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HIGH PERFORMANCE CONCRETE MADE RECYLED AGGREGATES

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ABSTRACT

Recycled aggregates are made up of crushed, graded inorganic particles that have been processed from construction materials and demolition detritus. The goal of this research is to investigate the strength characteristics of recycled aggregates for use in high-performance concrete, in order to gain a better knowledge of the features of concrete including recycled aggregates as a substitute for coarse aggregate in structural concrete. The goal of this study is to compare and identify the qualities of high-performance concrete made entirely of recycled aggregates. Using waste materials to create new products is a global trend that is rapidly gaining traction. Recycling materials allows for a more efficient life cycle and helps to safeguard the environment. Because of the scarcity of natural resources and the environmental issues associated with storing demolition waste, this practise has gained traction in the construction industry. As a result of this predicament, researchers are looking for new uses for these wastes, and using them as aggregates in concrete is an intriguing option. According to research conducted around the world, the issue with recycled aggregates in concrete is that they have a lower strength and durability. The use of recycled aggregate in high-performance concrete is one approach. The goal of this experiment is to see how recycled aggregate from high-strength parent concrete affects the attributes of high-performance concrete.

Keywords: Recycled Aggregates, Structural Strength, Waste Materials.

I. INTRODUCTION

Because of its high structural strength, stability, and longevity, concrete is a widely used construction material in the civil engineering industry. The Indian building industry uses about 400 million tonnes of concrete per year and is likely to surpass a billion tonnes in less than a decade. Deterioration, long-term poor performance, and insufficient resilience to hostile environments, combined with increased demands for more advanced architectural form, prompted faster study into cement and concrete micro structure. As a result, new auxiliary materials, enhanced concretes, and composites have been created. The development of a durable concrete that is less reliant on the quality of building work was prompted by the frequent occurrence of durability-related problems in concrete structures.

II. MATERIAL AND MIX PROPOTIONING

2.1.1 Cement

In this study, ordinary Portland cement of grade 53 from the local market was employed. The cement used was tested for various amounts according to IS 4031-1988 and determined to meet the requirements of IS 12269-1987. The fineness was 2280cm2/gm and the specific gravity was 3.1.

2.1.2 Fine Aggregate

The fine aggregate utilised in the study was river sand from a local river that met Indian standard specifications for zone II (IS 383-1970). The sand was sieved through a 4.75mm IS sieve to eliminate any particles larger than 4.75mm, then washed to remove dust.

2.1.3 Coarse Aggregate

Coarse aggregate is the material that passes through IS sieve no. 4.75. For the experiment, two types of coarse aggregate were used. There are two types of coarse aggregate: natural coarse aggregate and recycled coarse aggregate.

The coarse aggregate used in the project was recycled the information was gathered from the demolished cubes that were tested in the civil engineering department's concrete technology lab. They are taken from the final mix made with natural aggregate in this study. As a result, the parent concrete from which recycled aggregate

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was obtained at the age of 28 days was of grade 80 MPa, whereas natural aggregates were collected from a nearby stone quarry.

2.1.4 Silica fume

Silica fume is produced as a byproduct of the production of silicon metal or ferrosilicon alloys. One of the most prominent mineral admixtures with pozzolanic characteristics.

2.1.5 Superplasticizer

Auramix 400, manufactured by Fosroc Chemicals, is a high-performance superplasticiser designed for applications requiring high water reduction and long workability retention. It was designed for use in self-compacted concrete, pumped concrete, concrete with long workability retention, and high-performance concrete.

2.1.6 Mix Proportioning

Designing an acceptable mix proportion and analysing the qualities of the concrete thus obtained are the most important tasks in producing high-performance concrete. There are a variety of standard mix design and proportioning procedures. The preliminary mix design for this study was done using the ACI method for M80 grade high performance concrete with 100 percent natural coarse particles.

Following the initial mix design, trial mixes are created and tested for fresh concrete qualities. If the design mix fails to meet all of the standards for concrete's fresh properties. The quantities of the trial mixtures are fine-tuned until all requirements are met. We arrived at the final blends after repeating the trials.

III. EXPERIMENTAL METHOD

Procurement of Materials

⇓

Testing of Materials

⇓

Arriving mix Proportion

⇓

Testing of fresh concrete

⇓

Casting & curing of concrete

⇓

Strength Investigation

⇓

Permeability Test

⇓

Durability Test

⇓

Result & Discussion

IV. DESIGN STEPS

Target strength = 80 Mpa

Max size of aggregate used = 16 mm

Specific gravity of cement = 3.15

Specific gravity of fine aggregate (F.A) = 2.66

Specific gravity of Coarse aggregate (C.A) = 2.82

Dry Rodded Bulk Density of fine aggregate = 1723.37 Kg/ m^3

Dry Rodded Bulk Density of coarse aggregate = 1663.01 Kg/ m^3

Step-1

Calculation for weight of Coarse Aggregate:

From ACI 211.4R Table 4.3.3 Fractional volume of oven dry Rodded C.A for 16 mm size aggregate is 0.72 m^3

Weight of C.A, = 0.72*1663.01 = 1197.36 Kg/ m^3

Step-2

Calculation for Quantity of Water:

From ACI 211.4R Table 4.3.4

Assuming Slump as 50 to 75 mm and for C.A size 16 mm the Mixing water = 285 lb/yd^3

Void content of FA for this mixing water = 35%

Void content of FA (V)

V = {1-(Dry Rodded unit wt / specific gravity of FA*1000)}*100

= [1-(1723.37/2.66*1000)]*100

= 35.21%

Adjustment in mixing water = (V-35)*4.55 = (35.21 – 35)*4.55 = 0.96

Total water required = 285 + 0.96 = 285.96 lb/yd^3 = 169.65 Kg/ m^3

Step-3

Calculation for weight of cement

From ACI 211.4R Table 4.3.5(b)

Take W / C ratio = 0.27

Weight of cement = 169.65 / 0.27 = 628.33 Kg/ m^3

Step-4

Calculation for weight of Fine Aggregate:

Cement = 628.33 / 3.15*1000= .199

Water = 169.65 / 1*1000= 0.169

CA = 1197.36 / 3*1000= 0.399

Entrapped Air = 2 / 100= 0.020

Total = 0.78 m^3

Volume of Fine Aggregate= 1-0.78

Weight of Fine Aggregate= 0.22*2.66*1000= 585.2 Kg/ m^3

Step-5

Super plasticizer:

For 0.6% = (0.6 / 100)*585.2 = 3.511 ml

Step-6

Correction for water:

Weight of water (For 0.6%) =169.65 – 3.511 = 166.14 Kg/ m^3

Requirement of materials per Cubic meter

Cement = 628.33 Kg/ m^3

Fine Aggregate = 585.2 Kg/ m^3

Coarse Aggregate = 1197.36 Kg/ m^3

Water = 166.15 Kg/ m^3

Super plasticizers = 3.5012 Kg/ m^3

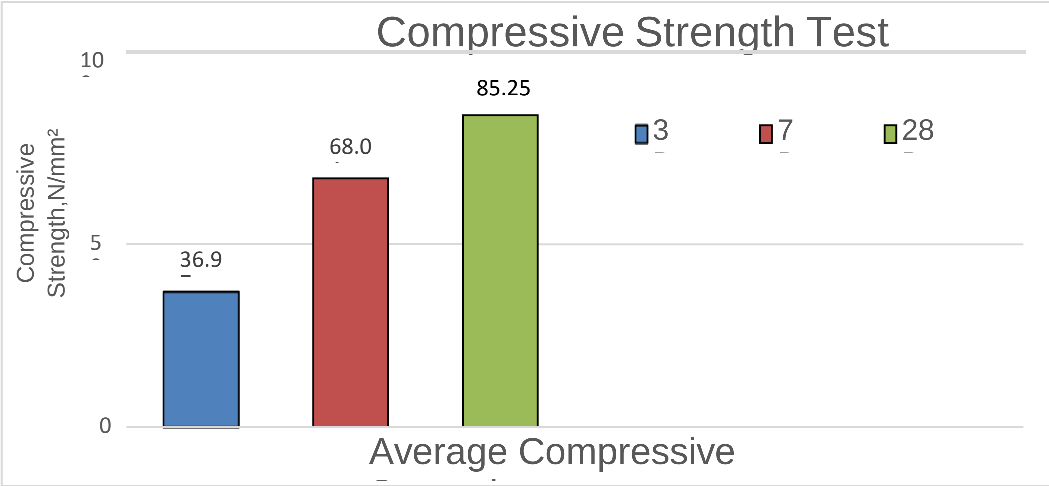
Silica fume =15% of cement =0.15*628.33 = 94 Kg/ m^3

So the final ratio becomes Cement : Fine agg (kg/m3) : Coarse agg (kg/m3) : Silica fume : Water (l/m3): Superplasticizer (l/m3)

V. RESULTS

5.1 Compressive strength results for natural aggregates

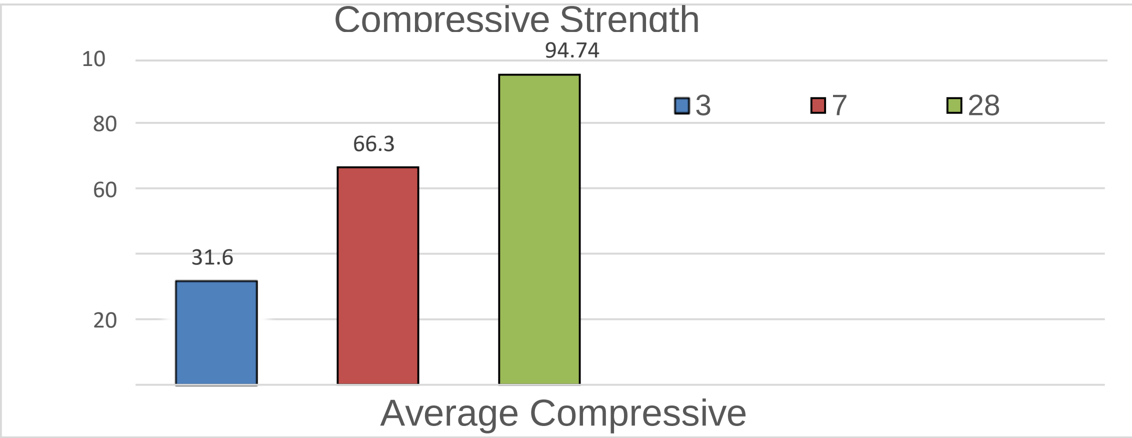
	Specimen 1	Specimen 2	Specimen 3	Average
3 days, N/mm^2	35.38	34.28	41.25	36.97
7 days, N/mm^2	62.8	71.46	69.87	68.04
28 days, N/mm^2	85.34	82.26	88.15	85.25



Average compressive strength of natural aggregates at 3, 7, 28 days.

5.2 Compressive strength results for recycled aggregates

	Specimen 1	Specimen 2	Specimen 3	Average
3 days, N/mm^2	30.31	33.6	32.7	32.20
7 days, N/mm^2	66.05	65.18	67.93	66.38
28 days, N/mm^2	86.19	98.93	86.16	90.43



Average compressive strength of recycled aggregates at 3, 7, 28 days

VI. CONCLUSION

The findings of the experiments are highly encouraging in terms of encouraging the usage of recycled aggregate in high-performance concrete. The following are some of the significant results reached from this research:

When compared to natural aggregate HPC, recycled aggregate HPC demonstrated better compressive strength and split tensile strength at 28 days.

The qualities of RCA concrete are more affected by the strength of the parent concrete from which recycled

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aggregate was produced. When compared to natural aggregate HPC, recycled aggregate HPC has a two-fold higher water absorption. The sorptivity coefficient of natural aggregate HPC was three times higher than that of recycled aggregate HPC. When compared to natural aggregate HPC, recycled aggregate HPC showed better acid resistance. The results of this experiment show that recycled aggregate obtained from high-quality parent concrete has the ability to totally replace natural aggregates in high-performance concrete.

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