



Self-monitoring: Evaluation of the overflow rate from a major combined sewer overflow



Challenge

Continuous measurement of the **volume discharged** by a geometrically or hydraulically complex **combined sewer overflow**

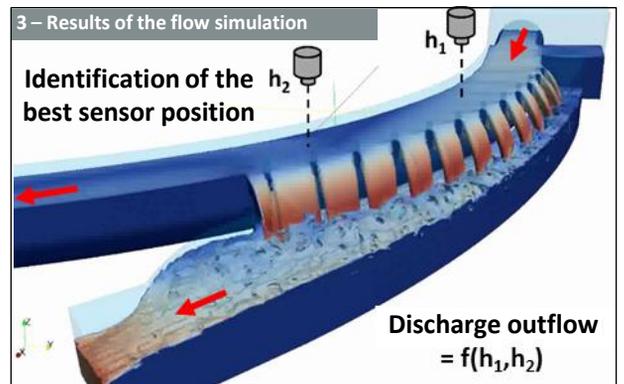
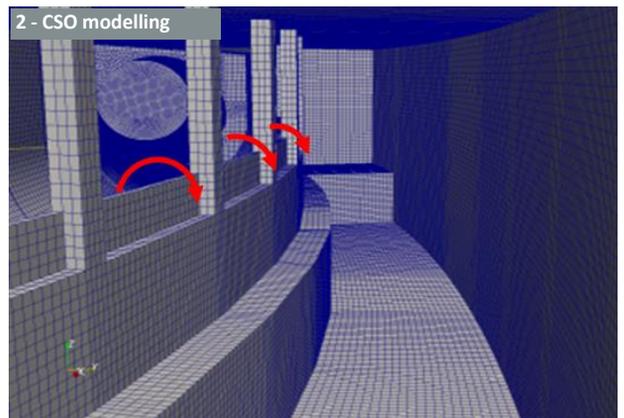


The 3D EAU solution

Evaluation of the overflow rate, **using non-contact water level measurement and 3D modelling** of the flows.

Determination of a site-specific **head-discharge relationships** considering its geometric and hydraulic properties and for which the **uncertainty** is quantified

Visualisation of the structure in operation in its hydraulic environment, in order to understand the flow and determine the most appropriate position for the sensor



Details of the proposed solution

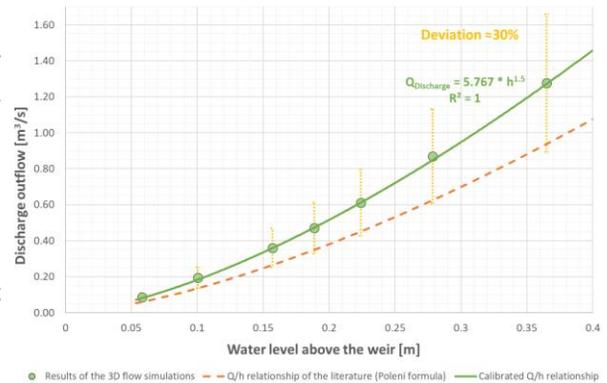
3DEAU has its own software solution for special applications, and develops and uses open-source software such as **Openfoam®** in order to solve Navier-Stokes equations for fluid mechanics.

The setup of the model leverages the 3D hydraulic modelling **expertise**, developed at the ICube laboratory (University of Strasbourg) and ENGEES¹, to which 3DEAU holds an exclusive licence. In combined sewer overflow studies, the flow is considered **turbulent** (RANS equation), **incompressible** and **without heat transfer**, subject to **gravity**, **transitory** (transient resolution) and **two-phase** (water + air).

- ¹ :
- Lipeme Kouyi, G., J. Vazquez, et J.B. Poulet. **3D free surface measurement and numerical modelling of flows in storm overflows**. Flow Measurement and Instrumentation 14, n° 3 (2003): 79-87
 - Lipeme Kouyi, G., J. Vazquez, Y. Gallin, D. Rollet, et A.G. Sadowski. **Use of 3D modelling and several ultrasound sensors to assess overflow rate**. Water Science and Technology 51, n° 2 (2005): 187–194.
 - Bardiaux J.B., Mosé R., Vazquez J, Wertel J, **Two turbulent flow 3D-modelings to improve sewer net instrumentation**, 11th International Conference on Urban Drainage, 31/08-5/09, Edinburgh, UK, 2008
 - Isel S., Dufresne M., Bardiaux J.B., Fischer M. and Vazquez J., **CFD based assessment of discharge-water depth relationships for combined sewer overflows**, Urban Water Journal, 2013
 - Isel S, Dufresne M, Fischer M, Vazquez J (2014). **Assessment of the overflow discharge in complex CSO chambers with water level measurements - On-site validation of a CFD-based methodology**. Flow Measurement and Instrumentation 35:39-43.

Example

The 3D modelling of this combined sewer overflow made it possible to calibrate an H-Q curve specific to the site, whereas a conventionally determined relationship (ex: Poleni's overflow formula) would have resulted in an underestimation of the CSO of approximately 30% in this specific practical case study.



Advantages

- **Improved understanding** of how the CSO works
- Increasing the reliability of the instrumentation, which requires simplified and safer maintenance (**non-contact measurement systems**)
- **Cost optimisation** of investment and operation (saving: ≈ 4 k€ / year/system)
- **Flexible model** for easy evaluation of the effects of geometric optimisations of the CSO on the flow
- **Solutions** for complex hydraulic problems



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