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STRENGTHENING OF PERMEABLE CONCRETE

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Abstract – *Due to increase in urbanization and population, the rate of precipitation has drastically increased to supply the demand of water for public. However, due to construction of Concrete, Bituminous or any other type of roads constructed, there has been decrease of groundwater recharge level during utilization of ground water even though the rate of precipitation is more; this is because the pavement constructed forms an impermeable layer which prevents the rain water discharging into the recharge well. To avoid this permeable concrete is an effective solution over it. This paper provides an overview on pervious concrete mix design, properties, durability and applications.*

***Key Words*: Permeable Concrete, Recharging ground water, Roads, Pavement**

1. INTRODUCTION

Permeable pavement is a porous urban surface which catches rainfall and surface runoff, which is stored in the reservoir while slowly allowing it to seep into the soil below. This study will evaluate how well different types of permeable pavement reduce the amount of pollutants and runoff volume.

Application of pervious concrete in pavement

Pervious concrete can be used in parking areas, areas with less traffic, residential, footpath, and greenhouses. It is an important application for stabilised construction and has many eco-friendly techniques used by builders to protect water quality and increase the groundwater.

Pervious concrete is now in great demand, partly because of its porous qualities. The flow rate of water through a pervious concrete pavement allows rainfall to seep inside and to percolate into the ground, reducing stormwater runoff, recharging groundwater, supporting sustainable construction, providing a solution for construction that is sensitive to environmental concerns, and helping owners comply with flood run-off. This property of permeable concrete makes it advantageous to the nature.

2. Application of Portland Cement Pervious Concrete (PCPC)

Portland cement pervious concrete (PCPC) is a special type of concrete since it consists of an interconnected porous structure having high void content typically in the range of 15 to 35% by volume. The use of PCPC may reduce flooding risk, recharge ground water, reduce stormwater runoff, reduce noise when in contact with vehicle tires, and prevents skidding of vehicles during monsoon season by allowing water to infiltrate freely through its pores. In addition, PCPC is produced at low cost, thus it can be considered among the most attractive sustainable urban drainage systems (SUDS). PCPC requires, however, regular maintenance to prevent any clogging of the pores by sediments and vegetation which might change its high permeability. PCPC is normally used without any reinforcement due to high risk of corrosion because of the open pores in its structure. PCPC can be used in pervious pavement for parking, rigid drainage layers under exterior areas, greenhouse floors to keep the floor free of standing water, structural wall applications, elements where better acoustic absorption characteristics are desired, base course for roads, surface course for parking lots, tennis courts, zoo areas, animal barns, swimming pool decks, beach structures, seawalls, embankments, etc.

Table -1: Mixed Design for Permeable Concrete

Cementitious Material (CM)	Aggregates (kg/m^3)	W/CM	Aggregate/ CM ratio	Water (W)
340	1460	0.32	--	109
321-487	1373-1692	0.25-0.35	3.0-5.0	84-161
195-535	1500-1700	0.30	--	--
309	1525	0.30	4.9	93
315-415	1200-1400	0.28-0.40	4-6	125-154
180-380	1510-1820	0.24-0.30	4.0-10	50-100
287-345	1542-1620	0.30	4.5-5.6	87-105
300-413	1651-1800	0.37-0.42	4-6	125-154

2.1 Materials used in PCPC

PCPC uses the same materials as normal concrete. The porosity in PCPC is created by the elimination of fine aggregate and the use of coarse aggregate with a narrow or uniform grading to allow relatively low particle packing.

The pore size in pervious concrete is also an important parameter as it affects properties such as permeability and sound absorption. More the diameter of the aggregates, more the permeability. Although adding little sand amounts can improve the strength of PCPC when compared with single-sized mixes, the permeability is reduced. Indeed, a small amount of fine aggregate (< 2.4 mm) has been found to be beneficial for strength and durability.

2.2 Issues regarding implementation of Permeable concrete in pavement

- Cannot be used other than areas prone to light traffic
- Lack of information about hydraulic and structural performance, maintenance, and life cycle cost.
- The land development where there is continuous rainfall that requires rain water handling systems, if permeable concrete is used it increases the cost

The materials used for permeable pavements are similar to those used for general pavement construction. The majority of tests required to determine quality are also the same. Pervious concrete and porous asphalt are similar to conventional with the exception that the coarser aggregate are required to make the concrete permeable.

Permeable Interlocking Concrete Pavement (PICP) comprises of a layer of concrete paver blocks separated by joints filled with fine aggregates and river sand. Water enters joints between solid concrete pavers and flows through the crushed stone layers with fine particles. The void spaces present in the spaces of crushed stones stores water and infiltrate it back into the soil subgrade. The stones in the joints provide 100% surface permeability and the base filters stormwater and reduces pollutants.

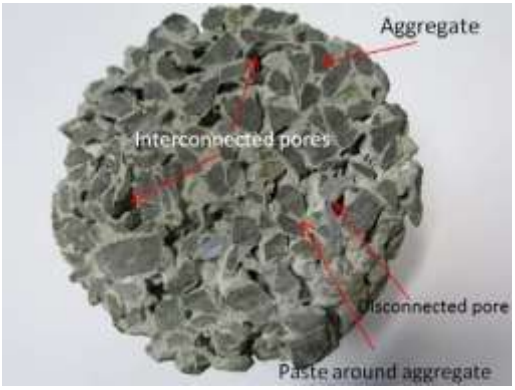

Fig -1: Cross-section of PCPC, illustrating porous structure.

Fig -2: Typical pervious concrete pavement section.

Types of Permeable Pavements and Paving Block Solutions:

- **Permeable pavements** –

  Geocell can use larger-size, poorly graded stone instead of high-quality/high-cost infill to meet sustainable drainage guidelines in urban areas.

- **Partially-permeable low impact pavements** –

  Geocell reinforcement reduces the permeable pavement layer thickness, while utilizing locally available soil for fill.

- **Non-permeable load bearing pavements** – Geocell heavy-duty structural reinforcement for inter-modal ports -modal ports and container yards.

3. CONCLUSION

Permeable pavements can be a major contributor to the effective management of stormwater and Recharging groundwater. They provide the opportunity of transforming a traditional source of stormwater runoff into a best management practice for capturing, storing and infiltrating stormwater into the natural surroundings for future use.

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