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" COMPARATIVE ANALYSIS OF DESIGN PRECAST CONCRETE PAVEMENT BLOCKS BY USING INDUSTRIAL SOLID WASTES "

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Abstract -This paper aims to Industrial solid wastes material used in Precast Concrete Pavement, because of day-by-day increasing industrial solid wastes and its direct attack to the global warming and environmental disastrous have become major issue start from 2015. In this research under the partial replacement of cement, coarse and fine aggregate by fly ash, steel slag and stone dust. Extensive research has clearly established, the Industrial waste such as fly ash used in Precast Concrete Pavement as replacement of cement, steel slag used as replacement of course Aggregate and stone dust as a replacement of fine aggregate. The results indicate that for conventional Precast Concrete Pavement, the partial replacement of cement, coarse and fine aggregate by fly ash, steel slag and stone dust improve the compressive, tensile and flexural strength. By using the mix design of M25, M30, M40 grade with replacement of fly ash as cement 15%, steel slag as coarse aggregate and stone dust as fine aggregate in different percentage (%) of replacement of steel slag and stone dust (40%, 50%, 60% and 100%) has a significant effect in increasing the strength and leads to economical construction of Precast Concrete Pavement. The use of such Pavement improves the time required for repairing and construction of highways. Also, minimize the industrial solid waste, so that it is economical and good for environment.

key Words: ***Precast Pavement, Precast Panel, Concrete Block Pavement, Industrial solid waste.***

1. INTRODUCTION

Precast concrete pavement (PCP) is an emerging technological know-how for the quickly restore and recuperation of high-volume overcrowded roadways. This is applicable for all types of roadways such as airfield, country highway, metropolis road, village road. Precast concrete pavement is a concrete block that is solid and cured in a manufacturing plant, then transported to the construction site. It does now not require discipline curing for the precast concrete panels alternatively than it requires minimal time for system components to attain power earlier than opening to traffic. In evaluation with traditional cast-in-place concrete pavements, the plausible benefits of PCP systems consist of better concrete curing conditions. The PCP casting in plant approves multiplied efficiency and higher great control. Durable everlasting steel forms are reused many times, reducing form-work fees compared to website online solid concrete.

High early strength cement and steam curing enable concrete block to be solid and cured in as little as 24 hours. These pavements require minimum time for perfect curing to all sides in the manufacturing plant. Controlled casting stipulations and extraordinary varieties allow for greater manipulate of surface finishes. This gadget is very beneficial for enhancing the carrier lifestyles of the pavement as in contrast to the conventional pavement. The lifestyles of traditional pavement which is built in web page (casting in place). These concrete pavements have been used for greater than twenty years. These pavement constructions have long-terms visitors' restriction due to the fact of massive scale and extend way shutdown. These pavements are of accurate fine control.

Precast Prestressed Concrete Pavement has been used in Texas and California Super-slab method in New York for building of new concrete pavement. Whereas, Full Depth Repair method in Michigan; Stitch-in-Time method in Colorado; the Four-byFour approach in California have been used as pavement repairing methods.

2. RESEARCH OBJECTIVE

- To achieve the designed/desired workability in the plastic stage.
- To achieve the desired minimum strength in the hardened stage.
- To produce concrete as economically as possible.
- Quick construction of roads of heavy traffic.
- Precast concrete pavement systems speed work and cut congestion on repair jobs in high-traffic areas.

3. METHODOLOGY

Materials required for experiments are: 1) CEMENT 2) SAND 3) AGGREGATE 4) STEEL SLAG 5) STONE DUST 6) FLY ASH 7) ADMIXTURE

3.1) CEMENT & FLY ASH: A cement is a binder, a Page 2 of 5 substance used for construction that sets, hardens, and adheres to other materials to bind them together. Ordinary Portland cement 53 grade (OPC 53) conforming to IS 12269:1987 is used throughout this study (Bureau of Indian Standards, 1987). The cement

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and fly ash properties were determined, and test results are summarized in Table 1

Sr. NO.	Test	Cement	Fly Ash
1	Normal Consistency	28%	
2	Specific Gravity	3.14	2.1-3.0
3	Initial setting time Final setting time	130 min. 250 min.	
4	Fineness Test	6.4%	16.26
5	Soundness Test	0.4cm	

Table 1 test on cement & fly ash

Fly ash is a fine powder that is a by-product of burning pulverized coal in electric generation power plants. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water, fly ash forms a compound similar to Portland cement.

3.2) SAND & STONE DUST: Locally available natural sand with 4.75mm maximum size was used as fine aggregate. Stone dust is waste material obtained from crusher plants. It has Potential to be used as partial replacement and partial replacement of river sand in concrete. The sand and stone dust properties were determined, and test results are summarized in Table 2.

Sr. No.	Test	Sand	Stone Dust
1	Sieve Analysis	2.6	3.12
2	Silt content	4.08%	4.20%
3	Bulking of Sand	14.40%	17.5%

Table 2 test on sand & stone dust

3.3) AGGREGATE & STEEL SLAG: Crushed stone with maximum 12.5mm graded aggregates (nominal size) were used. Slag forms when iron ore is melted and reduced into molten pig iron in blast furnaces. The amount of slag generation is roughly 300 kg per ton of pig iron produced. The maximum size of slag is greater than 20mm graded aggregates (nominal size) were used. The Aggregate and Stone dust properties were determined, and test results are summarized in Table 3.

Sr. No.	Test	Aggregate	Steel Slag
1	Sieve Analysis	6.33	6.35
2	Impact Test	7.07%	6.99%
3	Abrasion Value Test	27%	25.2%

Table 3 test on aggregate & steel slag

ADMIXTURE: Admixture CONPLAST SP550 is used. An admixture is defined as "a material other than water, aggregates, cementitious materials, and fibers reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing" (ACI Committee 212, 2010).

METHOD USED

The method used in this project is that the cube and beam is prepared for the testing. The test performed on cube is compressive strength test and test performed on beam is flexural strength test. The testing sample is of different grade i.e.M25, M30, M40 in replacement with different proportion and different industrial solid waste by 50%,60% and 100%. The material is replacement of course aggregate with steel SLAG, fine aggregate with stone dust, and 15% replacement of cement with fly ash in M40 grade.

COMPRESSIVE STRENGTH TEST: The compressive strength of the concrete cube test provides an idea about the characteristics of concrete. By this compressive strength test judge that whether concreting has been done properly or not. Compressive strength of concrete depends on many factors such as water cement ratio (W/C ratio). Cement strength, quality of concrete material etc. The test result of different grade with different proportion as discuss above are summarized in Table 4.

Concrete Mix Design.				
Sr. No.	Mix	Replacement (%)	Compressive strength test	
			7 Days	28Days
1.	M25	Conventional Concrete	17.55	26.74
		50% replacement of SD and Slag	19.04	38.16
		60% replacement of SD and Slag	17.49	33.33
2.	M30	Conventional Concrete	23.50	34.98
		50% replacement of SD and Slag	35.51	45.25
		60% replacement of SD and Slag	31.32	40.67
3.	M40	Conventional Concrete	30.04	45.13
		50% replacement of SD and Slag	28.26	46.86
		60% replacement of SD and 40% of Slag	25.57	44.82
		100% Replacement of SD and 50% of Slag	30.66	50.41

Where; SD-Stone Dust

Table 4 compressive strength test

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4.1) Flexural Strength Test: Flexural strength, also known as modulus of rupture, bend strength, or fracture strength a industrial parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three-point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress. The test result of different grade with different proportion as discuss above are summarized in Table 5.

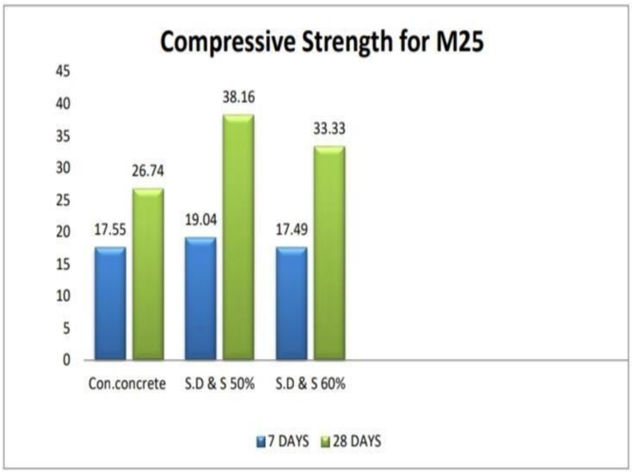
Sr. No.	Mix	Replacement (%)	Flexural Strength(N/mm²)
1	M25	Conventional Concrete	2.29
		50% replacement of SD and Slag	2.41
2	M30	Conventional Concrete	3.27
		50% replacement of SD and Slag	3.52
3	M40	Conventional Concrete	4.32
		100% Replacement of SD and 50% of Slag	5.12

Where; SD-Stone Dust

Table 5 flexural strength test

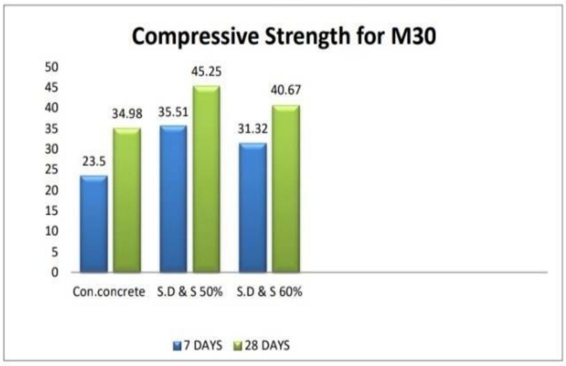
4. RESULTS AND DISCUSSION

The results indicate that for conventional , the partial replacement of cement, coarse and fine aggregate by fly ash, steel slag and stone dust improve the compressive, tensile and flexural strength. By using the mix design of M25, M30, M40 grade with replacement of fly ash as cement 15%, steel slag as coarse aggregate and stone dust as fine aggregate in different percentage (%) of replacement of steel slag and stone dust (40%, 50%, 60% and 100%) has a significant effect in increasing the strength and leads to economical construction of PCP. The use of such Pavement improves the time required for repairing and construction of highways. Also, minimize the industrial solid waste, so that it is economical and good for environment. Comparison between Conventional and Experimental Concrete are given below:



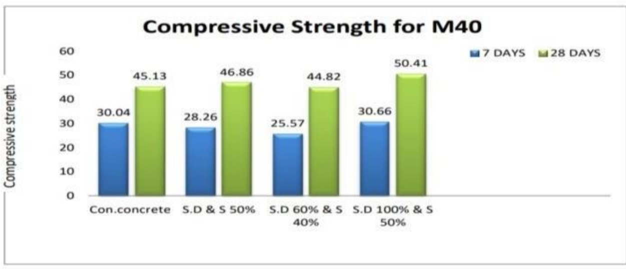
Where;

- Con. Concrete = Conventional Concrete
- S.D &S 50% = Stone Dust & Slag (50% Replacement)
- S.D & S 60% = Stone Dust & Slag (60% Replacement)



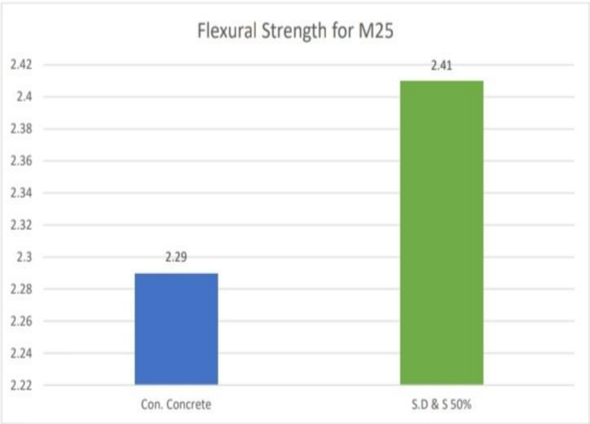
Where;

- Con. Concrete = Conventional Concrete
- S.D &S 50% = Stone Dust & Slag (50% Replacement)
- S.D & S 60% = Stone Dust & Slag (60% Replacement)

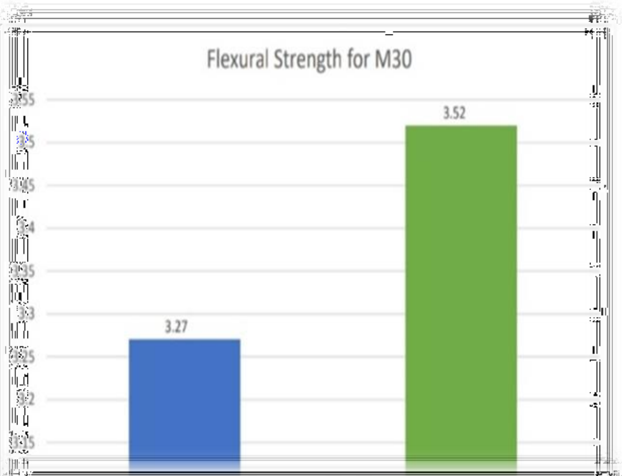


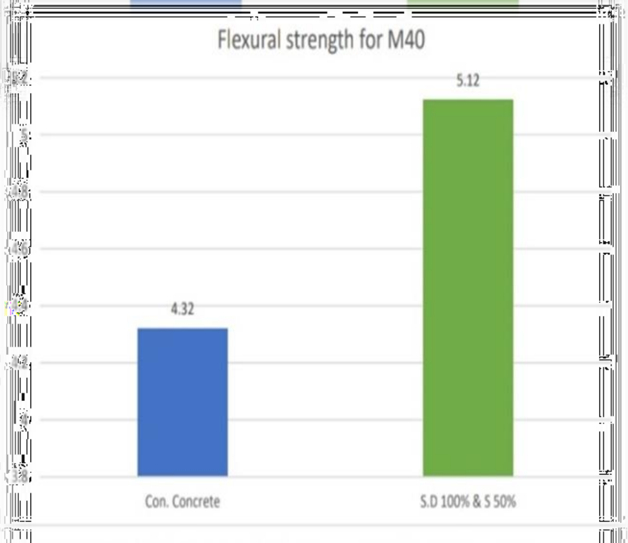
Where;

- Con. Concrete = Conventional Concrete
- S.D &S 50% = Stone Dust & Slag (50% Replacement)
- S.D 60% & S 40% = Stone Dust (60% Replacement) & Slag (40% Replacement)
- S.D 100% & S 50%= Stone Dust (100% Replacement) & Slag (50% Replacement



Where; S.D & S 50% - Stone Dust and Slag 50% Replacement





Where; S.D 100% & S 50%- Stone dust 100% replacement and slag 50% replacement

5. CONCLUSION

In this research, investigation of the possibility to replace the conventional aggregates by steel slag and sand by stone dust the strength and durability properties were studied. The preliminary conclusions obtained are as follows After 7 and 28 days of curing of concrete cubs, tested cubes has given satisfactory results regarding their compressive strength and workability. According to these results, the stone dust and slag concrete can easily be used for concreting work of the pavement. The use of waste materials in the concrete with helps to achieve the required strength at low cost from the results, the highway pavement can be constructed using these waste-materials which is liable to environment. It is expected that innovations in this technology will ensure a pavement place for application of the precast concrete pavement for durable, rapid repair and rehabilitation of existing pavements help reduce the cost of the installation.

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REFERENCE

1) Luh M. Chang, Yu-Tzu Chen, Sangwook Lee, “Using precast concrete panels for pavement construction in Indiana” Journal Transportation Research Program,2004.
2) V. Subathra Devi, B.K. Gnanavel, “Properties of concrete Manufactured Using Steel Slag”, ELSEVIER ScienceDirect, 2014.
3) E. Anastasiou, K. Georgiadisfilikas, M. Stefanidou,” Utilization of Fine Recycled Aggregate in concrete with fly ash and Steel Slag”, ELSEVIER,2014.
4) Eshmaiel Ganjian, GhassanJalull, Homayoon Sadeghipovya, “Using Waste Material and by-product to produce concrete Paving Block”, ELSEVIER, 2015.
5) Ashutosh Singh, D. S. Ray, "Study and evaluation of precast concrete pavement", International Journal of Engineering, Science and Computing,March 2019.
6) S.P. Raut, R. V. Ralegaokar, “Development of sustainable construction material using industrial solid waste”, ELSEVIER, 2015.
7) Eshmaiel Ganjian Ghassan Jalull, Homayoon Sadeghipovya, “Using Waste Material and by-product to produce concrete Paving Block”, ELSEVIER, 2015.
8) Ameen Syed, R. S. Sonparote, "Analysis of prestressed precast concrete pavement", ELSEVIER Science Direct, 2016.
9) Shiraz Tayabji, Neeraj Buch, “Precast concrete pavement: Technology overview and technical considerations," Research Gate, 2013.
10) S. C. Goyal, Shri Prakash, "Prestressed concrete pavement", Indian Concrete Journal, Volume 42, no. 9, September 1968.