Abstract

In many towns of the metropolitan area of Barcelona, an insufficient urban planning associated to the urban drainage systems is evident. In the last few decades, a spectacular increase of population has taken place in these zones, leading to an increase of urbanized area and, as a result of this, an increase of imperviousness in cities. This phenomenon is translated to a runoff volume increase, reducing the natural infiltration, and an increment of water surface speed, when reducing the surface roughness. This situation causes serious flood problems because, in many cases, the existing drainage systems are insufficient to deal with this runoff increase created by the urbanized surface increase.

The objective of urban drainage systems rehabilitation is to mitigate the flood problems of our municipalities. Given that the construction of new collectors is difficult due to problems of traffic, annoyances to the citizens, etc. it is preferred to put retention tanks as a rehabilitation alternative. The use of these retention tanks is a suitable solution if they are located in appropriated points of the sewer systems.

Retention tanks can operate, for example, without outflow regulation, and in this case, water is evacuated through a constant area orifice. This supposes the necessity of a certain surface area and a certain storage volume, to attenuate peak flows and to alleviate the system of an amount of water that is not able to convey.

Management without outflow regulation of retention tanks its denominated static management. This type of operation of retention tanks, even giving good results with reference to reduction of system outflow (floods) and having minimum management costs, has some disadvantages. A fixed orifice in retention tanks increases the time that these ones need to empty, leaving the drainage system in insufficient conditions to deal with another rain event during long period of time, in some cases, days.

Therefore, trying to reduce the empty time of retention tanks, and with the intention of reducing its size, we have considered that retention tanks can be operated on the basis of a real time control. In this way, according to flow conditions in drainage system, we manage the retention tank outflow with a certain criterion, for example, to agree with some selected downstream conditions. The real time control allows us to optimize the storage capacity of drainage system, and as well, to have retention tanks with less surface and storage volume. To be able to arrange smaller retention tanks supposes a very important reduction of construction costs and makes easy the location in the urban subsoil.

The establishment of a real time control strategy defines a dynamic management of retention tanks, in which, thanks to a floodgates system, the outlet orifice area of retention tanks can be changed in time, and then the drainage flow changes too. This real time control strategy is based on reference levels in other significant points of the system.

In order to be able to execute a real time control, it is necessary a suitable system of data adquisition: sensors taking level measures in different points in the system, a controller giving orders based on these measures and the control algorithm that has been defined, a regulation element (retention tanks floodgates) and finally, a information transmission system.

This work raises a real case, the Riera Roja basin in Sant Boi de Llobregat. His present situation, its solution by statically run retention tanks, and an alternative solution by real time controlled retention tanks is analyzed. We have used the simulation model SWMM 4.4, through PC-SWMM GIS program, which allows us to introduce all the information available, as much the one of urban basin surface, like the one of drainage system conduits, and it models the water movement in sewer system, according to a design storm for a return period of ten years.

It has been verified that dynamic operation of retention tanks shows important advantages as opposed to the static operation of them. These advantages are translated, on one hand, in a smaller empty time of retention tanks, that allows having the drainage system in suitable conditions, to deal with another rain event, in just a short time. On the other hand, it allows reducing the surface area of retention tanks, obtaining with smaller retention tanks dynamically operated the same results that with greater retention tanks statically operated, which facilitates its location in the city and reduces the construction cost.