Assessment of the potential implementation of Permeable Pavement Systems in the San Francisco Park of the historical city of Oviedo, NW Spain

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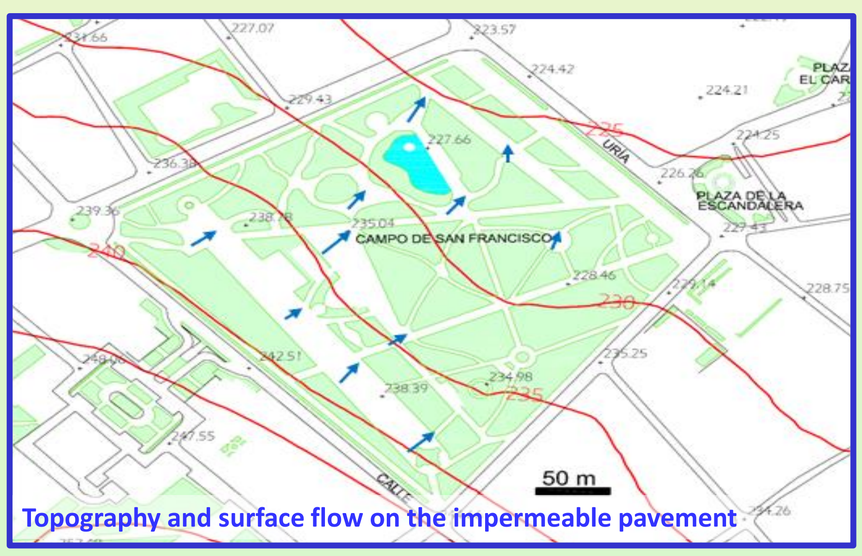
INTRODUCTION

Oviedo (NW Spain) is a historical city of 220,000 inhabitants. The San Francisco park constitutes the green lung of the city and it extends 8 hectares, of which 45% is paved with conventional impervious concrete. This impermeable pavement (which is already 25 years old) prevents the infiltration of rainwater, except through cracks produced by the effect of the roots of the trees and the infrequent passage of heavy vehicles. Rainfall and runoff in the park are managed through grey conventional drainage such as pipes and culverts, discharging into the city's sewer system.

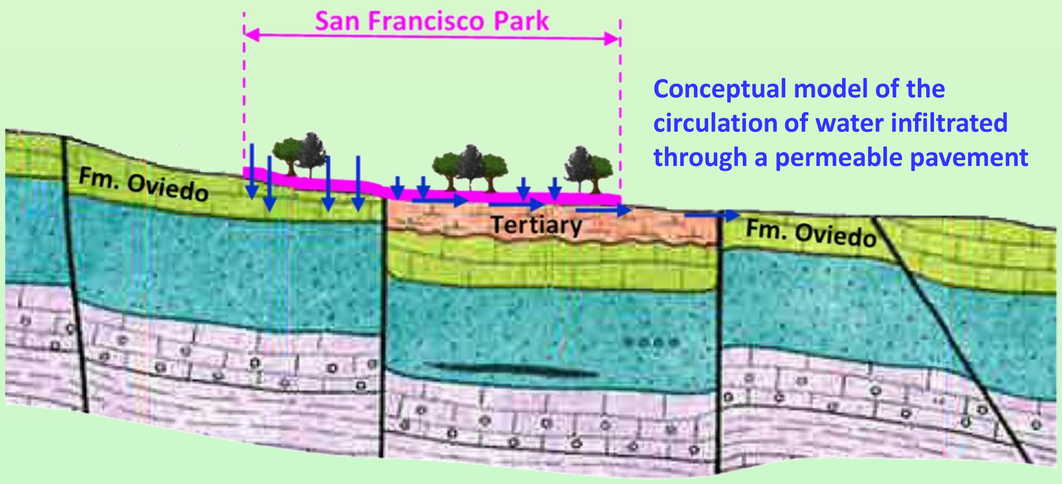


Topography and surface flow on the impermeable pavement

STUDY AREA

The climate is characterized by abundant rainfall, high humidity and mild temperatures. The precipitation of an average hydrological year is 992 mm, of which 64% evapotranspires, so the effective rainfall is estimated in 353 mm/year. Most of this water becomes runoff, which under normal conditions is estimated at 0.375 l/s. The park, with heights between 225 and 240 m a.s.l., has an approximate slope of 5%, and runoff flows to the NE. The maintenance of the drainage system is infrequent, but the pavement is cleaned with water, swept and vacuumed almost daily.

From the geological point of view, the study area is located on: i) Cretaceous materials (Fm Oviedo): permeable limestones and ii) impermeable tertiary materials (marls, clays and marly limestones). The underlying aquifer does not receive recharge from the park area, but this could change if the concrete pavement were replaced by a permeable one.



Conceptual model of the circulation of water infiltrated through a permeable pavement

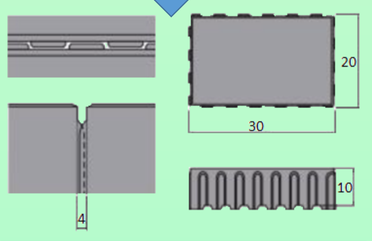
METHODOLOGY

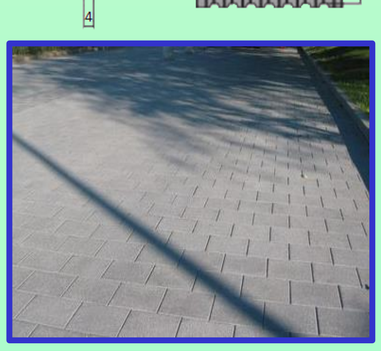
Firstly, the maximum surface drainage flow for different return periods was calculated according to Spanish Standard 5.2.-IC. In this case, for a 25-year return period (4% probability), a peak flow of 580 l/s can be expected.

This work proposes the substitution of the existing pavement by two types of porous pavement:

Interlocking impervious Concrete Block Pavement (ICBP)

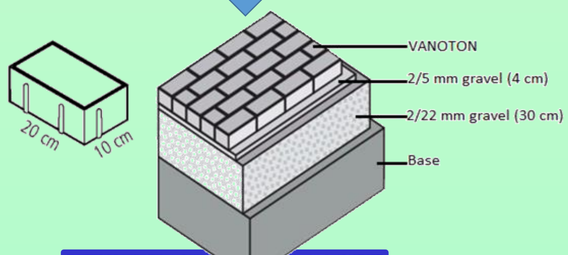
It is proposed for the areas where vehicles can occasionally circulate. It consists on a base layer with a permeability around 10^{-5} m/s and a sand/granite aggregate layer of about 5 cm; the joints are filled with fine sand.

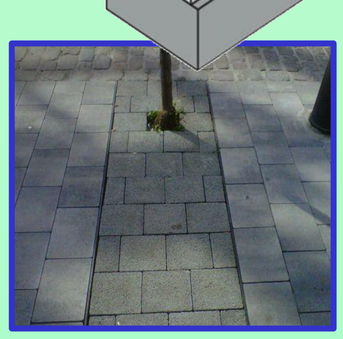




Porous Pavement (PP)

It is proposed for the pedestrian areas. Its infiltration capacity is 60-150 l/s per ha, so the water infiltrated would be 212-530 l/s. This pavement is constituted by concrete without fine particles in order to have high storage capacity, but it should be kept in good condition to maintain its infiltration capacity.





POROUS PAVEMENTS		
	ICBP (VS 5®)	PP (VANOTON®)
	60% of the paved area (zones with potential vehicle traffic)	40% of the paved area (pedestrian zones)
Technical criteria	Impervious concrete blocks with open joints. Easy and fast installation	Permeable concrete blocks
Environmental criteria	airclean® Less infiltration	Infiltration up to 5300 l/s
Economic criteria	574,482 € (unit price: 27€)	'Grey' colour: 216,226 € 'Desert' colour: 269,929 € (*similar to that of the existent pavement*)

COST

- Installation of porous pavement:
  - ICBP: 574,482€
  - PP: 250,000€
- Removal of the current impervious pavement: 400,000€
- Maintenance costs were not considered since the current maintenance activities carried out in the park (vacuuming and washing) would be sufficient for the new PP.

TOTAL: 1.2 million €

CONCLUSIONS

The current outdated pavement of San Francisco Park needs a reform. The cost of the replacement by the exposed porous pavement is high, but it would imply intangible advantages such as: sustainable stormwater management, vegetation improvements, recharge of the underlying limestone aquifer, attenuation of the flow peaks and possibility to reuse the stored water in the sub-base of the PP for irrigation or pavement washing, amongst others.

SUDSnet Sustainable Urban Drainage Systems Network

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