# INFLUENCE OF FINE AGGREGATES ON PROPERTIES OF PERVIOUS CONCRETE

*Studying the influence of various proportion Fine aggregates on the properties of Pervious Concrete*

[1]Prof. Prashant. K. Nawale, [2]Mr. Shubham.G. Dimble, [3]Mr. Ketan, S. Bharekar
[1]Assistant Professor (ZCOER, Narhe, Pune), [2]Student (ZCOER, Narhe, Pune), [3]Student (ZCOER, Narhe, Pune)
[1]Civil Department,
[1]Zeal College of Engineering & Research, Pune, India

***Abstract:*** The study aims to prepare a pervious concrete with high permeability as well as high compressive strength by using different proportions of fine aggregates and to establish the co-relation between the permeability and compressive strength of concrete. The study also aims to prepare a model-mix to give optimum results in terms of permeability and compressive strength. Pervious Concrete is an innovative pavement material particularly because of its environmental aspects that are particularly favorable in urban areas. Generally Pervious concrete is considered to have high permeability but it has less compressive strength. Due to this drawback there is an uncertainty of usage of this concrete for road pavements in areas having high traffic density. Fine aggregate of size 16-20mm are selected. The pervious concrete is prepared by using various proportions of fine aggregates such as 0%, 10%, 20%, 30% respectively and tested under compression testing machine (CTM) on 7$^{th}$ and 28$^{th}$ days. The permeability of the concrete is found out by using falling head permeability test.

***Index terms:*** **Pervious Concrete, Permeability, Compressive Strength, Fine Aggregates.**

## I. INTRODUCTION

Due to rapid urbanization most of the places are covered with impermeable surfaces like cement concrete. This has a major impact on the ground water table. Pervious Concrete pavement is an effective way to minimize this issue. Pervious concrete is an open graded structure with interconnected voids through which rain and storm water is permitted to percolate into the aquifer. It consists of cement, coarse aggregate, some percentage of fine aggregate or No Fine aggregates and water. 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. (Magueswari and Narasimha –2013).

Increasing Compressive strength of Pervious concrete results in lesser voids which ultimately results to lower permeability of Pervious concrete. The road pavements has to undergo from various weathering conditions, impact stresses, wear and tear (Abrasion), therefore the pavements need to have high compressive stress. But increasing the compressive strength will result high density concrete with lesser voids, which will ultimately result in lower permeability of road pavements. Pervious concrete with high permeability cannot be used where the pavements has to carry heavy traffic loads.

Pervious Concrete allows no accumulation of storm water on the surface of road pavement. This type of concrete comes with low installation costs, as there is no need of installing storm drains and underground piping.

## II. EXPERIMENTAL PROGRAM

Constituent used in the concrete are cement, crushed gravel as coarse aggregates, fine aggregate, admixture and water. Cement OPC 53 Grade conforming to IS: 12269 was used in all mixes, Crushed gravel was used as coarse aggregate of size 16-20mm. Tests on materials was conducted to find out properties of the materials used in this study.

Table 1. Physical properties of materials

| Properties | Values |
|---|---|
| Specific gravity of coarse aggregate | 2.69 |
| Specific gravity of fine aggregates | 2.78 |
| Specific gravity of cement | 3.15 |
| Specific gravity of admixture | 1.1 |

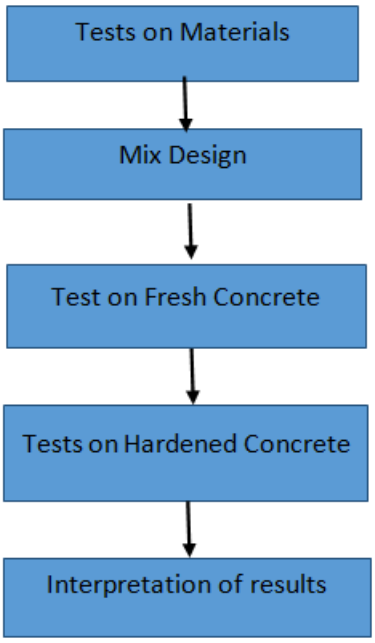
Proportion of fine aggregates was selected as 0%, 10%, 20%, 30% respectively and mix as designed as per IS 10262: 1982. Casting of cubes and cylinders was carried out for the mix proportions.

Cubes and cylinder were tested under Compression Testing Machine (CTM) on 7$^{th}$ & 28$^{th}$ day respectively to find out Compressive strength and Split tensile strength of the samples.

Coefficient of permeability was determined by falling head permeability test by using standard permeability apparatus confirming to IS: 2720 (Part 17) 1986. Specimen was casted in the mould of size 100 mm diameter and 120 mm length and tested after 28 days of curing.

## III. RESEARCH METHODOLOGY

Methodology covers the following:




The study begins with the various tests on materials (Coarse aggregates and Fine aggregates) such as Abrasion resistance, impact value, crushing value, specific gravity (for coarse aggregates), specific gravity test (for Fine aggregates). Depending on the various percentage of fine aggregates used in the concrete (i.e. 0%, 10%, 20%, 30%), 4 mixes were designed accordingly. Upon casting, the tests on fresh concrete (Slump cone test, Flow table test, Compaction factor test, Vee-bee consistometer test) were conducted to check the workability of concrete. After curing period of 7 and 28 days, tests on hardened concrete (compressive strength test and split tensile strength) were performed under Compression Testing Machine (CTM). The permeability of pervious concrete was determined by falling head permeability test. The specimen was casted in the mould of size 100 mm diameter and 120 mm length and tested after the curing period of 28 days.

## IV. RESULTS AND DISCUSSIONS

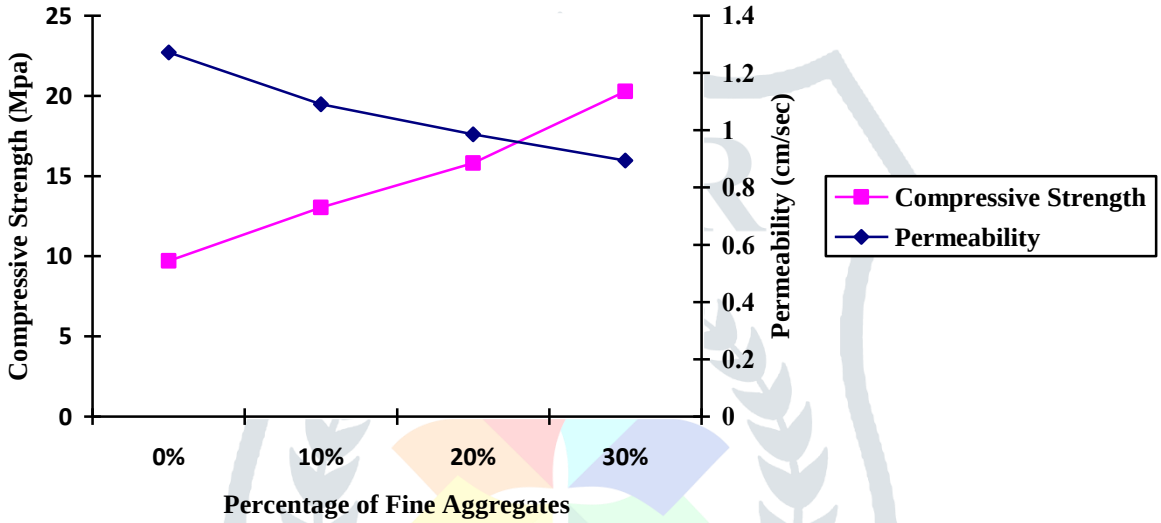
Table 2. Compressive Strength of Samples

| M30 Grade | Compressive Strength (Mpa) | | Split Tensile Strength (Mpa) | |
|---|---|---|---|---|
| Percentage of Fine Aggregates | 7 Days | 28 Days | 7 Days | 28 Days |
| 0 % | 6.763 | 9.79 | 5.06 | 6.74 |
| 10 % | 8.71 | 13.04 | 6.21 | 7.56 |
| 20 % | 9.48 | 15.81 | 6.62 | 8.74 |
| 30 % | 12.09 | 20.28 | 7.34 | 10.68 |

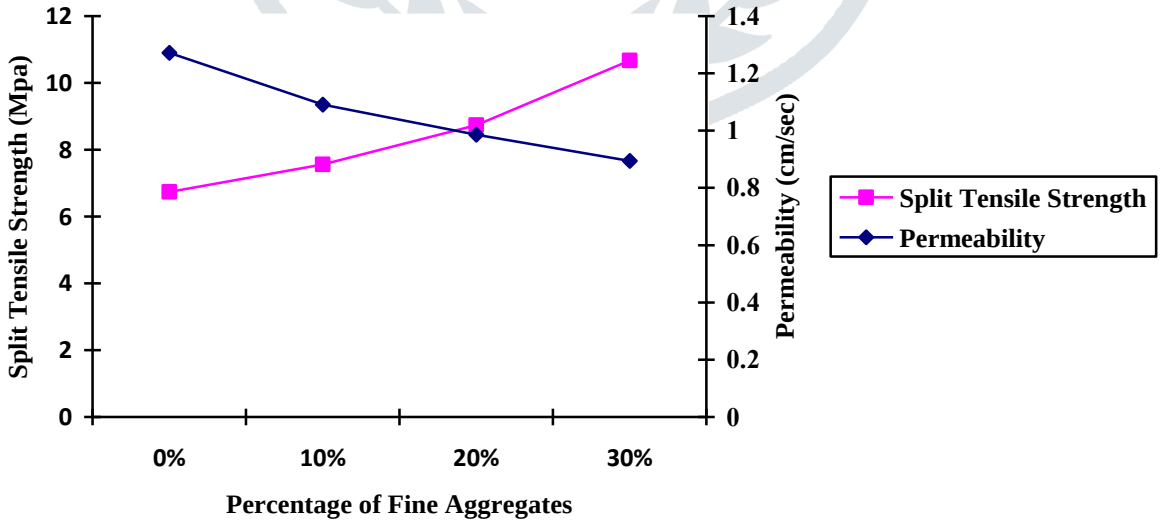
Table 3. Permeability of the Samples

| Percentage of F.A | Permeability (cm/sec) | | |
|---|---|---|---|
| | Sample 1 | Sample 2 | Sample 3 |
| 0 | 1.281 | 1.272 | 1.179 |
| 10 | 1.128 | 1.091 | 1.002 |
| 20 | 1.008 | 0.986 | 0.901 |
| 30 | 0.910 | 0.894 | 0.832 |

**Graph 1: Compressive Strength vs Permeability vs Percentage of Fine aggregates**




**Graph 2: Split Tensile Strength vs Permeability vs Percentage of Fne aggregates**




From the above graphs it has been observed that the increase in the volume of fine aggregates results in decrease in permeability and increase in the strength (Compressive strength, Split tensile strength). The optimum mix is obtained for the percentage of fine aggregates ranging between 20-25 % for optimum permeability as well as optimum compressive strength.

## V. ACKNOWLEDGMENT

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## VI. CONCLUSION

The study illustrates the influence of various proportions of fine aggregates on various properties as well as behavior of Pervious concrete. In this study it is observed that increasing the volume of fine aggregates results in decrease in volume of voids which reduces the permeability and ultimately increases the compressive strength, split tensile strength of pervious concrete. Optimum mix is identified by observing the graph showing the relation between the permeability and compressive strength by increasing proportions of fine aggregates. The optimum mix is obtained for the percentage of fine aggregates ranging between 20-25 % for optimum permeability as well as optimum compressive strength

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