HYDRAULIC ENGINEERING IN THE SERVICE OF LEISURE ACTIVITIES

EDITORIAL BY ANGELOS N. FINDIKAKIS

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Even though hydraulic engineering and research mostly supports the design of utilitarian water works and structures, and more recently the understanding and dealing with environmental problems, there is a history of the use of the principles of hydraulics in the service of leisure activities and aesthetic pleasure. Examples are the decorative fountains in ancient Rome, the water features in the Moorish gardens in Alhambra, the elaborate designs of fountains and water basins in France and Italy in the Renaissance, and the many water shows in the twentieth century from Planten un Blomen in Hamburg to Bellagio in Las Vegas.

In the twentieth century, as people in industrialized countries started having progressively more leisure time, the demand for recreational facilities increased rapidly leading to the development of water sports and activities in natural water bodies or in specially designed spaces. The equipment and accessories used in many of these activities has evolved and benefitted from developments in competitive water sports, whose rising popularity attracted sponsors and athletic product manufacturers willing to invest in research and development work that would give elite athletes a competitive edge in their performance. There are numerous examples of such work over the last few decades. Towing tanks in hydraulic laboratories and numerical models have been used for years to develop faster boats for international competitions, such as the America's Cup. In the last twenty years Computational Fluid Dynamics (CFD) codes have been used many times for the design of the hull, keel and underwater appendages of the yachts participating in this event. Similar hydrodynamic studies have been performed for the shape of rowing boats, canoes and kayaks used in the Olympic Games aiming at improving their speed. Numerical simulations have also been performed to analyze and understand the factors affecting the drag and propulsion forces in swimming and the forces on the body of competitive platform divers. CFD has also been used in the design of swimsuits worn by the competitors in the last few Olympics. These swimsuits have helped elite swimmers increase their speed and break many world records [1].

Hydraulic laboratory tests and numerical simulations have also been used for the design of special facilities that allow athletes to train. A recent example, that generated a lot of interest among the general public, is the Surf Ranch, an artificial wave facility in the Central Valley of California developed by a team led by world champion surfer Kelly Slater. The facility which took more than ten years to develop, is about 700 m long and can generate waves greater than 2 m. Solitary waves are generated by a large hydrofoil, designed at the University of Southern California in Los Angeles [2]. This facility has attracted the interest of many professional surfers and is expected to be used in the future as a competition venue for the World Surf League's Championship Tour.

Several smaller facilities with wave generating capabilities that attract many amateur athletes and surf lovers have opened in the last few years. For example, Wavegarden a Spanish company designing and manufacturing wave generating systems has developed its own surfing facilities in Wales and in Austin, Texas, and is planning several new similar facilities around the world. Water parks with smaller wave generating facilities and other recreational water attractions exist in many parts of the world.

The present issue of Hydrolink includes two articles that describe recent research in support of the development of surfing facilities in rivers. The article by Aufleger and Neisch discusses the standing wave formed in the manmade river Eisbach in Munich, which is a major local surfing spot, and describes their work using a combination of physical model tests and numerical simulations to develop a commercially viable technology for generating reliable standing waves in rivers that could serve as surfing venues. The article by Puckert, Mester, Noack and Wieprecht gives an overview of their work with physical and numerical models in support of the conceptual design of a hydraulic structure that would produce surfing waves for varying boundary conditions at the Neckar River in Stuttgart. The issue includes also an article by Ortiz-Angulo Cantos that discusses research in support of the design of submerged structures aimed at improving surfing conditions in the Somo-Loredo beach on the Cantabrian Coast in northern Spain.

As mentioned in the beginning of this editorial note, hydraulic engineering has been used many times to create pleasant and sometimes unexpected environments, where people can relax and enjoy their leisure time. Two such examples are given in the article by Llorca, who discusses the design of the water mirror (le mirroir d'eau) in the Place de la Bourse in Bordeaux, France, a thin layer of water formed quickly over a large area which creates beautiful reflections of the surrounding classical architecture buildings. Llorca also describes a similar design for the BJP Billiton water park in Perth, Australia that can be flooded with a thin layer of water and drained within seconds. The article by Segovia-Cardozo, Rodriguez-Sinobas and Zubelzu discusses the hydraulics of the irrigation system of a "living wall" consisting of a large number of different plants in pots arranged on a vertical surface at the Center for Innovation and Technology for Human Development in Madrid.

Both the design of venues for water sports and recreational activities and the use of water to create pleasant environments represent interesting applications of hydraulic engineering, some of which are still the subject of ongoing research.

References

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[2] Cohen, J., 2017: "A surfer and a scientist teamed up to create the perfect wave", AAAS Science magazine, November 8, 2017