Article, Published Version

Lee, Du-Han; Yeo, Hong-Koo; Ryu, Yong-Uk; Penning, Ellis

The river experiment centre andong - a unique near prototype outdoor flume facility

Hydrolink

THE RIVER EXPERIMENT CENTRE ANDONG – A UNIQUE NEAR PROTOTYPE OUTDOOR FLUME FACILITY

BY DU-HAN LEE, HONG-KOO YEO, YONG-UK RYU & ELLIS PENNING

Recognizing the importance of improving our knowledge about the complex interactions between hydrologic regime, geomorphic evolution of river channels and the associated interactions with vegetation and biologic responses combined with the difficulties of scaling many riverine processes down to the laboratory scale, the Korean Institute of Civil Engineering and Building Technology (KICT, see textbox) has developed one of the largest river experimentation facilities in the world, the River Experiment Center (REC), in Andong. The REC has a total area of 200,000 m^2 and was designed for full scale tests with three prototype channels (600 m long and 11 m wide) and a large capacity pump facility with a controllable flow rate up to 10 m^3/s and a flow velocity up to 5 m/s. Additionally, a 100 m long and 30 m wide hydraulic model test basin and a retention pond are also part of the premises equipped for various kinds and scales of river experiments.

The River Experiment Centre was constructed in 2009 and officially opened in 2012. From then on, a large variety of experiments has been undertaken, ranging from full size tests on bank erosion prevention measures to the validation and calibration of advanced flow measurement equipment. Being outdoor, with clean waters from the Nakdong River and with a natural bed, the REC provides excellent opportunities to carry out real scale tests on vegetated flows, with naturally rooted vegetation. Also, experiments on fish behavior have been carried out. As a result, the REC fits the position between indoor smaller scaled lab and real field conditions, with the advantage that despite being outdoor, flow and water levels can be controlled and the bed level is perfectly known.

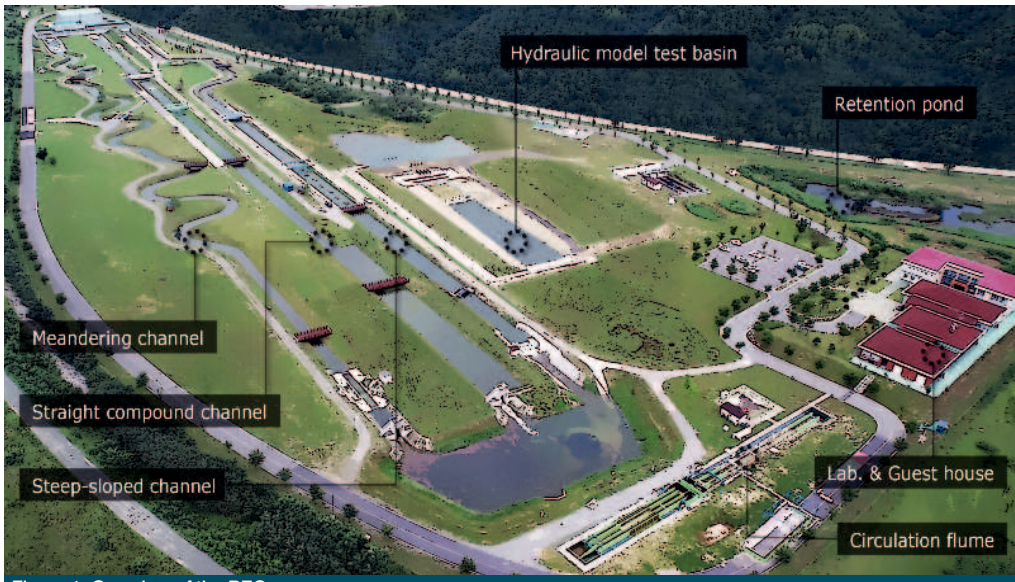

Figure 1. Overview of the REC

Facilities

The main facilities of the REC are three prototype channels that were designed to be able to study a wide range of stream characteristics. Four pumps with a large capacity generate a maximum flow rate of 10 m^3/s in the channels. Channel 1 has a steep section with sharp bends (slope of 1:80) to create super-critical flows for stability studies under extreme conditions. The steep section with a high flow rate generates a strong flow that is necessary for stability tests of structures such as levees, weirs and revetments. The sharp bends also allow a consideration of oblique flow direction. After the steep section, the channel has an almost flat section (slope of 1:1000) with a sandy bed. Channel 2 is a straight channel with a compound section, which allows for studies representing river-floodplain interaction. The one-sided floodplain section is located in the 150 m long downstream region of the channel. The base width of the floodplain is 6.5 times greater than the bed width of the main channel. Channel 3 is a meandering channel with various sinuosities to represent different river energy dynamics and better study flows through these bends. The meandering section is composed of 4 different sinuosities over a 400 m long region. After the meandering section, a two-sided compound section with equal berm width is located downstream. Along the channels, crossing instrumentation carriages moving over rails are equipped for accurate measurements. Besides the prototype channels, the hydraulic model test basin was designed for hydraulic model tests. Separately from the channels, the flume circulates water with its own pump system with a maximum flow rate of 2 m^3/s.
The flume is filled with sand for movable bed tests as well as for other model tests. The retention pond covers an area of 17,000 m^2 and is capable of storing 15,000 m^3 of water for environmental and ecological studies in stagnant waters.

Figure 3. Members of Andong River Experiment Forum

KICT is a government-sponsored research institute responsible for establishing government policies and performing R&D on infrastructure, buildings, water management and environmental engineering for the nation (www.kict.re.kr)

Figure 2. Experiments in the REC: (a) Safety test against strong flows (b) Flows over vegetated patches (c) Bank erosion mats (d) Flows along the meandering section

Sharing knowledge at the REC – The Andong River Experiment Forum

The vision of KICT is to develop the REC into a global hub for ecohydraulics experiments where engineers and scientists from around the world can address some of the grand challenges associated with managing the world's rivers. The REC seeks to facilitate the collaborative exploration of the complex interactions among flow, sediment, geomorphology and flora and fauna at a large scale. An important part of the philosophy underlying the development of this facility has been fostering networking and collaborative research activities, with particular encouragement for young professionals. The Andong River Experiment Forum is one of the activities for achieving this goal, where experiences from around the world can be shared with a goal of collectively accelerating knowledge discovery.

The Andong River Experiment Forum aims to provide river experts all around the world with a forum for regular-basis meetings, discussions, and training on experimental approaches of fluvial and aquatic hydraulics based at the REC. The Forum mainly pursues research discussions on experimental work conducted in either the REC, or elsewhere. The Forum is open to all scientists and engineers who work on river-based studies and encourages them to join its activities. Topics include river restoration, river hydraulics, fluvial geomorphology and eco-hydraulics. Special attention is given to emerging technologies that can be used to predict and evaluate alternative future conditions using hybrid analytical approaches that integrate field observations with large-scale laboratory experiments and computer simulations.

The 1st Andong River Experiment Forum (AREF) under the theme of "Current River and Ecology Hydraulics based on Experiments" was held at the REC on April 29, 2014. In the forum, the co-chairs (Dr. Peter Goodwin, Dr. Hong-Koo Yeo) and international specialists from the U.S. (Dr. Marian Muste), Canada (Dr. Ana Maria da Silva), the Netherlands (Dr. Ellis Penning) as well as Korea (Dr. Won Kim, Dr. Dongsu Kim, Dr. Chang-lae Jang) presented various studies and discussed future directions for the Forum. In the first forum, two topics were selected for further international cooperation projects: 1) performance of instrumentation and measurement accuracy, 2) vegetated flows. These items closely connect with the discussion on using inter-laboratory comparison tests for documenting the uncertainty related to site conditions. In the 2nd forum in 2015, various studies under the topics carried out in the REC since the 1st forum were presented. Besides the performed studies, new research items that are expected to extract meaningful outcomes from large scale and natural conditions were suggested and discussed for feasible future studies. In River Flows 2016 in Saint Louis, a special session was organized for introduction of the themes and studies under the forum as well as to present the REC as a unique facility to researchers over the world. We invite those interested to join the AREF2017 which will be organized by KICT on 16-17 October 2017 in South Korea. During this year's forum we will specifically focus on the role of the REC in the validation of new monitoring techniques and sensor calibration in unscaled yet controlled situations. For more information, please contact Yong-Uk Ryu at yuryu@kict.re.kr ■

Du-Han Lee **is the head of the REC, KICT. He received a Ph.D. in Civil and Environmental Engineering from Seoul National University. He specializes in physical and numerical modeling of river hydraulics.**

Hong-Koo Yeo **is the director of the REC, KICT. He received a Ph.D. in Civil and Environmental Engineering from Seoul National University. He leads a group working for conducting hydraulic model tests in river engineering and providing technical supports for government policies. He is currently one of chairs of Andong River Experiment Forum.**

Yong-Uk Ryu **is a senior researcher at the REC. He received his Ph.D. from Texas A&M University. He specializes in physical modeling of river hydraulics and wave mechanics. He is now involved in a cooperation project with Deltares on flow-vegetation interaction.**

Ellis Penning **is a senior ecologist at Deltares and co-chairs the International Steering Committee of the REC and the Andong River Experiment Forum. She specializes in ecohydraulics with a focus on the interaction between aquatic vegetation and hydro-morphodynamics and its application in daily water management. At Deltares she leads the research programme on Nature Based Flood Defences.**

GENDER EQUITY EFFORTS IN IAHR

BY SILKE WIEPRECHT

Gender equality is a human right and means that that everyone should receive equal treatment and not be discriminated against based on their gender [1]. United Nations Universal Declaration of Human Rights states: "Mainstreaming a gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programs, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programs in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality." [2]

IAHR still has some efforts to undertake to achieve the aim of gender equity within the organisation. The council expressed concerns about the lack of women in IAHR leadership roles, which led to the creation of a Task Force consisting of Sharon Nunes (Vice President for Research, IBM, USA), Jing Peng (Director, Division of International Cooperation, IWHR, China), Ioana Popescu (Associate Professor of Hydroinformatics, UNESCO IHE, The Netherlands), Ana Maria da Silva (Professor, Department of Civil Engineering, Queens University, Canada) and as Chair of the Task Force Silke Wieprecht (Professor, Institute for Modeling Hydraulic and Environmental Systems, University of Stuttgart, Germany). The aim was to analyze the demographics in IAHR and develop recommendations on how to ensure that the full intellectual capacity of the water profession will be represented in IAHR membership and leadership in the future.

Actual situation in IAHR

The membership database was provided by the IAHR head office (status 8/2016). Actually IAHR at that time had 4108 members, including 2506 males, 616 females and 986 whose gender was unknown. The group of "unknown" is quite high and could distort the analysis. Thus, in the following graphs this group is not considered (Figure 1).

***Silke Wieprecht* is a full-time professor and the head of the Department of Hydraulic Engineering and Water Resources Management of the University of Stuttgart. She is advisor of the Baden-Württemberg Young Professional Network of the IAHR, and member of the World Council of the IAHR.**

There are 154 members in committees and leadership teams, including 18 females and 136 males. 61 members are active in regional divisions, including 9 females and 52 males. 19 members are in the council of which 2 are females and 17 are males (Figure 2).

The age groups are represented almost equally: 34 % are under 35, 30% are in the age between 35 and 50, and 36 % are older than 50. Although there is a consistent age distribution the share of females in the age groups is very different. 30% of the members in the typical YPN-age are females, in the group of 35 to 50 the ratio of females reduces to 25 % and in the group of 50 years and older it is only 6%.

The decline of number of females is even more obvious when we look at the leadership positions. The overall share of women in IAHR membership is approximately 20%. As members of technical committees women are 12 % and in regional divisions 15 %. However, in the council there are only 2 % women.

Comparison with other institutions

Several publications and statistics can be found documenting more or less the same tendencies for STEM disciplines and for engineering in particular. DeCohen and Deterding (2009) [3] report that of the university students enrolled in engineering disciplines approximately 22 % are female and among the graduates 24 % are female. This means that the retention rate of females is higher compared to male students. However, the higher we climb the job ladder the more we are losing the young women.

Applying the published data from the National Science Foundation on the US Science and Engineering Workforce Trends and Composition we see how much (or little) women's involvement in STEM fields has changed over the course of 17 years between 1993 and 2010. The results of this study include men and women ages 16 and over pursuing studies or working in a STEM field. The male to female ratio has remained almost constant at 70:30, despite the time passed (Figure 3).

Typical drawbacks for women

Analyzing the literature, own experiences, and personal discussions with women in respective positions several typical drawbacks can be identified:

- **The struggle to break gender stereotypes:** There are many gender stereotypes surrounding everyone every day. Knowing that STEM disciplines are predominantly occupied by males, it is difficult for a female to start a career or even to be interested in STEM, or leadership positions. These stereotypes play a major role in a female's career choice.
- **Lack of female (and male) mentors:** Another barrier to females in STEM and leadership is the lack of a person they can go to for advice in a male-dominated environment. With the trend of STEM disciplines being surrounded with more men than women, it is difficult for a woman to fit in or even articulate their opinions.
- **Flexibility in the job:** Missing flexibility is a concern in some job positions. This is in a certain way also applicable to IAHR. Although, IAHR does not offer job positions for its members, it offers leadership positions and responsibilities. This represents the area where IAHR could be different from other organizations in being more flexible.

Potential measures to be taken in IAHR

Gender equity also requires an examination of organizational practices and policies that may

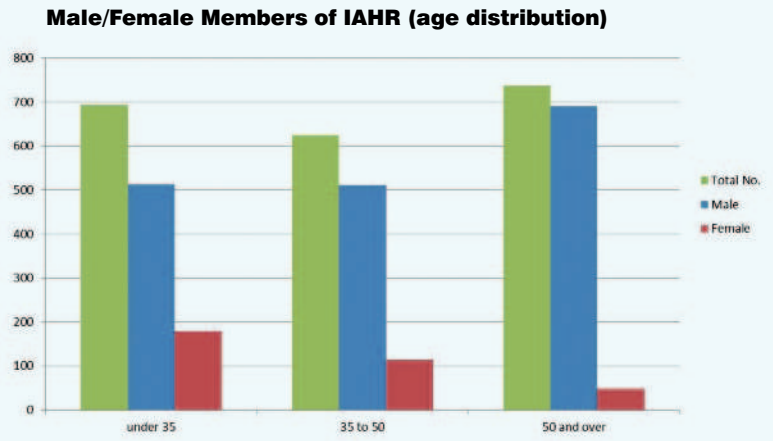

Figure 1. Absolute numbers of male and female members in IAHR distributed to the different age groups of under 35 (YPN), 35 to 50 as well as 50 and over

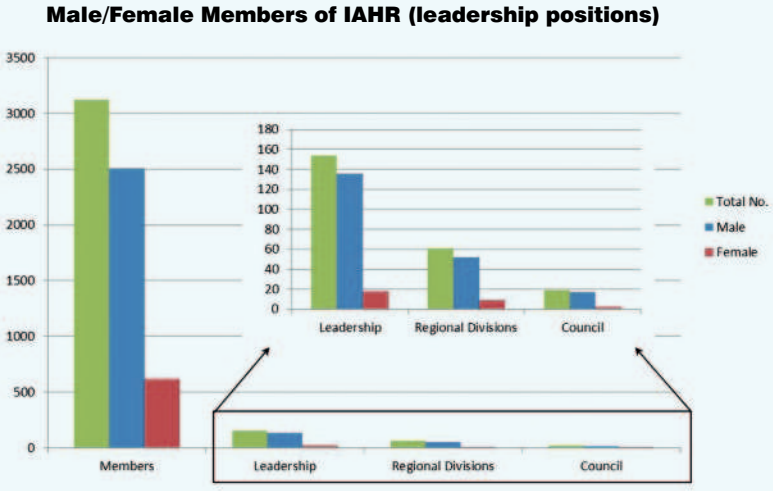

Figure 2. Absolute numbers of male and female members in IAHR distributed to the different positions of all members, leadership positions (e.g. technical committees), members in regional divisions as well as council members

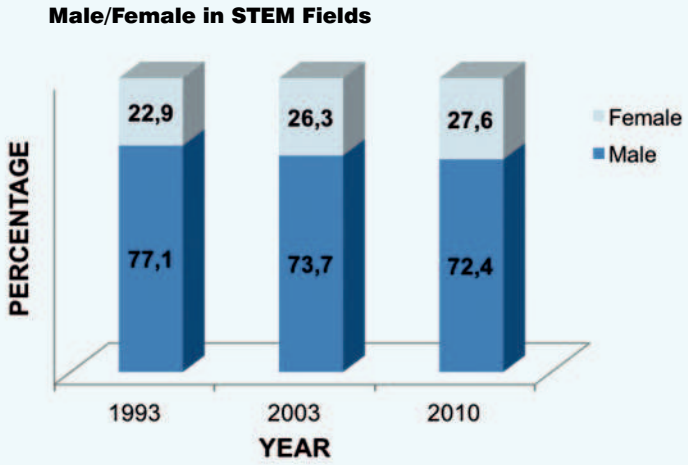

Figure 3. Percentage of women in STEM fields (Data from US S&E Workforce: Trends and Composition from National Science Foundation)

hinder the participation and development of women. Therefore ideas for potential measures are identified:

- **Awareness and importance of the topic:** It is important that we set up, enhance, revive and exemplify within IAHR a culture which breaks the gender stereotypes and mitigates their past effects. This means that gender equity is not an issue only for women. It is in fact an issue for the entire IAHR community. It is a serious and important topic and nobody should smile at it. It is also not a "nice-to-have", or an inconvenient duty. In fact, it is a basic requirement for a well-functioning, diverse and emancipated association.
- **Mentoring:** We are a male-dominated association. There is only a restricted number of females in leadership positions. Consequently, it is obvious that not only the women in IAHR can take over mentorship positions. It is a task for the whole community having mentors in a male-dominated workplace, who support females to work towards their interest in STEM fields and leadership positions.

Conclusion

Gender equality will be achieved only when women and men enjoy the same opportunities, rights and obligations in all spheres of life. This means sharing equally in the distribution of power and influence, and having equal opportunities and realizing their personal ambitions.

IAHR has committed itself to contribute to gender equity within the organization. Hence, it is essential to develop a common understanding that this topic is important for both, men and women. We want to provide an environment which supports women and men to step up and take ownership of this topic.

Especially, the young-age group, as the future generation of the association, can considerably contribute. The activities of the Young Professional Network (YPN) show the first successful results like increasing number of memberships. Quantity-wise this is also the age group with the highest share of females. Thus, it is very important to encourage them to stay loyal to IAHR when they proceed from the YPN status to "full" members. ■

References

[1] United Nations. Report of the Economic and Social Council for 1997. A/52/3.18 September 1997,
[2] United Nations "Universal Declaration of Human Rights" (PDF). wwda.org December 16, 1948. Retrieved October 31, 2016.
[3] De Cohen and Deterding, 2009. Widening the net: national estimates of gender disparities in Engineering, ASEE. Journal of Engineering Education, July 2009