

## Porous Concrete Systems

### Overview

Porous concrete (also called pervious concrete, permeable concrete, no fines concrete and porous pavement) can be an effective way of reducing the impervious area of a building site. Porous concrete is specifically designed to allow water to pass through site flatwork (roads and sidewalks) and reduce the volume and velocity of stormwater delivered to storm sewer systems, reducing erosion and the need for stormwater retention measures. Porous concrete is traditionally used in parking areas, roads with light traffic, pedestrian walkways, and greenhouses. Porous concrete should not be used on primary roads, fire lanes, loading docks and other areas subject to heavy vehicles.

Porous concrete is made using large, uniform, open-graded coarse aggregates with little to no fine aggregates along with specially formulated mixtures of Portland cement, resulting in a 15% to 20% void spaces.<sup>3</sup> The first known use of porous concrete spans back to the 19th century in Europe; however, it was not until the last few decades that porous concrete has been used in the United States.<sup>2</sup> Much of this recent surge in popularity is due to porous concrete's sustainability benefits in construction and low impact development.

### Benefits and Drawbacks

The benefits of using porous concrete include:

- Filtering stormwater thereby reducing contaminants and pollutants.
- Reducing erosion by significantly reducing runoff from parking and other paved areas.
- Reducing the need for curbing and storm sewers. May save on site retention / detention structures, swales and ponds, reducing project costs and providing land for other uses.
- Improving road safety due to better skid resistance.
- Helping with recharging of local aquifers.
- Providing potential LEED credits to assist with project sustainability goals: Credit SS-C6.1 (Storm Water Management – Rate and Quantity), Credit SS-C6.2 (Storm Water Management – Quantity Control) and Credit SS-C7.1 (Landscape and Exterior Design to Reduce Heat Island Effect).

Drawbacks of porous concrete include:

- Permeability may be reduced if improperly installed or not properly maintained.
- There is risk of groundwater contamination due to fuel leaks from cars and leaching of chemicals from binder surfaces within porous systems.
- Potential for the development of anaerobic conditions in soils underlying pervious systems if soils are unable to dry out between storm events.
- Lower compressive strength than standard concrete which does not allow for heavy vehicle traffic.
- Raveling may occur over time and require regular concrete ribbons along edges.

- Freeze / thaw spalling can develop in northern climates exposed to extreme cold temperatures.
- Many engineers and contractors still lack expertise and experience with this technology.
- First cost is higher than standard concrete applications, but may be offset by reduced needs of stormwater management installations.

### Design Criteria & Maintenance

Site conditions are of critical importance for a properly functioning and designed application of porous concrete systems. Systems should be located above soils which have a field-verified permeability rate of greater than 1.3 centimeters (0.5 inches) per hour and have a 1.2 meter (4 foot) minimum clearance from the bottom of the system to bedrock or the water table.<sup>1</sup> Sites prone to wind erosion of soils and sediments should be avoided. Flat sites are greatly preferred and systems are not recommended to be installed in areas where slopes are greater than 5%.<sup>1</sup> When used for automobile applications porous concrete should be installed for light traffic and low volumes of automobiles. Avoid locations which may require snow removal operations. Additional consideration should be given to the local climate and weather conditions throughout the seasons. It is generally recommended that these systems are designed to be capable of draining a 6 month, 24 hour storm event within 24 hours.<sup>1</sup>

In addition to routine inspection it is necessary to perform diligent maintenance on porous concrete systems. Maintenance is required to prevent clogging of the concrete pores and loss of permeability. Recommended maintenance operations include vacuum sweeping a minimum of four times a year in conjunction with high-pressure washing.<sup>2</sup> Inspections should occur after large storm events to identify any clogging or water buildup.

### Conclusion

Porous concrete systems can provide significant environmental and potential cost benefits when compared to traditional concrete in similar applications if properly designed, installed, and maintained. This is a relatively new technology to the United States, so designers should be diligent in investigating benefits, drawbacks and site conditions early to ensure system applicability and success.

### References

- [1] Storm Water Technology Fact Sheet: Porous Pavement". United States Environmental Protection Agency, EPA 832-F-99-023, September 1999.
- [2] Chopra, Manoj. "Compressive Strength of Pervious Concrete Pavements" (PDF). Florida Department of Transportation. Retrieved 1 October 2012.
- [3] John T. Kevern, Vernon R. Schaefer, and Kejin Wang (2011). "Mixture Proportion Development and Performance Evaluation of Pervious Concrete for Overlay Applications". Materials Journal (American Concrete Institute) 108 (4): 439–448.

