3D EAU

Hydraulic 3D modelling at the service of water and the environment

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

Challenge

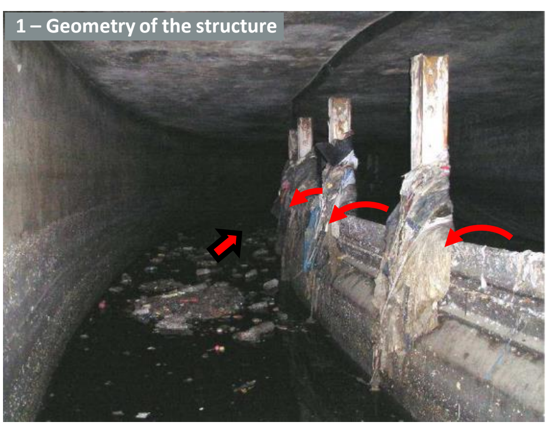
Continuous measurement of the **volume discharged** by a geometrically or hydraulically complex **combined sewer overflow**

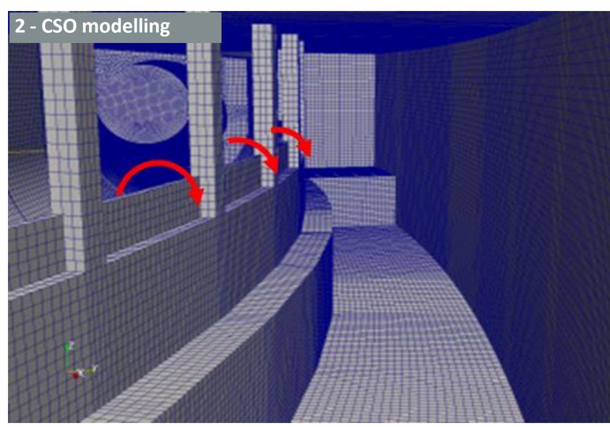
The 3D EAU solution

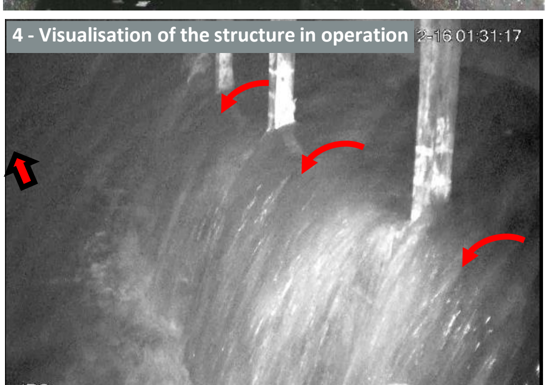
Evaluation of the overflow rate, **using non-contact water level measurement and 3D modelling** of the flows.

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

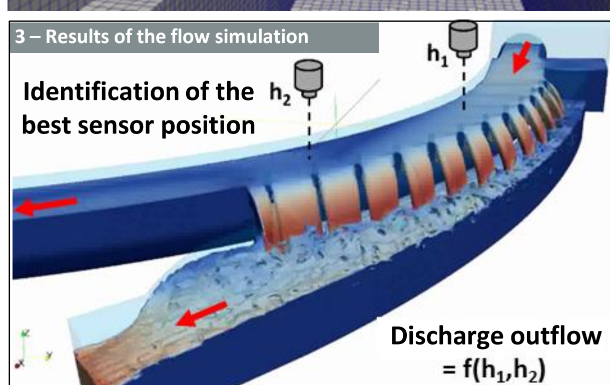
Visualisation of the structure in operation in its hydraulic environment, in order to understand the flow and determine the most appropriate position for the sensor


1 – Geometry of the structure


2 - CSO modelling



4 - Visualisation of the structure in operation



3 – Results of the flow simulation

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.

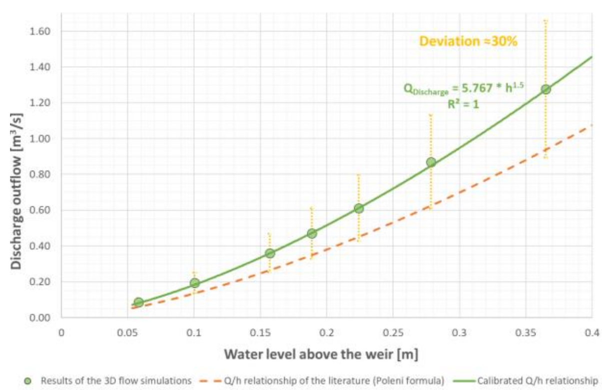
The setup of the model leverages the 3D hydraulic modelling **expertise**, developed at the ICube laboratory (University of Strasbourg) and ENGEES[1], to which 3DEAU holds an exclusive licence. In combined sewer overflow studies, the flow is considered **turbulent** (RANS equation), **incompressible** 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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