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EXPERIMENTAL INVESTIGATION OF PAVER BLOCKS USING HIGH EARLY STRENGHT CONCRETE

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Abstract - *High early strength concrete is one of the types in high performance concrete. A high early strength concrete means that the compressive strength of the concrete at the first 24 hours after site-pouring could achieve structural concrete quality (compressive strength > 21 MPa). There are (four) important factors that must be considered in the making process, those factors including: Portland cement type, cement content, water to cement ratio, and admixture. In accordance with its high performance, the production cost is estimated to be 25 to 30% higher than conventional concrete. One effort to cut the production cost is to utilize local materials. This paper will also explain about the local materials which were abundantly available, cheap, and located in strategic coast area of East Java Province, that is: Gresik, Turban and Bojonegoro city.*

Key Words: Concrete, quarry dust, river sand, compressive strength, replacement. Optimum percentage, Pozzolana, Tensile strength, Atmospheric curing

1. Introduction

Concrete is a construction material composed of cement, commonly Portland cement as well as other cementations materials such as fly ash and slag cement, coarse aggregate, fine aggregate, fine aggregate such as sand ,water, and chemical admixtures. Both the fine and coarse aggregate bind together with the fluid cement that hardened over time most concrete used are limed based concrete such as Portland cement concrete or concretes made with other hydraulic cements.

1.1 High Strength Concrete

High-performance concrete is a term used to describe concrete with special properties not attributed to normal concrete. High-performance means that the concrete has one or more of the following properties: low shrinkage, low permeability, a high modulus of elasticity, or high strength. According to Henry Russell, ACI defines high performance concrete as "concrete that meets special performance and uniformity requirements that cannot always be achieved routinely by using only conventional materials and normal mixing, placing, and curing practices.

1.2 High Performance Concrete

High-performance concrete (HPC) is concrete that has been designed to be more durable and, if necessary, stronger than conventional concrete. HPC mixtures are composed of essentially the same materials as conventional concrete mixtures, but the proportions are designed, or engineered, to provide the strength and durability needed for the structural and environmental requirements of the project. High-strength concrete is defined as having a specified compressive strength of 8000 psi (55 MPa) or greater.

1.3 Objective

- The main objective is to gain the early strength of the pavement block using accelerator.
- To study compressive strength and density of pavement block.
- To utilize the waste material such as rice husk ash in paver blocks.
- To study properties of $CaCl_2$ used in paver blocks in lieu of cement.

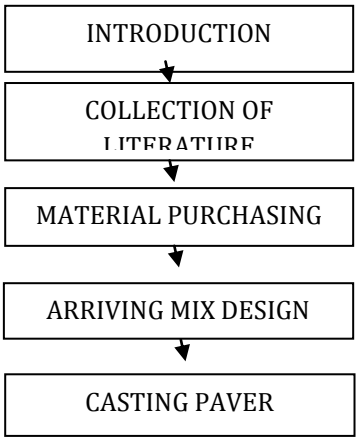
- To study the effect of the partial replacement of cement with different replacement ratio i.e. 0%, 5%, 10%, 15% of $CaCl_2$ in the paver blocks used under light traffic conditions.

2. Literature review

In this study the effect of quarry dust and sawdust, by adding quarry dust of 0%, 10%, 20%, 30% and 40%. And sawdust of 0%, 5%, 10% and 15% with fine aggregate, a matured fine aggregate has prepared. Investigated that Pervious concrete is a special high porosity concrete used for flatwork application that allows water from precipitation and other sources to pass through, thereby reducing the runoff from a site and recharging ground water levels.

In this study as the percentage sawdust increase the density is found to decrease. Wastage of sawdust is minimized and recycled for construction work. In addition to latex, natural sand and fiber were included to enhance the strength properties of pervious concrete. The test results indicate that it was possible to produce pervious concrete mixture with acceptable permeability and strength through the combination of latex and sand, pervious concrete has seen increasingly used to reduce the amount of runoff water and improve the water quality near pavements and parking lots.

3. Methodology



4. Materials

The materials used for preparing concrete are selected from these by the conventional concrete industry.

Cement, Coarse aggregate, Fine aggregate Calcium chloride, Water.

Cement:

OPC is the general purpose cement used in concrete constructions. OPC is a compound of lime (CaO), silica (SiO2), alumina (AL2O3), iron (Fe2O3) and sulfur trioxide (SO3). Magnesium (MgO) is present in small quantities as an impurity associated with limestone.

Coarse aggregate:

Coarse aggregates are widely used in construction applications. They are generally categorized as rock larger than a standard No. 4 sieve (3/16 inches) and less than 2 inches. Usually available coarse aggregates having the maximum size of 20mm were used in this project.

Fine aggregate:

Fine aggregate (sand) are those that pass through No.4 (4.75 mm) sieve and are retained on the No. 200 (75 µm) sieve. The fine aggregates were tested as per IS: 383-1970. Washed sand from local crusher was used. The SSD (saturated surface dry) coarse and fine aggregates were used.

Admixture:

High range water reducing agent/super plasticizer and high early strength is used in the mix to reduce the water content in the mix and to obtain the initial hardening of the

paver blocks so that the paver blocks should be stacked as early as possible. Calcium chloride should be uniformly distributed throughout the mix by distributing the admixture in mixing water then adding it to the concrete mix.

5. Tests of materials

Cement:

Fineness test

- Take a sample of cement and rub the cement with your hands. The test sample should be free of lumps.
- Now Take 100g of cement and note it as **W1.**
- Pour 100g of cement in 90 µm sieve and close it with the lid.
- Now place the sieve in Sieve shaking machine. You can also shake the sieve with your hands by agitating the sieve in planetary and linear movements for 15 minutes.
- Neatly, weight the residue retained on the 90 µm sieve as **W2.**
- Then calculate the percentage of Wt of cement-retained on Sieve.
- Repeat the above experiment with three different samples of cement and average the values for accurate results.

Coarse Aggregate

Specific gravity test:

- Dry the pycnometer and weigh it with its cap. (W1)
- Take about 200 gm of oven dried aggregate passing through 10 mm sieve into the pycnometer and weigh again (W2).
- Add sufficient de-aired water to cover the aggregate and screw on the cap.
- Shake the pycnometer well and remove entrapped air if any.
- After the air has been removed, fill the pycnometer with water completely.
- Thoroughly dry the pycnometer from outside and weigh it (W3).
- Clean the pycnometer by washing thoroughly.
- Fill the cleaned pycnometer completely with water up to its top with cap screw on.
- Weigh the pycnometer after drying it on the outside thoroughly (W4).
- Repeat the procedure for three samples and obtain the average value of specific gravity.

$$\text{Specific gravity (G)} = \frac{(W_3 - W_1)}{(W_2 - W_1) - (W_4 - W_3)}$$

6. Mix Design

Concept of Mix Design:

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. One of the ultimate aims of studying the various properties of the materials of concrete, plastic concrete and hardened concrete is to enable a concrete technologist to design a concrete mix for a particular strength and durability.

Design Stipulations:

Grade Designation	M-20
Type of cement	O.P.C-53grade
Fine Aggregate	Zone-I
Sp. Gravity Cement	3.15
Sp. Gravity Fine Aggregate	2.65
Sp. Gravity Coarse Aggregate	2.68

7. Test on fresh and harden concrete

Slump test:

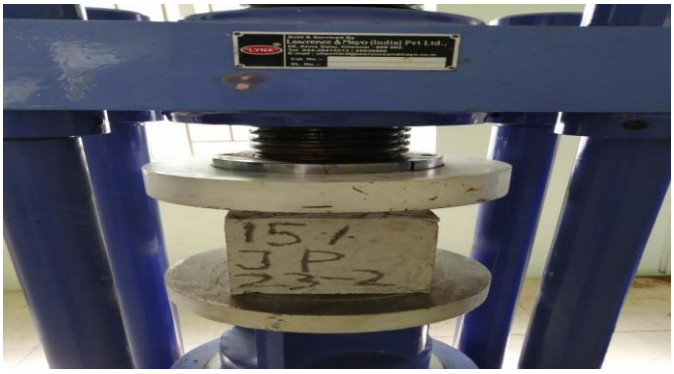
The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease

with which concrete flows. It can also be used as an indicator of an improperly mixed batch. The test is popular due to the simplicity of apparatus used and simple procedure. The slump test is used to ensure uniformity for different loads of concrete under field conditions.

Types of slump

Compressive Strength Test:

The compressive strength of any material is defined as the resistance to failure under the action of compressive forces. Especially for concrete, compressive strength is an important parameter to determine the performance of the material during service conditions. Concrete mix can be designed or proportioned to obtain the required engineering and durability properties as required by the design engineer.



8. Result and Discussion

In this section, results of the various tests conducted on both control and accelerator concrete mixes, both in their fresh and in hardened states are discussed. In fresh state, their workability, and in hardened state, their mechanical properties (compressive) at 7days, 14days and 28days of curing are discussed and evaluated.

Table 6 Compressive strength test for normal concrete

Curing days	Applied load (KN)	Compressive strength (N/mm2)
7 days	450	20
14 days	455	20.23
28 days	482	21.45

Tale 7 Compressive strength test for 5% accelerator in concrete

Curing days	Applied load (KN)	Compressive strength (N/mm2)
7 days	460	20.45
14 days	550	24.44
28 days	605	26.89

Table 8 Compressive strength test for 10% accelerator in concrete

Curing days	Applied load (KN)	Compressive strength (N/mm2)
7 days	495	22
14 days	575	25.56
28 days	625	27.78

Table 9 Compressive strength test for 15% accelerator in concrete

Curing days	Applied load (KN)	Compressive strength (N/mm2)
7 days	505	22.44
14 days	656	29.15
28 days	735	32.67

It is seen that the compressive strength of all concrete mixes incased with the increase of age. It s observed that, the larger the amount of accelerator in concrete, the lesser the compressive strength. As expected, the normal weight concrete has more compressive strength at all ages compared light weight concrete. At 28 days, it was found that compressive strength of 0%, 0%, 10% and 15%. The test result is graphically represented in below.

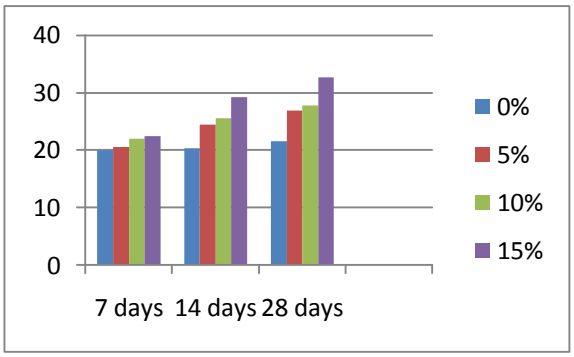


Chart – 1: Compressive strength

9. Conclusion

After the investigation of the paver block it is found that the strength of the paver block with accelerator gained high early strength as compared to the normal paver block. The uses of the accelerator have reduced the duration of final setting time with greater strength and higher durability.

All the results and data show that the accelerator is a suitable for alternative of natural sand in concrete. The results of compressive strength test shows that 50% replacement of sand by accelerator gives higher value of compressive strength and 100 % replacement of sand by accelerator also gives better result than natural sand concrete. The result of workability test shows accelerator concrete is more workable than sand concrete.

10. Reference

[1] Optimization of fly ash in concrete: High lime fly ash as a replacement for cement and filler material by Carolyne Namagga1, Rebecca A. Atadero2

[2] Fly ash a partial replacement of cement in concrete and durability study of fly ash in acidic environment by T.G.S.Kiran and M.K.M V Ratnam

[3] High early strength concrete containing large quantities of fly ash by Tarun R. Naik1 and Bruce W. Ramme2

[4] Sustainability in construction: using fly ash as a cement replacement by Phil seabrook PEng1 and Kevin Campbell PEng2

[5] Effect of fly ash on properties of concrete by P. R. Wankhede1, V. A. Fulari

[6] Effect of partial replacement of cement by fly ash and lime sludge on strength characteristics of concrete by Ravindra kumar. [7] Gainful utilization of fly ash and hypo sludge in concrete by Dr.jayeshkumar pitroda.

[8] A miniscule endeavour for accomplishing hypo sludge , fly ash brick in Indian context by Apurva Kulkarni1, Samruddha Raje2, Juned Peerzada3, Mamata Rajgor4.

[9] Assessment of concrete masonary units containing aggregate replacement of waste glass and rubber tire particles by Jerry w.isler.

[10] The use of fly ash and lime sludge as partial replacement of cement in mortar (2014). By Vaishali sahu1, V. Gayathri2.