Modelling Internal Boundary Conditions of a Sewer Network

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Structure of the Presentation

Introduction

Methodology

Physical Model

Hydraulic Numerical Models

Data Analysis

Results and Discussion

Conclusion

Introduction

Flooding in Manila - Philippines

Flooding in UK - 2012

Sewer system flooding

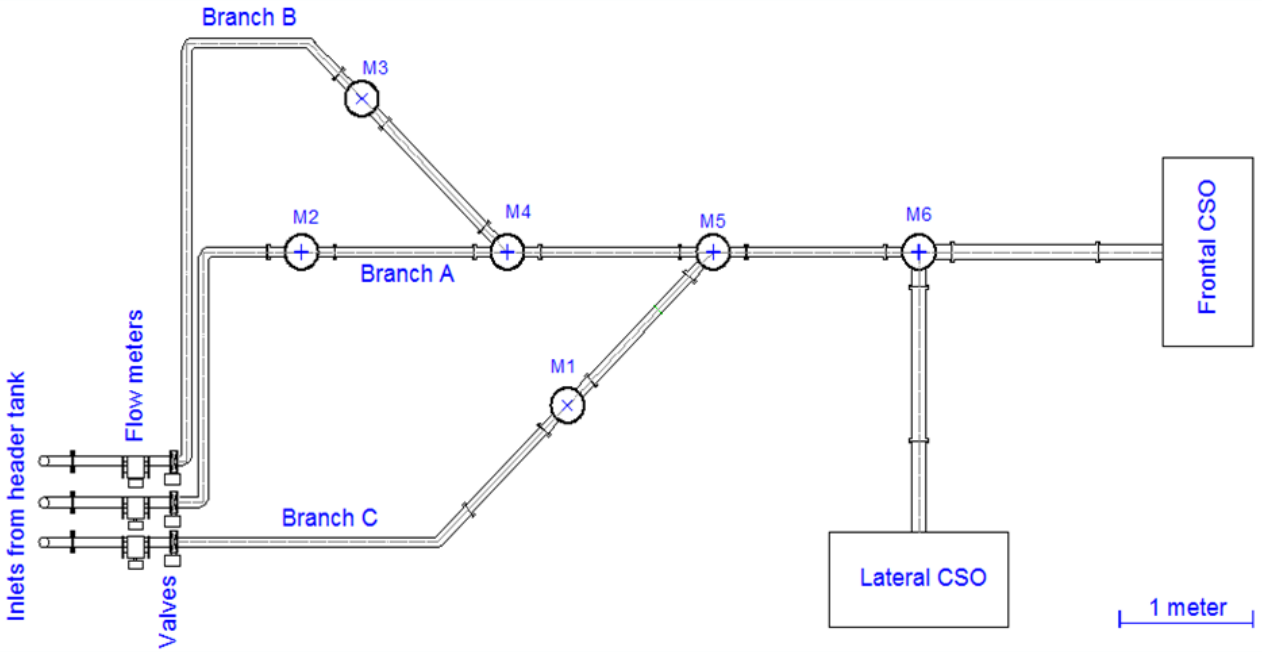
Introduction

The aim of the work is to validate the internal boundary conditions of a scale model of an urban drainage system.

The facility is a scale model of an urban drainage system.

The calibration of the models is done using the experimental data of two storm events.

Methodology



Scheme of the facility (M stands for manhole)

Physical Model

Methodology

SIPSON – “Simulation of Interaction between Pipe flow and Overland flow in Networks”.

Djordjevic (2001)

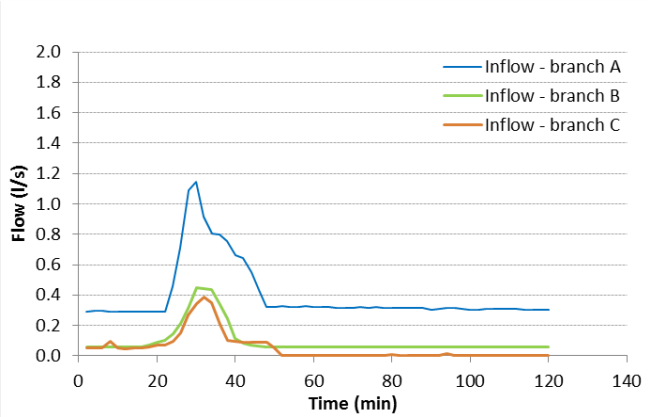
SWMM – “Storm Water Management Model”.

Rossman (2010)

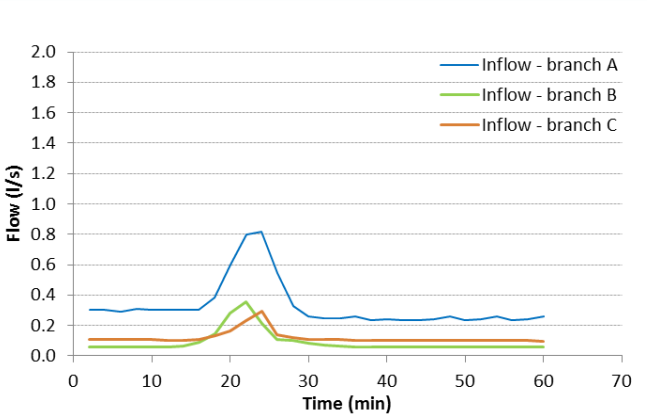
Hydraulic Numerical Models

Methodology

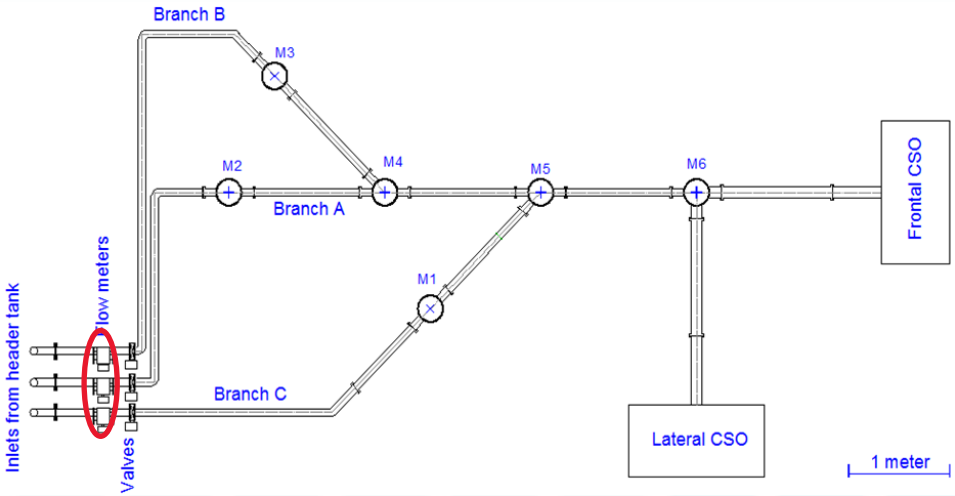
Inflow hydrographs at each inlet pipe



Event of 12th December 2008



Event of 17th January 2009



Data Analysis

Results and Discussion

It was found that the flow Froude number is always less than unity irrespectively of the event, indicating that we are in the presence of subcritical flow.

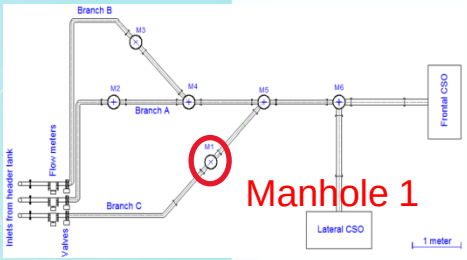
According to Zhao et al. (2006) subcritical flow in sewer junctions has relatively small energy losses.

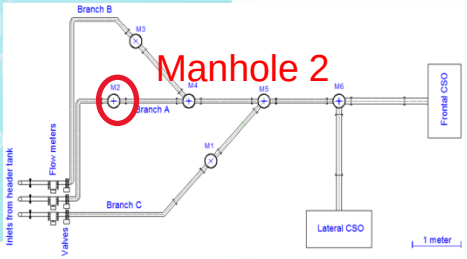
In SIPSON the head losses considered in manholes was Special Type 3 (least energy loss considered in SIPSON).

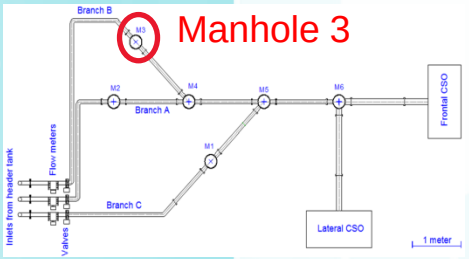
In SWMM, the head losses in manholes are calculated considering losses coefficients on their inlet and outlet pipes.

Results and Discussion

Variation of water depth

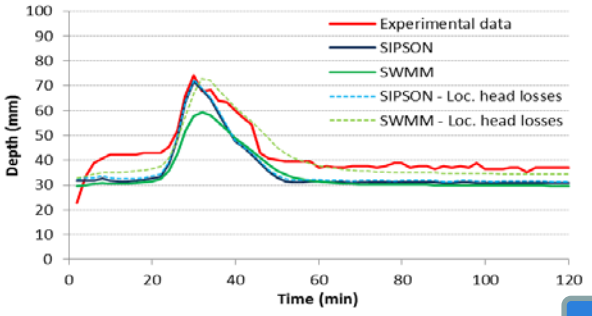


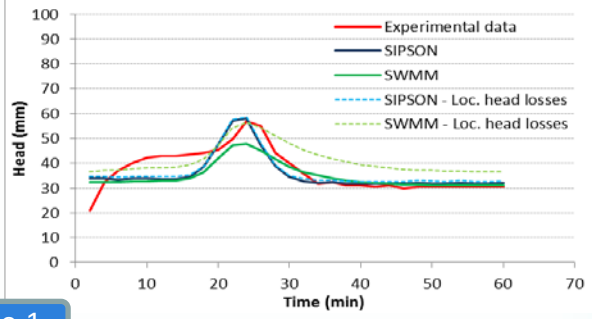




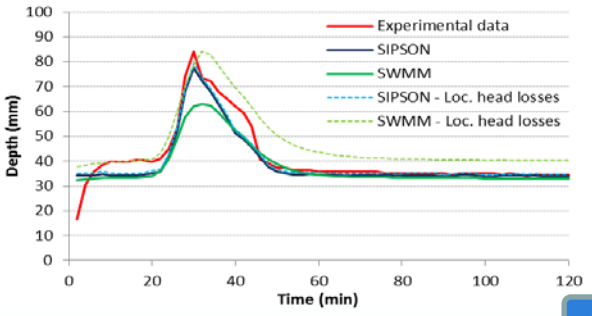
12th December 2008

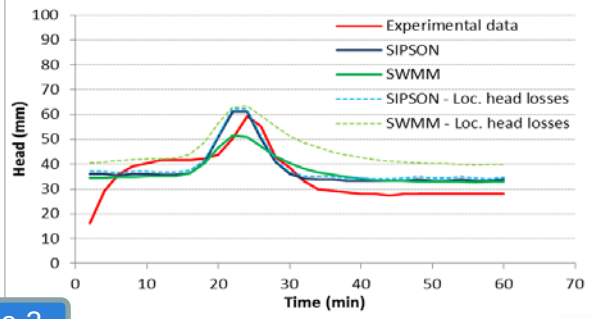
17th January 2009



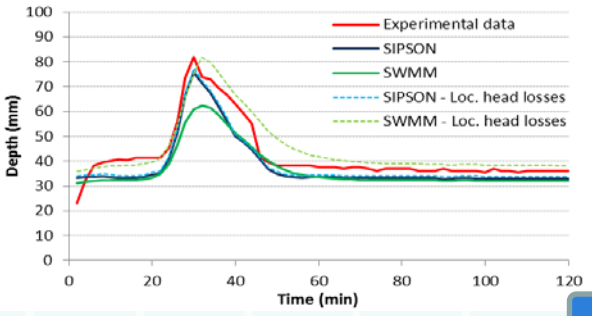


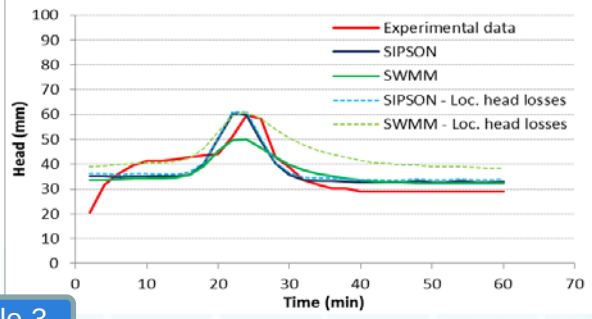
Manhole 1





Manhole 2





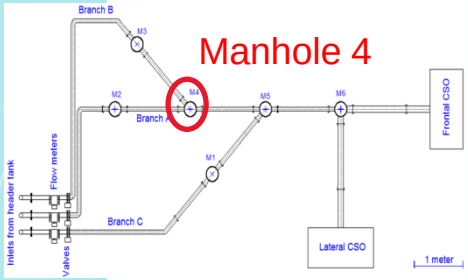
Manhole 3

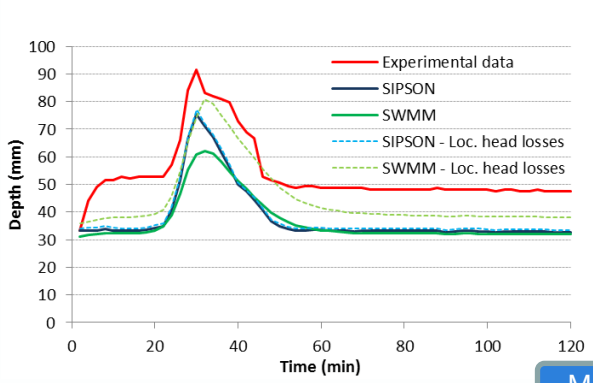
Results and Discussion

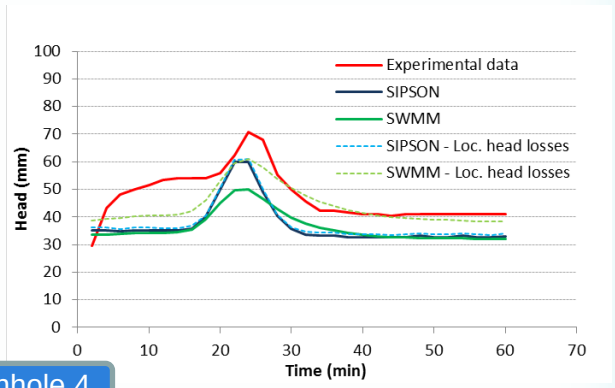
Variation of water depth

12th December 2008

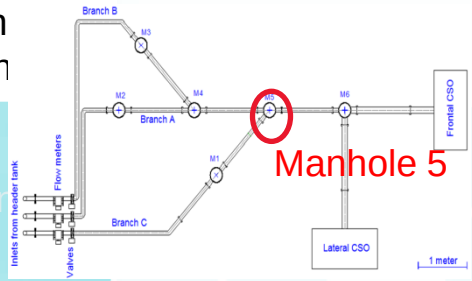
17th January 2009

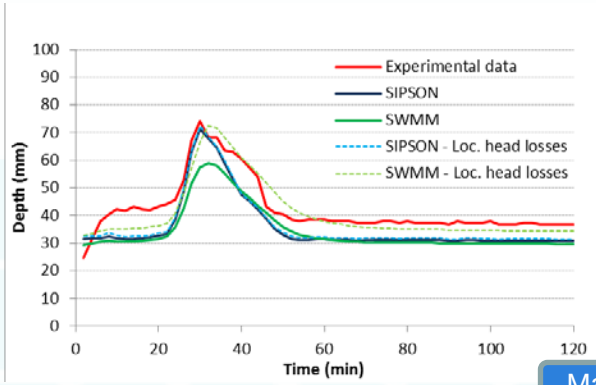


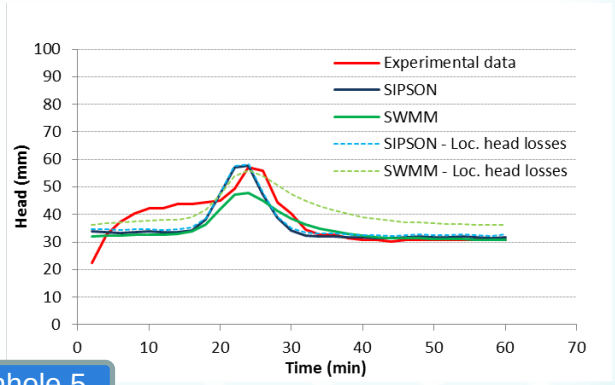




Manhole 4





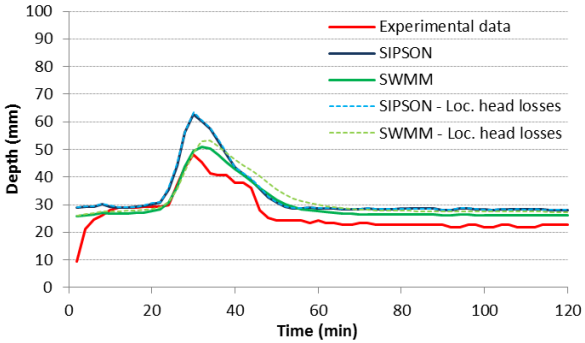


Manhole 5

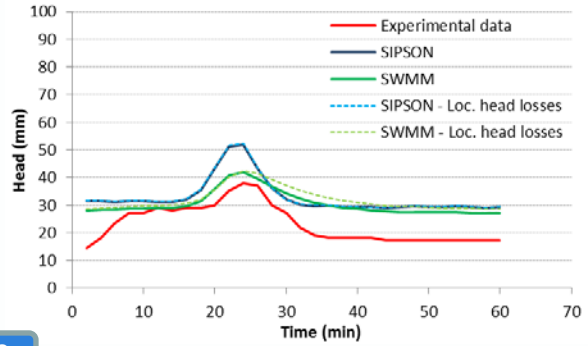
Results and Discussion

Variation of water depth

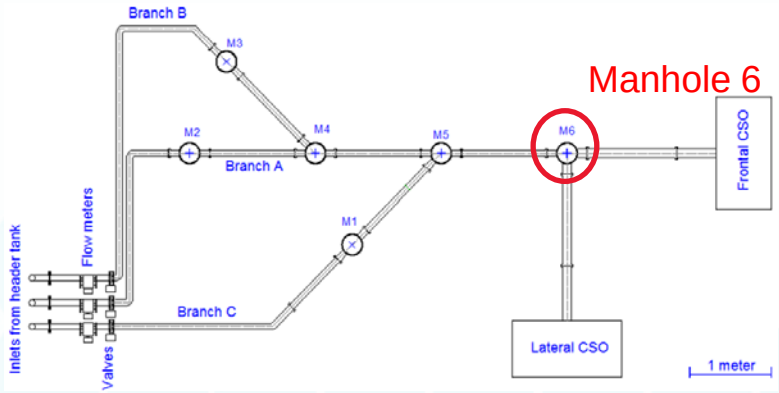
12th December 2008



17th January 2009



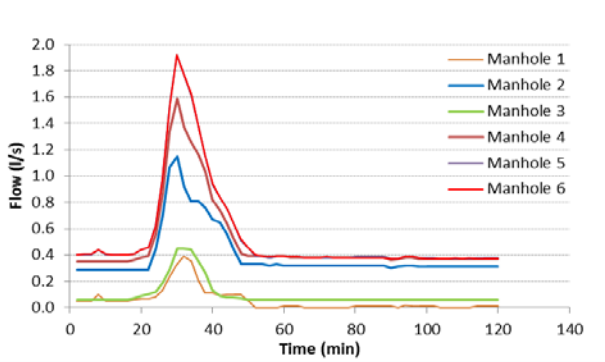
Manhole 6



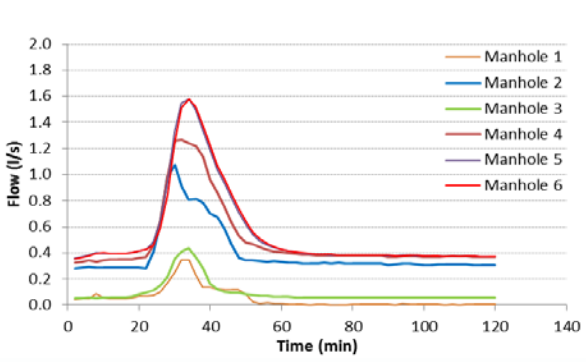
Results and Discussion

Variation of flow rate at manholes - event of 12th December 2008

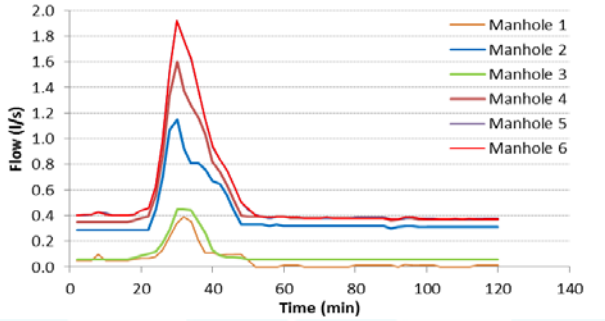
SIPSON results

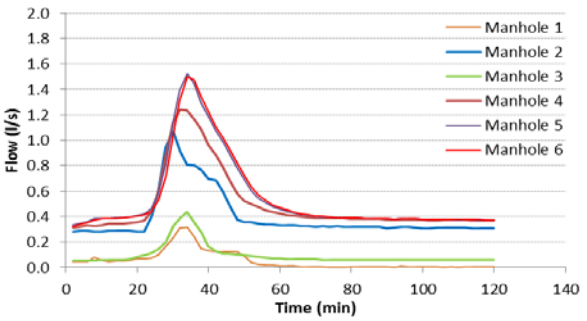


SWMM results



without considering head losses in manholes



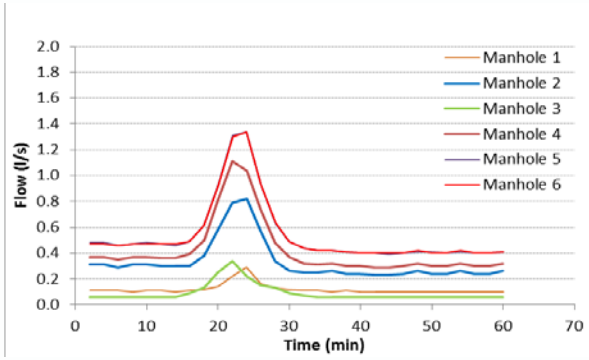


considering head losses in manholes

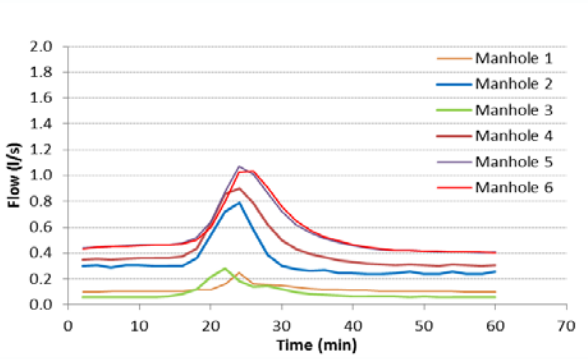
Results and Discussion

Variation of flow rate at manholes - event of 17th January 2009

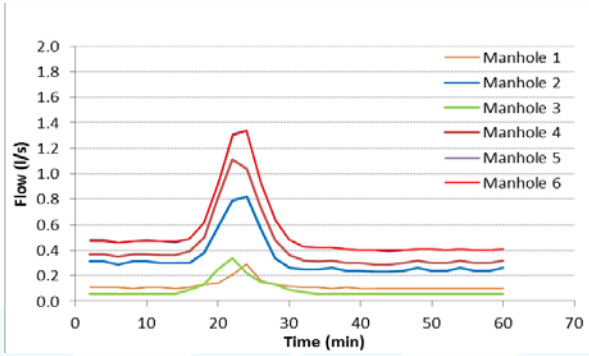
SIPSON results

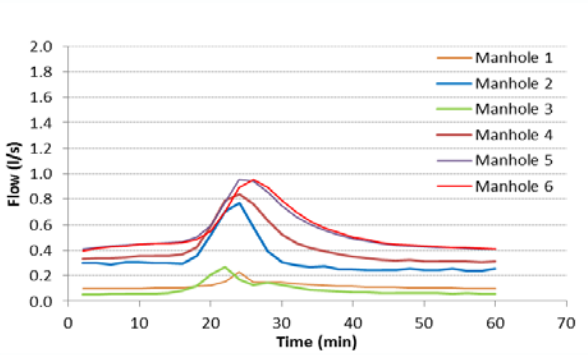


SWMM results



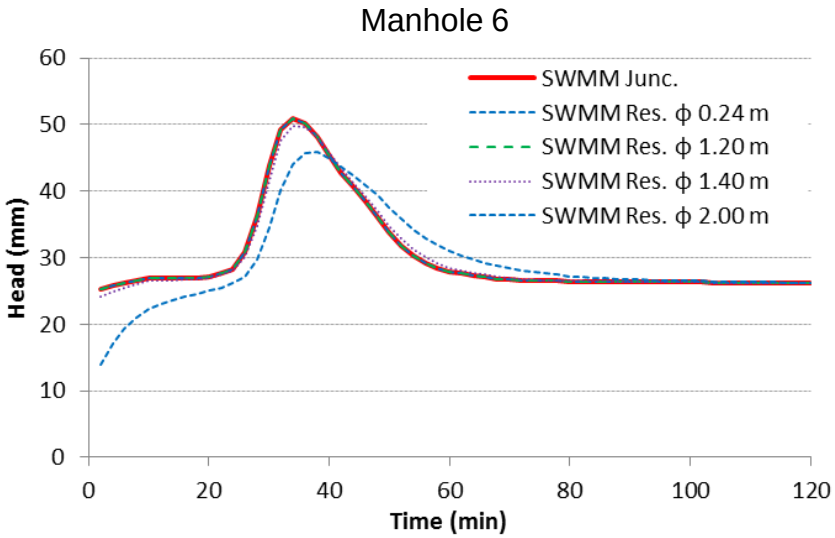
without considering head losses in manholes





considering head losses in manholes

Results and Discussion



Comparison of the variation of water depth for two different simulations (with junctions or reservoirs to modelling manholes in SWMM).

Conclusion

SIPSON calculates the flow depth in manholes taking into consideration the depth increase due to transfer of kinetic energy to potential energy.

SWMM Flow depth inside manholes is equal to the average between the pipes upstream and downstream values.

In this experimental facility SIPSON reproduced fairly well the water depths in the manholes.

Thank you for your attention

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