EFFECT OF MIX PROPORTION ON COMPRESSIVE STRENGTH AND PERMEABILITY OF PERVIOUS CONCRETE

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Abstract - Most of the developing countries, the use of pervious concrete for the construction of pavements, car parks and driveways is becoming more prevalent. The goal of this project is to investigate the influence of permeability on compressive strength of pervious concrete. Using smaller sized aggregate in the previous concrete can enhance the strength. Compressive strength and permeability tests were conducted for different aggregate cement ratios namely 4:1, 6:1, 8:1 and 10:1 with water cement ratios of 0.4 and 0.45 and suitability of aggregate cement ratios are studied. The results of this project can be used as a baseline for selection of mix proportion with specific strength requirements and satisfactory level of permeability. Pervious concrete is instrumental in recharging groundwater and reducing storm water runoff. The permeability and strength of pervious concrete depend on the particle sizes and proportions of the constituent materials of which the concrete is made off.

Keywords: Pervious concrete, Permeability.

1. INTRODUCTION

Pervious concrete is a mixture of cement, water and a single sized coarse aggregate combined to produce a porous structural material. It has a high volume of voids, which is the factor responsible for the lower strength and its lightweight nature. Pervious concrete has many different names including zero-fines concrete, no-fines concrete and porous concrete. No fines concrete has been used as a structural building material in Europe, and the Middle East for over 70years, in South-Eastern America for the past 20years in pavement applications.
This form of concrete has the ability to allow water to permeate the material which reduces the environmental problems associated with asphalt and conventional concrete pavements. The most common application of no-fines concrete is in low traffic volume areas, for example: parking lots, residential roads, driveways and footpaths. The force exerted on the foundations by no-fines concrete is approximately one-third of that produced by the same structure constructed from conventional concrete. This difference may be of critical importance when considering structures on ground with a low bearing capacity. No-fines concrete has been predominantly used in non-pavements applications, with only a limited use in pavements applications. V. Saritha et al. (1) investigated compressive strength, flexural strength, and drainage conditions of various mix proportions of pervious pavement. Ahmed Ibrahim et al. (2) studied about inter connected void spaces which allow the concrete to transmit water at relatively high rates, developed relationship between compressive strength and permeability. A.K.Jain et al. (3) investigated the effect of shape and size of aggregates on permeability of pervious concrete

1.1 Research significance

The aim of our project is to eliminate fine aggregates and having coarse aggregates of sizes less than 10mm in pervious concrete. Our objective is to study the properties like compressive strength and permeability of concrete with different ratios 4:1,6:1,8:1,10:1 at 3, 7 and 28 days.

1.2 Scope of work

The purpose of this project is to assess the suitability for no-fines concrete to be used for the construction of road pavements. This assessment will include investigating current literature on the topic and standard concrete testing on no-fines concrete

- A number of pervious concrete mixes was produced with different proportions. The main properties studied include density, compressive strength, and water permeability.
- Although water permeability is the most important characteristic of the pervious concrete, there is no well-established method for its quantification. Therefore, an experimental procedure to assess the water permeability of pervious concrete is developed.

2. Test materials

The materials used in this present work are Ordinary Portland cement (53 grade), coarse aggregates. Cement is a binder, a substance that sets and hardens and can bind other materials together. Ordinary Portland cement of grade 53 which had a specific gravity of 3.10, fineness 98%, the normal consistency of cement is found to be 29% at 6 mm penetration, the initial setting time and the final setting time is 30 minutes and 10hours. Crushed granite was used as coarse aggregate passing through 10 mm having specific gravity of 2.62 and water absorption is 0.45 %.

3. Experimental Testing Procedure

3.1 Permeability Test:

All samples were prepared as cylindrical specimens. In order to evaluate the permeability of porous concrete samples three specimens were used for each mix. The diameters of the sample was 100mm The specimens were compacted in the mould. Concrete was placed in mould in either 2 or 3 lifts. To provide uniform compaction in all cylinders, each lift was tamped 25 times with an appropriately sized tamping rod.

Figure 1: Permeability setup and moulds

Permeability tests were performed using falling head Permeability meter, specifically designed to accommodate specimen of 100mm diameter. Figure shows a Permeability meter used for testing.

3.2 Compressive strength

Compressive test was conducted in universal compressive testing machine of capacity 2000 kN at a loading rate of 2.5 kN/sec. The compressive strength of concrete is one of the most important and useful properties of concrete. In most structural applications concrete is employed primarily to resist compressive stresses.

Figure 2: Compression testing machine

4. Results and discussions

The present experimental study is carried out to find the compressive strength for 150mm cubes and permeability for 100mm cylinders for different mix proportions. The cubes are tested for compressive strength at 3, 7 and 28 days. The results of compressive strength and permeability of specimens are presented in the graphical representation and different water cement ratios are presented.

4.1 Results of compression test:

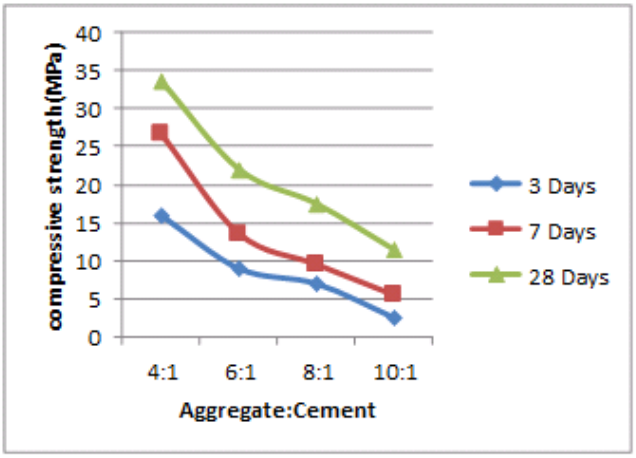

Chart 1: Variation of compressive strength for 0.40(w/c) with different mix proportions in days

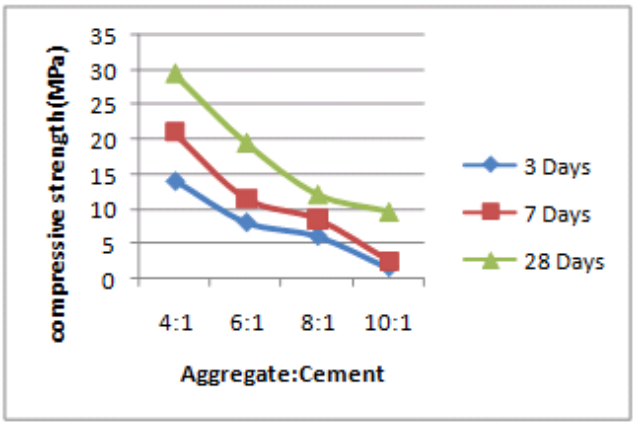

Chart 2: Variation of compressive strength for 0.45(w/c) with different mix proportions in days

4.2 Results of permeability test:

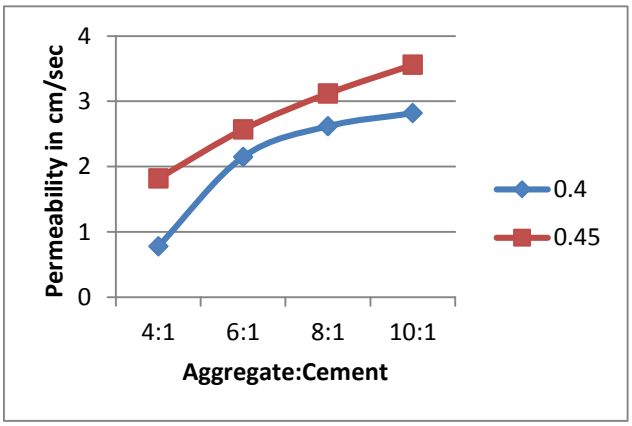

Chart 3: Variation in permeability for different (w/c) ratios with different mix proportions.

5. Conclusions

1. The average compressive strength for different aggregate cement ratios decreases with an increase in water cement ratios.

2. As the aggregate cement ratio increases, rate of permeability increases.

3. As the aggregate cement ratio increases, average compressive strength decreases.

4. The smaller the size coarse aggregate should be able to produce a higher compressive strength and at the same time produce a higher permeability rate.

5. The mixtures with lower aggregate cement ratio 4:1 and 6:1 are considered to be useful for a pavement that requires high compressive strength and low permeability rate.

6. The mixtures with higher aggregate cement ratio 8:1 and 10:1 are considered to be useful for a pavement that requires low compressive strength and high permeability rate.

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