

Contribution of the Weighing lysimeter design for measures of direct run off in the floods formation

Rogério SAMPAIO GOMES* and J. A. N. BATISTA**

* Master of Science of the postgraduate program of the faculty of the civil & building engineering Civil, architecture and Urban of the Unicamp – Rua Benedito de Carvalho, 40 – Caraguatatuba-SP – Brazil

E-mail: cvrogerio@terra.com.br

** Professor doctoral degree of the water resources department of the faculty of the civil & building engineering Civil, architecture and Urban of the Unicamp – Av. Albert Einstein, 951, CEP 13083-852 Cx6021, Campinas, SP, Brazil

Email: nbatista@fec.unicamp.br

Abstract

A lysimeter design is presented to study the overland flow in an urbanized watershed and in a forested watershed in the cities of Valinhos and Vinhedo in the Campinas metropolitan region. The lysimeter, which is under development, is to separate the volumes of water kept in the topsoil (overland flow), water entering the soil (infiltration) and water drained to aquifers (direct recharge). Monitoring the soil infiltration capacity between storm events, which is due to evapotranspiration and direct recharge, is also planned with aim of pluviometer data.

Keywords

Flood Peak; Drainage; Modelling; Lysimeter; Runoff

INTRODUCTION

Urban disasters caused by floods generate great damage and victim. The collapse of the urban system drainage is common with increasing urban spot, which reduces the infiltration process and reaffirm the needs of better understanding of hydric balance of the flood events. Predict disasters and implement an urban infrastructure consistent with the growth is a multidisciplinary task. Therefore, with the crowded densification and development, increase the medium value of the landproperty which concerns more the people and authorities about the risk of flooding, which cause financial and psychological misfortunes.

The same economic growth that enhances the landed properties causes environmental damage. Against these effects, adequacies of infrastructure combined with warning systems and efficient recovery find in the engineer the fundamental role of the design and the operation.

However many variables are involved, some of them still little known. Contributing to the size of the challenges, the growth of urban stain in the watersheds change drenage, micro-climate etc.. Binley et al. (1991) had just noted the large number of parameters of distributed models to adjust and deficiency of representativeness of the collected data for the basin as a source of great uncertainty.

Tucci (1997) cites that the Brazilian urban development has produced significant increase in the frequency of floods in the production of sediment and water quality deterioration. Leopold

(1968, apud Tucci, 1997) states that after being urbanized city in general, notice yourself an increase of maximum flowing out rates up to seven times.

This paper aims to raise field data for processes of infiltration and production of direct superficial drainage in two neighboring watersheds in the metropolitan region of Campinas, one in Valinhos and another one in Vinhedo, comparing the data from the two basins. The basin of the Pinheirinhos stream (urban) and the Bom Jardim stream (forest) will be instrumented with lysimeter and a weather station to monitor the processes of formation of floods. The lysimeter will work as a extravasor at the top allowing the separation of rain over the surface.

The perspective of this study is the direct run off on the surface of the basins from leakage data, reproducing them in laboratory and analyze the flow of the basin, making this a functional mechanism for analysis of the formation of flood estimate the soil and its ability of absorbing the precipitation. The analysis of flow will occur in one forest basin and in an urban basin, possession of these data will have the same precipitation, and infiltration and comparing the basis we'll check exactly the effect of precipitation versus infiltration and formation of floods, with the curve of retention can estimate the water content. We'll work with the prospect of obtaining the intersection of the data with curves of precipitation against infiltration capacity and precipitation control the flow exultory.

STUDY AREA & MATERIALS

The study watersheds are in the state of São Paulo, see Figure 1, approximately 20 km from Campinas in the region of Valinhos and Vinhedo, see Figure 2. The basin of Ribeirão Jardim mostly in the municipality of Valinhos, has area of 22.5 km², with 7 km² of native vegetation, 0.3 km² of exposed soil and other by grassland, called in this paper forested area.

The watershed in Vinhedo town, the stream Cachoeira Paulista has an area of 18.1 km², with approximately 50% of urbanized area occupied by 57 thousand inhabitants, of which 50 thousand in the urban area, with growth of 6.6% per year. The rest of the basin is occupied by 70% pasture areas, 20% of native vegetation, and approximately 0,4km² of highlighted areas with exposed soil.

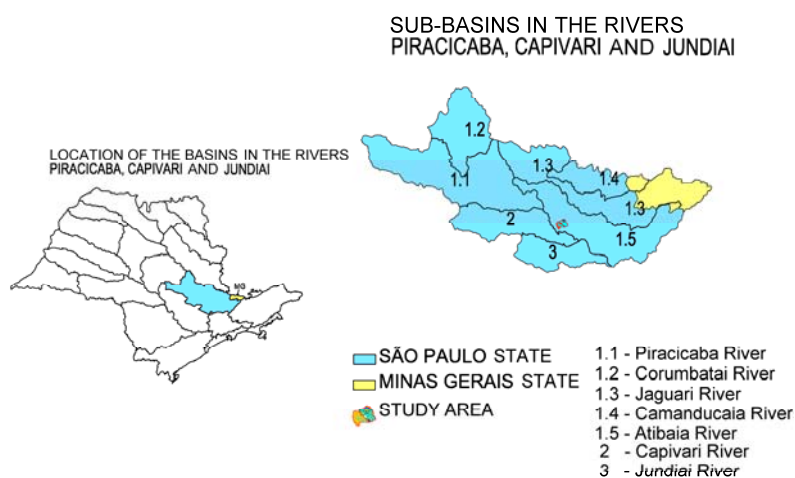


Figure 1 – Location of the Basins in the Sao Paulo State

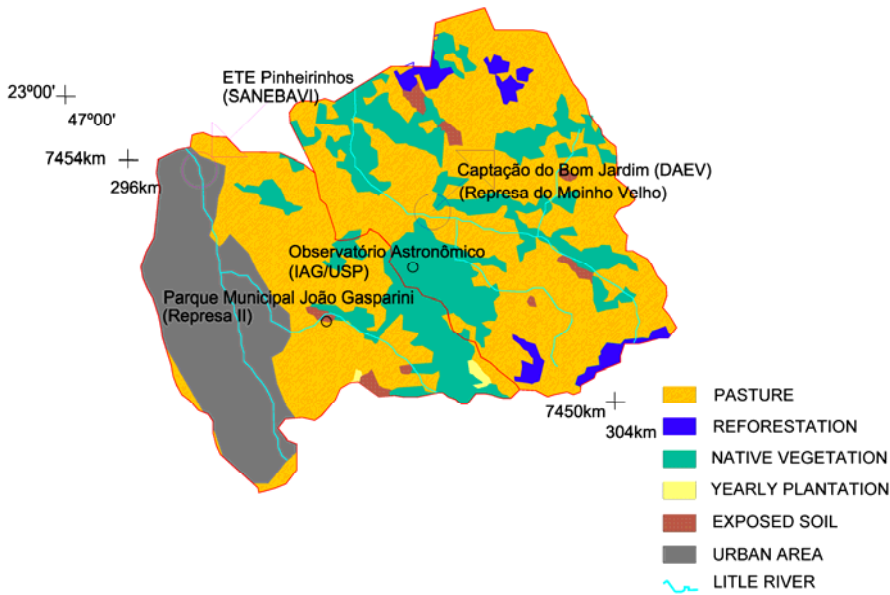


Figure 2 – Study Area

The sites provided for the installation of fluviometrical and hydrometeorological stations belong to the sewerage companies (Sanebavi and DAEV) and the City hall of Vinhedo (Municipal Parque João Gasparini), respectively. The installation of these stations will depend on the approval of specific terms of agreements that, perhaps, may exist between these institutions and Unicamp, as proponent of the study.

The lysimeter is constructed with the walls of the tank away from the walls to contain the ground (see Figure 3). The data collected will be used to analyze measures of the flow stream Pinheirinhos and the Bom Jardim stream.

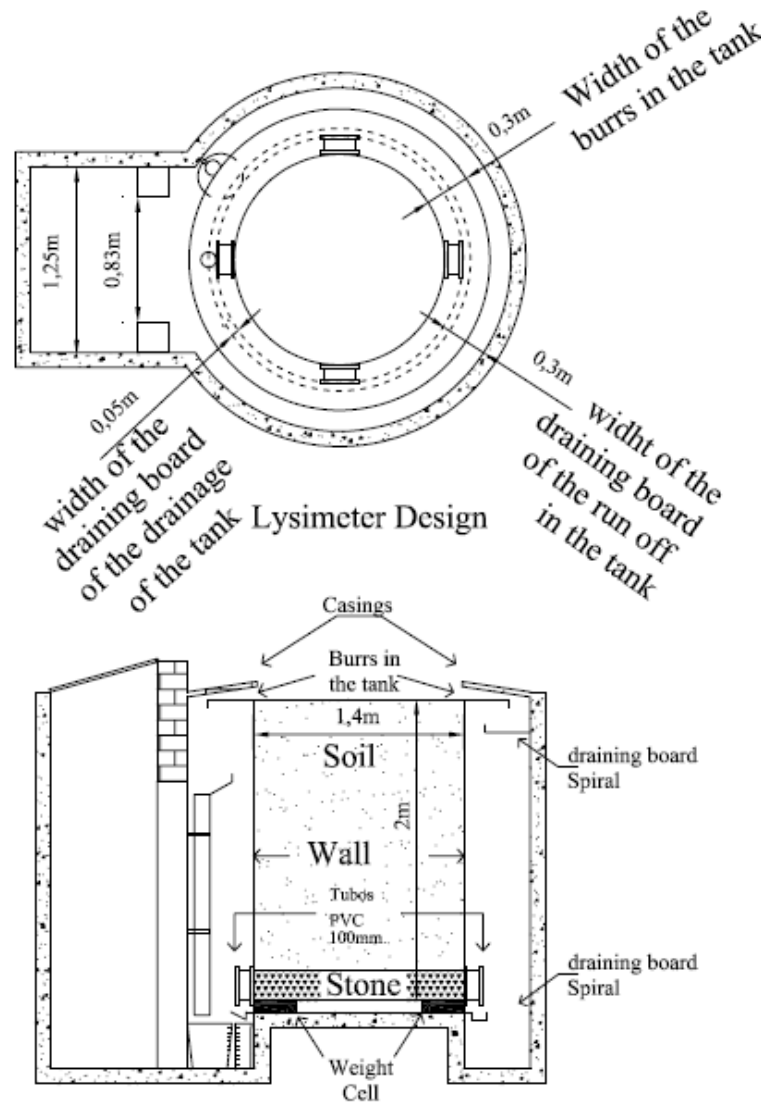


Figure 3 – lysimeter skatch

The lysimeter will have the weight monitored by load cell connected to a weather station datalogger. The casings have important role to prevent the entry of volume sold in other parts of the ground, forming a chimney out of the lysimeter. An innovation in this lysimeter are burrs in the tank that will get the volume of direct flow with the load cell can also measure the drained volume and the analysis chute collector, of the can measure the evapotranspiration, factor that in most experiments and is estimated not measured. The precipitate is total volume of flow directly, drained volume and the volume retained in the soil in the form of humidity. During rain events, the evapotranspiration nulls the water balance lysimeter is:

$$P \times A - Q - R = \Delta U \times Vol$$

Being A the top area of the lysimeter and Vol the volume of the lysimeter, P is the precipitous slide, Q is the translated volume from the top of the lysimeter, R is the drained volume for direct recharge and $\Delta U \times Vol$ the change of the water volume in lysimeter. Therefore, the lysimeter will the volume of water also monitored by tensiometers expecting its connection to the station datalogger which will become the water balance more precise. The volume of water lost by evapotranspiration and

soil percolation is given by the difference in the stored volume in the lysimeter, which promotes the recovery of soil infiltration capacity. Among events of rainfall, evapotranspiration occurs, which requires the lysimeter the following loss of volume:

$$- ETR - R = \Delta U \times Vol$$

Pereira et al (1997, apud Pereira et al 2002), states that the evapotranspiration, although simple and well defined from the theoretical point of view, is complex and difficult to determine in terms of its direct measurement field. With use of this equipment, and enhanced by burr pipeline collector can determine the soil humidity and evapotranspiration with no assumptions.

Parallel to this paper will occur in two other papers in the verification flow exutories of the two basins and studies in an lysimeter ex situ from laboratory. Both papers have an important role in the study and comparison of the basins.

EXPECTED RESULTS AND PROSPECTS

The water balance of the lysimeter in situ will produce ratings of the flow components in the soil by data of the previous soil humidity moisture, curve of humidity. The recovery of infiltration capacity which is given as a function of evapotranspiration and leachate volume for the recharge will be obtained by hortonianos models.

Intend to determine the flow in the basin exutory compared to collected data. With the simulation of precipitation for different periods of return you can verify which precipitation for the critical flow under the conditions of humidity in the soil. The model can also be reproduced in laboratory to represent the basins and obtain data of effective precipitation and infiltration.

The comparison of the basin will show that the urban patches increase the peak flows and the important role of infiltration in reducing effective precipitation, verifying the results for short and long rainfall with different term levels of humidity soil versus effects of floods.

These data with other papers the study still has the prospect of studying graphs with crossing of precipitation data of effective precipitation, humidity, infiltration and flow in exutory on hoping to draw a standard curve of floods formation. With all these data we should show the contribution of urbanization in the flood formation comparing the two basins and quantify them.

REFERENCES

- BINLEY, A. M., K. J. Beven, A. Calver, and L. G. Watts (1991), Changing Responses in Hydrology: Assessing the Uncertainty in Physically Based Model Predictions, *Water Resour. Res.*, 27(6), 1253–1261.
- PEREIRA A. R., A. V. Santiago, S. M. Maggioletto, M. V. Follegatti (2002), Problemas operacionais com lisímetro de pesagem durante a estação chuvosa e em dias secos com rajadas de vento, revista brasileira de agrometereologia, V.10, n.1, pp 51-56.
- R. L. BESCHTA, M. R. Pyles, A. E. Skaugset, C. G. Surfleet (2000), Peakflow responses to forest practices in the western cascades of Oregon, USA, *Journal of Hydrology*, Volume 233, Issues 1-4, pp 102-120

*9th World Wide Workshop for Young Environmental Scientists WWW-YES-Brazil-2009: Urban waters:
resource or risks? 26-30 October 2009*

TUCCI, C. E. M.(1997), Plano Diretor de Drenagem Urbana: Princípios e Concepção, RBRH –
Revista Brasileira de Recursos Hídricos, Vol. 2 nº. 2, pp 5-12.

18-WWW-YES-2009-Brazil-Sampaio-Gomes-Paper-2009-07-09.doc