**Experimental data for the detention tests with the conventional green roof system and the code for the physically-based model.**

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1. **Introduction**

The dataset supports the finding of Peng et al. (2021). This dataset contains the results of the detention tests with a conventional green roof drainage layer (Zinco FD-25) and a complete conventional green roof system. The experiments were conducted by Dr Gianni Vesuviano as part of his PhD. Gianni Vesuviano was funded via a University of Sheffield studentship and an EU MCIAPP secondment stipend (Project reference: 230636).

The full description of the detention test with the drainage layer can be found in the following paper:

Vesuviano, G., and Stovin, V. (2013). "A generic hydrological model for a green roof drainage layer." Water Science & Technology, IWA Publishing, 68(4), 769.

It should be noted that not all the tests with the drainage layer presented in Vesuviano et al. (2013) were used in Peng et al. (2021); please refer to Peng et al. (2021) for information on the tests that were used for analysis.

The configuration and the description of the detention tests with the complete conventional green roof system can be found in the following paper:

Vesuviano, G., Sonnenwald, F., and Stovin, V. (2014). "A two-stage storage routing model for green roof runoff detention." *Water Science & Technology*, IWA Publishing, 69(6), 1191.

This dataset also contains an example code for a two-stage physically-based green roof detention model, which was developed by Zhangjie Peng at the University of Sheffield, under the supervision of Prof. Virginia Stovin, as part of her PhD thesis. Zhangjie Peng’s PhD project is funded by the University of Sheffield, Faculty of Engineering Doctoral Academy Award.

The two-stage physically-based model consists of two models, for the substrate layer and the drainage layer, respectively. A description of the substrate model (Richards Equation), including the three-segment hydraulic conductivity function and model implementation, can be found in the following paper:

Peng, Z., Smith, C., and Stovin, V. (2020). "The importance of unsaturated hydraulic conductivity measurements for green roof detention modelling." *Journal of Hydrology*, Elsevier B.V., 590, 125273.

The information for the drainage layer model (Saint-Venant Equation) can be found in:

Peng, Z., Garner, B., Stovin, V. (2021). ‘’Two Green Roof Detention Models Applied in Two Green Roof Systems.’’ Journal of Hydrologic Engineering. (DOI: 10.1061/(ASCE)HE.1943-5584.0002155)

Peng, Z. (2021), Detention performance of green roof systems: Experimental characterisations and numerical modelling, PhD Thesis, University of Sheffield.

1. **File naming and data format**

The file ‘FD\_25\_Drainage\_Layer.mat’ is a MATLAB data file that contains the experimental results of the detention tests with the FD-25 drainage layer. The heading and units for each data column can be found in ‘File headings.docx’.

The file ‘Complete\_Conventional\_System.mat’ is a MATLAB data file that contains the experimental results of the detention tests with the complete conventional green roof system. The heading and units for each data column can be found in ‘File headings.docx’.

The following files are the MATLAB scrips for the two-stage physically-based green roof detention model:

1. Substrate\_Parameters. m
2. Durner-New-HCF. m
3. Drainage\_Layer\_Parameters.m
4. Drainage\_Layer\_Model.m
5. Runoff\_Calculation.m

To run the model, first of all, the ‘Complete\_Conventional\_System.mat’ file should be saved in the same folder as the model files, as the model uses the rainfall input in that file. The parameters for the substrate should be set in file #1. Once the parameters are set, running this script will save the substrate parameters such that they can be used in later scripts. Running file #2 will generate the outflow from the substrate. The parameters for the drainage layer should be defined in file #3, and running this script will save the parameters be used in file #4. Run file #4 to generate the water level distribution in the drainage layer. Run file #5 to obtain the runoff based on the results generated from files #2 and #4 and plot the hydrograph. All scripts contain instructions for use.