PHOENICS News

Table of Contents:

Title **Page**

PHOENICS for teaching at Politecnico di Milano: the new course "Laboratory of Fluid Mechanics: the Green Valve case study" by Gianandrea Vittorio Messa, Politecnico di Milano.

The FluidLab research group at the department of Civil and Environmental Engineering of Politecnico di Milano has long-term experience in the use of PHOENICS for teaching activities. Since 2010, PHOENICS has been used within the "Fluid Labs" course for the MSc in Civil and Mathematical Engineering, taught by Professors Stefano Malavasi and Francesco Ballio. The students are given advanced knowledge of selected topics in fluid mechanics, such as the boundary layer theory of internal flows and the problem of fluid-structure interaction, and they apply the theoretical concepts by performing laboratory experiments and numerical simulations on different benchmark cases (developing turbulent channel flow, pipe orifice flow, and flow around a prismatic object.)

Figure 1. The students and the teacher of the Laboratory.

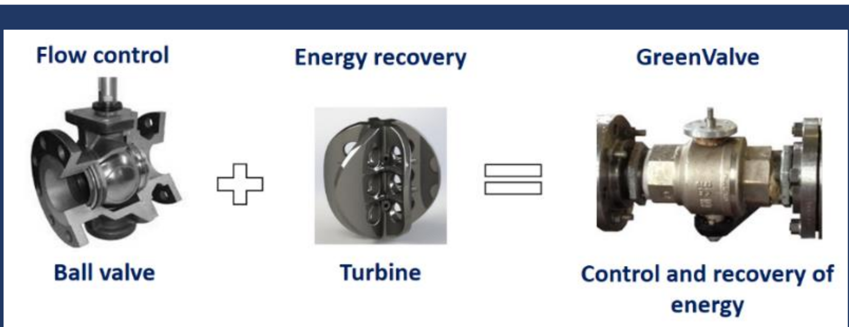


Figure 2. The Green Valve concept.

In the present academic year, a new course involving PHOENICS was established; namely the "Laboratory of Fluid Mechanics: the Green Valve case study", taught by Dr Gianandrea Vittorio Messa. To understand the framework in which the course was developed, it should be borne in mind that Politecnico di Milano is strongly encouraging innovative methods in teaching and learning. The "Passion in Action" programme includes open participation teaching activities offered to students to support the development of transversal, soft and social skills and to encourage/facilitate students in enriching their personal, cultural and professional experience. Dr Messa, already in charge of "Fluid Mechanics" for finalyear BSc students in Mechanical Engineering, organized the Laboratory as part of the above programme. His goal was to provide students with an overview of the problem-solving approaches in industrial fluid mechanics, namely laboratory testing, concentrated parameter modelling, and Computational Fluid Dynamics (CFD). The initiative, held in the Piacenza Campus of Politecnico di Milano, involved some 50 participants.

Students were given a case study that was both innovative and complex from the fluid dynamic and modelling points of view. This is the Green Valve, a device for the control and recovery of energy patented by Politecnico di Milano (DICA.15.002.A; inventor: Stefano Malavasi). In its original configuration, the Green Valve consists of a ball valve with a horizontal shaft turbine, which allows recovering a fraction of the energy dissipated in the flow control process (Figure. 2). In turn, the recovered energy can be used for various purposes, such as feeding monitoring systems to control the quality of the flowing water or the supply of power to the actuator; alternatively, it may simply be connected to the utility grid (Figure. 3).

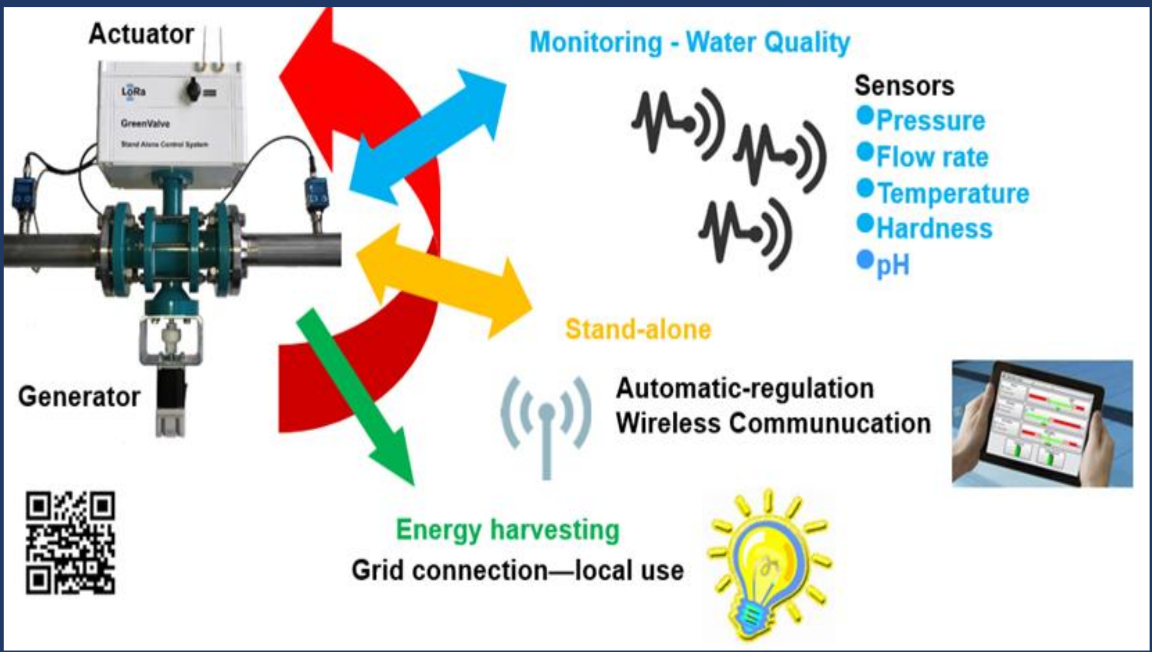


Figure 3. Possible uses of the recovered energy.

In the part of the Laboratory dedicated to CFD, students were given an engineering-oriented overview of this approach, (thus becoming aware of possible sources of inaccuracy), and they were shown best practices and guidelines for attaining reliable numerical predictions. Students became familiar with the basic concepts of the numerical consistency of the solution (eg, grid-independence), sensitivity of the estimates upon modelling parameters, and experimental validation. Since reproducing the Green Valve would have required an excessive calculation time, only a 2D slice of the device with the blades in fixed positions was simulated in class.

Students were aware that this simplified model would not completely represent the actual flow (Figure. 4). They worked in small groups, which were assigned different input data in terms of combinations of valve opening, position of the blades, and inlet velocity. After developing the CFD setup and verifying its consistency, they used the 2D solution to gather a rough estimation of the flow coefficient of the Green Valve under the same working conditions. The numerical estimates provided by some groups are reported in Figure. 5, together with those calculated by PhD students Qi Yang and Yongo Wang from the FluidLab group. The results compare quite well with experimental data collected in the Hydraulic Laboratory of Politecnico di Milano.

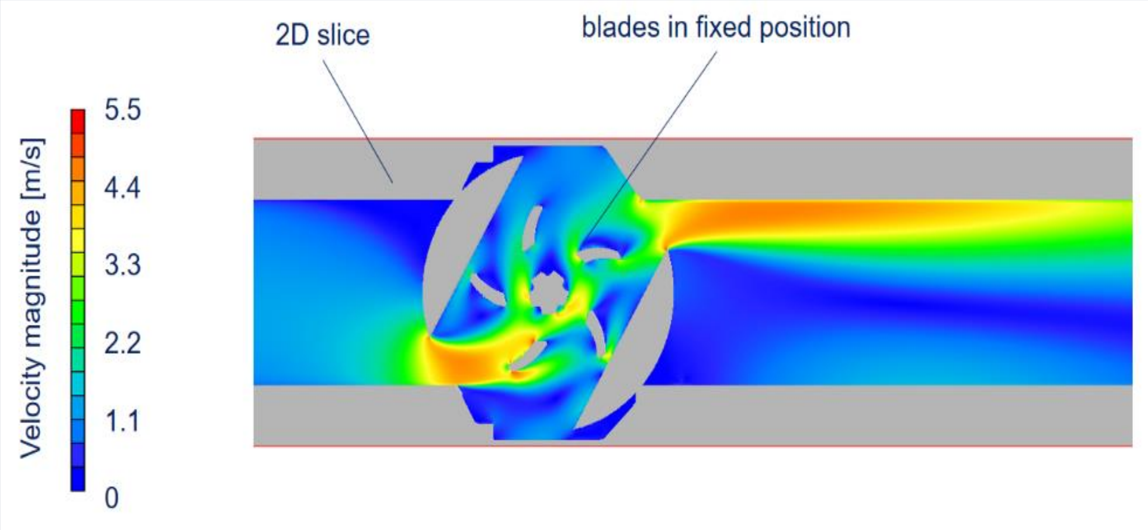


Figure 4. A typical velocity field obtained from PHOENICS.

The first-year experience of the course has definitely proven successful. The number of attenders was significantly greater than was expected, and they all provided a good evaluation of the course. The students faced, for the first time, different problem-solving techniques used in engineering practice, and they were introduced to PHOENICS as their first CFD code. The positive feedback encourages the teacher to repeat the initiative in the future.

Post Script: The numerical results shown in Figure 4 and 5 were obtained by PhD students Qi Yang and Yongo Wang from the FluidLab group and by the following attenders of the course: Emilio Giorgio Carlo Azzoni, Matteo Bertelli, Lorenzo Cenotti, Marco Dante Clerici, Mattia Libiani, Raffaele Marchetti, Lorenzo Palermino, Edison Shehu, Ermes Zamboni. For more information about the Green Valve, please refer to the website www.fluidlab.polimi.it or contact Stefano Malavasi (e-mail: stefano.malavasi@polimi.it)

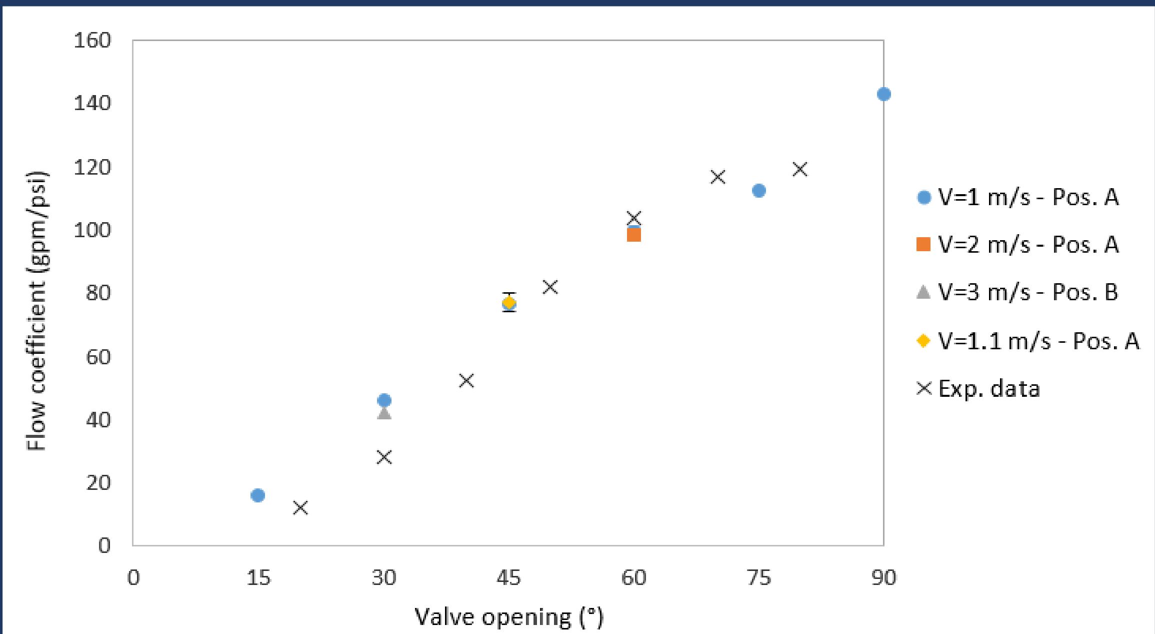


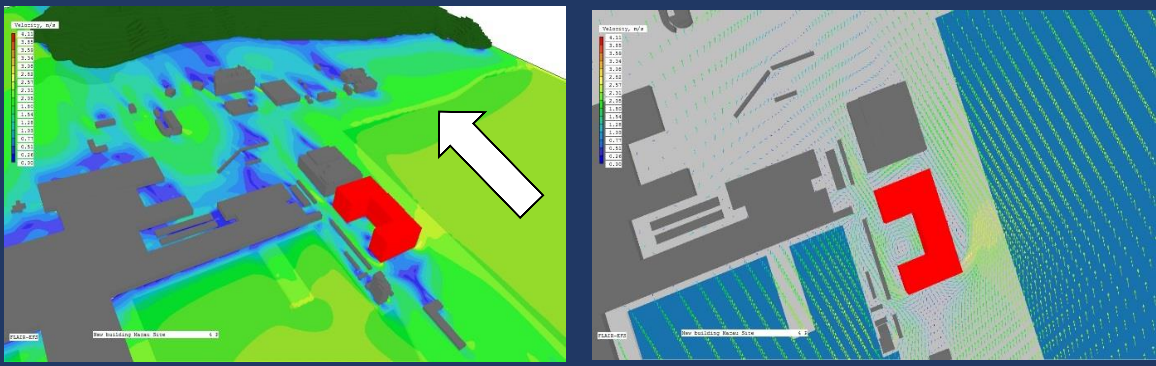
Figure 5. The flow coefficient of the Green Valve, as estimated by the students from the 2D model solution, and the experimentally measured values collected in the Hydraulic Laboratory.

CFD Simulation of Wind Flows Around a New Building Structure Using the Flair-EFS Subset of PHOENICS-Flair 2018

By Timothy Brauner, CHAM & Susana Baptista, Agri-Pro Ambiente

Portuguese-based environmental consulting company, Agri-Pro Ambiente, approached CHAM for CFD software to model the external built environment, resulting in procurement of the Flair-EFS (External Flow Simulation) subset of the PHOENICS/Flair package. The following describes a demonstration case of Flair-EFS applied to a proposed quay-side development in Macau.

Google Maps image of the Macau Quay and CFD model (ignoring reclaimed land area to the right.) Proposed new structure is shown in red.



Wind velocity contours and vectors. Proposed new structure shown in red.

Below & right: Surface pressure on new building and Pedestrian level measurement points

CHAM engineers created a 3D representation of the region of interest based upon 2D topology information supplied by the client, combined with the proposed new structure and its surrounding buildings, within the Flair-EFS user environment. The prevailing wind (for this particular demonstration case only the North direction was used) and environmental conditions were then added.

Flair-EFS creates a suitable computational mesh automatically; the building of interest is sited at the centre of the domain with all else placed around it on the assumption that those objects are centred relative to the building of interest. It is straightforward to use the centre of the building of interest as the datum point for all objects; eg having surrounding information in equal distances in all directions away from the building centre.

Multiple data collection points were generated at pedestrian level in the region, in line with customer requirements, with and without the new structure in situ. A macro file was created - activated from Flair-EFS in its post-processing mode - to extract simulation data at the location of the points specified.

The customer's objective was to assess wind velocity at various locations, under varying environmental conditions, in order to investigate the possibility of any adverse local conditions - in particular those arising at pedestrian level - that may result from the construction of the new building.
"This simulation confirmed a preliminary assessment made by AgriPro Ambiente, and due to the ease of use of the software, the excellent graphic results obtained and the achievement of the desired results, this software was acquired by this company and has already been used in two subsequent projects, with formal approval by our clients."

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Flair-EFS is a reduced-cost subset of CHAM's PHOENICS/Flair module for the simulation of the built environment – see: http://www.cham.co.uk/_docs/FLAIR_BROCHURE2015_PLSWBS.pdf. Contact Sales@cham.co.uk for further information.

Presentation of RhinoCFD (Powered by PHOENICS) at the January 2019 Rhino User Meeting in Helsinki

CHAM's Andrew Carmichael presented the company's RhinoCFD Software (powered by PHOENICS) at the Rhino User Meeting held by McNeel in Helsinki in January this year. The presentation took the form of a case study based on the modelling of a Trombe Wall which had been prepared at CHAM.

It seemed that, though many of those at the presentation were from institutions relating to the built environment, many did not seem to be aware of the Trombe Wall, and what it does.

Time was limited for Exhibitors so there was no opportunity to take questions after the presentation but it would seem that fields of particular interest included the heat transfer element of Trombe Wall activity, the use, and effect, of hedges diverting flow away from the building and thus reducing the cooling effect of wind and mention of comfort indices.

Those visiting CHAM's stand (pictured left) during the day were able to be shown what RhinoCFD could do and take information away with them. Visitors were positive about the fact that results modelled using PHOENICS could be displayed directly in Rhino which saved the necessity of using several pieces of software to obtain a finished result. Positive comments were also made regarding convergence coming up automatically and being colour coded for ease of understanding. There was a favourable ease of use comparison and questions were asked regarding integration with Grasshopper and the Ladybug Tools environment. The speed with which the meshing system could be set up when geometry changed had a positive impact given that user experience (as is normal with unstructured meshes), indicated that re-meshing involved expenditure in time and cost.

PHOENICS 2019

Work in currently in hand completing the next upgrade of PHOENICS. The code is scheduled to be available by end March. It will be supplied to all new customers from the beginning of April and also to all maintained users who wish to upgrade.

Full information on new features in PHOENICS 2019 will be available on our website and in the next issue of the Newsletter (to be distributed in April/May this year).

For advance information or to order an upgrade please contact sales@cham.co.uk.

CHAM Announcement

A Memorial bench has been placed on Wimbledon Common in memory of our founder, Professor Brian Spalding.

Contact Us:

Should you require any further information on any of our offered products or services, please give us a call on +44 (20) 8947 7651. Alternatively, you can email us on sales@CHAM.co.uk

Our website can be viewed at www.CHAM.co.uk and we are on the following social media:

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