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To Study the Effect on Mechanical Behaviour of High Performance Railway Concrete Sleepers and Ceramic Wastes

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Abstract: Significant quantities of waste are being produced and discarded by the construction and demolition industries within the asia and many other developed countries, and this is likely to increase considerably in the future. On the other hand, in recent years the construction industry throughout the world has supports initiatives to improve sustainability by increasing the use of recycled aggregates in concrete production. This is mainly because of the depletion of quality primary aggregates and in some quarters, greater awareness of environmental protection. The industrial waste contains many inorganic and toxic substances beyond the acceptable limit which cause an impact on the environment. In ceramic industries about 15%-30% production goes as waste while manufacturing the products. These wastes are dumped at open places which results in environment pollution. Scarcity of the construction materials using the natural resources like sand aggregates and stone aggregate. The partial replacement of aggregates is required for the future generation of concrete structures for the environment sustainability. The depletion of the natural resources get exhausted. We have think over the alternate replacement of the materials. In present work the partial replacement of the ceramic waste with the fine aggregates and the coarse aggregates is partially replaced by the high performance recycled concrete sleepers. The percentage addition of high performance recycled aggregate concrete sleepers with percentage ratio of 0%, 20%, 40% and 60% and ceramic waste (0%,20%,40%,60%). A series of experiment were carried out to measure the compressive strength, split tensile strength and flexural strength of the concrete. The result shows that the compressive strength, split tensile strength and flexural strength increases with the adding of the high performance concrete sleepers and ceramic waste.

Keywords: Ceramic waste, High performance recycled concrete sleepers, workability, compressive strength, Split Tensile strength, Flexural strength.

I. INTRODUCTION

The on-site recycling of demolition materials is the most efficient process of reducing waste landfill and natural aggregates consumption, as well as reducing transportation costs and detrimental environmental impact. Several types of recycled aggregates can be obtained from C&DW. Recycled concrete aggregates (RCA) has been reported as the recycled aggregate type with the most suitable physical and mechanical properties. The predominant composition of concrete particles in RCA prevents the higher sulphate contents and lower densities which are normally caused by the presence of gypsum and masonry particles. Nonetheless, most properties of the RCA are usually poorer than those of natural aggregates, especially the properties of water absorption, porosity and crushing value due to the old mortar attached to the aggregates. Over the last twenty years, there have been many studies which have concerned themselves with the influence of RCA on the physical, mechanical and durability properties of recycled aggregate concrete (RCA). Comparative studies of the RCA with natural aggregates conclude that the lower properties of the RCA have in general negative effects on the properties of the recycled aggregate concrete (RAC). Some typical negative effects are lower workability due to their higher water absorption, lower compressive strength and lower durability properties due to RCA's lower mechanical toughness and higher porosity. There is a general consensus in the literature that recycled concrete aggregate (RCA) is more porous and heterogeneous than natural aggregate. High-quality RCA can be obtained from waste concrete via a crushing process. This usually entails three to seven steps, including the elimination of foreign substances, rebar, and residual mortar (RM). During the crushing process, the RM quantity adhering to the RCA is altered. The primary properties adversely influenced by the adhered RM are density, absorption, etc. The principle waste coming into the ceramic industry is the ceramic powder, specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill, The disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use of ceramic waste produced. Ceramic waste can be used in concrete to improve its strength and other durability factors. Ceramic waste can be used as a partial replacement of cement or as a partial replacement of fine aggregate sand as a supplementary addition to achieve different properties of concrete

II. LITERATURE REVIEW

S. K. Singh P. C. Sharma(2012) This paper presents the experimental results of recycled coarse aggregate concrete and results are compared with the natural crushed aggregate concrete. The fine aggregate used in the concrete, i.e. recycled and conventional is 100 percent natural. The recycled aggregate are collected from four sources all demolished structures. For both types of concrete i.e. M-20 and M-25, w/c ratio, maximum size of aggregate and mix proportion are kept constant. The development of compressive strength of recycled aggregate concrete at the age of 1,3,7,14,28, 56, and 90 days; the development of tensile & flexural strength at the age of 1,3,7,14 and static modulus of elasticity at the age of 28 days are investigated. The results shows the compressive, tensile and flexural strengths of recycled aggregate are on average 85% to 95% of the natural aggregate concrete. The durability parameters are also investigated for recycled aggregate concrete and are found to be in good agreement with BIS specifications.

Ajibola Tijani, Jian Yang, and Samir Dira(2015): The conventional ballasted rail track system incorporating steel tendon in prestressed concrete sleepers is predominantly used throughout the railway network in the UK.despite its benefits, the associated demerits and the need to revolution is rail transportation in the UK necessitated this investigation. The objective was to determine physical and mechanical characteristics of recycled aggregate concrete in cooperating synthetic macro fibre and mineral admixtures to develop a low maintenance and corrosion-free prestressed concrete sleepers which is a high strength structural application. These materials were incorporated with varying percentage replacement (i.e. 0%, 25%, 50%, 75% & 100% respectively) of natural coarse aggregate by recycled aggregate, 54mm for synthetic macro fibre dosage (0.11% and 0.5%), 5% dosage of Micro silica and 0.4% High Range Super plasticiser by weight of cement.

A total of 621 concrete samples (cubes, cylinders &prisms) were subjected to workability test, density measurement, and modulus of elasticity, compressive strength, flexural strength, and tensile splitting strength test in four different phases. Results obtained from phases 1, 2, and 3 indicate reduction in workability, density, modulus of elasticity, compressive strength, tensile splitting strength, and flexural strength of recycled aggregate concrete without mineral and chemical admixtures as the percentage content of recycled coarse aggregate increased compared with the control concrete samples and no significant effect was observed from dosage of synthetic macro fibre.

The addition of micro silica and super plasticiser to the concrete mix in brought about great improvement in workability, density, compressive strength, flexural strength, and tensile splitting strength and this was evident from 1, 7, and 28 curing days' strengths respectively. This enhanced strength could be associated with the identifying quality and pozzolanic action of micro silica. Recycled aggregate concrete without fibre dosage performed satisfactorily up to 25% replacement, while50% replacement produced 97% of the target compressive strength, which indicates the possibility of raising the current recommended optimum use of recycled aggregate in concrete production from 25% to 50%.

G. Sivaprakash, V. Saravana Kumar and Lakhi Jyoti Saikia(2016): The demand of river sand and decrease in its availability, there is an immediate need for finding suitable alternatives which can replace sand partially or at a high proportion. Much research study investigates the effect of several waste products such as Glass sheet powder, Incinerated Sewage sludge, foundry bed waste, crushed rock flour, building demolition waste in the partial replacement of river sand. Utilization of Ceramic waste is one of the active research area that, Encompass the effectiveness of replacement in all the aspects of construction materials. It is very essential to develop eco-friendly concrete from ceramic waste. This paper deals with the experimental study on the mechanical strength properties of M25 grade concrete with the partial replacement of sand by using ceramic waste. In order to analyze the mechanical properties such as compressive, split tensile, flexural strength, the samples were casted with 10%, 20%, 30%, 40%, 50% replacement of sand using ceramic waste and tested for different periods of curing like 7 days, 14 days and 28 days. The optimum of percentage addition of Ceramic waste is analyzed considering the requirements of mechanical properties of concrete.

A. Objective of the study

1) To determine optimum value of compressive strength of concrete containing high performance recycled aggregates and ceramic wastes.
2) To determine optimum value of Split Tensile strength of concrete containing high performance recycled aggregates and ceramic wastes.
3) To determine optimum value of Flexural strength of concrete containing high performance recycled aggregates and ceramic wastes.
4) To check the workability of the concrete containing high performance recycled aggregates and ceramic wastes.

III. MATERIAL AND METHODOLOGY

A. Cement

Cement is one of the binding materials in this work. Cement is the important building material in today's construction world. 43 grade Ordinary Portland Cement conforming to IS: 8112-1989 will be used. The Ultra Tech cement is used in the present work.

B. Fine Aggregates

The Local Available sand is used in the present work.

C. Coarse Aggregates

The local available coarse aggregates (natural stone Aggregates) are used in the present work. The coarse aggregates with maximum size of 20mm will be used in this present work.

D. High Performance Recycled Concrete Sleepers

Concrete sleepers collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Metals such as rebar are accepted, since they can be removed with magnets and other sorting devices and melted down for recycling elsewhere The remaining aggregate chunks are sorted by size. Larger chunks may go through the crusher again. After crushing has taken place, other particulates are filtered out through a variety of methods including hand-picking and water flotation.

Crushing at the actual construction site using portable crushers reduces construction costs and the pollution generated when compared with transporting material to and from a quarry. Large roadportable plants can crush concrete and asphalt rubble at 600 tons per hour or more. These systems normally consist of a rubble crusher, side discharge conveyor, screening plant, and a return conveyor from the screen to the crusher inlet for reprocessing oversize materials. Compact, selfcontained mini-crushers are also available that can handle up to 150 tons per hour and fit into tighter areas. With the advent of crusher attachments - those connected to various construction equipment, such as excavators - the trend towards recycling on-site with smaller volumes of material is growing rapidly. These attachments encompass volumes of 100 tons/hour and less.

Test Items	Specifications
Specific Gravity	2.48
Absorption Coefficient	4.53
LA Abrasion Coefficient	32.2

Properties of HPRC

E. Ceramic Waste

Ceramic waste is available from large ceramic factories, ceramic products manufacturing units and from everyday construction activities. Traditional ceramics, such as bricks, roof and floor tiles, other construction materials, and technical ceramics, such as porcelain are usually highly heterogenous due to wide compositional range of the natural clays used as raw materials. Ceramic wastes was crushed with a tamping rod manully to make the ceramic aggregate, fine aggregates and ceramic powder. After sieving it can be used witout additional work and with minimal cost implication. Ceramic waste is obtained from RUCHI INDUSTRIES (J&K)

S.No.	Ingrdients	%content
1	CaO	2.16%
2	SiO_2	60.21%
3	Al_2O_3	32.43%
4	Fe_2O_3	1.15%
5	MgO	0.251%
6	K_2O	0.009%
7	Na_2O	0.093%

Chemical composition of ceramic waste

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F. Water

Potable water is used in the entire work.

G. Concrete Mix Design

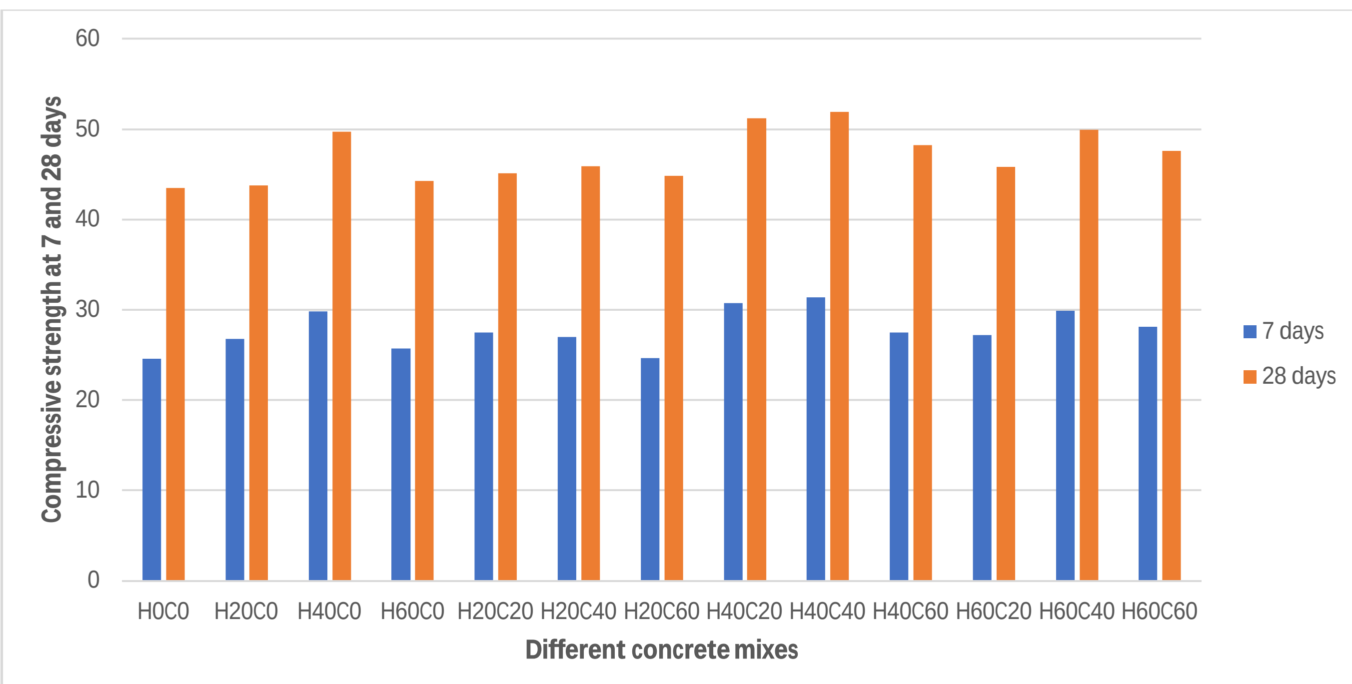
In this work M30 grade of concrete is designed by referring Indian standard codes IS: 456:2000 and IS: 10262:1982 Cement used = OPC 43 grade.

IV. RESULT AND DISCUSSION

A. Compressive Strength Test

Three cubes (150mm) from each batch of concrete mix are casted and cured for 7 and 28 days in order to determine the compressive strength of concrete. The below tables shows the average compressive strength of different mix combination tested at 7 and 28 days.

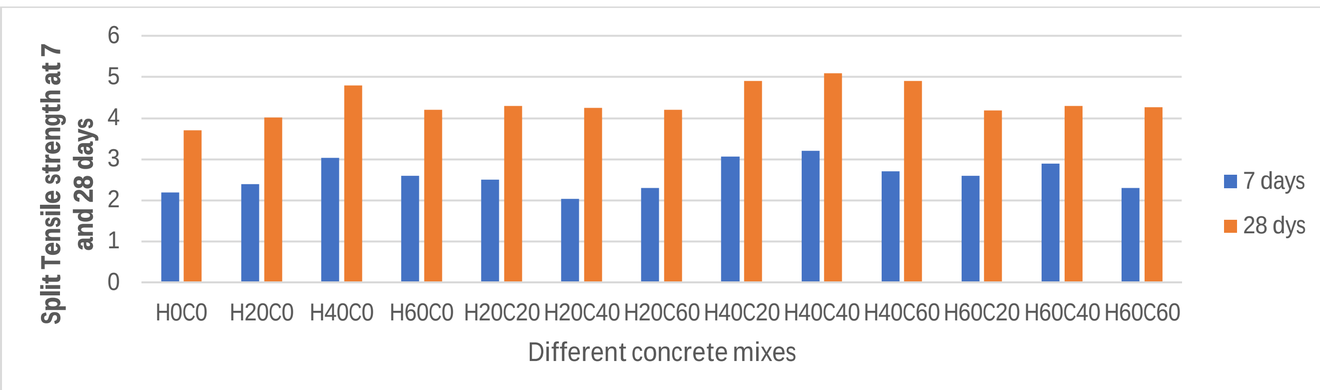
Sr.No.	Mix design	7 days Avg. Compressive strength (MPA)	28 days Avg. Compressive strength (MPA)
1	H0C0	24.6	43.5
2	H20C0	26.28	43.8
3	H40C0	29.8	49.7
4	H60C0	25.69	44.3
5	H20C20	27.5	45.1
6	H20C40	27.0	45.9
7	H20C60	24.64	44.8
8	H40C20	30.72	51.2
9	H40C40	31.4	51.9
10	H40C60	27.47	48.2
11	H60C20	27.2	45.8
12	H60C40	29.9	49.9
13	H60C60	28.1	43.5



B. Split Tensile Strength

Split tensile strength studies were carried out at the age of 7 & 28 days. Cylindrical beams of dimension 15cm diameter and 30cm height were used for split tensile strength. The results of Split Tensile Strength are tabulated below:

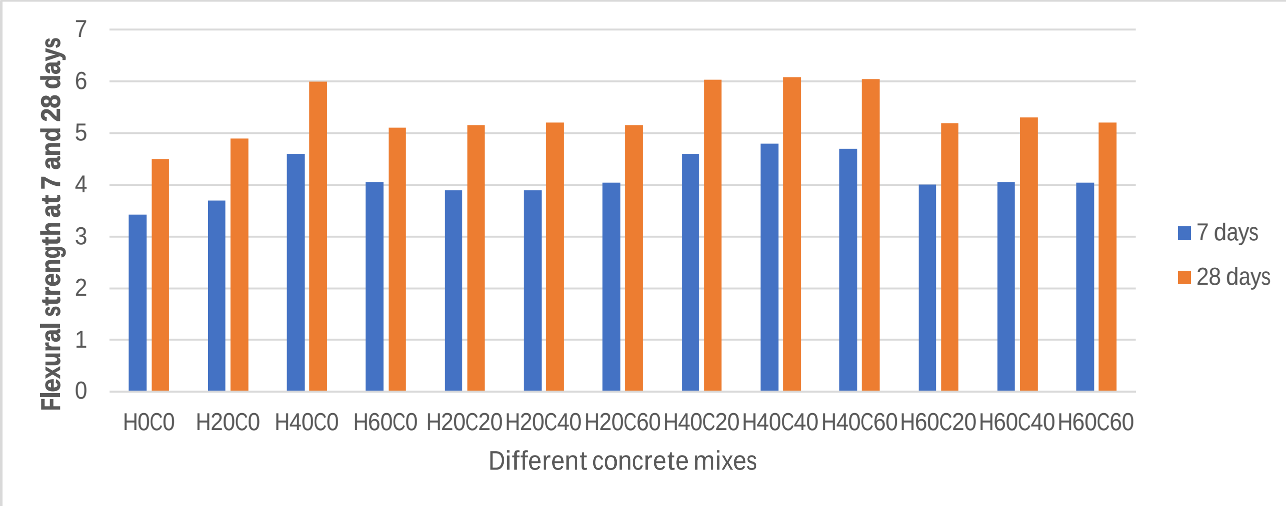
Sr.No.	Mix design	7 days Avg. Split tensile strength (MPA)	28days Avg. Split tensile strength (MPA)
1	H0C0	2.2	3.7
2	H20C0	2.4	4.01
3	H40C0	3.03	4.8
4	H60C0	2.6	4.2
5	H20C20	2.5	4.3
6	H20C40	2.04	4.25
7	H20C60	2.3	4.2
8	H40C20	3.06	4.9
9	H40C40	3.2	5.1
10	H40C60	2.7	4.9
11	H60C20	2.6	4.19
12	H60C40	2.9	4.29
13	H60C60	2.3	4.26



C. Flexural Strength Test

Flexural strength of alkali activated concrete was determined at 7days and 28days. The test is conducted on beams of size 500mm × 100mm × 100mm. The results of Flexural Strength are tabulated below:

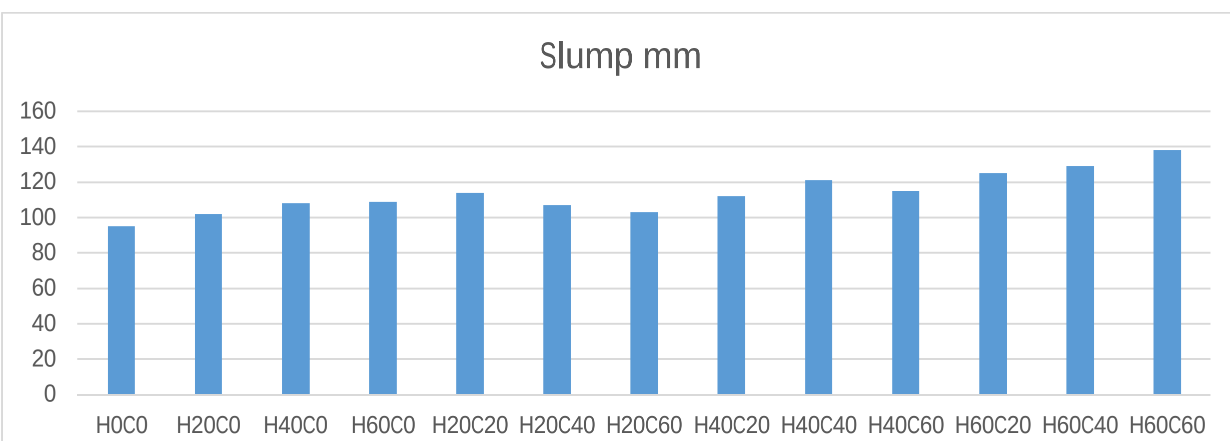
Sr.No.	Mix design	7days Avg. Flexural strength (MPA)	28days Avg. Flexural strength (MPA)
1	H0C0	3.42	4.5
2	H20C0	3.7	4.9
3	H40C0	4.6	6.0
4	H60C0	4.05	5.1
5	H20C20	3.9	5.15
6	H20C40	3.9	5.2
7	H20C60	4.04	5.16
8	H40C20	4.6	6.03
9	H40C40	4.8	6.08
10	H40C60	4.7	6.05
11	H60C20	4.0	5.19
12	H60C40	4.06	5.3
13	H60C60	4.04	5.2



D. Workability of Concrete

In this present experimental work workability was measured by slump cone test. The results of workability test performed on different mixes are tabulated below:

Sr.No.	Concrete designation	Slump(mm)
1	H0C0	95
2	H20C0	102
3	H40C0	108
4	H60C0	109
5	H20C20	114
6	H20C40	107
7	H20C60	103
8	H40C20	112
9	H40C40	121
10	H40C60	115
11	H60C20	125
12	H60C40	129
13	H60C60	138

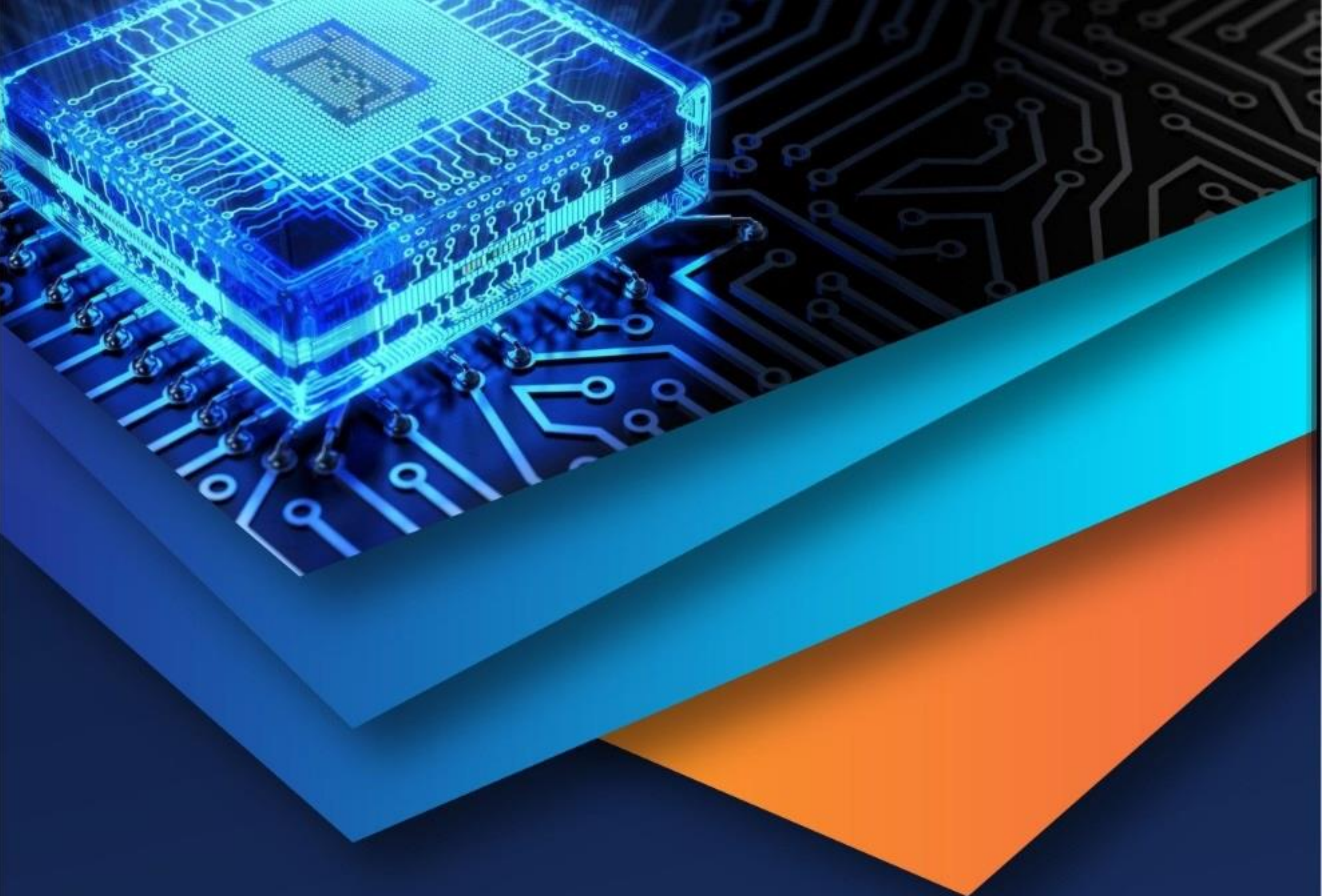


V. CONCLUSIONS

A. The Compressive strength result concludes that compressive strength of concrete maximum at H40C40 is 51.9N/mm2
B. With the addition of the ceramic waste in the recycled concrete sleepers there is an increase in the compressive strength of the mixture
C. The split tensile strength concluded that the maximum split tensile strength attained at H40C40 is 5.1N/mm2
D. The flexural strength test concluded that the maximum flexural strength attained at H40C40 is 6.08N/mm2
E. Slump of the concrete mix proportions increased with addition of the high performance recycled concrete and ceramic waste
F. Average compressive strength at H40C40 is increased by 21.65% at 7 days as compared to the ordinary concrete.
G. Average compressive strength at H40C40 is increased by 16.18% at 28 days as compared to the ordinary concrete.
H. Average split tensile strength at H40C40 is increased by 31.25% at 7 days as compared to the ordinary concrete.
I. Average split tensile strength at H40C40 is increased by 27.45% in 28 days as compared to the ordinary concrete.
J. Average Flexural strength at H40C40 is increased by 28.75% at 7 days as compared to the ordinary concrete.
K. Average Flexural strength at H40C40 is increased by 25.9% in 28 days as compared to the ordinary concrete.

REFERENCES

[1] S.k Singh ,P.C Sharma , Use of recycled aggregates in concrete.2012,NBM& Infra Construction & Equipment Magazine.
[2] Amit kumar Raval, Dr. Inderjit n.patel, Dr.jayesh kumar Pitroda. Effective replacement of cement for establishing sustainable concrete, Interantional journal of engineering trends and technology(IJETT)-volume4 issue6-june2013
[3] Francisco Carrion, Mechanical and Physical Properties of Polyester Polymer Concrete Using Recycled Aggregates from Concrete Sleepers, Scientific World Journal, 2014; 2014: 526346.Published online 2014 Aug 27. doi: 10.1155/2014/526346
[4] Sheriff Yehia, Kareem helal, Anaam Abu Sharakh, Amani Zaher(2015),Strength and durability evaluation of recycled aggregate concrete, International Journal of Concrete Structures and Materials volume 9, pages219–239(2015).
[5] [Ajibola Tijani, Jian Yang, and Samir Dira: High performance concrete using recycled aggregate, Microsilica and synthetic macrofibre2015, International Journal of Civil and Structural Engineering– IJCSEVolume 2 : Issue 1 [ISSN : 2372-3971]Publication Date: 30 April, 2015.
[6] G. SIVAPRAKASH, V. SARAVANA KUMAR and LAKHI JYOTI SAIKIA(2016): Experimental studies on partial replacement of sand by ceramic waste in concrete, Int. J. Chem. Sci.: 14(S1), 2016, 266-274 ISSN 0972-768.
[7] IS 2386-1963, Method of Test for Aggregate for Concrete, Bureau of Indian Standards, New Delhi.
[8] IS 516-1959, Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
[9] IS 383-1970, Specifications for Coarse and Fine Aggregate from Natural Source of concrete", Bureau of Indian Standards New Delhi.
[10] IS 12269-1987, Specifications for 53 Grade Ordinary Portland Cement", Bureau of Indian Standards, New Delhi.
[11] IS 10262-2009, Recommended Guidelines for Concrete Mix Design", Bureau of Indian Standards, New Delhi.
[12] IS 456-2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards New Delhi.



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