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EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF COARSE AGGREGATE BY CERAMIC AGGREGATE

P. Praneet Sai Kumar[1]

[1] M.Tech Student, Koneru Lakshmaiah Educational Foundation, Vaddeswaram, Andhra Pradesh, India

S. Monika Sri[2]

[2] M.Tech Student, Koneru Lakshmaiah Educational Foundation, Vaddeswaram, Andhra Pradesh, India

M. Sai Manideep[3]

[3] M.Tech Student, Koneru Lakshmaiah Educational Foundation, Vaddeswaram, Andhra Pradesh, India

I. Siva Kishore[4]

[4] Assistant Professor, Koneru Lakshmaiah Educational Foundation, Vaddeswaram, Andhra Pradesh, India

ABSTRACT

The main aim of this study is to search an alternative of coarse aggregate and to present an experimental study on the strength of concrete with the replacement of coarse aggregate with ceramic aggregate. In this paper, six samples of M30 grade at desired ceramic percentages of 20, 40, 60, 80, 100 in comparison with the control mix (CM). The strength were studied by compressive strength and tensile strength. The higher compressive strength were observed at 20% replacement and lower compressive strength were observed at 100% replacement of coarse aggregate by ceramic aggregate. The higher tensile strength were observed at 40% replacement and lower tensile strength were observed at 80% replacement of coarse aggregate by ceramic aggregate. It is also observed that workability of ceramic waste aggregate concrete is good.

KEYWORDS: *Ceramic Aggregate, Workability, Compressive Strength, Tensile Strength*

INTRODUCTION

Concrete is most widely used construction material all around world. It has become inevitable construction material in human life due to wide spread usage in modern construction and its properties like strength and durability. Ceramic waste from ceramic industries is one of the serious problem of generating waste near by the industries. In India it is observed that ceramic production is 100 million tons per year and about 15-30% of ceramic waste is generating from the total production. Ceramic products are made from natural materials which contain high proportion of earth minerals through a process of dehydration followed by controlled firing at temperature of 1200 to 1290°c. Ceramic industrial waste is used in to production of new concrete by replacing natural coarse aggregate and fine aggregate at different levels. Recycling of Ceramic waste is not practicing at present however the ceramic waste is durable, hard and highly resistant to the biological,

chemical and physical degradation forces. There is an interest mounting up to the handling of waste materials as different aggregates and significant research was performed on the use of many different materials as aggregate substitute such as ceramic waste and other industrial wastes. The waste aggregate can be used as well as in mortar and concrete. These waste materials can solve few problems like lack of aggregate in construction sites and environmental studies.

S. No	Property	Natural coarse aggregate	Waste ceramic aggregate
1	Specific gravity	2.64	2.50
2	Water absorption	0.10%	0.18%
3	Impact value	18.6%	22%
4	Crushing value	15.3%	20%
5	Abrasion value	14.25%	19%

MATERIALS

In this experimental work, OPC 43 grade cement was utilized which is having a specific gravity 3.15, Standard consistency 34, initial setting time 43 minutes and final setting time 123 minutes. Fine aggregate confirming to zone-III and specific gravity 2.60 was used. The natural coarse aggregate of size 10mm and 20mm are used, specific aggregate of 2.64 and water absorption 0.10% were used. Ceramic waste aggregate having a specific gravity 2.50 and water absorption 0.18%.

Table .1 Comparison of coarse aggregate

Fig. 1 Ceramic waste aggregate

Fig. 2 Measurement of slump fall

METHODOLOGY

Mix proportion

Taking after IS: 10262-2009, our mix design was done for ordinary Portland cement concrete having 28 days compressive strength of 30Mpa for control mix. For control mix having a compressive strength of 30Mpa, the mix proportion in Table .2. Other concrete mixes were prepared by replacing natural coarse aggregate with a ceramic waste aggregate i.e., 20, 40, 60, 80, 100%. Different constitution were kept steady.

Compressive strength test procedure

To assess the impact on compressive strength cube specimens were made. Standard sized cube specimens of 15x15x15 cm according to IS: 516-1959 were tested for compressive strength utilizing the compressive testing machine were shown in fig .3. The results of compressive strength were tabulated in Table .3.

Fig. 3 Compressive testing machine

Tensile strength test procedure

To assess the impact on split tensile strength cylindrical specimen were made. Standard sized cylindrical specimens of 15x30 cm according to IS: 5816-1999 were tested for split tensile strength. Utilizing the compressive testing machine. Placing cylinder in diametrical position in compressive testing machine. The results of split tensile strength were tabulated in Table .4.

Fig. 4 Tensile strength testing

RESULTS AND DISCUSSION

Table .2 Mix proportion

Mix Type	Ceramic Waste Coarse Aggregate (%)	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Ceramic Waste Coarse Aggregate (kg/m^3)	W/C Ratio
CM	0	427.00	743.60	960.96	0	0.5
CWCA20	20	427.00	743.60	768.76	192.19	0.5
CWCA40	40	427.00	743.60	576.58	384.38	0.5
CWCA60	60	427.00	743.60	384.39	576.57	0.5
CWCA80	80	427.00	743.60	192.20	768.76	0.5
CWCA100	100	427.00	743.60	0	960.96	0.5

Table .3 Compressive strength test results

S.NO	Mix Type	Compressive strength in MPa (28 days)
1	CM	38.80
2	CWCA20	38.91
3	CWCA40	32.52
4	CWCA60	30.65
5	CWCA80	28.15
6	CWCA100	26.85

Table .4 Tensile strength test results

S.NO	Mix Type	Split Tensile strength in MPa(28 days)
1	CM	4.31
2	CWCA20	4.32
3	CWCA40	4.56
4	CWCA60	4.28
5	CWCA80	3.97
6	CWCA100	4.05

CONCLUSION

The results of the experimental investigation indicate that the addition of ceramic aggregate in Ordinary Portland cement replacement for concrete preparation.

- Using the test results it can be concluded that with the increase in the percentage of ceramic aggregate in concrete up to 20%

of replacement the strength is increased and further increase in ceramic, properties of concrete were decreased.

- The split tensile strength is increases up to 40 % replacement of coarse aggregate by ceramic aggregate ad the again increase the percentage of ceramic, the tensile strength is decreases.
- By using ceramic tile aggregate, the mass of aggregate reduces about 50% which in turn reduces the weight of concrete.

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