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"Experimental Investigation on Precast cements concrete Block manufactured by using Industrial wastes in Construction Management"

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ABSTRACT: The rapid development in housing and infrastructure from last one decade continuously takes place in India. Along with that naturally the product required to overcome this development produce in mass quantities like Pavement blocks, which are known as industrial products of precast made up by concrete, having various shapes and sizes utilizes in huge quantity in housing and infrastructure construction. The conventional materials in manufacturing these blocks are utilized in large quantity, which may create impact on natural resources. To overcome these impact we can use different materials such as, Sisal fiber, waste glass, fly ash etc,which helps to save natural resources and achieve economy so that buyers and sellers of these type of materials can also get benefited.The present experimental research investigation examines the effect of waste glass, fly ash and sisal fibers at partial replacement of fine aggregate and cement respectively, Experiment is done on M30 mix, with 15%, 30% & 45% partial replacement of both sand and cement. Similarly, sisal fiber is also added in the concrete paving block in 0.5%, 1% and 2% of weight of cement, so as to provide compressive strength to the same. After getting optimum percentage of all these, further experimental work is intended over the use of all these three in a single paving block. The replaced ingredients in this research are artificial waste or partially natural waste. Experimentation is carried out to find the compressive strength, abrasion resistance of the concrete paving blocks. Further these studies compare economical aspect of conventional product and new manufactured product.

KEYWORDS: Housing and infrastructure development, natural resources, Sisal fibers, glass, flyash, Compressive strength of concrete pavement block, economical aspect.

I. INTRODUCTION

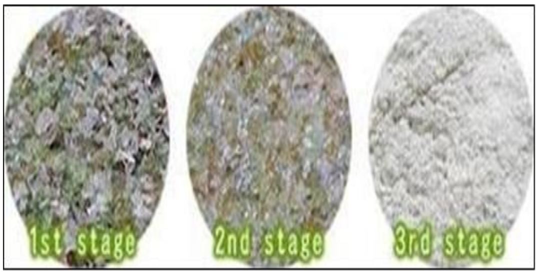
Due to industrialization, consumption of construction materials is increased which causes the decrease of natural resources day by day. It creates environmental imbalance, so it is necessary to find alternative materials such as industrial waste or agricultural waste which can be replaced with construction materials completely or partially. Pavement blocks, which are industrial products of pre-fabricated unarmed concrete, having various dimensions and special morphology are used for pavement lying of residential project carrying pedestrian and vehicular traffic. Cement concrete paving blocks are precast solid products made out of cement concrete. The product is made in various sizes and shapes viz. rectangular, square and round blocks of different dimensions with designs for interlocking of adjacent tiles blocks. The raw materials required for manufacture of the product are Portland cement and aggregates which are available locally in every part of the country. A concrete paving block is an accurately dimensioned combination of well-graded aggregates and hydrated Portland cement which fits closely together with other paving blocks to form a pavement surface. The blocks are manufactured in wide variety of shapes, some of which are shown in figure. The blocks are then compacted with a manually operated vibratory plate compacted which seats the blocks in the sand layer, compacts the sand layer, and forces some sand into the joints between the blocks. Additional sand is then applied to the surface and swept into the joints between the blocks. More passes are made with the vibratory plate compactor to compact and wedge the sand into the joints. A base and sub-base course under the leveling course provides structural support similar to that of a conventional flexible pavement. CBP provides low-maintenance, high-strength pavement surface that resists heavy, concentrated or abrasive loads and chemical spills involving fuel, hydraulic fluid, and other materials. Their modular nature and potential for reuse allow easy removal and replacement for access to bury utilities or to correct settlement. A block pavements unique characteristic (strength, abrasion resistance, flexible structure and aesthetics) make it applicable to many pavement uses, including military applications.

Cement concrete paving blocks find applications in pavements, footpaths, gardens, passenger waiting sheds, bus-stops, industry and other public places. The product is commonlyused in urban areas for the above applications. Hence, the unit may be set up in urban and semi- urban areas, near the market.

A lot of face-lift can be being given to roads, footpaths along the roadside. Concrete paving blocks are ideal materials on the footpaths for easy laying, better look and finish. Whereas the pavement blocks find extensive use outside the large building and houses, lots of these materials are also used in flooring in the open areas of public offices and commercial buildings and residential apartments.

[1].**Fly Ash-** Fly ash is a waste produced in coal-fired thermal power stations. It has pozzolonic properties and can therefore be stabilized with either cement or lime to achieve the strength required for use as base courses in pavements. Agencies such as the Electric Power Research Institute (EPRI) have specified criteria and guidelines for the determination of the stabilizer content. This requires carrying out unconfined compression tests on stabilized fly ash specimens prepared and cured as per standard procedures. The stabilizer content is the minimum amount of the stabilizer for which the unconfined compressive strength of the specimens complies with the specified values. The actual curing conditions of the stabilized fly ash bases in the field, however, will differ from those of the laboratory specimens. This will affect the strength development of the bases, their durability, and their performance.

[2].**Waste Glass-** As solid waste disposal has received increasing attention, waste glass has been heavily targeted for recycling efforts, with some localities contemplating prohibitions of glass in landfills. Not all waste glass can be recycled into new glass because of impurities, prohibitive shipping costs, or mixed color waste streams that may be difficult to separate into useful raw glass stocks. Use of this waste glass in construction materials is among the most attractive options because of the volume of material involved, the capacity for use of the material in bulk, and the likely ability of construction applications to afford allowances for slight variation in composition or form. Considering waste glass not as waste but as a new resource, we crush, bake and foam it to produce Supersol, an artificial light porous foamed material. It can be used in various areas, such as greening, insulation, horticulture, water purification, architecture and civil engineering, and thus is a highly value-added product indispensible for developing recycling societies.



[3].**Sisal Plant -** Sisal fibre is a leaf fibre extracted from the leaves of plant which is scientifically known as Agave sisalana. The Sisal plant is one of the types of perennial shrub which grows in the tropical and subtropical regions of the world

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II. METHODOLOGY

The main steps are elaborated in detail as per IS Code provision.

Phase I: - Testing of materials: -

a) Cement: Various properties were evaluated such as fineness of cement, standard consistency, setting time, soundness, compressive strength, specific gravity through IS Code provision such as IS 1489 (Part I) 199112

b) Fine aggregate: Various properties such as specific gravity, fineness modulus as per IS 2386 Part I, III-196311

c) Coarse aggregate: Various properties such as fineness modulus, Impact value as per IS 2386 Part I & III-196311.

Phase II: - Concrete mix is designed for M30 grade considering properties of materials like cement, sand and coarse aggregate. The controlled concrete specimens are cast and tested for compressive strength, abrasion resistance.

Phase III: - In the concrete thus designed, cement is replaced by fly ash in the percentages 15%,30 % 45% (by weight of cement) and fine aggregate is replaced by waste glass. Specimen cast for this concrete for various strength tests and the results are compared with the control concrete.For each fly ash replacement percentage 15% ,30 % 45% and waste glass replacement plasticizer is added as an admixture to the concrete in various percentages like 15% ,30 % 45% (by weight of fine aggregate).

The concrete is prepared and specimens are casted for various strength properties of hardened concrete such as compressive strength, abrasion resistance. In the present study the dosage of Sisal fiber starting 0% then 0.5%, 1%, up to 2 % are added for M30 grade concrete to determining the Compressive strength ,Abrasion resistance of paving block.

III. EXPERIMENTATION

To effectively research the improvement in the properties of the cement concrete pavement block, preliminary planning, procedures and methods must be wisely chosen. The criteria to assess properties of ingredients of the mix are based on the activities to plan and preparation, which carried out by before the testing of the fresh and hardened properties of cement concrete pavement block. These activities are:

- Cement Testing
- Fine Aggregate Testing
- Coarse Aggregate Testing
- Mix design.
- Preparation of test specimens.
- Concrete mixing.
- Casting of pavement blocks.
- Tests on Pavement block.

Experimentation is an activity required by the majority of the engineering researches, where it comprises all preparation and plan of action to be taken and being situated into operation afterwards. This chapter describes preliminary design and planning such as experimentation of the coarse and fine aggregates, target strength of concrete specimens, mix design and number of mix batches and concrete specimens required to meet the scope of this project.

Mix design is known as the selection of mix ingredients and their proportions required in a concrete mix. In this case, some calculations and knowledge of the proper proportioning of concrete mixes will be desirable. There are several methods of mix design used throughout the world. Eventually, all of these methods follow the same procedure and produce similar results. The mix design involves that amount of cement fine aggregate and coarse aggregate and the relation between water/cement ratio and target strength must be known.

CONCRETE MIX DESIGN OF M30 GRADE OF CONCRETE

a) Design Stipulation:

i) Characteristic strength 30 N/mm2

ii) Maximum size of aggregate 10 mm

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iii) Degree of quality control Good

iv) Type of exposure Moderate

b) Materials:

i) Specific gravity of cement	3.15
ii) Specific gravity of sand	2.62
iii) Specific gravity of coarse aggregate	2.67

Step-1) Standard mean strength for mix design:
f´ck = fck +1.65S
S = Standard deviation.
Now, for M30 concrete, fck = 30 N/mm² & S = 5 N/mm².
f´ck = 30 + 1.65 × 5
f´ck = 38.25 N/mm²

Step-2) Selection of water/cement ratio :
For maximum aggregate size of 10mm, W/C Ratio is 0.45, Adopt ***W/C = 0.45***

Step-3) Selection of water content:
Maximum water content for max agg.size10mm, is 208 kg/m³.
Let us, take it as 189 kg/m³.
W = 188 Kg/m³

Step-4) Selection of cement content: W/C = 0.45, Water content = 189 kg/m³.
So, cement content = 420 kg/m³
C = 417.78 Kg/m³

Step-5) Estimation of entrapped air:
For maximum aggregate size of 10mm, ***entrapped air is 3% of volume of concrete.***

Step-6) Selection of volume of aggregates in all-in-aggregate: For 10 mm size of aggregate (zone I) Volume of coarse aggregate = 0.440 Volume of fine aggregate = 0.560
But for every 0.1 increase in C.F. & for zoneI, reduce fine aggregate volume by 0.015 Hence, volume of fine aggregates in all-in-aggregate is 0.545.

Step-7) Mix Proportion:
V = [W+ (C/Sc) + (1/P) × (Fa/Sfa)]×(1/1000)
0.97= [188+ (417.78/3.15) + (1/0.545) × (Fa/2.62)] × (1/1000)
F.A. = 925.24 Kg/m³
CA = [((1-P)/P) × Fa × (Sca/Sfa)]
CA = [((1-0.545)/0.545) × 925.24 × (2.67/2.62)]
CA = 787.19 Kg/m³

Table: 3.1 Summary of Mix Design

Sr. No.	Particulars	Quantity
1.	Water-cement ratio	0.45
2.	Cement	417.78 kg/m3
3.	Water	188 kg/m3
4.	Fine aggregate	925.24 kg/m3
5.	Coarse aggregate	787.19 kg/m3

IV. RESULTS AND DISCUSSION

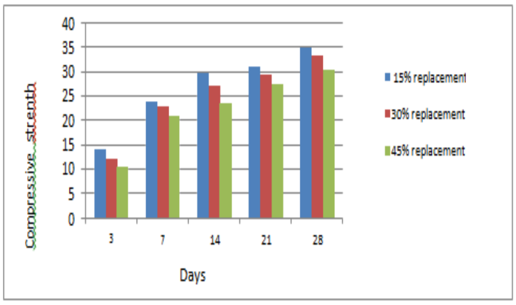
Conventional Concrete: Cubes are casted and tested of M 30 grade of concrete for conventional concrete without any replacement result as follows:
4.1 (Table No 1: Normal Concrete without Any Replacement)

Block No.	Peak Load (KN)	14 Days Comp. Strength	Avg. (N/mm²)
1	658	29.24	
2	659	29.3	
3	662	29.4	29.31
Block No.	**Peak Load (KN)**	**21 Days Comp. Strength**	**Avg. (N/mm²)**
1.	707	31.4	
2.	709	31.5	
3.	711	31.6	31.50

Block No.	Peak Load (KN)	28 Days Comp. Strength	Avg. (N/mm²)
1.	791	35.15	35.21
2.	792	35.2	
3.	794	35.3	

4.2 Determination of Optimum percentage of Fly ash

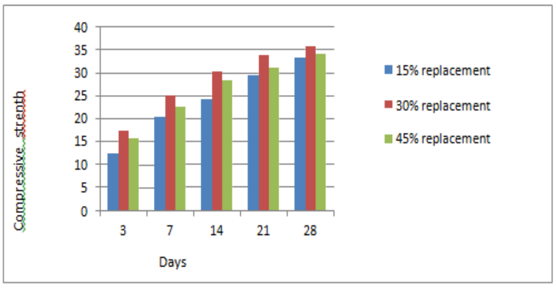
The fly ash added (15%, 30%, and 45% of weight of cement) and cubes are casted and tested to determine optimum percentages of replacement of cement by fly ash. The result as follows



Graph no 1 Optimum Result For fly Ash Replacement

4.3 Determination of Optimum percentage of glass

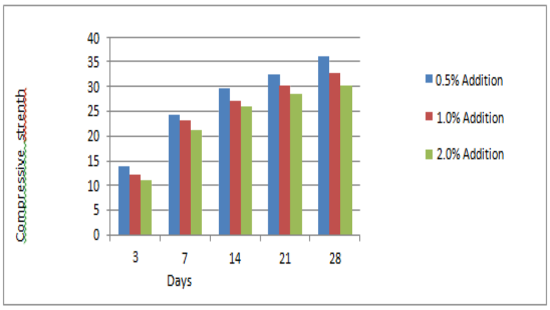
The fly ash added in 15%, 30%, 45% of weight of fine aggregate and cubes are casted and tested to determine optimum percentages of replacement of fine aggregate by glass powder. The result as follows



Graph no 2 Optimum Results For glass Replacement

4.4 Determination of Optimum percentage of Sisal fibers

The sisal Fibers added in 0.5%, 1%, 2% of weight of cement and cubes are casted and tested to determine optimum percentages of addition of sisal fibers. The result as follows,



Graph no 3 Optimum Results ForSisal fibers Replacement

5.8.4 Sample Calculations:

For the manufacturing of conventional paving block here we take Mix design of M30 (1:0.75:1.5).
1. Consider 10 m3 of concrete. The wet volume of concrete for 10 m3, take 30% extra. Hence it becomes 13 m3.
2. Consider wastage up to 20%, then total volume of concrete becomes 15.6m3.
For 15.6m3 concrete following quantities of various ingredients are required and their rates are assumed as per DSR.
1. Cement 138 bags (330Rs per Bag)
2. Sand 3.6 m3 (2120 per m3)
3. Course aggregates 7.2 m3 (880Rs.per m3)

For conventional cement concrete block

Sr.No.	Description	Qty.	Unit	Rate	Amount
1	Cement	138	Bag	330	45540/-
2	Sand	3.6	m3	2120	7632/-
3	Course aggregates	7.2	m3	880	6336/-
Total			**59508**		

Total cost of concrete is **59508/-.** (Excluding labor, machine, water charges)
If we replace above cement and fine aggregate by fly ash and glass powder by 15% then,

For waste used cement concrete block

Sr.No.	Description	Qty.	Unit	Rate	Amount
1	Cement	117	Bag	330	38610/-
2	Sand	3.06	m3	2120	6488/-
3	Course aggregates	7.2	m3	880	6336/-
4	Glass powder	0.54	m3	1000	540/-
5	Fly ash	1.05	m3	1000	1050/-
Total			**53024/-**		

Hence above it is clear that if we replace cement and sand by 15% of fly ash and glass powder cost is reduced up to **10.89%**

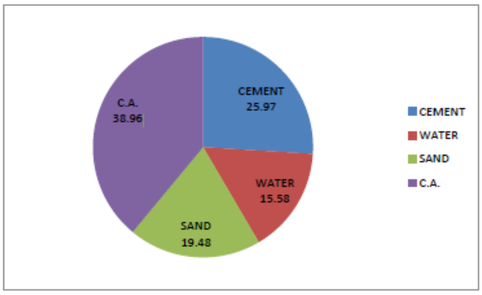
V. CONCLUSION

From the Experimental results we can conclude that,

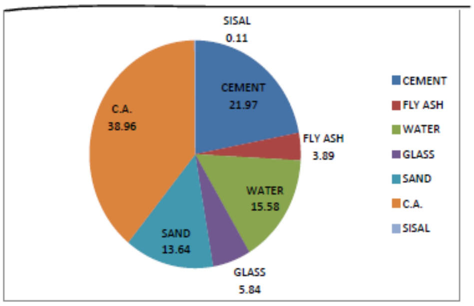
1) The properties of ingredients of concrete which are using for conventional concrete are as per limit of IS code, so it can be used for further process.

2) The properties of fly ash, sisal fibers, and glass powder examined carefully , then we conclude that due to some similar properties of conventional ingredients this waste materials can be added in concrete.

3) By the comparative study we can conclude that



Convention - % use of conventional Material



Using industrial waste - % use of industrial waste

i) Incorporating 15% Fly ash in place of cement helps to reduce the cost and thereby achieve economy with increase in compressive strength 30% waste glass in place of fine aggregate, gives acceptable mechanical properties with increased compressive strength at an age of 28 days. Additional sisal fiber (0.5% by weight of cement) increases compressive strength of concrete pavement block.

ii) Compressive strength increases with increasing the glass percentages from 15% to 30%, replacement of glass to the fine aggregate ,which helps to reduce cost and after 30% waste glass replacement onward, the strength decreases as the internal void of waste glass increases.

4) Fly ash can replace the cement up to 15%, which will help to reduce the cost & thereby bring economy. Cost of paving blocks decreases with increase in glass content. Sisal fiber will develop the strength in the concrete paving blocks which helps to give a long lasting performance by the paving blocks.

5) The value of abrasion resistance for paving block with addition of waste is minimum which is within limit of IS code.

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS

a) It can be seen that the strength of paving blocks with waste is greater than that of normal or conventional paving blocks.

b)Further fly ash can be added into the concrete at the place of cement to get the acceptable strength So cement can be replaced by fly ash which makes it economical.

c)The manufacturing cost can be reduced by 10%.

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