COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Research and Creative Experience for Undergraduates Program (RCEU) Summer 2019

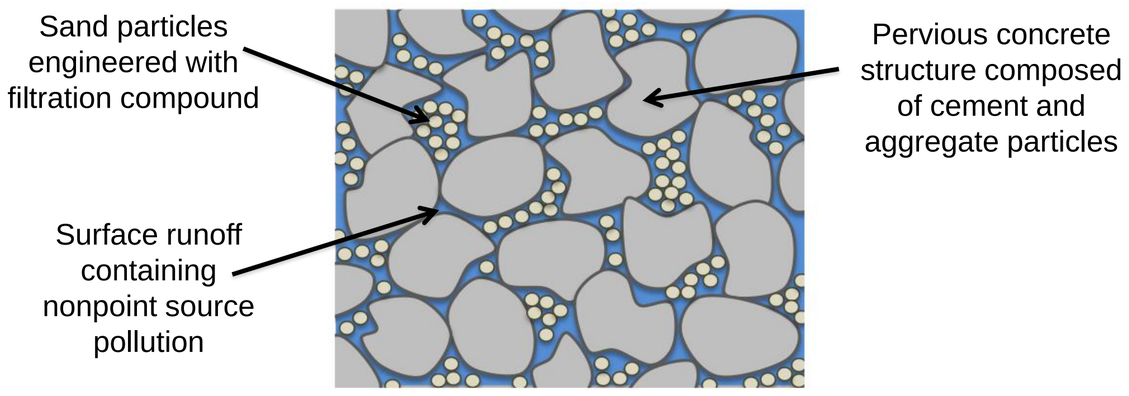
COLLEGE OF SCIENCE
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Pervious Lightweight Concrete and Engineered Sand Filter

Sarah Puchner, Dr. Hongyu Zhou
Civil and Environmental Engineering

Introduction

Pervious concrete is a specialty concrete that is single size graded and normally has low cement to aggregate ratios. This leads to concrete with a large number of void spaces and high porosity. Pervious concrete is especially useful in pavements, parking lots, and other large areas of concrete because of its ability to allow water to pass through the concrete to the soil beneath reducing surface runoff.
However, because of urbanization this runoff is often contaminated by nonpoint source pollutants that degrade water quality (Davis, 2005). Filling pervious concrete with engineered sand allows the pavement surface to control water runoff quantity as well as filtering the water to improve quality. After the engineered sand has reached its lifetime expectancy the sand can be vacuumed out of the pervious concrete, cleaned of containments and then replaced without requiring the removal of the pervious concrete.



A simplified diagram of a pervious concrete filter. Diagram is not drawn to scale.

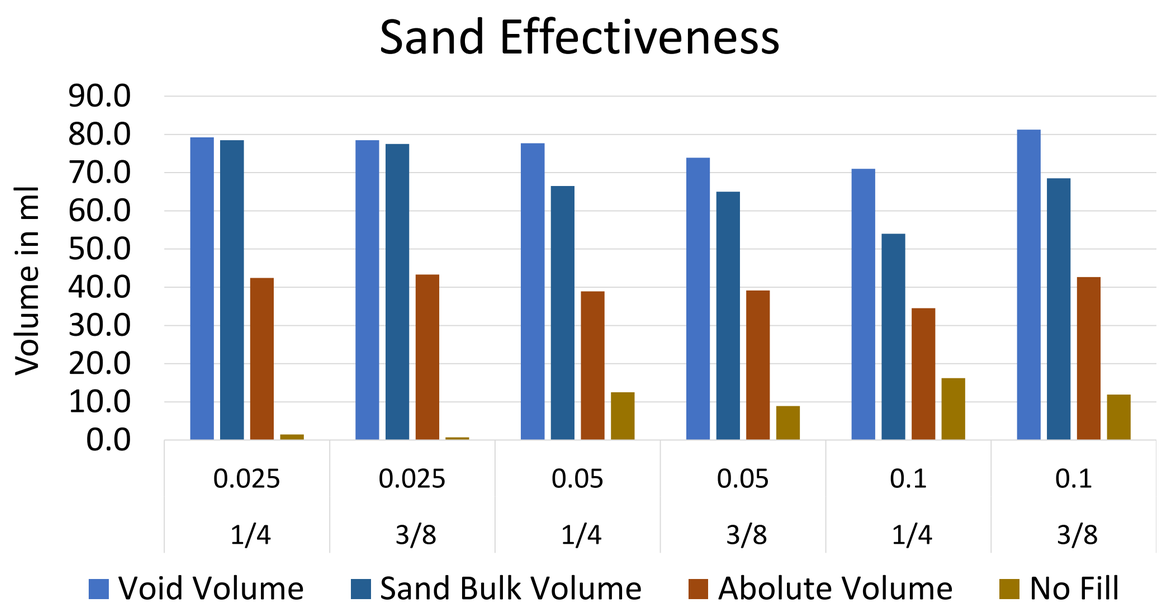
Methodology

This study evaluated the effectiveness of filling pervious concrete void spaces with fine silica sand. Three samples of each mix design were made to obtain an average of the data. Samples were placed in saturated surface dry (SSD) condition and then filled with water to obtain the void volume of the samples. Samples were then oven dried to obtain the dry weight and filled by vibration with fine silica sand. The sand was measured by mass and volume to obtain the sand bulk volume and the absolute volume. The volume that the sand was unable to fill due to the size of the grains was also calculated.

References
Davis, A.P., 2005. Green engineering principles promote low-impact development. Environ. Sci. Technol. 39, 338Ae344A. https://doi.org/10.1021/es053327e.

Results

It was found that sand's effectiveness of filling the void volume decreased with increasing cement to aggregate ratios. The size of aggregate used generally did not effect the sand's effectiveness. Cement to aggregate ratios lower than 0.025 did not provide adequate strength for handling.



Mix Design Table		
Size of Aggregate	Cement to Aggregate Ratio	Water to Cement Ratio
1/4	0.025	0.22
3/8	0.025	0.22
1/4	0.05	0.22
3/8	0.05	0.22
1/4	0.1	0.22
3/8	0.1	0.22

Pervious concrete sample filled with fine silica sand

Pervious Concrete samples oven drying

Conclusions

High percentages of the void volume of the pervious concrete samples tested can be filled with fine silica sand. Thus the pervious concrete can act as an effective structure to contain engineered filtering sand. More research is necessary to determine the flow rate of this system and its effectiveness at filtering containments.

Acknowledgements

I would like to thank Adam Brooks, a civil engineering graduate student for his assistance. I also want to acknowledge Dr. Bernhard Vogler, Mr. David Cook, the UAH Office of the Provost, UAH Office of the Vice President for Research and Economic Development for making this opportunity possible.

HONORS COLLEGE
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

ALABAMA SPACE GRANT CONSORTIUM
NASA
INDUSTRY
UNIVERSITY
COMMUNITY
1989