experienced an increasing human population, a growing agricultural industry, and limited water supplies throughout much of the state, construction began on two major water supply projects to convey water to metropolitan centers and the Central Valley. The Central Valley Project and State Water Project were constructed in the south Delta between the 1930s and 1970s (Figure 3). Today, these projects are two of the largest water diversions in the world diverting up to 8 billion cubic meters per year.

The Delta, as the main conveyor of freshwater in California, is an incredibly important resource for water supply and agriculture. It provides water to ~25 million people, about 2/3 of California's population and irrigates more than a million hectares of farmland. With 45 percent of fruits and vegetables produced in the United States growing in California on land irrigated by water from the Delta, much of the state's economy depends on the health and sustainability of the Delta. Agricultural production from land receiving Delta water contributes $27 billion annually to California's economy.

With so much at stake in terms of agricultural production and water resources, the system is at risk for major flooding and levee failure. Atmospheric rivers, which bring immense amounts of water vapor up from the tropics, deposit large amounts of water once they make landfall at higher elevations along the west coast. While these processes are integral to delivering much of the freshwater to the system, more extreme atmospheric rivers are the driver for catastrophic flooding events (Dettinger 2013). This hydrologic phenomenon means that northern California experiences some of the most extreme precipitation events in North America. One such event in 1861 wreaked havoc in the Central Valley and Sacramento region turning the whole area into an inland sea. These extreme events will continue to affect California with increased variability being expected due to climate change.

Similarly, the levees constructed in the 20th century were gradually built and modified over time, without the benefit of modern geotechnical designs. Many were haphazardly engineered with heavy mineral sediments on top of less stable peat. While there is limited understanding of the response of peat to large magnitude

earthquakes and is the subject of current researchers by the University of California, Los Angeles, it is possible that a devastating earthquake could result in widespread levee failure, followed by flooding of the Delta islands that have subsided and are up to 8m below sea level. Flooding of the islands would draw salt water from the Bay into the Delta and the region of the water diversions to the South, consequently interrupting the freshwater supply. This event could be on a scale that far exceeds the flooding of New Orleans following Hurricane Katrina in 2005 (Hanak et al. 2011).

In addition to potential catastrophic flooding, other major drivers of change that affect the Delta's sustainability include subsidence, sea level rise, climate change, invasive species, and population growth. Along with changes in the Delta's hydrology and massive land use changes, peat oxidation and compaction have resulted in the region's subsidence. When coupled with sea level rise, the whole area is under threat of being inundated.

Other effects of climate change include warmer temperatures, shifts in precipitation, and diminishing snowpack. Since a large amount of water in California is stored as snowpack, this could have major implications for water supply reliability. Warmer temperatures will result in more precipitation falling as rain, leading to greater flooding in winter and reduced water supplies in drier months. An increasing human population will further stress the Delta as more and more people rely on water from the Delta.

The increasing demands on the Delta from humans for water supply and agriculture on top of the threat of climate change put the ecosystem at risk. Due to the loss of habitat, flow modification, and introduction of invasive species, many native species are threatened, including the delta smelt, an important indicator species (Figure 4). According to the Endangered Species Act, landmark environmental legislation in the US since the 1970s, water operations must be managed to avoid jeopardy of threatened and endangered species such as delta smelt. If too many of these tiny fish are entrained in the pumps for the state's water projects, court orders dictate reduced pumping, which affects water delivery to the Central Valley and southern California. Invasive species, which are flourishing in this heavily modified deltaic ecosystem, are also contributing to the decline of delta smelt and Chinook salmon, an iconic and economically important species. Climate change and the other significant drivers of change threaten the sustainability of the Delta when there are competing interests for water supply reliability and ecosystem health.

"Since a large amount of water in California is stored as snowpack, climate change could have major implications for water supply reliability"

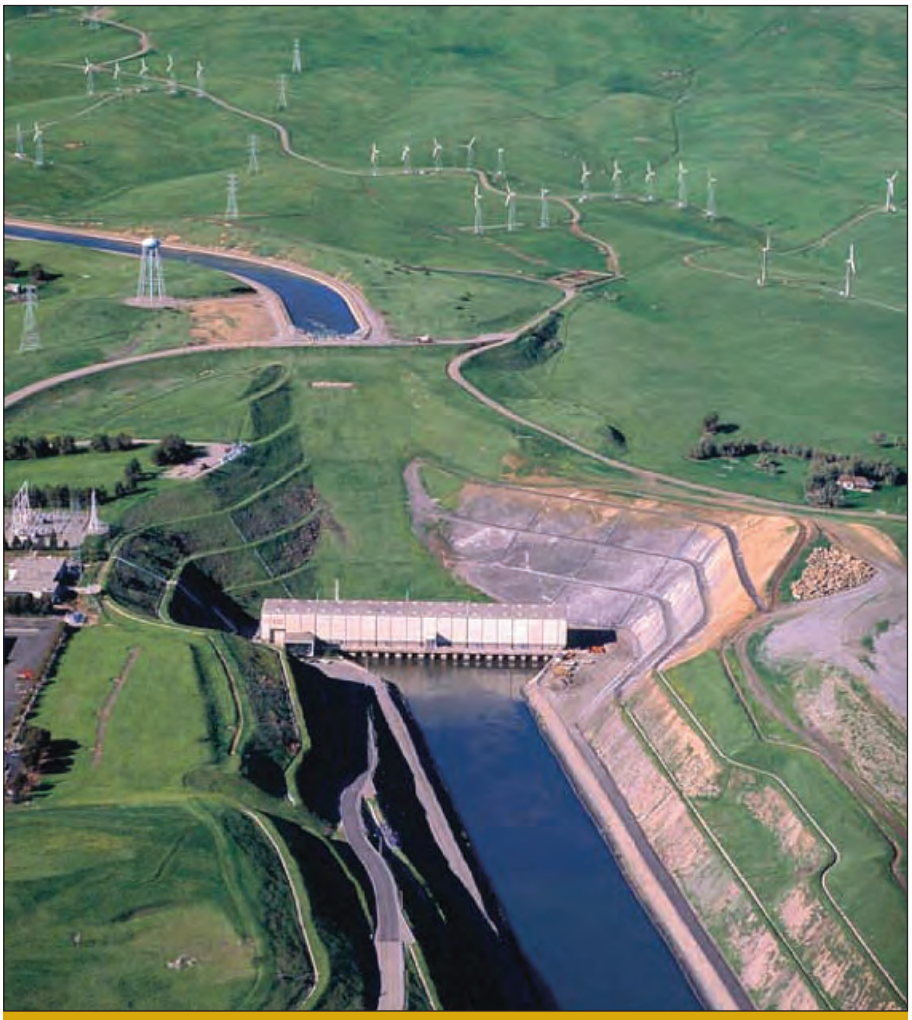

Figure 3. State Water Project's Harvey Banks Pumping Plant is powerful enough to alter circulation patterns in the Delta. The pumps also trap fish. Source: CA Dept of Water Resources.

The need for a reliable water supply and the push to protect the Delta ecosystem led to the Delta Reform Act of 2009 and the establishment of the Delta Stewardship Council. The Delta Stewardship Council sets out to meet the coequal goals of providing California with a more reliable water supply as well as protecting, restoring, and enhancing the Delta ecosystem. The goals will be achieved in such a way that preserves and improves the Delta as a place (culturally, recreationally, and agriculturally). The Delta Reform Act also calls for regions that depend on Delta water to improve self-reliance for water.

With the passage of the Delta Reform Act, the Delta Science Program (DSP), was appointed to facilitate and coordinate Delta science. The central tenant of the DSP is to act as an honest broker of science and to ensure that policies and management actions are founded on the best available science. The objectives of the DSP are to support and facilitate research, synthesize scientific information, facilitate independent peer review, and coordinate and communicate science.

The Bay Delta Conservation Plan is being developed by a number of agencies and if approved, will result in the construction of an improved water conveyance system to increase

Figure 4. The delta smelt is an endangered species endemic to the Delta. Source: CA Dept of Water Resources.

water supply reliability. This will be achieved through two major tunnels capable of discharging up to 255 cubic meters per second from north of the Delta directly to the pump intakes, thus avoiding the critical Delta habitat. Discharge rates will be heavily regulated. The project will cost roughly $20 billion. The plan must meet habitat restoration goals for the Delta and will be based on adaptive management. The Delta Plan, developed by the Delta Stewardship Council, is also in its final stages of development and will guide state and local agencies to help achieve the coequal goals of a reliable water supply and a protected and restored Delta. Currently there are upwards of 200 agencies involved in some aspect of the Delta, and it is essential to have a coordinating group to help unify and promote Delta science for more successful management of this complex and valuable system.

Make sure to check out an article to come out later this year, 'Ten Questions with Phil Isenberg' to learn more about the innovative approach to link policy and science to address the challenges of adapting the 1950s water resource infrastructure to cope with finite resources, a fragile ecosystem, population growth, and uncertainties due to climate change.

For more information:
http://deltacouncil.ca.gov/
http://baydeltaconservationplan.com/Home.aspx

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RESEARCH ON HYDRAULIC OPERATION SYSTEM SOUTH-TO-NORTH WATE

BY GAO JIZHANG AND CHEN WENXUE

China's South-to-North Water Diversion Project (SNWDP) is a major strategic infrastructure aimed at easing severe water shortage in North China and optimizing water resources allocation. General layout for SNWDP has been worked out as three water transfer sub-projects, i.e. the Eastern Route, Middle Route and Western Route, which are to divert water from the lower, middle and upper reaches of the Yangtze River respectively.

Gao Jizhang **Professor at China Institute of Water Resources and Hydropower Research (IWHR). Eminent expert in hydraulics Chairman of IAHR China Chapter.**

Chen Wenxue **Professor at China Institute of Water Resources and Hydropower Research (IWHR) Chief Engineer of the Department of Hydraulics of IWHR. Deputy Secretary-General of IAHR China Chapter.**

The Middle Route Project (MRP), diverting water by gravity flow in open canals, starts from Danjiangkou Reservoir in Hubei Province and finally reaches Beijing and Tianjin. It goes through quite urbanized regions in Hubei, Henan, Hebei Provinces, and Tianjin and Beijing Municipalities, altogether crossing a dozen of medium-large cities and over 100 counties and towns. The main channel of the MRP is 1432km long and diverts 13 billion m3 to 14 billion m3 of water in annual average.

The MRP has over 1790 hydraulic structures: over 160 river-canal crossing structures (including the Yellow River Crossing Project), over 490 left-bank drainage structures, over 130 canal-canal crossing structures, over 40 railway-crossing structures, over 730 over-canal bridges, over 80 water diversion outlets, over 60 check gates, over 50 wasteway gates, 2 exit gates, nearly 30 deicing gates, 8 retaining weirs, 3 overflow weirs, 9 tunnels and 1 pump station. Among them there are over 270 real time regulation structures, including water diversion outlets, check gates, outlet gates, wasteway gates, outlet control gates of inverted siphon and pump station.

The significant number of hydraulic structures along the MRP, coupled with varied geological and climate conditions, confront the hydraulic operation system with many technical challenges, such as water diversion in freezing periods. Chinese researchers have risen to these issues with various researches over the decade. This paper briefly introduces some results on the hydraulic operation control of the main canal.

Development of the hydraulic operation method of the MRP

The main canal of the MRP is designed to operate under constant downstream water depth for reducing construction costs. When the flow rate is to be changed, the requirement of the storage volume in the canal pools is contrary to the change tendency of the storage volume. The response of the hydraulic operation system is consequently slow. In order to increase response speed and shorten the response time of the operation system, a distributed control algorithm combining a feedforward control loop, a feedback control loop and an upstream

Layout of MRP

OF THE MIDDLE ROUTE PROJECT OF CHINA
R DIVERSION PROJECT

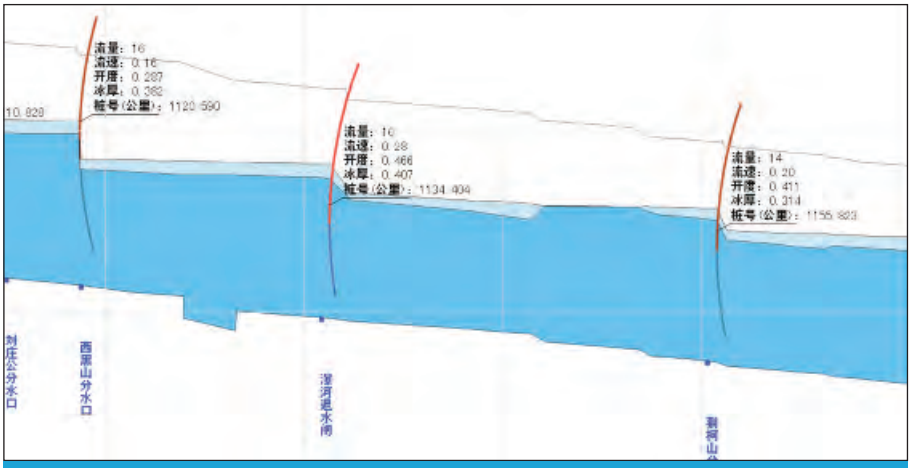
decoupler is devised. The feedforward control is to determine the controlled flow through each gate based on the demand delivery and the delay time of the canal pools; The feedback control is aimed at maintaining the constant water depth by eliminating the impact of known and unknown disturbances; and the decoupler is aimed at eliminating the coupling effects among canal pools and shortening the transition time for the canal. Such a threefold algorithm can effectively speed up the system response, hence laying the groundwork for diverting water in ten-day's allotment.

The feedforward control loop uses an improved volume compensation method. Different from the original one put forward by Bautista et al., the improved volume compensation method allows for variances in feedforward control time, which is determined by not only the flow of turnouts, but also the constraints of the canal systems, such as the drawdown rate of the canal pools and fluctuation range of the water level.

The feedback control loop uses a water level-flow cascade control that, when compared with the traditional method, can quickly eliminate the impact of disturbances on the system, reduce operation frequency of check gates and restrain water level fluctuation. This kind of control method also has decoupling effect on the downstream canal, since the flow rate of the check gates can maintain constant despite upstream disturbances.

A control algorithm for the system operation under the variant downstream water level is also developed, since the water level at the upstream of the check gates will be changed such as in the freezing period. This algorithm consists of the ordinary algorithm mentioned above and a volume compensation algorithm considering the variance in water depth. Therefore, the presented algorithm can not only deal with the canal system operated under the constant downstream water depth, but that under the variant downstream water depth also.

Canal model in IWHR



Ice simulation of MRP

As the developer of the industry's first Acoustic Doppler Current Profiler (ADCP), with nearly 30 years of experience designing the products that have set the standard for river flow and discharge measurements, Teledyne RDI once again raises the bar with their revolutionary new **RiverRay** ADCP.

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Research on safe water diversion in freezing period

The canal systems in high latitude areas are usually operated under ice cover during winter time, because the ice cover's heat insulation can avoid further formation of ice floes in the water under the cover. The MRP, especially the canal pools at the north of the Yellow River, will be operated under ice cover also. Various control measures are developed in order to avoid ice jam and ice dams and guarantee safe water transfer during freezing period. They include:

1) Control Froude number at each flow cross-section below the second critical Froud number of 0.08, beyond which floating ice will submerge at the edge of the ice cover or the ice boom and ice jam may be formed. Controlling Froude number helps ensure ice cover will be formed smoothly. The maximum water diversion capacity in the freezing period in the main canal of the MRP does not exceed 50% of normal diversion capacity.

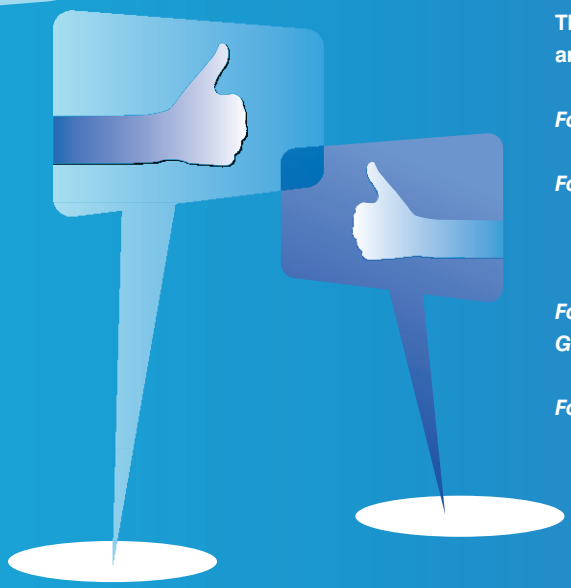
2) The canal system should be operated under constant downstream water depth. During formation of the ice cover, floating ice will build up before the ice boom and the ice cover will be formed at the end of the canal, and then extend upstream. The composite roughness along the canal will be increased during the forming of the ice cover, and the storage capacity of the canal pools will be increased also since the flow rate of the canal pools should be kept constant. At the same time, the water surface profile of the canal pools will pivot around the ice boom. Therefore, the operation method of the canal system with constant downstream water depth will be favorable to the formation of the ice cover.

3) A water level-flow cascade feedback control algorithm should be used during the freezing period of the canal system. During the formation and break-up of the ice cover, the water level and the flow rate will be changed because of the variation of the composite roughness of the canal system, and ice jam or ice dam may be formed if the operation of the canal system is not controlled properly. Numerical simulation reveals that when the water level-flow cascade feedback control algorithm is applied during the freezing period, the maximum fluctuation range of water level near the check gates is ±10.0cm, and maximum water level fluctuation is about ±10.6cm/day, hence the stability of ice cover could be achieved, and it is also favorable to the ice cover melt in situ.

4) Ice booms are erected in front of inverted siphon and check gates. A net-style ice boom is developed for better ice stopping effect. This new ice boom is highly stable and can facilitate the formation of ice cover, thus helping water transfer under the ice cover.

The Middle Route Project of SNWDP faces many technical challenges. The research results aforementioned in this paper have yielded benefits in supporting the sound hydraulic operation of the Project.

IAHR 2013 COUNCIL ELECTIONS: **SLATE OF CANDIDATES**



The 2013 Nominating Committee chaired by Prof. Nobuyuki Tamai has completed its work and proposes the following slate of candidates for the Council elections to be held in July:

For President:	**Roger A. Falconer**
For Vice President:	**(Asia and Pacific): Zhaoyin Wang** **(Europe): Philippe Gourbesville and Arthur Mynett** **(North & South America and Others): Marian Muste**
For Secretary General:	**Ramon Gutierrez Serret**
For Council:	**(Europe): Michele Mossa, Anton Schleiss, Hovhannes Tokmajyan, Damien Violeau and Silke Wieprecht** **(Asia and Pacific): James Ball, Jing Peng, Hitoshi Tanaka and Hyoseop Woo** **(North and South America and Others): Angelos Findikakis and Arturo Marcano**

According to the By Laws IAHR members may also propose additional candidates "by petition" for the post of Council Member, independently of the Nominating Committee. For more information see the IAHR website.

The deadline for submitting such petitions is June 1st. Please send your nominations to Elsa Incio at membership@iahr.org

STORM SURGE AND WAVE MOD PROTECTION GATES IN NEW OR

BY DAVID SCHOWALTER AND PETER GRANT

In August of 2012, Alden Research Laboratory, Inc. (Alden), headquartered in Holden, Massachusetts, U.S.A., acquired AECOM's hydraulic engineering and modeling laboratory in Redmond, Washington, and hired the associated staff. By combining the modeling talents and fisheries knowledge of Alden staff with the hydraulic modeling and fisheries engineering experience of the AECOM hydraulic engineering and modeling operation, Alden has created the largest commercial hydraulic engineering laboratory system in North America.

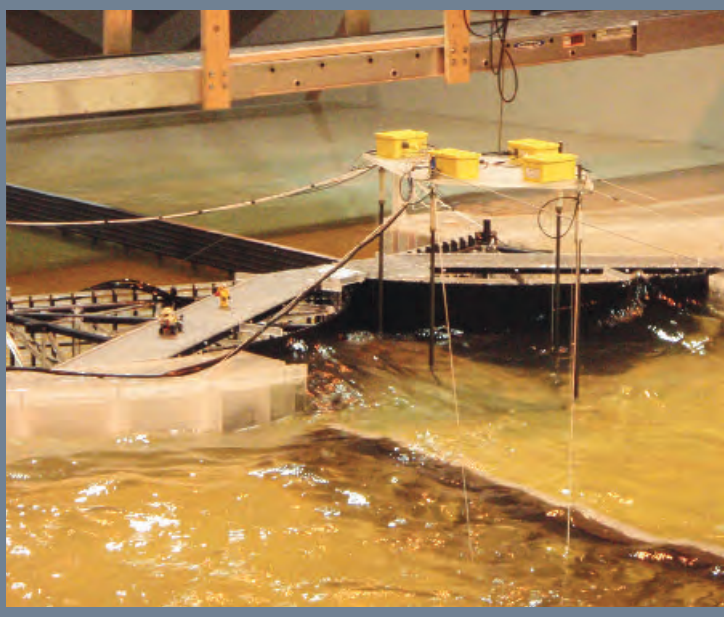
The AECOM laboratory was formerly known as the "ENSR hydraulics lab." and became part of AECOM in 2005 when AECOM acquired ENSR. Charles "Chick" Sweeney, P.E., started the independent hydraulic modeling laboratory in 1978. The hydraulics lab. has been a leader in the optimization of hydraulic structures and fish passage systems associated with hydroelectric power generation, working especially closely with federal agencies and hydroelectric power utilities in the Pacific Northwest. Additionally, the group has helped municipal utilities to ensure proper performance of pump stations and water conveyance systems. Capabilities include physical hydraulic modeling, 1-D and 2-D numerical modeling, 3-D computational fluid dynamics (CFD) modeling, fisheries and hydraulic engineering design, and associated field services.

Alden has been expanding geographically in recent years, having opened up an office in Fort Collins, Colorado, in 2009, and establishing a presence in Portland, Oregon, in 2011. This addition is a major milestone in an ongoing effort to better serve clients in the U.S. and internationally. It establishes Alden's presence on both coasts and enables the company to better serve the growing hydraulic design and flow modeling market. The two units have similar corporate cultures and have not been competing directly on projects in recent years.That translates into the ability to offer more resources and more talent to the customers of both facilities. A continued collaboration with AECOM is also expected.

Complementary Experience

While the groups centered in Holden and Redmond have similar physical and computational hydraulic modeling experience, some subtle and strategic differences exist. For example, the Redmond team has had a special focus on fish passage hydraulics and habitat protection in the U.S. Pacific Northwest and federal agency work, whereas the Holden operation was more focused on fish passage and protection in the Midwest and East Coast,

Hydroelastically Scaled Sector Gates



Storm Surge and Waves Testing

ELING FOR THE LEANS

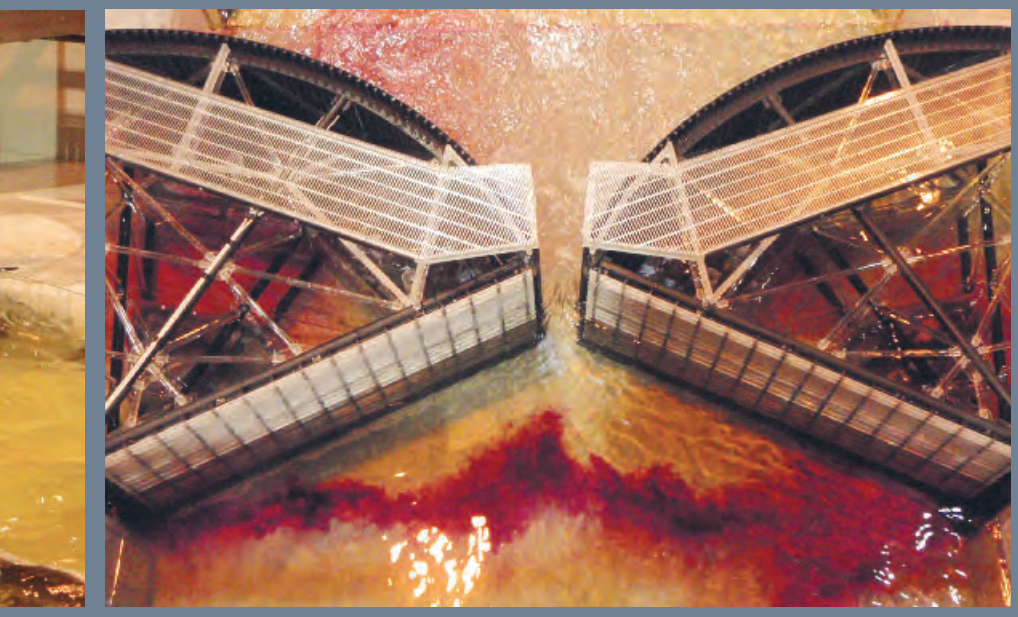
with very unique facilities for using live fish in testing flumes. The Holden operation is also very well known for flow meter and flow control equipment testing and calibration, has a long history of working with the U.S. nuclear power industry on safety system hydraulics, and services the fossil power industry with gas flow modeling, especially in the area of air quality control system optimization.

While both groups have developed physical models of coastal structures in recent years, the Redmond operation's work in this area has been more extensive. The following case study provides an example of Alden's new capabilities through the Redmond acquisition. With rising sea levels and increased awareness of storm surge flooding dangers, Alden anticipates providing more of this type of infrastructure support in the coming years.

Case Study: Storm Surge and Wave Modeling

In 2009, the Redmond laboratory developed a 3-D hydroelastic 1:20 scale physical model study of the neutrally buoyant sector gates that are part of the 3 km long Inner Harbor Navigational Canal (IHNC) storm surge barrier in New Orleans. This modeling effort was commissioned by the United States Army Corps of Engineers (USACE) in response to destruction brought by Hurricane Katrina. The IHNC surge barrier is the first line of defense against storm surge and is designed to allow some waves to overtop the structure. A polder (an area of low land) behind the surge barrier can accumulate up to 1.5 ft of additional water surface elevation during a 1 percent chance hurricane. The system's sector gates then become a large flood-relief valve and are required to open to let the accumulated water back out to sea. The study was performed to affirm the design loads under storm surge and wave conditions, and to determine loads under reverse head conditions caused by storm surge receedance.

Besides being geometrically similar at a one-twentieth scale, the model components were individually designed to bend and vibrate at a scalable frequency recorded by accelerometers placed on the gate, exhibiting the effects of model generated waves with size and frequency spectrum similar to Hurricane Katrina. This



Reverse Head Test

Peter Grant **is a Senior Engineer in Alden's Hydraulic Engineering and Modeling group. He is a graduate in mechanical engineering from Purdue University, where he obtained his B.S.M.E. and M.S. in Fluid Dynamics. His experience includes all aspects of design-build projects from physical modeling of hydraulic systems and design of automated machinery, through quality inspections and plant start-ups of fish collection systems and other automated equipment. Mr. Grant is a registered professional engineer and a member of ASCE and ASME.**

David Schowalter **is currently Principal Engineer and Director of Business Development for Alden. Dr. Schowalter received his Bachelor's degree at Cornell University and his M.S. and Ph.D. degrees at the University of California, San Diego. He spent three years as a Visiting Assistant Professor at North Carolina State University. He joined Fluent Inc. in 1997 and was involved in technical support, consulting, sales, and business development with a focus in the energy industry through the ANSYS acquisition in 2006. He joined Alden in 2008, and manages strategic business initiatives, as well as some specific technical activities, particularly those associated with Computational Fluid Dynamics applications.**

scaling technique is not often utilized for coastal structures like surge barriers and breakwaters but is more common for the investigation of gate vibration in a dam's floodgates. The IHNC sector gates, which are similar to radial Tainter gates turned on their side, have significantly more structural members, forming three truss layers that resist the roughly 6 m storm surge corresponding to a 1 percent chance hurricane.

The gates incorporated two buoyancy tanks per gate leaf. A large buoyancy tank near the front of the gate helps to ease gate movement by reducing the force placed on the bottom seal. A smaller buoyancy tank near the gate's axle allowed these large, 25.6 m radial sector gates to be floated in place for final assembly. The innovative use of these tanks in the sector gate design was necessary to ease the operability of the gates and to reduce operations and maintenance costs. However, this also presented the designers with challenging questions regarding the forces experienced by the gates and the plausibility of exciting resonant vibrations.

Key findings from the experiments showed that waves directly in front of the sector gates were reduced by the channel's deeper waters and the long approach walls in front of the structure. Although these waves were reduced in total height, the curvature of the sector gates tended to focus wave energy where the gates meet, occasionally creating wave pressures acting on an overhanging portion of the gate that were twice the horizontal design pressure. Vibrations, however, were only observed during overtopping events; the frequency of which were far from dangerously resonant conditions.

Confirming the magnitude of wave pressures and forces during large wave impacts helped designers make final selections for structural members and the casting design of the main bearing supporting the weight of the sector gate.

For reverse head tests (simulating the release of flood waters from the polder behind the surge barrier after a storm's passing), the gates were instrumented to monitor vibration and the 1-D forces on the gates' actuating cylinders. During these tests, it was found that the hydraulic torque curve was considerably different than that for sector gates without buoyancy tanks (the only source of design data available up to that point). The test results created new hydraulic torque curves for sector gates with buoyancy tanks that the designers used for their selection of an appropriately sized gate opening and closing actuator.

A Common Future

The merging of AECOM's former Redmond hydraulic laboratory and Alden's legacy staff has resulted in a very rapid but smooth transition, owing to the similar culture and common technical work scope of the units. The coming years will be a building experience as the two groups work together on joint projects that combine the coastal and large hydropower facility experience in Redmond with the fisheries biology expertise in Holden.

For more information, please visit www.aldenlab.com.

THE VENICE DEFENCE SYSTEM (MOSE)

***Giampaolo Di Silvio*, Professor of Hydraulics, University of Padua, Italy. Director of the Department of Hydraulic, Maritime, Environmental and Geotechnical Engineering since 1996. Director of the International Centre of Hydrology "Dino Tonini" from 1992 to 1994. In the last years he mostly worked in the field of fluvial and coastal hydraulics, with special emphasis on erosion processes and morphological effects of human interventions. Prof. Di Silvio is a Honorary Member of IAHR.**

INTRODUCTION BY GIAMPAOLO DI SILVIO

On November 4th, 1966, the city of Venice was hit by the worst "Acqua Alta" (high water) in the last century, following an exceptional combination of astronomical tide, low pressure conditions and storm surges in the Adriatic sea. In the very same days, the same meteorological conditions also resulted in catastrophic flooding by the Arno river of Florence, another unique Italian city, as well as to countless inundations, landslides and debris flows all over the peninsula.

Positioning of the hinges on the caisson gate housings

Although Venice has been built on a group of low estuarine islets barely above the mean sea level, its vulnerability has progressively increased due to the mean sea level rise and soil subsidence, the last fostered by an excessive water pumping for industrial use in the years between the 1950's and 1970's . After the 1966 event it was immediately clear that a protection system of the city should been implemented and several engineering solutions (including the MOSE) have been proposed, all based on different types of barrier to be activated during the most significant episodes of "Acqua Alta".

The protection project, however, has been continuously procrastinated over many decades due to a persistent conviction, professed by some political groups and part of the public opinion, that the "acqua alta" problem could be properly solved by the re-establishment of the previous morphological conditions of the old lagoon or, at least, by a sufficient narrowing of its present three inlets. Unfortunately, while it is true that the Lagoon of Venice has experienced a consistent degradation of its morphology and ecology, the flooding of the city, mainly depending on subsidence and sea level rise, cannot be controlled by any reasonable permanent reduction of the inlets, unless allowing for unacceptable hindrance to navigation and reduction of tidal exchange.

Only a few years ago the postulation of separating the two problems (protecting the city from high water and the lagoon from degradation) was formally accepted, and the MOSE system definitely approved with the inclusion of a large parallel project devoted to morphological restoration.

MOSE Defence System

BY CONSORZIO VENEZIA NUOVA

Introduction

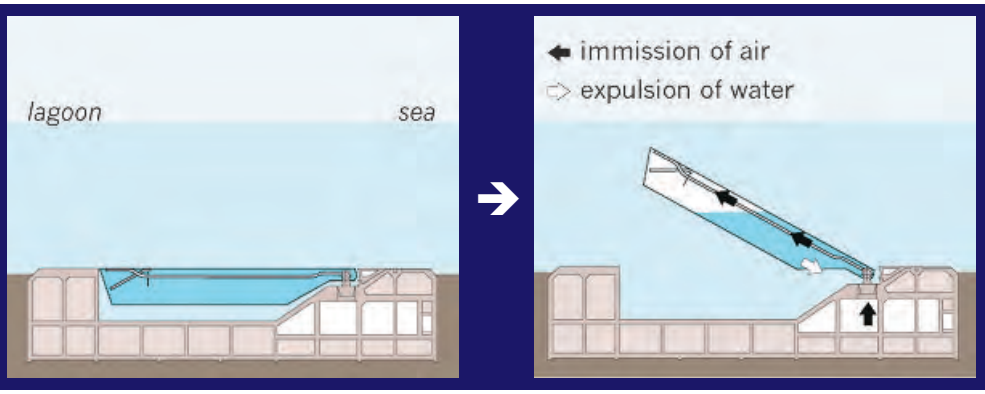
Mose is the last and most important element in the plan of measures to safeguard the lagoon being implemented for the last two decades across the entire lagoon basin. Its construction, in fact, proceeds in parallel with a programme of work to protect the ecosystem unequalled anywhere in the world for the size of the area involved, nature of the problems tackled and scale and characteristics of the measures implemented.
The Mose System to safeguard Venice from high waters consists of mobile barriers able to temporarily separate the lagoon from the sea and protect Venice from both exceptional destructive events and more frequent events.
It is being constructed at the lagoon inlets of Lido, Malamocco and Chioggia, the three openings in the barrier island through which tides propagate in the lagoon.
The mobile barriers consist of rows of gates. In normal tidal conditions, the gates (a type of pontoon) rest in housing structures on the bed in the inlets, completely invisible and without modifying exchanges between sea and lagoon. They are raised only when necessary to block the incoming tide and avoid flooding the lagoon and built up areas. When the gates are in operation, the continuity of port operations will be guaranteed by a lock for large shipping already constructed at the Malamocco inlet.
Mose can protect the lagoon and its cities and towns from tides of up to 3 m.
In the future, the phenomenon of high waters could, in fact, be further aggravated by the predicted rise in sea level resulting from climate change. With respect to this problem, Mose (together with reinforcement of the barrier island, the narrow strip of land separating the lagoon from the sea) has been dimensioned on the basis of a precautionary criterion to cope with eustatism of up to 60 cm, in other words, even higher than recent scenarios estimated by the international scientific community. Management of Mose is flexible enough to cope with an increase in high waters in various ways, depending on the characteristics and scale of the tidal event. Depending on the situation, the defence strategies can involve simultaneous closure of all three inlets in the event of an exceptional event or alternatively and according to the winds, pressure and amplitude of the forecast tide, differentiated closure of the inlets, or again, partial closure of each inlet, as the gates are all independent.
About 75% of the work proceeding in parallel at all three inlets, Lido, Malamocco and Chioggia, has been completed. Currently about 4000 people are employed in the construction of Mose.

The parties involved

The Venice Water Authority is a branch of the Ministry of Infrastructure and Transport. Its responsibilities include activities to safeguard Venice and its lagoon according to the Special Law for Venice.
Implementation of the measures is delegated to a single body able to operate according to a systemic vision of the lagoon ecosystem, with a global project integrating protection from high waters with restoration of the naturalness of the lagoon. This implementing body is the Consorzio Venezia Nuova consisting of national and local Italian companies and working under the surveillance of the Water Authority which has the role of policy, control and surveillance.

Last steps

The Mose System to definitively protect Venice



The Mose System. Movement of the gates. Mose consists of rows of hinged gates which in normal tidal conditions contain water and rest invisible in caissons at the bottom of the three inlets. When a high tide is forecast, compressed air is pumped into the gates to empty them of water, causing them to rise above the surface and create a continuous barrier dividing the sea and the lagoon for the time necessary. Small craft harbours connected to locks allow vessels to enter the lagoon when the barriers are raised - small locks for pleasure and fishing boats at Lido and Chioggia and a lock for large ships heading for the port at Malamocco.

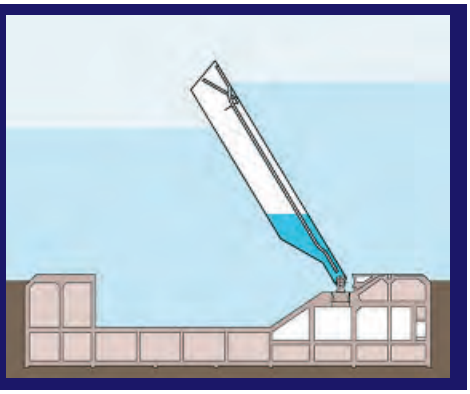
and its lagoon from all floods is due to be completed in 2016 at a total cost of 5,500 Million Euro.
Regarding its construction important and final steps are underway. In fact, the gate housing structures for the north barrier (Treporti side) have already been launched and positioned in the sea bed. Between April and May 2013 the first gates for this barriers are going to be installed.
This step will allow the gates also to be tested during 2013, and this is fundamental in order to optimize the methods used to construct and install the main elements of Mose, with evident advantages for construction of the other barriers.
During 2013, also the housing structures (currently being constructed) for the south barrier (San Nicolò side) and for the Malamocco barrier, will be launched and installed.

The Mose Control Centre

The Mose control centre, completed in 2011, has been constructed in Venice Arsenal by Thetis SpA for the Consorzio Venezia Nuova - Venice Water Authority. This is where the key decisions will be taken on raising and lowering the mobile barriers according to measurements made by the tide gauges positioned in front of the lagoon inlets to record the rising tide in real time.
Operation of the barriers is highly reliable, as the actual decision on closing the barriers is made on the basis of direct measurement of the water level and not the forecast level.
The forecasts provide a warning that a high tide event may be imminent, but it is the actual on-site measurement which provides the information needed to decide whether the barriers should be activated or not.
The gate raising command is given when the level established by the procedure to begin the manoeuvre and guarantee that the water level in the lagoon does not exceed the safeguard level is reached. This also makes it possible to react to any unexpected changes in the weather and sea conditions rapidly and right up to just before the event and to modify (in positive or negative) the danger level.

For more information visit: www.salve.it

Credits: Ministry of Infrastructure and Transport – Magistrato alle Acque di Venezia, concessionary Consorzio Venezia Nuova.



The Venice lagoon. Location of the inlets, the three openings in the barrier island through which tides propagate in the lagoon.

MAKING KNOWLEDGE AND IN IN WATER ENVIRONMENTS

BY HENRIETTE TAMAŠAUSKAS

Karsten Mangor, DHI, conducting a Shoreline Management course. The aim is to convey an understanding of the available tools and procedures that can help create a sustainable management of the physical environment in the coastal zone.

Knowledge sharing and capacity building

In order to address challenges in the water environments, our knowledge on the development of sustainable water strategies and tools for implementing them are essential. But tools and knowledge are not enough. We must ensure that the existing knowledge is shared and not kept in organisations and libraries, and we must enable water managers all over the world to work actively together. This is the aim of The Academy by DHI, a newly established entity within DHI.

Together we must find answers to questions like: How will the changing climate impact our lives? How can we protect ourselves against floods? How do we use an oil spill model to make decisions to protect our coastlines against disasters? How can we model water in mines to develop efficient dewatering and to minimise contaminants? Where can I find the latest research results and practical experience on urban storm water management? Where can I learn more about the risk assessment of combined exposure of chemicals in drinking water?

These and many more questions are being asked daily by water professionals and managers around the world.

'Live as if you were to die tomorrow. Learn as if you were to live forever' Mahatma Gandhi once said. We continuously need to develop our skills and learn new approaches to face the challenges that we meet. We need to share our experiences with others working in the same field so that we can learn from one another.

The primary goal of The Academy by DHI is to make knowledge and innovation accessible in Water Environments –through specific training activities, capacity building packages or simply by sharing results from our research and creating forums for experience exchange. Specific examples are that you can download state-of-the-art scientific papers from the website along with guidelines free of charge.

The training activities and capacity building packages come in many forms – ranging from long term education packages at various locations (perhaps offered through aid organisations), to a few days of practical hands-on training courses or university collaborations with

NNOVATION ACCESSIBLE

DHI, as an international not-for-profit organisation, invests 120 man years every year in research and development to further our knowledge in water environments – the result of this effort is put forward through our solutions, software and in the sharing of this knowledge through The Academy.
DHI is an IAHR Institute Member

Henriette Tamašauskas **has worked at DHI for more than a decade contributing to software design, development management and support of the MIKE by DHI products. The last couple of years have been spent on managing and conducting training activities worldwide. Henriette Tamasauskas is Head of The Academy by DHI as per 1January 2013.**

input provided through lectures or in the development of university training programmes. The collaboration with universities will improve our extensive knowledge partner network, thus helping us educate the next generation of water experts.

Training activities – building expertise

Skills development and capacity building contribute to the further development of sustainable water management strategies and global partnerships.
For this reason we arrange hundreds of courses each year, which thousands of professionals attend and learn from. In 2012 training courses took place in more than 40 countries. The palette of training courses with a duration from a few days up to months cover both open enrolment courses and courses tailored to meet specific needs. The 2013 global course calendar for the open enrolment courses is seen here: http://www.mikebydhi.com/GlobalTraining/Globalcoursecalendar.aspx and for the courses in environmental risk and product safety courses it is found here: http://tox.dhigroup.com/Courses.aspx . The courses range from thematic and capacity building workshops to training in the use of specific software tools, and cover areas such as:
The courses range from thematic and capacity building workshops to training in the use of specific software tools and cover areas like:

- climate change adaption
- energy, environment & ecosystems
- urban water
- coast & sea
- surface & groundwater
- product safety &environmental risk
- integrated water resources management.

The Academy offers a large number of courses that can be used to assist the development of people at university level and higher. Through DHI's knowledge partner network, which includes universities around the world, The Academy is constantly developing new training courses. DHI has the technology platform necessary to support the water sector with respect to education and training. This includes the development of a serious gaming platform (Aqua Republica, www.aquarepublica.com), which can teach specific skills through an interactive gaming environment. The game provides an engaging learning platform for understanding the role/importance of water resources and for building capacity in water resources management and sustainable development.

> **"In some places in the world there is a need for improving capacity development in the water sector"**

Global partnerships

In certain parts of the world there is a need for improving capacity development in the water sector, as a skilled and dedicated workforce is necessary to provide solutions to constraints and for more effective use of water. If we are to live up to global development and sustainability goals, we need not only funds and infrastructure - we also need enough highly skilled people in the water sector.
We offer capacity building packages in cooperation with Danida and other aid organisations. In Burkina Faso in West Africa we organise courses, not just to train water resource managers but also to build up the capacity at the local engineering school and to strengthen local development of sustainable water management strategies.
DHI is hosting a UNEP collaboration centre on water and environment – the UNEP-DHI Centre http://www.unepdhi.org/ , which has been responsible for the development of training materials and activities on integrated water resources management and water quality management, and we have jointly developed WRIAM (Water Rapid Impact Analysis Model), a tool aimed at developing EIA's related to water.
We have also, in cooperation with Danida, facilitated knowledge sharing between river basin organisations in the Mekong Basin, the Nile Basin and the Zambezi Basin / Southern African Development cooperation and have helped to ensure that stakeholders from the three basin organisations meet and learn from each other.
In the Nile Basin training has been provided to

the Nile Basin Initiative (NBI) and counterpart national organisations in the use of decision support systems and water management models. Training has been implemented in nine Nile Basin countries, as well as in Denmark, with over 200 participants during the span of the project.

Women's Water Fund

A very specific initiative at DHI is the *Global Initiative for Women Water Managers*. This was established in 2007 as an initiative benefiting from the "King Hassan II Great World Water Prize", which was presented to Dr. Torkil Jønch Clausen by the World Water Council and Government of Morocco at the Fourth World Water Forum in Mexico in 2006. The objective of the DHI Women's Water Fund is to support women in developing countries in advancing their career opportunities in the development and management of water resources.

The initiative has just completed the first five-year phase (2007-2012), during which period 22 women from 17 different developing countries participated. The capacity-building activities included participation in relevant short courses on water resources technologies and management combined with internships at Danish organisations within the field of water. DHI provided the teaching at the courses along with a number of other sector specialists from universities, organisations and private companies.

A mentoring component provided each of the women with a mentor. Each mentor was a senior manager from organisations and companies in the Danish water sector. This mentor arrangement continued for at least one year after participants' visit to Denmark as a long distance learning and support relationship. This learning arrangement has turned out to be a strong model not only for individual women's career advancement but also for mutual learning and partnership building. The global interest in the course has been overwhelming. During the first five years many women applied to join the courses - in 2011 alone there were 270 applicants from more than 30 countries. Learning from concrete Danish experiences and the linking of knowledge to practical solutions to water problems has been essential to its success. And the women truly benefitted from participation in the course. We know that a number of the participants were actually promoted after participating in the programme.

"I want to believe the two weeks in Denmark had an impact as I was promoted to be head of my department as of July 2011" (Tracy Molefi, Botswana, Ministry of Minerals, Energy and Water Resources)

Knowledge sharing: DHI's Climate Change guidelines are publicly available as are other guidelines with DHI contributions. One example is a joint knowledge product of GWP, UNEP-DHI Center, DHI and SIWI, which is a technical focus paper providing guidelines for the elaboration and validation of modelling/DSS tools to assist decision-makers in implementing IWRM.

On below link you can see interviews with some of the participating women:
http://www.dhigroup.com/News/2011/08/26/WomenSWaterFund2011.aspx

Sharing climate change knowledge at all ages

Learning about water and climate change starts at an early age – at least at DHI in Denmark, where The Academy regularly hosts climate change days for school children, ranging from the age of 11 to high school students. Together we discuss how to put climate change on the agenda and we cover topics such as state-of-the-art knowledge on climate change, how to prepare for climate change and what we can do as individuals. After having attended the climate change day even primary school children have understood the advantages of using numerical models for simulating flooding and tsunamis. As of April 2012, 850 students had attended these sessions and now science teachers are attending seminars tailored specifically to teachers. The objective is to inspire teachers to make the sciences classes at school exciting by using examples from the students' daily lives. Attendance is free of charge and schools can sign up via the DHI webpage, http://www.dhi.dk/News/2012/04/30/KlimaundervisningP%C3%A5DHI.aspx .

The knowledge that DHI has gained while conducting projects related to climate change worldwide - whether they are complex multi-lateral decision support systems for integrated water management, flood prevention measures or coastal protection projects – is shared with everyone through the climate change adaption guidelines on the DHI website, http://www.dhigroup.com/Publications/Guidelines.aspx .Publications from research projects and other guidelines are also available on this website. The scientific articles (see http://www.dhigroup.com/Publications/ScientificPublications.aspx) cover specific projects/studies in all the various areas of water environments.

Looking ahead

Within The Academy by DHI it is our mission to enable people and organisations to address water-related issues and to develop sustainable water strategies to overcome challenges. We believe that the way to do this is through building expertise and skills – and through the sharing of global knowledge on water environments, making research and innovation accessible. So, please stop by our website http://www.dhigroup.com/THEACADEMYByDHI.aspx and our seminars and let us know what you think. Do YOU have any ideas about what we can do together?

RESEARCH PROGRESS OF THE DAM BREAK TEST AND SIMULATION TECHNOLOGY

BY LI YUN, XUAN GUOXIANG, WANG XIAOGANG

1 The status and significance of dam break study

Dams have brought enormous social and economic benefits to human beings. However, for various reasons, quite a lot of dams have potential safety defects. Once a dam fails it can potentially cause tremendous losses in lives and properties downstream. For example, the 1993 failure of the Gouhou Dam in Qinghai Province in China resulted in the loss of over 1,000 lives, together with serious social disruption and economic losses. The Opuha Dam in the South Island of New Zealand failed during construction (at about 60% of design height) in February 1997. Although no lives were lost from the overtopping failure of the 35-m-high dam, the resulting flood event caused huge economic and environmental damages. Accurate assessment of the consequences of dam failure events has been a worldwide problem, which has promoted dam failure studies and analyses in recent years.

Dam breach usually occurs in embankment dams[1, 2], and is a gradual process. Forecast accuracy of the flow process in dam breach directly determines the accuracy of flood routing calculation. Therefore, it is of great significance to master the practical process of dam breach development. The process of dam breach involves sediment transport in unsteady rapidly varied flow, and is a strongly nonlinear process. The mechanism involves hydraulics, soil mechanics, sediment transport mechanics and so on. Therefore, the research on dam breach has no breakthrough as yet[3]. Dam break model test technology is still at the starting stage.

The magnitude and extent of damage caused by a dam break depends largely on the dam-breaking rate and degree, which determines the breach outflow and its spreading speed downstream. Due to the capability for simulating dam break and predicting flood hydrograph, a dam break model is of tremendous importance to the disaster control and reduction.

2 Ongoing research

2.1 Numerical simulation technology for dam break

The CADAM project launched by the European Commission in 1998 compared the results obtained by calculation with experiment achievements (the observed data included). The research report indicates that the existing mathematical models have limited accuracy. The errors may reach ±50% between the predicted peak flow and the observed data. And the consequences are even worse in other aspects.

The numerical models developed at present can be divided into two categories. The first one is based on parameters, such as the DAMBRK model and SMPDBK model developed by the National Weather Service of U.S. This type of model is relatively simple. It has less input requirements and are more convenient to use the data, but the accuracy is inadequate as they do not reproduce the dam break mechanism. The second one is based on the physical process of dam break. The models always integrate hydraulics, sediment transport mechanics, soil mechanics, hydrology and other disciplines to build a time-dependent process in order to simulate the actual process of dam failure and outburst flood. This type of model is more complex in structure and more accurate and detailed to simulate the dam break process. However, the models are also restricted by current mechanisms. There are some famous models, such as the BEED model, BREACH model, BRES model, and Zhu (2006) model.

The study of dam break in China began in the 1950s. The research is mostly based on the analysis of dam break data in history. Empirical relationships are established between various parameters by making some assumptions (instant outburst for example). Many achievements have been obtained up to now. Based on the study of the mechanism of dam break, Nanjing Hydraulic Research Institute under China's Ministry of Water Resources has been conducting an in-depth research on three subjects: "whether it will collapse", "when the collapse happens" and "how to rescue" in recent years. Some discriminating models have been achieved. By use of various formula [4, 5], we can calculate the discriminating score to distinguish the stability of the dam quickly and

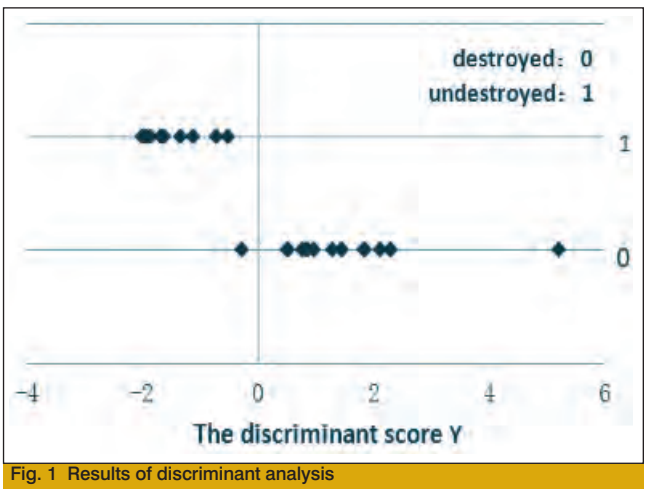


Fig. 1 Results of discriminant analysis


Fig. 2 Large-scale field test

effectively. The calculation results with a set of data are shown in figure 1.

2.2 Physical experiment study on dam break

Countries all over the world attach great importance to the dam safety since the consequences of dam break are so serious. Since the 19th century, quite a good number of scholars have carried out detailed studies of the dam break problem through theoretical analysis, physical model tests, numerical simulation, historical data statistical analysis and so on. In recent years, dam break risk assessment, dam monitoring, the development of early warning systems and dam failure mechanisms have become new research targets. Physical model tests are still necessary to discover unknown factors in breach formation. The experiment results can not only compensate for the limitations of historical data in quantity and reliability, but also provide validation data for the numerical simulation.

At present, physical simulation research at home and abroad can be divided into three main regions: the European Union, the United States and China.

2.2.1 Physical experiment study abroad

The European Commission launched the IMPACT (Investigation of Extreme Flood Processes and Uncertainty) project immediately after the end of the CADAM (Concerted Action on Dam Break Modeling) project in 2001, focusing on the key technical issues presented by the research report of the CADAM project. The study mainly includes five aspects: the process of dam break, flood routing, sediment movement, error analysis and geophysical exploration.

The NDSP (National Dam Safety Program) in U.S.

Dam break analysis is the ninth subject of NDSP, which started in 1999. A workshop named "Workshop on Issues, Resolutions, and Research Needs Related to Dam Failure Analyses" was held in June 2001, and its purpose was to determine the recent and long-term research goals based on the dam break research and technical level of America.

The others

Besides, human stability and mobility in flood as well as the roughness of forests and buildings were considered in the research of the RESCDAM project in Finland. The NATO project in Portugal made a discussion of dam break flood routing and sediment movement in an

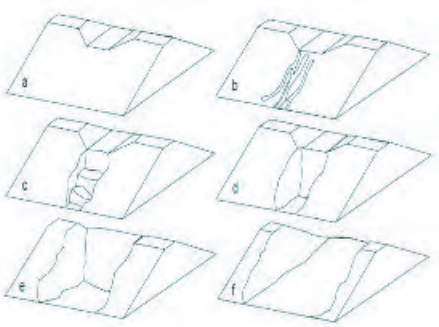


Fig.3 Headcut advance mechanism

irregular valley. A project named IJKDIJK was started in the Netherlands in 2007 and is still continuing. It's a Dutch research program with the two-fold aim to test any kind of sensors for the monitoring of levees under field conditions and to increase the knowledge on levee failure mechanisms. The all-in-one Sensor Validation Test of the IJKDIJK was carried out in August and September 2012, while the liquefaction test will be carried out in 2013. Experts and scholars from all over the world have made various studies on dam break issues and related experimental studies have been carried out. The flood routing, overtopping, dam break process of non-cohesive homogeneous dams, seepage failure, characteristics of thixotropic flow caused by the dam failure, the aeration of water flow, vortices generated by the flood wave and so on have all been investigated.

2.2.2 Physical experiment study in China

The experimental study of dam break in China began in the 1950s, and the models were generally distorted models whose test results were directly offered to engineering design. An insightful discussion was held after the dam break of Banqiao reservoir in 1975. Some experimental studies on fuse plug spillways have been carried out since the 1970s. Scholars in Henan Province have made some 30 tests on the fuse plug spillway for Yahekou reservoir. The Hydraulic Research Institute of Zhejiang Province carried out some experiments on the

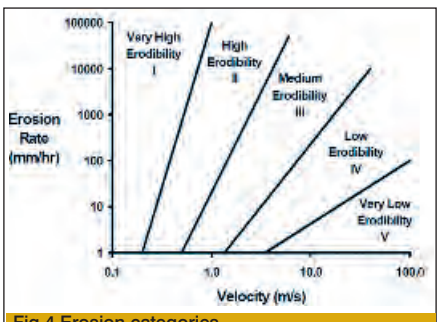


Fig.4 Erosion categories

***Prof. Li Yun,* vice president of Nanjing Hydraulic Research Institute, is now director of the Key Laboratory of Water Science and Engineering under China's Ministry of Water Resources, director of the Chinese Society for Hydropower Engineering, and deputy director of IAHR China Chapter, etc. So far, he has chaired and completed a number of national and international research projects with a lot of innovative achievements.**

***Professor Xuan Gouxiang,* chief engineer of Hydraulic Engineering Department of Nanjing Hydraulic Research Institute and vice secretary-general of Navigation Committee of China Society for Hydropower Engineering, has published about 30 papers and written more than 30 research reports, 1 academic monograph, and 2 standards of related specialties.**

***Senior Engineer Wang Xiaogang,* member of the Chinese Association of Young Scientists and Technologists, long engaged in dam-break hydraulics research, works in Hydraulic Engineering Department of Nanjing Hydraulic Research Institute, and has published more than 15 papers.**

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scour of dams in 1978 for the Nanshan reservoir. The control and measurement technology of the fuse plug spillway has also been paid close attention along with the experiments. Similar experiments were also carried out in Guangxi, Liaoning, Shandong and other provinces. After the dam failure of Gouhou dam in Qinghai Province in 1993, the Ministry of Water Resources immediately organized Nanjing Hydraulic Research Institute and China Institute of Water Resources and Hydropower Research to make a research and significant results were achieved.

Considering the range of clay content of Chinese earth dams, the world's largest-scale dam breach tests with the widest range of clay content (the largest height of the dam is 9.7 m and the range of the cohesion of filling is from 7.5 kPa to 39.5 kPa) have been conducted in recent years by Nanjing Hydraulic Research Institute in close cooperation with Deltares (from the Netherlands) to study the effect of cohesion of filling of a cohesive homogeneous earth dam and the breach formation (see Fig. 2). The test is of great help to the improvement of the forecast accuracy of discharge process in the breach, the study on the mechanism of occurrence and development of dam breach, the mastering of the law of the downstream dam break flood routing, and the operation of flood warning, evacuation and emergency relief, etc.

3 New directions for future research

The review of the work done in the past has shown that countries all over the world have contributed a great deal to research on the dam break with considerable progress already made. But due to the complicated dam break process and mechanism of the soil dams, there is still a lot of work to be done. The existing mathematical models are far from perfect. Most of the existing models are partially empirical. And there are still many problems in the dam break research. It is clear that dam break research still to be solved should be greatly developed in the future with its main focus on the mechanism of the break.

(1) In recent years, some experts and scholars put forward the "headcut" theory (see Fig. 3). This theory, however, is still in its infancy. There is a lot of work needed to be carried out in the future.

(2) Affected by global climate change, extreme climate events occur frequently, hence resulting in more dam breaches, with growing economic and property losses in recent years. So it's very necessary to present a fast and efficient discriminating method for the stability of earth-rock dams facing over standard floods. Time is so valuable in the fight against floods, for example, the time to carry out emergency warning and rescue operation. However, the accuracy of most discriminating methods and prediction formulae nowadays is not enough. It is necessary to strengthen research in this area.

(3) The key technical problem of dam breach is the prediction of erosion rate of dam body. However, it is very complex and diffcult because the process of dam breach formation is strongly nonlinear and transient, which involves hydraulics, sediment transport mechanics and soil mechanics, etc. So far, the prediction accuracy of peak flow of dam breach only reaches 50%. The prediction of breach time (decided by erosion rate) is worse than that of peak flow. After Hurricane Katrina devastated the New Orleans area, a lot of experts and scholars made some researches on the erodibility of overtopped levees. J.-L. Briaud [6] conducted a preliminary study on the erosion rate. He divided the erosion rate of soil into six categories, as shown in Figure 4. But this is not enough. It's very important to conduct a detailed study on the erosion rate so as to improve the forecast accuracy of discharge process in the breach, and master the law of the downstream dam break flood routing, which may help to provide more advance warning for announcing floods, organizing evacuation and rescue operations, and implementing emergency relief and so on.

(4) The previous dam break model tests and numerical simulation mostly concentrate their attention on flood routing [7-9].The research of similarity criteria of dam breach is little reported so far. Understanding of the core issues of similarity criteria still depends on a lot of basic research work.

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FISH PASSES: CONTRIBUTING

BY AMY KRAFT

A river study in the U.S. Northeast has found that many fish species are unable to use standard passageways to swim past dams on their spawning runs.

A crew from NOAA installs a ladder on a dam in Massachusetts. Image: Flickr/NOAA

Fishes may not need bicycles, as Gloria Steinem once suggested, but elevators and ladders can come in handy. Since the 1960s the Federal Energy Regulatory Commission has required dam builders to install state-of-the-art fish passages on public waterways to help shad, salmon and other species make their annual spring journeys upriver to spawn. Hydropower dams have built inclined water channels called ladders that fishes could swim through or elevators that use caged buckets to lift fish up and over the dam. Although these passages are monitored to ensure that fishes use them, a new study by ecologists and economists shows that very few fishes actually pass through to reach their spawning grounds, which exacerbates the decline in fish populations.

Jed Brown of the Masdar Institute of Science and Technology in Abu Dhabi and colleagues analyzed decades-worth of data on fish passages in the Merrimack, Connecticut and Susquehanna rivers in the U.S. Northeast. Roughly 2 percent of the targeted number of American shad made it through Essex Dam on the Merrimack River in 2011 and close to 0 percent passed through dams on the Connecticut and Susquehanna. Restoration targets for river herring, two species of silver-colored fishes, are in the hundreds of thousands to millions of fish but in recent years,

A crew from NOAA installs a ladder on a dam in Massachusetts. Image: Flickr/NOAA

TO POPULATION DECLINE?

Amy Kraft **is a freelance writer based in New York. She has written for New Scientist and DNAinfo and has produced podcasts for Scientific American's 60-Second-Science. She holds degrees from CUNY Graduate School of Journalism and the University of Illinois at Chicago.**

less than 1,000 herring on average have returned to these rivers from the ocean. Atlantic salmon numbers in the Connecticut River have been similarly low despite decades of restoration efforts.

One problem is that some fish passages are maladapted to the fishes they were built to help. A 2001 report by the United States Geological Survey showed that some fishes require specialized fishways because they cannot maneuver on ladders, which are meant to simulate natural rapids. For example, Atlantic salmon and river herring can easily navigate fish ladders because they naturally plunge through headwaters. Sturgeon and striped bass, on the other hand, do not possess the same swimming ability. "If you have one bad dam or one bad fishway, then the fish really aren't moving up the river," says Theodore Castro-Santos, a research ecologist at USGS's Conte Anadromous Fish Research Center in Massachusetts. Castro-Santos said that modern fishways are modeled after those installed on the Bonneville Dam in the 1950s and have never been properly studied to prove their effectiveness.

Even if fish do make it upstream to spawn, many have a hard time getting back downstream. A 1994 study in Transactions of the American Fisheries Society found that some fish species get killed attempting to pass through turbines. "We've taken species that spawn more than once in their lives and turned them into one-time spawners," says John Waldman, a professor of biology at Queens College, The City University of New York, one of the authors of the new study.

The best solution to restoring fish populations, Waldman argues, is dam removal. Past research on dam removal showed that it is effective at restoring fish stocks and improving water quality. Studies on the removal of Edwards Dam, a 280-meter-long hydroelectric dam on the Kennebec River in Maine, found that fisheries have improved since its take-down in 1999 and insect counts have increased, a good indicator of improved water quality.

But dams are an important source of renewable energy, and removing them is costly and can have sudden, dramatic impacts on ecosystems, as this 2001 study in Hydrological Processes noted. Castro-Santos believes that instead of removing dams, more robust research should be conducted on fishways and the various fish species that move through them. A 2012 study in River Research and Applications looked at how the biological characteristics of different fish species determined their propensity to use certain types of fishways. "In order to evaluate the effectiveness of fishways, you need to know the behavior of fish," Castro-Santos says.

Waldman agrees that improved fishway technology could be the answer. "If a dam can't be taken down the best fishway possible is better than any alternative," he says.

For now the researchers hope that the study will help guide authorities as they consider dam renewal licenses and as construction begins on dam projects in the Amazon and Mekong rivers. "This is a warning to the rest of the world where big dam projects are starting," Waldman says. "If it's not working in the northeast U.S., it's not likely to work elsewhere."

"If it's not working in the northeast U.S., it's not likely to work elsewhere."

10TH INTERNATIONAL CONFERENCE ON HYDROINFORMATICS (HIC 2012)
HAMBURG, GERMANY, JULY 14 – 18, 2012

On the behalf of the International Organization Committee,
Reinhard 'Phillip' Hinkelmann, Berlin, Germany; Yui Liong, Singapore; Dragan Savic, Exeter, UK; Mohammad Hassan Nasermoaddeli, Karl-Friedrich Daemrich, Peter Fröhle, Hamburg, Germany

The conference held at Hamburg University of Technology brought together about 350 participants from 43 different countries to discuss and advance the latest developments in Hydroinformatics. HIC is a well-established series of bi-annual Hydroinformatics Conferences started in the early nineties. It was supported by three world-leading international organizations, IAHR (International Association of Hydro-Environment Engineering and Research), IAHS (International Association of Hydrological Sciences) and IWA (International Water Association).
The main theme of this conference was Understanding Changing Climate and Environment and Finding Solutions with the aim of assessing the impact of these changes on our aquatic environment and on developing suitable adaptation and mitigation measures. Recent natural disasters such as disastrous floods occurring frequently all over the world, or the tsunami of 2011 in Japan, have demonstrated how vulnerable our mother earth is, with its ever rapidly growing urbanization, to changes in climate and environment, and the limitations of our engineering tools to protect society and the environment. Finding solutions to these challenging problems was discussed by scientists, software developers, practitioners, and stakeholders from public, private and federal organizations.

We saw considerable progress in all eight conference topics:
- Advances in Physically-based Modelling Methods
- Data-driven Modelling, Soft Computing and Model Optimization
- Remote Sensing, Digital and Sensor Technology
- Early Warning Systems and Disaster Mitigation
- Real-Time Control and Decision Support Systems
- Climate Change Impacts
- Knowledge and Data Management and Models Interoperability
- Education, Public Awareness and Socio-economic Aspects

Five keynote lectures were presented by distinguished leaders in the fields of climate sciences and hydroinformatics. Two keynote lectures directly focused on climate change impacts: Prof. Daniela Jacobs, from the CSC-Climate Service Centre, Hamburg, talked about regional climate change projections for bridging global climate change and local applications, while Prof. Mojib Latif, from GEOMAR, Kiel, Germany offered an interesting answer to the question: Global warming, fact or fiction? The emerging topics of global water security and its challenges for hydroinformatics were presented by Prof. Roger Falconer, from Cardiff University, UK. Prof. Dimitri Solomatine, from UNESCO-IHE Delft, Netherlands, discussed various aspects of uncertainties in modelling and hydroinformatics, while Prof. Dragan Savic, from University of Exeter, UK, showed how water supply and demand, food production and energy provision and consumption in various parts of the world are intimately linked, and are increasingly a cause for concern with hydroinformatics offering tools for assessing the long-term behaviour modes of the water-energy-food system capable of informing more effective policy at various scales.

A further highlight of the conference was the presentation of the Hydroinformatics Vision Report, commissioned by the IAHR-IWA Hydroinformatics Committee and completed in 2011. The report was presented by Prof. Peter Holz.
Hydroinformatics Vision Report can be downloaded from the HI Committee Area on the IAHR website.

We are confident that the conference has greatly contributed to the advancement of knowledge in hydroinformatics and thus in hydro and environmental sciences and engineering, in facing the changing climate and environment and in finding solutions to better prepare and protect our society.

HYDRAULIC MEASUREMENTS AND EXPERIMENTAL METHODS (HMEM)

SNOWBIRD, UTAH, USA FROM AUGUST 12-15, 2012

BY COLIN RENNIE

Hydraulic Measurements and Experimental Methods (HMEM) 2012 was held at Snowbird, Utah, USA from August 12-15. HMEM is the leading international conference on the development of new techniques for collection, processing, and interpretation of hydraulics data. This was the fourth conference in the HMEM series, which is held every five years. The conference series is co-sponsored by the Environmental and Water Resource Institute of the American Society of Civil Engineers (ASCE) and IAHR. The conference is organized by the Hydraulic Measurements and Experimentation Committee of ASCE-EWRI and the Experimental Methods and Instrumentation Committee of IAHR. HMEM 2012 was attended by 167 delegates, who presented 122 papers describing the leading edge of research in hydraulic experimental methods and instrumentation.

HMEM 2012 focussed on new trends in established methods such as acoustic velocimetry and particle image velocimetry, as well as new experimental techniques for difficult direct measurements such as aeration and fluid drag. Morphodynamics was discussed extensively, including several sessions on advances in sediment transport measurements, and others exploring emerging techniques for generation of digital elevation models across a range of scales. Environmental flows were also a topic of particular interest, including water quality sensor networks.

The conference opened with a Keynote Lecture by Daniel Parsons from the University of Leeds, in which he presented results from several field campaigns to understand morphodynamic processes in geophysical flows such as large rivers and submarine gravity currents. New experimental techniques were developed for these measurements, including interpretation of side-scan sonar data for monitoring suspended sediment, and utilization of an autonomous submarine to deploy an Acoustic Doppler Current Profiler (ADCP) for measurement of a saline gravity flow in the Black Sea.

HMEM 2012 was also fortunate to host the ASCE Hunter Rouse Hydraulic Engineering Award Lecture, given by Marcelo Garcia from the University of Illinois. He also discussed gravity flows, reviewing seminal sediment suspension experiments by Hunter Rouse, as well key results from his own prolific career examining turbidity currents.

The conference concluded with both a hands-on workshop and a technical tour. Workshop attendees learned how to use the Velocity Mapping Toolbox to process and interpret ADCP data. The tour group visited the fascinating Provo River Restoration Project, which involved construction and subsequent monitoring of 12 kilometres of naturalized channel.

Colin Rennie **is Associate Professor and Director of the Hydraulics Laboratory at the University of Ottawa. He is an Associate Editor of both the Journal of Geophysical Research – Earth Surface (AGU) and the Journal of Hydraulic Engineering (ASCE). He is Past-Chair of the IAHR Experimental Methods and Instrumentation Committee**

HMEM 2012 demonstrated that advances in hydraulic experimental methods and instrumentation are increasingly providing detailed information and greater understanding of complex flow fields across a range of scales at spatiotemporal resolution that was unimaginable in previous decades.

NINTH INTERNATIONAL CON ON URBAN DRAINAGE MODE

UDM-2012, BELGRADE, SERBIA, 3-6 SEPTEMBER 2012

BY DUŠAN PRODANOVIĆ

UDM-2012 was the ninth in the series of highly successful Urban Drainage Modelling conferences. It was organized by the University of Belgrade, Faculty of Civil Engineering as a tribute to retirement of Professor Čedo Maksimović, the co-founder and the spiritus movens of the whole UDM conference series. Total of 252 participants from 34 countries attended UDM-2012 and four pre-conference workshops.

Modelling of urban drainage systems emerged in the 1970s, following the advent of computers. It started with rather humble efforts to model surface runoff and flow in sewer systems. The rise in computing power and measurement equipment provided a fertile ground for the development of a range of advanced methodologies for the design, observation, analysis, optimization and management of sewer systems. Today, urban drainage modelling is a mature scientific and technical discipline that looks at interactions between various urban water systems and the urban environment. With the challenges presented by climate change, the ever growing urban population, and limited natural resources, and the opportunities provided by research investments, it is no surprise that urban drainage modelling is in its golden age.

The first UDM conference was organized by Professor Čedo Maksimović and the late Professor Miodrag Radojković from the University of Belgrade in 1986. Since then, the conferences have been organized on four continents (twice in Dubrovnik, Russia, UK, USA, Germany, Australia and Japan), with Prof. Čedo Maksimović being the spiritus movens of the whole series. The UDM-2012 held in Belgrade, from 3 to 6 September 2012, was ninth conference in the series, organized by Joint IAHR/IWA Committee on Urban Drainage (JCUD). Former co-workers of Prof. Maksimović, all members of the Local Organizing Committee, were also paying him a tribute with this conference at the moment when he has reached the retirement age.

The UDM-2012 conference has gathered 252 urban drainage specialists, with 169 papers peer reviewed and selected by the International Scientific Committee out of 290 submitted abstracts. The four internationally recognized keynote speakers gave the exceptional keynote lectures establishing the scene of urban drainage in forthcoming future:

- Tony Wong (Australia): Emerging trends in modelling integrated urban water systems
- David Khan (Bangladesh): Historical development of hydroinformatics tools in Bangladesh and challenges and state-of-the-art in urban drainage modelling
- Jörg Rieckermann (Switzerland) "If you can't measure it, you can't manage it" – Intelligent sewer operation requires better information
- Wolfgang Rauch (Austria): Modelling transitions in urban drainage management

Short lecture abstracts, together with biographies, could be found at: http://hikom.grf.bg.ac.rs/9UDM/KeynoteLectures.html

A total of 138 papers selected for oral presentation were presented in three parallel sessions. Additional 31 papers were presented as posters in two poster sessions. Main topics at the Conference were: Data issues, Modelling,

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Applications, Management and Special topics. Since most authors allowed us to publish their presentations, you can find them, together with short abstract, on the website: http://hikom.grf.bg.ac.rs/9UDM/AllSubmissions.html

During the UDM-2012, four successful all-day pre-conference workshops were organized:

1. Towards more Flood Resilient Cities – joining practitioners and researchers to discuss possible ways to increase flood resilience of cities and urban areas.
2. MicroPollutants in sewer and drainage systems – with two sessions: metrology and monitoring, and data sets at international level.
3. DHI software for urban water modelling seminar – attended by designers and urban sewer system operators.
4. Integrated UDM system modelling with XPSWMM – workshop supported by the Serbian Chamber of Engineers with more than 50 participants.

More details about workshops could be found at http://hikom.grf.bg.ac.rs/9UDM/Workshops.html

The UDM-2012 conference will be memorable for the excellent venue, great organization, the informal relaxing atmosphere so conducive to discussion, and the stimulating cultural and social events. Many long-lasting partnerships and friendships were built during the Conference, and captured by camera: http://hikom.grf.bg.ac.rs/9UDM/PhotoGallery.html. The next UDM will be organized by Université Laval, Quebec, Canada in September 2015 (udm2015@modeleau.org).

Prof. Dr Dušan Prodanović,
University of Belgrade, Faculty of Civil Engineering, Serbia
UDM-2012 Conference Chair
eprodano@hikom.grf.bg.ac.rs

Proceedings

Papers presented at UDM-2012 are available

- in paper, as the two-page extended abstracts: URBAN DRAINAGE MODELLING, Proceedings of the Ninth International Conference on Urban Drainage Modelling, Belgrade, Serbia, 4-6 September 2012, ISBN 978-86-7518-155-2, soft cover.
- in e-version with full papers: Urban Drainage Modelling, Proceedings of the Ninth International Conference on Urban Drainage Modelling, Belgrade, Serbia, 4-6 September 2012, ISBN 978-86-7518-156-9.

Gala dinner – Prof. Maksimovi


Gala dinner – Traditional welcome with bread and salt

Best conference paper award (Gregor Burger, Austria)

With this issue Hydrolink inaugurates a new column updating news of past topics wich have been covered by our magazine in previous articles. Particularly, in this issue a follow-up report on the 2011 tsunami disaster in Japan is published. As our readers will remember the tragic event was related by Prof. Hitoshi Tanaka (Tohoku University, Japan, and Chairman of Asia Pacific Division of IAHR) in Issue 3 of the year 2011 of Hydrolinkwhich included an editorial entitled “Could David overpower Goliath (again)?” From the updating news it seems that even if it is an arduous fight we could have many successes.

Michele Mossa, Editor

FOLLOW-UP REPORT ON THE 2011 TSUNAMI DISASTER IN JAPAN

BY HITOSHI TANAKA

Almost two years have passed since the devastating tsunami disaster in 2011. In order to prevent future tsunami disasters, reconstruction of sea dyke is ongoing in many places in Japan (Fig.1). It is demonstrated during the 2011 tsunami that structural measures alone are not sufficient to prevent such huge tsunami disasters. During the course of designing of coastal structures, height of historical tsunami has been investigated, including the 869 Jogan Tsunami which caused flooding and resultant sediment deposits on the Sendai Plane. They are classified into two levels: Level 1 with relatively higher possibility of occurrence around 100 years, and Level 2 with extremely lower possibility but causes devastating disaster (Fig.2). Coastal structures are designed to secure safety against Level 1 tsunami, whereas against Level 2 tsunami, multiple defense approach should be employed by combining structural and nonstructural measures. Due to the extreme height of the incoming tsunami waves during the 2011 tsunami, they propagated to upstream rivers with massive force, causing damages to various hydraulic facilities for operation and maintenance along the rivers. Hence upstream area will be defended either by elevating the existing river embankment or by constructing a floodgate at a river entrance.

***Professor Hitoshi Tanaka is* Chairman of Asia Pacific Division of IAHR. Professor, Civil Eng. Dept., Tohoku University, Japan.**

Fig. 1 Reconstruction of sea dyke along the Sendai Coast (Jan. 31, 2013. courtesy of Sendai Office of River and National Highway)

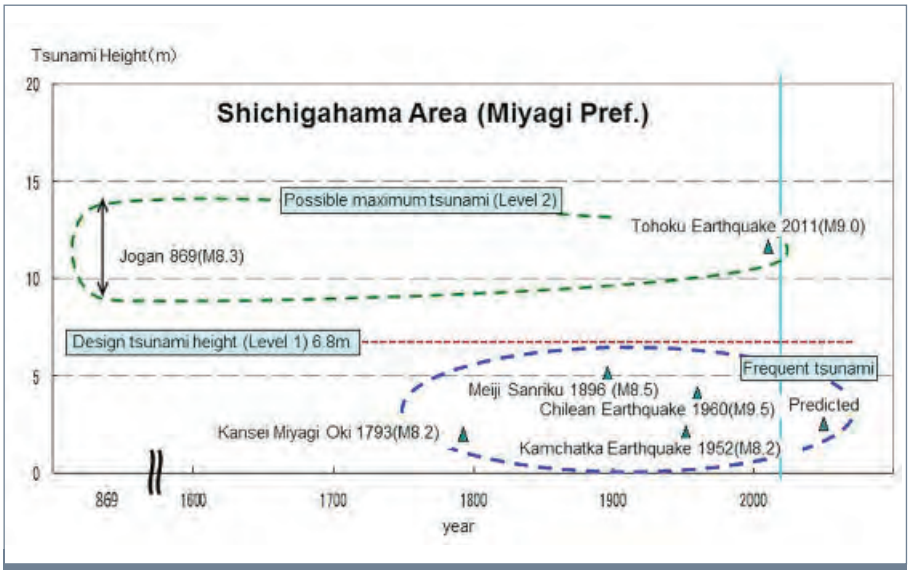


Fig. 2 Classification of past tsunamis into two levels (courtesy of Miyagi Prefectural Government)

PEOPLE & PLACES

Kuniyoshi Takeuchi wins IAHS 2012 Hydrology Prize

Director of the International Centre for Water Hazard and Risk Management (ICHARM) and former presdient of IAHS has been awarded the 2012 International Hydrology prize for his outstanding contributions to hydrological research especially in water resources management, education of young researchers, and his leadership in water sciences link www.iahs.info

Recent PhD Awards

Tiago Abreu of Coimbra University, Portugal for his Thesis entitled "Coastal Sediment Dynamics Under Asymmetric Waves and Currents: Measurements and Simulations"
The thesis (in english) can be accessed at: http://hdl.handle.net/10316/17989
Supervisors: Francisco Eduardo da Ponte Sancho and Paulo Manuel Cruz Alves da Silva.

Daniela Molinari, Italy for her Thesis "Flood early warning systems performance: an approach at the warning chain perspective"
PhD in Hydraulic Engineering at Politecnico di Milano
Supervisors: Francesco Ballio, Scira Menoni
The thesis can be accessed at:
https://www.diiar.polimi.it/idra/persona.asp?id=58

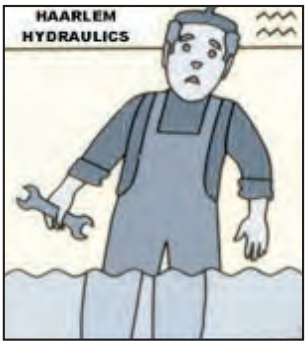
Carlos de Gonzalo Aranoa, Costa Rica
Title: Propuesta metodológica de modelización hidrometeorológica e hidrodinámica enfocada a la ordenación del riesgo de inundación: aplicación a la cuenca del río Pejibaye (Costa Rica).
Director: José Carlos Robredo SánchezT
http://oa.upm.es/9082/

New institute member

Wasserkraft Volk AG, Germany
www.wkv-ag.com

Retired

Peter JM Kerssens has retired from Deltares, and has consecutively set up his own consulting company, Haarlem Hydraulics in 2011, which can be considered a spin-off company from Delft Hydraulics (which since 2008 is part of Deltares).
Haarlem Hydraulics is specialized in consultancy in the range of water resources management, flood (risk) management, river basin management and related issues. They mainly provide knowledge and advice in this field to governments, in the Netherlands or abroad, to engineering consultants and research institutes. Clients also are development organizations and international banks, like for instance the WorldBank, Asian Development Bank, UNDP, etc.



IAHR Membership Grows

We are reintroducing the IAHR Roll of Honour in the next issue and any member who introduces a new member is eligible for a 50% membership fee discount in their invoice for the following year!

Our membership is growing and at the time of going to print we are at 2986!

Inspection Visit

IAHR Executive Director,
Dr. Christopher George has recently visited China as part of preparations for the Congress in Chengdu and to visit our Institute Members IWHR and NHRI.

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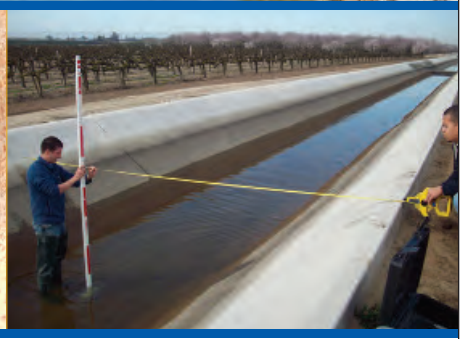

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