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Published in:
18th DWF Water Conference 30th January 2024

Publication date:
2024

Document Version
Publisher's PDF, also known as Version of record

DWF
Danish Water Forum

WATER VALLEY
DENMARK

Venue:
Copenhagen University
Thorvaldsensvej 40
1871 Frederiksberg

18th DWF Water Research Conference – 30th January 2024

Program and abstract catalogue

Assessing the performance of a green downspout solution to handle rainwater by using IoT based monitoring system

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Introduction: Local rainwater retaining systems distributed all over a watershed can contribute to reduce peak flows, minimize flood risks and enable rainwater harvesting being an complementary solution to reduce the demand for huge centralized infrastructures as retention basins. On the other hand, digitalization associated with such solutions are essential to support real time monitoring aiming a active control systems and integrated water management of the distributed retaining systems. So, the main purpose of this paper is to implement and evaluate an IoT sensor system as a tool to support monitoring and assessment of a green downspout solution system based on rockwool substrate.

Methods and data: The experimental apparatus was installed in the Technical University of Denmark - Ballerup Campus. Two setups with different highs were tested in this research. Both systems present a thickness of 20 cm and a width of 60 cm, one of them is 1m high and another 1.5m high. As presented in Figure 1, the green downspout pilots consisted of unplanted batches made of a perforated metallic structure filled with mineral wool. In a conventional downspout, water collected from the roofs will be drained and sent to a vertical pipe reaching almost immediately the main drainage system. In the case of the green downspout instead of having only a vertical pipe, there is an intermediate porous media made of mineral wool, which will be used to delay the rainwater by two processes: reducing the water velocity as the flow passes through a porous media and temporary storage of the water in the porous media.

Results: The water collected from the roof is distributed in the top of the mineral wool using a perforated pipe and flows through the batch from top to down, a perforated pipe at the top of the batch is used as a water inlet, and at the bottom, it is collected by a plexiglass tank connected to the outlet pipe. The system presents water flow meters, temperature, and moisture sensors. All the results are exported to the cloud and can be visualized in real time in an open data-based platform. The pilot system was tested using different water flows and configurations. The system showed different peak flow delayed times ranging from 4 to 8 min. As expected, the batch with 1,5m presented a higher retention and delay than the 1m, and the real-time monitoring system enabled to clearly follow the differences in terms of the filling and emptying process enabling better understand and analyze water flow over time.

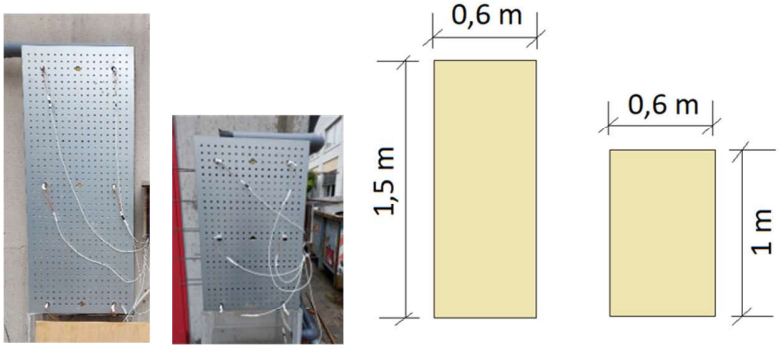

Figure 1: Overall dimension and real images of the green downspout pilot system.

Discussion and take-home message: The IoT monitoring was able to provide insightful information on a real-time basis to the system, with remote monitoring, facilitating data management, and system performance analysis. The hydraulic results showed that the water retention capacity and delay increase with the height of the batch, which indicates that such solutions have a high potential to be used as downspouts and delay rainwater in vertical buildings. Future steps include testing higher pilot systems to check scalability as well as water quality analysis.

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