Development in Pervious Concrete by Using Green Concept

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ABSTRACT: Pervious concrete or No fineness concrete is a conventional concrete that is used in foreign countries for draining of storm water and increasing the ground water level. This project is mainly based on the investigation and increasing the strength characteristics of Pervious concrete. The mix design is designed considering only cement and coarse aggregate since the concrete is a “NO FINENESS CONCRETE”. The mix ratio is considered as 1:6 and the water cement ratio are taken from 0.4-0.45. The admixtures are added in % of cement for Nano silica & % of concrete for polypropylene. The final outcome to be received is increase in the strength of pervious concrete by improving their characteristics and make them utilized for Road pavements.

Keywords: Pervious Concrete, Nano Silica

1. INTRODUCTION
Pervious concrete is a high-performance concrete which has relatively high-water permeability compare to conventional concrete due to interconnected pore structure. Pervious concrete is also termed as porous concrete or permeable concrete. It can be produced using conventional Concrete-Making materials, namely cement, cement supplementary materials, all type of course and fine aggregate and water. Pervious mortar is produced with fine aggregate without the finest part, binder materials and water. Water logging and depleting ground water table are the two major problems faced by the people all over the world. Even though some places have very well-planned drainage facilities it becomes difficult sometimes to drain water from road surfaces. In modern times due to increasing population in developing countries like India the exposure of soil surface to the nature is highly reduced because of increased construction activities. Urbanization reduced soil surface exposure on the top earth surface which is often being covered by a layer of Tar or Concrete for roadway. The ground water level is also reducing due to low rate of infiltration and also the run-off water is generally high. Pervious concrete is one of the modern methods which is highly capable of draining water and also has low strength characteristics. Implementation of pervious concrete roads for Indian conditions is very essential for a beneficial town planning with efficient collection system for run-off water. Pervious concrete is a zero-slum graded material consisting of hydraulic cement, coarse aggregate, admixtures and water.

2. LITERATURE REVIEW
Kessel, J. S. (2013) Shoal Creek, in Austin, TX, runs through Pease popular recreational area near the campus of the University of Texas. Like many urban streams, Shoal Creek exhibits problems related to flooding, erosion, and degraded water quality. Seeking to address these ailments where they occur within the park, the city of Austin is pursuing a comprehensive set of integrated solutions including a pervious parking lot intended stabilize the stream channel better manage stormwater, and restore heavily degraded riparia zones.

Brzozowski, C.
In Charlotte, NC, the Sanctuary—a development built by Crescent Communities of Raleigh, NC—is racking up awards for its environmentally sensitive features. The community features 187 homes on 1,300 acres bordering Lake Wylie in Charlotte.

Charlotte and Mecklenburg County, NC, to be LEED certified. It incorporates many green features including a pervious concrete drivew. Kartini et al. (2006) He investigated the properties of concrete by partial replacement of cement with 20%, 30% of rice husk ash. He concluded that there was not any significant effect up to 20% increase of RHA in compressive strength, but after that it started to decrease. Replacement of RHA does not improve the flexural and tensile strength of concrete.

Srinivasan et al. (2010)
He investigated the properties of concrete by partial replacement of cement with 10%, 20%, 30%, 40%, 50%, 60% and 70% of hypo sludge. He investigated that the compressive strength of concrete should be increased when the percentage of replacement is increased up to 40% and replacement increased compressive strength becomes reduced. The split tensile strength should be decreased when the percentage of the replacement is increased.

Pitroda et al. (2012)
He investigated the properties of concrete by replacing cement with hypo sludge accordingly in the range of 0%, 10%, 20%, 30% & 40% by weight for M-25. Investigation shows that compressive strength and flexural strength reduce when replacement Of hypo sludge percentage increases when compare to traditional concrete. Replacement of cement with this paper industries waste material
provides maximum compressive strength at 10% replacement, but it is lesser than traditional concrete. It recommended to use hypo sludge in concrete to save the paper industry waste disposal cost.

3. METHODOLOGY

Material properties
Cement: Cement used is Ordinary Portland cement (OPC) having 53 grades as per IS 12269-1970 cement. This cement is brought from ULTRATECH CEMENT PVT.LTD. The preliminary tests like normal consistency, specific gravity, initial setting time and final setting time test conducted and result are listed below.

Properties of cement

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Properties</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific gravity</td>
<td>3.14</td>
</tr>
<tr>
<td>2</td>
<td>Normal consistency</td>
<td>35%</td>
</tr>
<tr>
<td>3</td>
<td>Initial setting time</td>
<td>30min</td>
</tr>
<tr>
<td>4</td>
<td>Final setting time</td>
<td>5 hrs</td>
</tr>
<tr>
<td>5</td>
<td>Compressive strengths</td>
<td>53Mpa (28 days)</td>
</tr>
</tbody>
</table>

Coarse aggregate:
Locally available coarse aggregate passing through 80mm sieve and retained on 150μ sieve were used for this experimental study. Differential test is conducted on coarse aggregate are specific gravity, water absorption, fineness modulus is tested and resulted are tabulated below.

Properties of Coarse Aggregate

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Properties</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shape of aggregate</td>
<td>Angular</td>
</tr>
<tr>
<td>2</td>
<td>Specific gravity</td>
<td>2.67</td>
</tr>
<tr>
<td>3</td>
<td>Water absorption</td>
<td>0.5%</td>
</tr>
<tr>
<td>4</td>
<td>Fineness modulus</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Properties Of Nano- Silica
Particle size = 17 Nano
SiO2 content = 99.88%
Tamped density = 44g/l
pH value = 4.12

Water: Portable water used for this experimental study during both casting as well as curing of specimen as per IS 456-2000

Properties of Polypropylene

<table>
<thead>
<tr>
<th>Properties of Polypropylene</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (/kgm^-3)</td>
<td>905</td>
</tr>
<tr>
<td>Tensile Strength (/Mpa)</td>
<td>33</td>
</tr>
<tr>
<td>Elongation at break (%)</td>
<td>80</td>
</tr>
<tr>
<td>Hardness (Rockwell R scale)</td>
<td>90</td>
</tr>
<tr>
<td>Heat distortion temperature (@ 0.25 Mpa/ d. C)</td>
<td>105</td>
</tr>
<tr>
<td>Heat distortion temperature (@ 1.80 Mpa/ d. C)</td>
<td>65</td>
</tr>
<tr>
<td>Volume resistivity(/log Um)</td>
<td>19</td>
</tr>
</tbody>
</table>

4. MIX DESIGN
As per IS 456:2000, the concrete of M30 grade has following proportion of cement, sand and aggregate

\[ M20 = 1:0.75:1.5 \]

Moe let us consider M30 grade concrete as per IS 456:2000 M30 grade concrete proportion is =1:0.75:1.5

We have added all the value to know total volume = 1+0.75+1.5=3.25

As we know that during concreting when we place wet concrete, it gets harden gets after certain standard time. Considering the same it had been decided upon by civil design engineers to take a factor of safety ranging from 1.54 to 1.57 to counter that shrinkage. volume of dry concrete = 1.54 to 1.57 times volume of wet concrete.

we assumed 1.57 as factor of safety so, total volume of concrete required is 1.57 cum.

5. CALCULATION OF VOLUME OF CEMENT IN M30 GRADE OF CONCRETE

Volume of cement = cement / (cement + aggregate + crushed stone) x 1.57

= 1 / (1 + 0.75 + 1.5) x 1.57

= 0.48 m3

1 m cube of cement = 1440 kg

0.28 m cube of cement = 0.28 x 1440 = 403.2 kg

FOR 1M CUBE OF M20 GRADE CONCRETE REQUIRED 403 KG OF CEMENT

Each bag of cement = 50 kg

No. of cement bags = 403.2 / 50

= 8.06 bag

says 8 bags hence we required 8 bags of cement for 1m cube of concrete

Volume of crushed stone = crushed stone / (cement + aggregate + crushed stone) x 1.57

= 1.5 / (1 + 1.5 + 3) x 1.57

FOR 1M CUBE OF M20 GRADE CONCRETE REQUIRES

672 KG OF CRUSHED STONE

Sand usually consist of moisture contains. It increases the volume sand (bulking of sand for accurate calculations use dry sand or include the effect of bulking of in calculation.) Hence, we required 672 kg of cement of sand for 1 cubic meter of concrete. FOR 1M CUBE OF M20 GRADE OF CONCRETE REQUIRES 1326 Kg OF AGGREGATE Density of aggregate may go higher if void spaces decrease. 5 mm aggregate has more density when compared with 20 mm size of aggregate. Hence, we required 1326 kg of 20 mm aggregate for 1m cube of concrete.

AMOUNT OF WATER REQUIRED FOR 1M CUBE OF CONCRETE

For making concrete, required amount of water is added. Water quantity is depending upon the climatic factors and workability required. We generally mountain 0.35- 0.50 of water cement ratio remember, above values may change according to the moisture content present in crushed stone and aggregate. Cement required for 1m cube of concrete = 400 kg Assume W/C ratio = 0.50 (50 % of cement) Water required for 1m cube of concrete = 400 x 0.50 =200 kg Hence 200 litters of water is required for 1m cube of M20 grade of aggregate.

6. RESULT AND CONCLUSION

<table>
<thead>
<tr>
<th>Sample No</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of cement (W) gm</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Weight of cement retained after sieving through 90</td>
<td>6</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Percentage weight of retained on the sieve W1 / W2 x 10</td>
<td>3%</td>
<td>2.5%</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

Result – The fineness of given sample of cement by sieving method is found to be 3 %

Conclusion – The specific surface of the given sample of cement is within the limit specified by IS

The fineness of given sample of cement is within the limit specified by IS Coarse Aggregate Fineness modulus of coarse aggregate by sieve analysis Total weight of coarse aggregate sample take sieving W =2000 gm
### Result
The fineness modulus of coarse aggregate is found to be 6.9.

### Conclusion
The given aggregate is suitable for concrete used for both the type of surface

### Comparative Results for Compression
Comparing the results of compression from the 3 types of specimens it is typically found that the mix containing Nano silica has relatively high strength compared with that of the conventional one. It is clearly observed that even though there is a failure in the mix 3 but the cubes underwent partial failure rather than complete failure.

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Compression Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 day</td>
</tr>
<tr>
<td>Mix 1</td>
<td>5.88</td>
</tr>
<tr>
<td>Mix 2</td>
<td>7.02</td>
</tr>
<tr>
<td>Mix 3</td>
<td>5.24</td>
</tr>
</tbody>
</table>

### Comparative Results for Split Tensile:
It is clearly seen that the split tensile strength is high for the first 2 mixes due to the bonding between aggregate and cement. Whereas for Mix 3 the split tensile strength is slightly lower than the other two. This might be due to the low bonding between polypropylene fibres and the aggregates.

<table>
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<th>Split Tensile Strength</th>
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<td></td>
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</tr>
</tbody>
</table>

### Comparative Results for Flexural Strength
Comparing the results of compression from the 3 types of specimens it is typically found the mix containing Nano silica has relatively high strength compared with that of the conventional one. The third mix with stands a high flexural strength than the other two mix.

### 7. ACKNOWLEDGMENT
We are thankful to our principal Prof. Gajanan R. Dharane for their encouragement and without whom these projects would not have been success.

### Advantages
- Investigate the properties of pervious concrete with and without fly ash.
- Establish an experimental procedure to determine water permeability of pervious concrete and pervious mortar.
- Develop pervious mortar suitable for pervious pavement.
- Investigate the performance of a pervious concrete and pervious mortar combinative layer as a pavement system.
- To save water and Ground Water Recharge.
- The pervious concrete helps the water to infiltrate, which is helpful.
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