Utilization of Pervious Concrete In Construction

Shekhar Dixit[1], Sandeep Kumar Shrivastava[2]
[1, 2] OIST, Bhopal (M. P.), India

Abstract- *Pervious concrete pavement is a unique and effective means to meet growing environmental demands. By capturing rainwater and allowing it to seep into the ground, pervious concrete is helpful in recharging groundwater. In fact, the use of pervious concrete in the construction of pavement, for the hot and low rainfall places of India is seems to be significant for improving the water table. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices.*

I. INTRODUCTION

Pervious concrete is an alternative paving surface that can be used to reduce the nonpoint source pollution effects of storm water runoff from paved surfaces such as roadways and parking lots by allowing some of the rainfall to permeate into the ground below. A properly designed pervious concrete pavement system can reduce the environmental impact often associated with development. Pervious concrete pavement systems can also be used to improve the environmental performance of existing sites without compromising the business value of a property by replacing existing conventional pavements.

II. BENEFITS AND COMPOSITION OF PERVIOUS CONCRETE

Pervious concrete has been gaining a lot of attention. Various environmental benefits such as controlling storm water runoff, restoring groundwater supplies, and reducing water and soil pollution have become focal points in many jurisdictions worldwide. Portland cement pervious concrete is a discontinuous mixture of coarse aggregate, hydraulic cement and other cementious materials, admixtures and water. By creating a permeable surface, storm water is given access to filter through the pavement and underlying soil, provided that the underlying soil is suitable for drainage.

Pervious concrete is mainly composed by coarse aggregate, cement, and water. Small amount of fine aggregate may be added to obtain higher compressive strength. Other admixtures such as High/Middle Range Water Reducer (HRWR, MRWR), water retarder, viscosity modifying admixtures, and fibres are usually used. In some cases, fly ash is used as a substitute for Portland cement to enhance the environmental friendliness of pervious concrete.

(a) Course Aggregate

Coarse aggregate is the main component of pervious concrete. The gradation, size, and type of coarse aggregate have been found to affect the character of pervious concrete. Coarse aggregate grading in pervious concrete normally consists of either a single sized coarse aggregate or a narrow grading from 3/4 to 3/8 in. (19~9.5 mm).

(b) Fine Aggregate

A fine aggregate is sometimes used in pervious concrete to improve the mechanical capabilities of pervious concrete. On the other hand, the permeability will typically decrease when fine aggregate is added. However, the amount of fine aggregate is recommended to be limited within 7% of the total aggregate by weight so that permeability is satisfied.

(c) Cement

Portland cement is another main component of pervious concrete. Type I/II cement is normally used in pervious concrete. The content of cement is dependent on the amount and size of coarse aggregate and the water content. Various amounts of cement are recommended by different agencies.

(d) Marble powder

Marble is one of the important materials used in the construction industry. Marble powder is produced from processing plants during the sawing and polishing of marble blocks and about 20 - 25% of the processed marble is turn into powder form. Disposal of the marble powder material from the marble industry is a significant ecological problem worldwide today. However, waste material from marble industry can be used to develop numerous properties of concrete. It has been observed from literatures that usually compressive strength increased with addition of waste marble powder in place of sand.

(e) Water

Water is a crucial component in pervious concrete. Enough water should be added so that cement hydration is thoroughly developed. However, too much water will settle the paste at the base of the pavement and clog the pores. Meanwhile, too much water increases the distance between particles, causing higher porosity and lower strength. The correct amount of water will maximize the strength without compromising the permeability characteristics of the pervious concrete.

III. LITERATURE REVIEW

Pervious concrete is an environmental friendly building material and EPA (Environmental Protection agency) has identified it as a Best Management Practice (BMP) for storm water Management. It can be used for lower traffic roads, shoulders, sidewalks and parking lots. This will add points to a project with a sustainable material managing storm water, reducing ground water pollution. (Uma Maguesvari 2013)

Normally, the water cement ratio is one of the important factors for the compressive strength of cement concrete. However, in case of pervious concrete the above concept may have little significance. Because, water is essential to produce the fresh cement paste with a good workability but not clog up all the pores. Optimum range of water cement ratio for both strength and permeability point of view ranges from 0.30 to 0.38(Y. Zhuge and C.Lian, 2009).

Meininger (1988) found that an intermediate water-cement ratio yielded the highest compressive strength. Both high and low water cement ratio had lower compressive strength than the intermediate level. Meininger suggested that this seemingly counter-intuitive result was due to poor cohesion between the paste and aggregates at lower w/c. However, it should also be noted that at the lower w/c mixtures, there is a lower paste content and a higher void content.

The amount of water required to complete hydration and achieve maximum strength has long been debated. As previously discussed, the strength in concrete is developed through bonds. These bonds develop through a chemical reaction of cement and water. This reaction produces calcium silicate hydrate. One gram of cement requires 0.22 grams of water in order to fully hydrate. However, the volume of the products of hydration is greater than the volume of cement and water used in the reaction. Specifically, it requires a volume of 1.2 mL of water for the products of hydration for 1mL of cement. This equates to a W/C ratio of 0.42 for complete hydration (Aitcin and Neville, 2003).

Wanielista and Chopra(2007) discussed the importance of adding appropriate amount of water in pervious concrete mix. Enough water should be added so that cement hydration is thoroughly developed. However, too much water will settle the paste at the base of the pavement and clog the pores. Meanwhile, too much water increases the distance between particles, causing higher porosity and lower strength. Wanielista and Chopra, stated that "the correct amount of water will maximize the strength without compromising the permeability characteristics of the pervious concrete."

Wang et al.(2006) mixed pervious concrete batches with W/C ratios 0.22 and 0.27, and suggested using the lower value, if workability could be maintained. In contrast, in an actual applicaiton published by NRMCA W/C ratio up to 0.55 was used.

IV. DISCUSSION

1. By capturing rainwater and allowing it to seep into the ground, pervious concrete is helpful in recharging groundwater.
2. A pervious concrete mixture contains little or no sand, creating a substantial void content.
3. Water is a crucial component in pervious concrete. Enough water should be added so that cement hydration is thoroughly developed. However, too much water will settle the paste at the base of the pavement and clog the pores.

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