# Implementation of Porous Concrete In Sidewalks in New Jersey

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## Abstract

Pervious concrete has been gaining popularity as a potential solution to reduce the amount of impermeable surface area associated with sidewalks, reduce puddling, slow storm water surface flow rates, and recharge groundwater with efficiency. As important as these benefits are to surface runoff mitigation, there are concerns with the ability of pervious concrete mixes to provide sufficient structural support and longevity for the expected service life of the sidewalks. In this project, porous concrete will be implemented in sidewalks in the Skillman Pathway Project in Montgomery Township. The purpose of the implementation is to evaluate construction practices of porous concrete, study maintenance methods to avoid clogging from debris and sediments, and study resistance of porous concrete in sidewalks to potential raveling as well the effects of freeze and thaw conditions and deicing salts. Periodic field infiltration tests will be performed to evaluate changes in void ratios. The Rutgers research team is also evaluating several porous concrete mix designs to improve strength. In particular, the research team is evaluating the effects of adding specified percentage of sand to the mix and the effect of compaction methods on strength and void ratio.

## Implementation Project – Skillman Road

Porous concrete sidewalks will be implemented in the Skillman Park Pathway Project in Montgomery Township. The sidewalk will be approximately 400 ft long and 6 ft wide starting on the south side of Skillman Road and will extend to the west side of Burnt Hill Road. Construction activities will begin in October 2020.

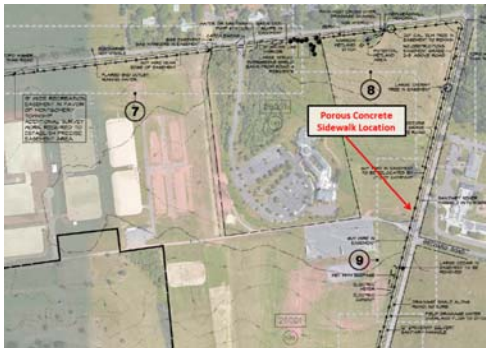


Fig. 1. Skillman Park Plan

## Effect of Sand on Strength and Void Ratio

***Mixing and Testing:***

Mixing: The mix included cement, water, 3/8 in aggregates with and without sand. The mixes included 0% sand, 10% sand, 15% sand and 20% sand with respect to the aggregate weight. Three different compaction methods were used: rodding using 3/8 in diam. rod; rodding using 5/8 in diam. rod and compacting using 2 in diam. compactor. The samples were 4 in x 8 in cylinders and were kept in the curing room for 14 days.

Testing: Testing follows the ASTM specifications. The cylinders were tested in a compression machine at 28 days. The compressive strength was determined for each mix from 3 cylinders. Strength results are shown in the table in Fig. 7. In addition to testing strength, the void ratio of each mix was determined. The void ratios for the various mixes are shown in Fig. 7.


Fig. 6. Rods and compatcor

Fig. 2. Field Infiltration Test Setup

Fig. 3. Lab Mixing

Fig. 4. 4"x8" Cylinder


Fig. 5. Compression Test

***Preliminary Results***

**Variation of compressive Strength (psi) with compaction methods**

| Mix | 2" Φ Compactor | 5/8 " Φ Rod | 3/8 " Φ Rod | No Compaction |
|---|---|---|---|---|
| Mix 3* | 1920 | 1797 | - | 1220 |
| Mix 3S10 (10% sand) | 2930 | 1805 | 1627 | 405 |
| Mix 3S15 (15% sand) | 5490 | 3392 | - | - |
| Mix 3S20 (20% sand) | 4750 | 3910 | - | 801 |
| Mix 3SH10** | 3866 | 2300 | | |

* Cement= 620 lbs, Aggregates = 2600 lbs, Water = 186 lbs (per cubic yd)
** Mix 3SH10 has a blend of 3/8 in and ¼ in aggregates and 10% sand

**Variation of void ratio with compaction methods**

| Mix | 2" Φ Compactor | 5/8 " Φ Rod | 3/8 " Φ Rod | No Compaction |
|---|---|---|---|---|
| Mix 3 | 24.0% | 27.9% | - | - |
| Mix 3S10 | 18.1% | 26.5% | 27.8% | 35.5% |
| Mix 3S15 | | | - | - |
| Mix 3S20 | 11.9% | 13.8% | 27.4% | - |
| Mix 3SH10 | | | | |

Fig. 7. Preliminary Results

## Hydrological Design

Hydrological design was performed to study the variation of the reservoir layer thickness (T) with different factors such as, Storm Return Period and Porous Retention Area (PRA). Fig. 8 shows the location of the storage layer and Figs. 9, 10, and 11 show results from the hydrological analysis.

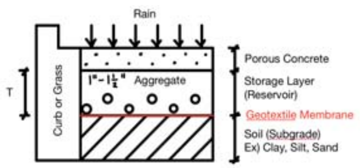


Fig. 8. Cross Section a sidewalk with porous concrete

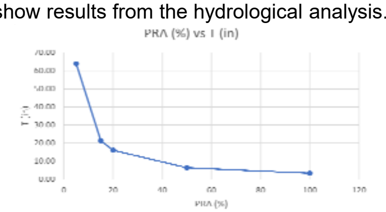


Fig. 9. Reservoir thicknesses for different PRA percentages

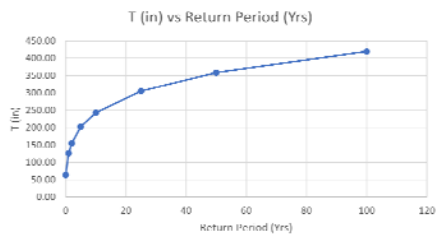


Fig. 10. Reservoir thicknesses for different Return Periods (PRA: 5%)

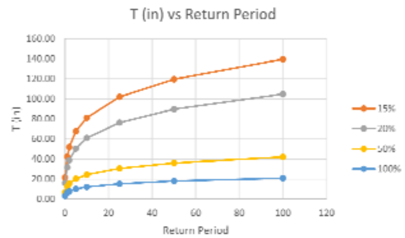


Fig. 11. Reservoir thickness comparison

## Conclusions and Future Work

Results from this study show optimal mixes can be designed based on several desirable properties, including sand content, aggregate size, and vibration methods. From the results, the 2" diameter compactor has proven to be the most effective method thus far; providing the greatest compressive strength and an acceptable void ratio. Our results also show that significant progress was towards meeting NJDOT compression strength requirements as well as the NJDEP desired void ratio and and drainage standards. Future work will focus on continued evaluation of effects of sand and compaction methods. We will complete tests for 15% sand content, our most promising mix, and preparing more samples to confirm the initial results. The effects of water content and admixtures will also be evaluated. Hydrological designs were developed for the storage layer thickness for various storm events. We will also collect porous concrete cylinders from the Skillman Park Pathway Project and test them in the lab.

## Acknowledgment

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## References

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http://www.perviouspavement.org/index.html

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