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STUDY ON RECYCLED AGGREGATE CONCRETE WITH FLY ASH

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Abstract - Use of recycled coarse aggregate concrete can be useful for environmental protection and economical terms. Recycled aggregates are the materials for the future. Fly ash is a group of materials that canvary significantly in composition. It is residue left from burning coal, which is collected in an electrostatic Precipitators or in a bag house. it mixes with flue gases that result hen powdered coal is used to produce electric power. Globally, the concrete industry consumes large quantities of natural resources, which are becoming insufficient to meet the increasing demands. At the same time, large number of old buildings and other structures have reached the end of their service life and are being demolished, resulting in generation of demolished concrete. Recycling concrete by using it as replacement to new aggregate in concrete could reduce concrete waste and conserve natural sources of aggregate. The aim of present investigation is mix design of recycled aggregate concrete. The ACI (211.1-91) mix design procedure is adopted with targeted design strength of concrete for 28days is 26 Mpa. Six concrete proportions were used with 0, 25, 50, 75 and 100% replacement of natural aggregate by recycled aggregate and addition of fly ash with 15%. Total 30 number of cube specimens were caste for cube compression and 30 number of cylinders specimens were caste for split tensile strength of concrete.

Key Words*: *Key words: Fly ash, OPC, Fine aggregate, Recycled coarse aggregate, Natural coarse aggregate, w/c ratio.

1.INTRODUCTION

Globally, the concrete industry consumes large quantities of natural resources, which are becoming insufficient to meet the increasing demands. At the same time, large number of old buildings 8 other structures have reached the end of their service life and are being demolished, resulting in generation of demolished concrete. Some of this concrete waste isused as backfill material, and much being sent to landfills. Recycling concrete by using it as replacement to new aggregate in concrete could reduce concrete waste and conserve natural sources of aggregate. In the last two decades, a variety of recycling methods for construction and demolition wastes (CDW) have been explored and are in well developed stage. BS EN Standards for recycled. concrete to be in secondary structural members of relatively low grades, e.g. curbs, paving blocks and ground bear. Concrete composite effects of fly ash, silica fume and rice husk ash as pozzolanas, RACderived from even lower grades of concretes can be used to produce HS - RAC [1]. Recycled aggregate concrete for transportation infrastructure, the elastic modulus of RAC decreased with increase in percentage of RAC [2]. Utilization of recycled coarse aggregates for application in high strength structural concrete, reduced permeability to water and aggressive chemicals [3]. Natural coarse aggregate (NCA) is replaced with RCA at different percentage and the mechanical strength of concrete is tested, RCA and FAup to 30% can be used for making concrete [4].Combined effects of incorporating high contents of fly ash (FA) and recycled concrete aggregates (RCA) in concrete, carbonation depth can be doubled in the worst case scenario (100% of RCA and about 50% of FA) at 10 year [5]. Life Cycle Assessment (LCA) methodology was used to determine the most influential factors, the GWP and PE-NRE of concrete mixtures seem not to be considerably affected by the incorporation of RA [6]. Durability of Recycled Aggregate Concrete, The chloridepenetrability resistance and abrasion resistance of RAC linearly reduce with the increase of replacement percentage of RCA [7]. Improving methods used to keep the properties of the recycled aggregate concrete Using supplementary materials, the properties of MRAC can be improved [8].Review on Sustainable Developments and Economic Considerations research on indirect utilization of CFA includes recovery of the magnetic fraction, alumina, Ti, Fe and REEs [9]. Fundamental behavior of recycled aggregate concrete, the steel corrosion and corrosion-induced cracking in RAC are more serious than those in natural aggregate concrete [10].

2. MATERIAL PROPERTIES OF RECYCLE AGGREGATE AND FLY ASH

The recycled aggregate concrete (RAC) is a new concrete which is Similar to natural aggregate concrete, but the only difference is that the aggregate used is arrived from the demolished concrete waste. Till today the research of RAC is mostly carried out in countries like United States, Europe and Japan etc. in India its Research is at very initial stage. Advanced countries are using this RAC mostly for the non structural elements because the research is

Fig :1 Recycled Aggregate

Fig :2 Fly Ash

2.1 PROPERTIES OF FLY ASH

It's a fine powdery material that is a byproduct of burning coal in power plants. One of its key properties is its pozzolanic nature, which means it can react with water and calcium hydroxide to form cementious compounds. This makes it a great addition to concrete, as it can improve its strength and durability. Fly ash also has a low permeability, which helps make concrete more resistant to moisture and chemical damage. Plus, using fly ash in concrete production can help reduce greenhouse gas emissions. So, it's a win- win for construction and the environment

Table 1 : Physical Properties of fly ash

S.no	Properties	value
1	Specific gravity	2.2
2	Fine modulus	10%
3	Consistency	30%

2.2 PROPERTIES OF CEMENT

The specific gravity , normal consistency , initial setting time and fineness of cement tests had been carried out and the results are presented in Table 2.

Table 2: Physical properties of cement.

S.no	Properties	Value
1	Specific gravity	3.12
2	Initial setting time	90min
3	Normal setting time	32%
4	Fineness of cement	7

2.3 PROPERTIES OF FINE AGGREGATE AND COARSE AGGREGATE

Locally available natural penna river sand is used. Sand having fineness modulus 2.71 and confirmed to grading zone-II as per IS: 383-1970 recommendation Fine aggregate (Sand) Fills voids between aggregates. It forms the bulk and makes mortar or concrete economical. It provides resistance against shrinking and cracking. Fine aggregate fractions from 4.75 mm to 150 microns are termed as fine aggregate. The physical properties of fine aggregate results are tabulated in table 3.

Crushed stone aggregates were collected from the local quarry of 20mm down and 12.5mm down size are used as coarse aggregates in this experiment. The above mentioned aggregates are blended in equal proportion and tested as per IS:383- 1970 to from 20mm well graded aggregates Coarse aggregates are particulates that are greater than 4.75mm. Coarse aggregates refer to irregular and granular materials such as sand, gravel, or crushed stone, and are used for making concrete. The coarse aggregate density used for construction is generally between 1450 –2082 kg/m^3. The test results of coarse aggregate are presented in table 4.

Table 3: Physical properties of fine aggregate.

S.no	Properties	Value
1	Specific gravity	2.62
2	Fineness modulus	2.71
3	Grading	Zone-II

Table 4: Physical properties of coarse aggregate

S.no	Properties	Value
1	Specific gravity	2.66
2	Bulk density	1320
3	Water absorption	0.55

2.4 SPECIFIC DETAILS OF THE PROJECT

Cubes and cylinders are cast with standard cube and cylinder moulds . The slumps were measured at the time of casting cubes and are listed in Table 5. The 30no of specimens cube and 15 no of cylinder are de- moulded

after 24 hours and were cured for 7 days, 28day and 90 days.

Table 5 Mix Propotions

Nomenclature	Coarse Aggregate %	Recycled Coarse Aggregate
S1	100	0
S2	75	25
S3	50	50
S4	25	75
S5	0	100

2.5 COMPRESSIVE STRENGTH OF CUBES

For cube test mould of size 15 cm x 15cm x 15 cm are commonly used and the size of cylinders are 15cm dia and 30 cm height. This concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these mould are removed and test specimens are put in water for curing. The top surface of these specimens should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen. These specimens are tested by compression testing machine after 7 days curing , 28 days curing and 90 days curing. Load at the failure divided by area of specimen gives the compressive strength of concrete.

Table 6: Results of compressive strength of cubes

sample	7 days (N/mm^2)	28 days (N/mm^2)	90 days (N/mm^2)
S1	24.44	34.22	37.64
S2	23.11	32.44	35.69
S3	21.96	30.67	33.73
S4	20.74	29.19	32.10
S5	18.07	25.19	27.10

It can be seen that there is increase in strength with the increase in fly ash percentages. The highest compressive strength was achieved by15% addition of fly ash, which was found about 24.4 Mpa compared with 37.6 Mpa for the control mixture at 90 days. The compressive strength of concrete is increased as fly ash content increases up to 15%, beyond that compressive strength was significant decreases due to increases free water content in the mixes. This means that there is an increase in the strength of 10% compared to the control mix. However, mixtures with 15% addition of fly ash gave the lowest compressive strength 27.7 compared with 18.07Mpa. The compressive strength of concrete decreased as 9%.

2.6 SPLIT TENSILE STRENGTH FOR CYLINDER

A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter. It is an indirect method of testing tensile strength of concrete. The concrete is not usually expected to resist the direct tension because of its low tensile stress and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. The split tensile strength was determined by testing cylinders of size 150mm diameter and 300mm height in compressive testing machine. The split tensile strength of concrete was then calculated.

Table 7: Results of split tensile strength test

sample	7 days (N/mm^2)	28 days (N/mm^2)	90 days (N/mm^2)
S1	2.03	2.81	3.09
S2	1.86	2.62	2.90
S3	1.75	2.45	2.74
S4	1.65	2.36	2.64
S5	1.46	2.17	2.41

The highest split tensile strength was achieved by 15% addition of fly ash, which was found about 2.03 N/mm^2 compared with 3.09 N/mm^2 for the control mix. This means that there is an increase in the strength of almost 1% compared to the control mix at 90 days.

3.CONCLUSION

- By our project, we conclude that the strength of Recycled aggregate concrete increased by the addition of cement by fly ash. Fly ash addition Portland cement, save concrete materials costs. Here we using OPC of 53 grade, F fly ash, well graded coarse and fine aggregate.
- 15% fly ash addition showed maximum workability. The workability of concrete had been found to decrease after 40% in concrete. Among different mixes of concrete 25% showed maximum compressive strength at later ages.
- Maximum split tensile strength is obtained for S1 mix which is 15% addition of cement in Fly ash.

- The cost analysis indicates that percent of cement reduction decrease the cost of concrete, but at the same time strength increases.

- The spherical shaped particles of fly ash act as miniature ball bearings within the concrete mix, thus providing a lubricant effect. This same effect also improves concrete pumpability by reducing frictional losses during the pumping process and flat work finishability.

- The S1 mix is the most economical and gives high strength compared to control mix. Other uses:

  - Greater strength
  - Decreased permeability
  - Increased durability
  - Reduced alkali silica reactivity
  - Reduced heat of hydration
  - Reduced efflorescence.

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