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The influence of high-rise buildings on urban stormwater response - a laboratory physical model

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One consequence of the tendency for population agglomeration in large urban centres is the construction of more high-rise buildings, which both allows for a better use of the space available and reduces the construction cost per unit of area. The influence of high-rise buildings on the response of urban drainage systems to wind-driven rain is currently not well known.

The importance of the combined action of wind and rain has been recognized by a number of investigators. Some investigators have also considered the movement of rainfall over basins, particularly upstream or downstream movement.

This study, based on the physical modelling in the laboratory of the rainfall-runoff process in areas with a range of densities of high-rise buildings (typical in downtown areas), aims to help to improve our knowledge in this specific domain.

Laboratory tests were carried out to simulate the response of a drainage system to static and moving rainfall in diverse directions, with varied building density, and considering the existence or non-existence of wind.

A physical model (1:100 scale) was built in the laboratory, representing an urban area of 40 000 m2, with high rise buildings (rectangular three dimensional elements representing medium to large buildings of approximately 20 storeys). A rain simulator (full-cone nozzle) was installed on a structure that was electrically driven along a rail to simulate the rain cell movement.

Preliminary laboratory experiments illustrate the influence of high density construction on stormwater's flow. Results will also analyse the influence of storm movement and wind which affects the spatial and temporal distribution of rainfall at ground level.

The laboratory experiments described in this work show that the construction density, spatial and temporal distributions of rainfall, wind and storm movement have a marked influence on the processes of overland flow. The results indicate considerable differences in runoff volumes and peaks, and hydrograph shapes. Thus, it can be concluded that there are distinct hydrologic responses to storms in areas with a distinct density of high rise buildings. The work will also include a comparison of the experimental and numerical results.