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Influence of fly ash on the properties of recycled coarse aggregate concrete

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ABSTRACT

The availability of concrete manufacturing materials is the greatest crisis faced by the construction industry these days. The future generations will face terrific problems by digging up and blasting the limited natural resources. So, there is an importance for using the recycled demolition waste and fly ash which are considered as waste materials till years. To decrease the disposal of these materials, reduce the cost and for protection of environment these materials are highly useful. This is an experimental study to inspect the strength of the demolished aggregate and fly ash concrete. The idea is to trim down the amount of demolished concrete waste materials and fly ash going into landfill and discarding pits. Three combinations of M25 grade concrete by replacing demolished aggregate concrete and fly ash in various percentages (0%, 5%, 10%, 15%, and 20%) at 0.48 water/cement ratios were performed. From the experimental study it was proved that the limited applications of demolished recycled coarse aggregate and fly ash is recommended in structural concrete.

Key words: Fly ash (FA), Cement, Recycled coarse aggregate (RCA), Natural coarse aggregate (NCA), sand, Compressive strength (CS), Workability

1. INTRODUCTION

Right now, heaves of demolished construction waste and fly ash are generated every year as a result of development in the construction field. The large amount of demolished concrete and fly ash are available, which are now posing a grave trouble of dumping in urban areas (AGYEKUM). The usage of natural aggregates getting more and more with the advance development of infrastructure [1]. This usage can be reduced by using recycled aggregates instead of natural coarse aggregates and fly ash instead of cement at a certain optimum percentage. Research and development performances have been engaged all over the globe for proving its practicability, financially, viability and cost effectiveness.

Type of curing also influence on the strength of concrete and it is also depending upon the type of admixture.

The replacement of natural aggregates by using recycled aggregates from construction and demolition waste is showing potential function in construction as substitute to natural fresh aggregates [2]. It conserves space required for the discarding. Re-use of demolition concrete in construction, it involves breaking, crushing and make it from immaterial and polluted materials from active concrete and then using it in recent construction work. Fly ash is generally used in concrete in replacements that are ranging from 0 to 30% by mass of total cementitious stuff. A high proportion of the cement contained by concrete can be replaced by fly ash exclusive of unfavorably disturbing concrete properties [3].

1.1 Objective

- The present study is to identify the mechanical properties of recycled coarse aggregate concrete by adding fly ash (5%, 10%, 15%, 20%.) as partial replacement cement.
- Identify the workability property of recycled coarse aggregate concrete and suggest best combination for good workability
- Comparison of properties of concrete with different proportions of fly ash and recycled coarse aggregates and suggests the best combination.

1.2 Methodology

1. Collection of The materials normal coarse aggregate, recycled coarse aggregate, sand, cement, fly ash is to be collected.
2. Tests on materials like cement (specific gravity, Soundness, Fineness, Normal consistency, Initial and final setting time), aggregates (water absorption), sand (Bulking of sand, Fineness modulus) are conducted.
3. Mix design preparation.
4. Casting and curing of cubes.
5. Tests on cubes: compressive strength test

2. MATERIALS

Use the main units SI (MKS) or CGS. English units may be used as secondary units (SI units strongly encouraged) [4].

2.1 Ordinary Portland cement (OPC)

In this experimental work 53 grade cement was used. Here 53 is used as compressive strength of cement at 28 days of curing. According to IS 12269-2013 different tests are conducted on OPC as shown in Table 1.

Table-1: Properties of 53 grade OPC

S. No	Properties	value	Maximum permissible values as per IS 12269-2013
1	Specific gravity of cement	2.96	-
2	Soundness of cement	1mm	10 mm
3	Fineness of cement	3.33%	10%
4	Normal consistency	30%	-
5	Initial setting time of cement	70 min	Minimum 30min
6	Final setting time of cement	440 min	Maximum 600 n

2.2 River Sand

Generally fine aggregates are rock particles with particle size less than 4.75mm. Fine aggregates need to be processed by the perfect aggregate production line [5]. The minimum size of fine aggregate is 0.075mm which is preferred for concreting work. Different tests on fine aggregate are conducted as shown in Table 2.

Table 2: Properties of sand

S. No	Properties	value
1	Bulking of sand	4%
2	Fineness modulus of sand	3.15

2.3 Fly ash (FA)

The non-combustible mineral part present in the coal is called fly ash [6]. In this project we used dry fly ash collected from the electrostatic precipitators of NTPS thermal power plant. The concrete with cement replaced by fly ash gives less strength in comparison to replacement of sand by fly ash.

2.4 Natural coarse aggregate (NCA)

In this experimental study 12mm and 20mm size coarse aggregate was used. The goal of concrete mix design is to use as much coarse aggregate as possible, and then use successively smaller sized particles to fill in the gaps between the larger coarse aggregate particles [7]. This is the purpose of choosing two aggregate sizes in (12mm and 20mm) the experimental work. Test on natural coarse aggregate is given in Table 3.

Table 3: Properties on natural coarse aggregate

S. No	Properties	value
1	Water absorption on coarse aggregate	0.5%

2.4 Recycled coarse aggregate (RCA)

In this experimental study concrete aggregate is collected from the nearby demolished revenue building in Velvadam. In this project 20mm recycled coarse aggregate was used. The demolished aggregate concrete is recycling involves crushing it down to size requires the use of natural resources and dressing of these demolished aggregate was performed by using Los Angeles abrasion machine [8]. Test on recycled coarse aggregate is given in Table-4.

Table 4: Properties on recycled coarse aggregate

S. No	Properties	value
1	Water absorption on recycled coarse aggregate	3%

2.6 Water

In this project potable water which is locally available is used for making and curing of concrete.

3. MIX DESIGN DETAILS

Using material test data, M_{25} is prepared for concrete mix design and proportions are tabulated in Table-5.

Table 5: Mix proportions

Water (litres)	Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)
176	366	684	1137
1:1.86: 3.1			

4. RESULTS AND DISCUSSION

The test results for workability, Compressive strength (at 7 days and 28 days) of concrete mix M_{25} with different percentages [9] of Fly ash and Recycled coarse aggregate (0%, 5%, 10%, 15% and 20%) with constant W/C ratio 0.48 are shown in Table 6, Table 7, Table 8.

4.1. Workability

Compaction Factor values for M25 Concrete prepared by adding Fly ash and Recycled coarse aggregate separately and combinedly at 0%, 5%, 10%, 15% and 20%.

Table 6: Compaction Factor values

S. No	%	CF values for FA	CF values for RCA	CF values for FA & RCA
1	0	0.9	0.9	0.9
2	5	0.9	0.85	0.66
3	10	0.89	0.8	0.6
4	15	0.87	0.78	0.52
5	20	0.8	0.7	0.5

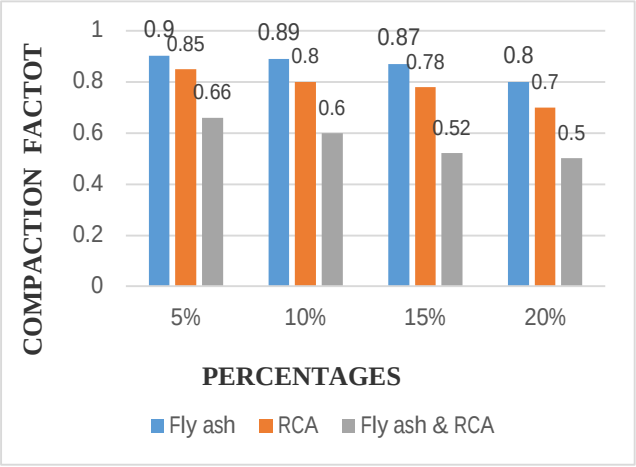

Figure 1: Comparison of Compaction factor values for % of Fly ash, RCA and both Fly ash & RCA in Cement, NCA and Cement & NCA

4.2. Compressive strength values

Compressive strength values are taken at 7 days and 28 days for M25 Concrete prepared by adding Fly ash and Recycled coarse aggregate separately and combinedly at 0%, 5%, 10%, 15% and 20%.

Table 7: Compressive strength (CS) values @ 7 days

S. No	%	CS(N/mm^2) for FA	CS(N/mm^2) for RCA	CS(N/mm^2) for FA & RCA
1	0	20.4	20.4	20.4
2	5	20	20.38	20.37
3	10	19.65	18.46	19.6
4	15	19.15	18.11	17.9
5	20	18	16.33	17.71

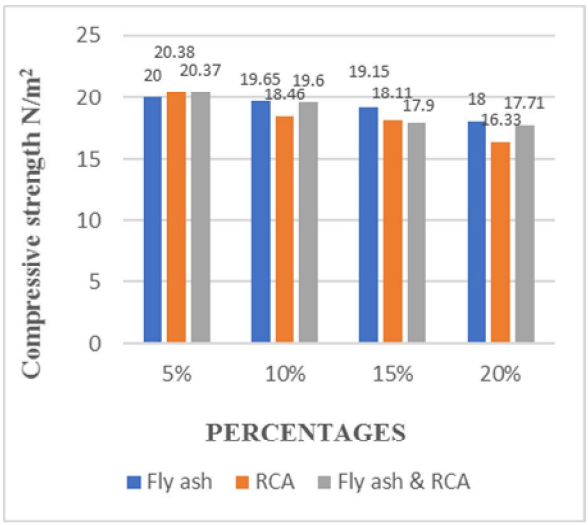

Figure 2: Comparison of Compaction strength for % of Fly ash, RCA and both Fly ash & RCA in Cement, NCA and Cement & NCA @ 7 days

Table 8: Compressive strength values @28days

S. No	%	CS(N/mm^2) for FA	CS(N/mm^2) for RCA	CS(N/mm^2) for FA & RCA
1	0	34.11	34.11	34.11
2	5	33.05	32.72	25
3	10	30.14	31.38	20
4	15	28.33	29.53	17.37
5	20	25.46	26.06	16.26

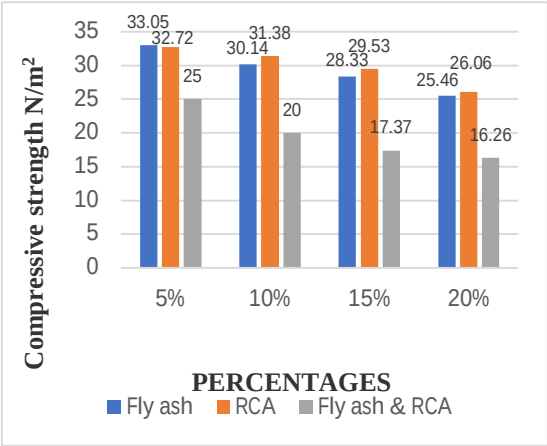

Figure 3: Comparison of Compaction strength for % of Fly ash, RCA and both Fly ash & RCA in Cement, NCA and Cement & NCA @ 28 days.

5. CONCLUSION

- Target strength is achieved for M25 grade of conventional concrete.
- It is observed that the workability of fly ash cocnrete and recycled aggregate cocnrete decreased compared to conventional concrete.
- Upto 20% of fly ash and upto 10% of RCA is used for better workability.
- For fly ash cocnrete, it is observed that upto 15% the strength is good and behind that the strength of cocnrete is decreased.
- For recycled coarse aggregate concrete , it is observed that upto 10% of RCA the Strength is good and behind that the strength of cocnrete decreased.
- For combination of fly ash and recycled coarse aggregate concrete, it is observed that upto 5% of FA+RCA the strength is good and behind that the strength of cocnrete decreased.
- For all the combinations there is no increment in percentage of strength.
- It is suggested that upto 15% of FA, 10% of RCA and 5% of FA+RCA is replaced on the basis of compressive strength of cocncrete.

REFERENCES

1. De Brito, J., Poon, C. S., & Zhan, B., **New trends in recycled aggregate concrete.** Applied Sciences, pp. 1-5, 2019. https://doi.org/10.3390/app9112324
2. Mahesh V. Raut, S. V. , **Influence of High Volume Fly Ash as a Replacement of Cement and Sand Along With Glass Fiber on the Durability of Concrete**. International Journal of Engineering and Advanced Technology, Vol. 8 ,Issue-5, pp. 42-48, 2019.
3. Manohar, V., & Polu Raju, P. **Comparative study on compressive strength of fly ash concrete**. International Journal of Civil Engineering and Technology, Vol 8, Issue 4, pp. 1668-1676, 2017.
4. Rama Krishna, B., Harish Kumar, K., Mani Kumar, T., & Likitha, I., **Properties of GGBS concrete under various curing conditions.** International Journal of Emerging Trends in Engineering Research, Vol 8, No. 4, pp. 1384-1387, 2020.
5. Kutwad, A. G., Nikam, M. B., Wagare, M. T., Birajdar, V. B., & Vispute, G. C., **A Study and Use of Recycled Aggregate with Fly Ash in Concrete.** International Research Journal of Engineering and Technology(IRJET), Vol 04, Issue: 04, pp. 2380-2383, 2017.
6. Kou, S. C., Poon, C. S., & Dixon, C., **Influence of fly ash as cement replacement on the properties of recycled aggregate concrete.** Journal of Materials in Civil Engineering, Vol 19, No.9, 709–717, 2007.
7. Dabhade, A. N., Chaudari, S. R., & Gajbhaye, A. R., **Effect of Flyash on Recycle Coarse Aggregate Concrete**. International Journal of Civil Engineering Research, Vol 5, No 1, pp. 35-42, 2014.
8. Elchalakani, M., Basarir, H., & Karrech, A. (2017). **Green concrete with high-volume fly ash and slag with recycled aggregate and recycled water to build future sustainable cities.** Journal of Materials in Civil Engineering, Vol 29, Issue 2, 2017. https://doi.org/10.1061/(ASCE)MT.1943-5533.0001748
9. Muda, M. F., Ahmad, S. W., Muftah, F., Syahrul, M., & Mohd, H., **Mechanical Behavior of Mortar Made with Washed Bottom Ash as Sand Replacement**, International Journal of Emerging Trends in Engineering Research, Vol. 7, No. 9, pp. 7-14, 2019.