WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Flexural Behavior of Concrete Made with RCA and Coal Bottom Ash

Hemant Malviya [1] ***Rajesh Kumar Misra***[2]

[1]Post Graduate Student, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA
[2]Professor, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA

ABSTRACT

Recycled aggregate concrete (RAC) is an alternative to using natural aggregate (NA) in concrete. Recycled concrete aggregate (RCA) is a type of aggregate made from concrete debris. Recycled aggregate concrete can be used in a variety of applications. It can be used in a variety of construction tasks, landscaping, and home renovation projects. The study looked into concrete mixes with a water cementitious material ratio of 0.4. In this study, ordinary Portland cement with a grade of 43 was used. The percentages of recycled aggregates that partially replaced natural aggregates by weight were 0 percent, 25%, 50%, 75 percent, and 100%, with 10% bottom ash as a partial replacement with cement. In laboratories, concrete cubes, cylinders, and beams were cast and tested. Mechanical characteristics tests such as the Compressive strength test and the Split tensile strength test were used to determine the optimal proportion of replacement.

Keywords: - bottom ash, Rca, design mix, compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

Environment, economy and society are the three dimensions that make up the universal purpose known as Sustainable Development. Now-a-days concrete industry is consuming lot of natural resources. This causes lot of damage to environment and mother earth. As a result, the less cement and natural aggregates used in concrete manufacturing, the less environmental impact. The rising cost of disposal and the paucity of natural aggregate resources stimulate the use of building waste as an aggregate source. The reuse of coal combustion by-products such as bottom ash is required for coal-fired electricity generation to become sustainable.However, by reducing energy and raw material consumption, coal bottom ash (CBA) used as a Portland cement element will aid in more sustainable cement manufacture. The European Union is promoting waste reuse and recycling in accordance with the European Waste Framework's waste hierarchy in order to improve resource efficiency and reduce climatic and environmental consequences.

2. LITERATURE REVIEWS

Evangelista et al. (2010) investigated the durability performance of concrete made with fine recycled concrete aggregates. It was observed that the parameters of mix proportions, such as Ordinary Portland Cement, fine recycled aggregates by crushing the waste concrete by impact crusher, natural coarse aggregates and W/C ratio 0.52 were used. The tests performed were water absorption by immersion, water absorption through capillarity and carbonation depth. It was found to be the addition of water absorption by both the above two methods was enormously increasing, when the percentage of fine recycled aggregates was increased. Carbonation resistance also found to be decreases by increasing the percentage of fine RCA. The feasible percentage replacement of fine aggregates by fine RCA was found to be 30%.**Asamoah and Afrifa (2018)** carried out study on concrete properties using phyllite as coarse aggregates. A total of 400 numbers of 100×100×100 mm concrete cubes, 200 each of granite and phyllite were found to be cast and cured for 3,7,14,28,56,90,180 and 360 days. Phyllite aggregates was more flaky and elongated nature compared to that of granite aggregates and phyllite aggregate has good absorbance to shock. It was found that the physical and mechanical properties of phyllite aggregates satisfied the minimum requirements for aggregate suitable for concrete. Phyllite aggregate concrete become less workable when the fines on course aggregate are not properly removed and the rate of strength development in phyllite concrete (PC) was lower than granite concrete (GC). The compressive and bending strengths of PC were found to be generally 15-20% lower than those of corresponding GC mix ratios for all ages.**Grdic et al. (2019)** carried out study on the properties of self-compacting concrete prepared with coarse recycled concrete aggregate. The potential for usage of coarse recycled aggregate obtained from crushed concrete for making of self- compacting concrete was researched additionally emphasizing its ecological value. On the other hand the issue of the waste disposal sites created by the demolition of old structures is solved. Three types of concrete mixtures were made, where the percentage of substitution of coarse aggregate by the recycled aggregated was observed to be 0%, 50% and 100%. Usage of 50–100% of coarse recycled aggregate increase the water absorption by 0.15–0.37% , decreases the tensile strength by bending to 2.49–13.95% and decrease in compressive strength by 3.88% - 8.55%. It was found to be the difference is very less to use recycled coarse aggregates for making self compacting concrete.

3. MATERIALS AND METHODOLOGY

3.1 Cement

Although all materials that go into concrete mix are essential, cement is very often the most important because it is usually the delicate link in the chain. The function of cement is first of all to bind the sand and stone together and second to fill up the voids in between sand and stone particles to form a compact mass. Although it constitutes only about 20 per cent of the volume of concrete mix, it is the active portion of binding medium and is the only scientifically controlled ingredient of concrete. Any variation in its quantity affects the compressive strength of the concrete mix. In the present investigation, Ordinary Portland Cement (OPC) of 43 Grade was used for all concrete mixes.

3.2 Fine aggregate

IS: 383-1963 defines the fine aggregate as the aggregate most of which will pass 4.75mmIS sieve. The fine aggregate is usually termed as Sand. The sand is generally considered to have a lower size limit of 0.007 mm. usually natural sand is used as a fine aggregate. The sand used for the experimental work is locally available and conformed to grading zone III..

3.3 Course Aggregate

The aggregate is the matrix or principal structure consisting of relatively inert and coarse particles. The coarse aggregate is used primarily for the purpose of providing bulk to the concrete. The most important function of fine aggregates is toassist in producing a workable and a uniform concrete mix. The fine aggregate also assists the cement paste to hold the coarse aggregate particles in suspension. This action promotes plasticity in the concrete mix and prevents segregation of the paste and coarse aggregates during its transportation. The aggregates provide about 75 per cent of the body of concrete and hence their influence is extremely important. The properties of these particles greatly affect the performance of concrete.

. 3.4 RCA

Concrete wastes of material testing laboratory was used as a coarse aggregates. Both natural and recycled aggregates followed the same grading and the same

3.5 Bottom ash

Management of coal combustion products has created a challenge for utilities and regulators. In many countries coal combustion products are classified as hazardous substances and usage of them is limited. From the other hand, the coal combustion products have chemical and physical properties that make them suitable for engineering and construction works. Coal combustion products are mainly utilised in the building materials industry, in civil engineering, in road construction, for construction works in underground coal mining as well as for re-cultivation and restoration purposes in open caste mining. They are used as a replacement of natural resources.

4. RESULT AND DISCUSSIONS

4.1 Slump test

The slump test is the most popular method of determining concrete consistency. All of the concrete mixtures in the concrete laboratory were subjected to a slump test. This test proved quite beneficial in finding differences in the homogeneity of a mixture of specified proportions. It also gives an idea of Water cement ratio to be used for different mixes. Fresh unsupported concrete flows to and sinking in the height takes place. This vertical settlement is known as Slump.

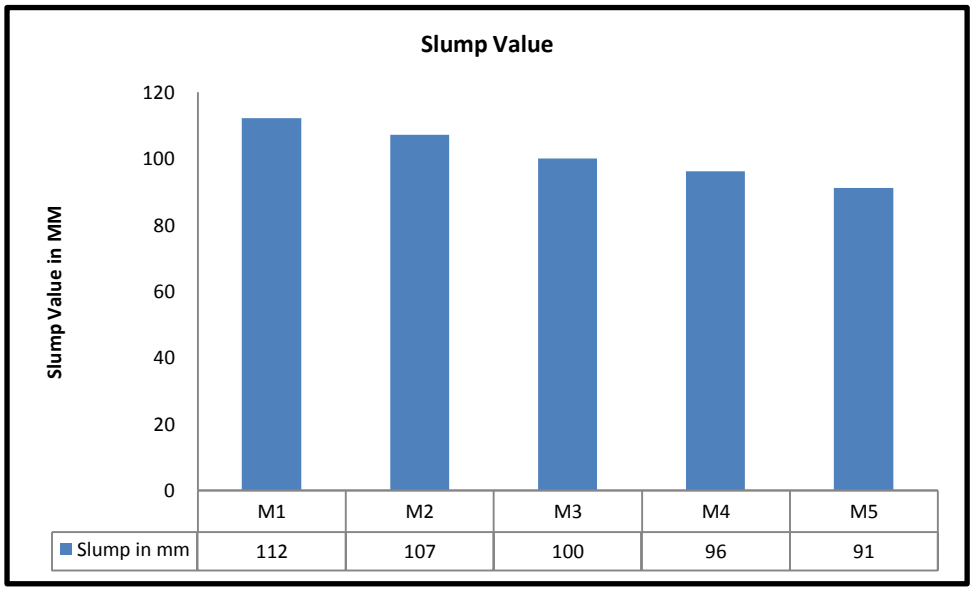
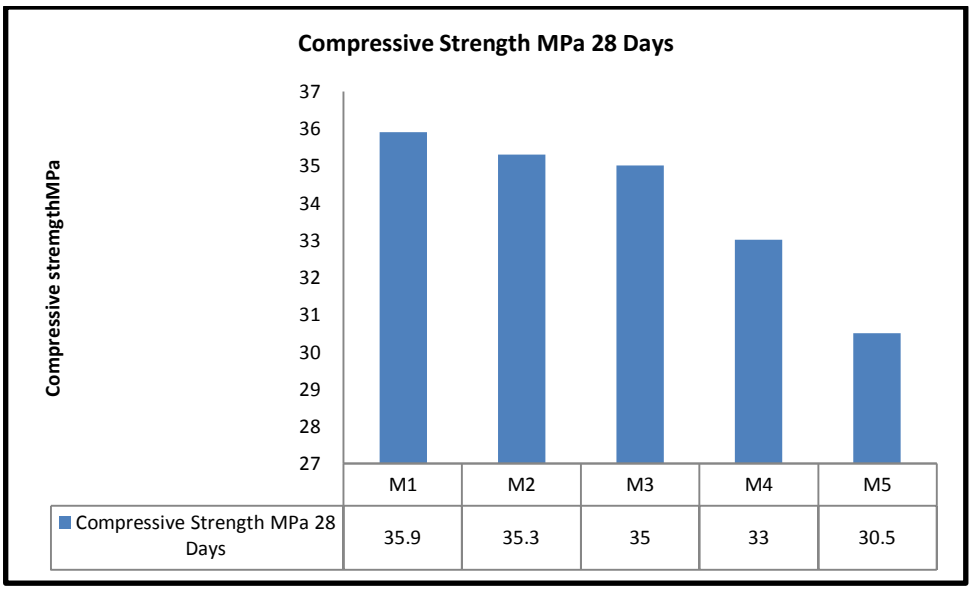


Table 4.2 shows that as the percentage of recycled concrete in the mix increases, the slump value decreases. This is due to the presence of dust and mortar on the surface of recycled aggregates, which causes them to absorb more water than conventional aggregates. By changing the super plasticizer dosage, all slump values were kept between 90 and 110 mm.

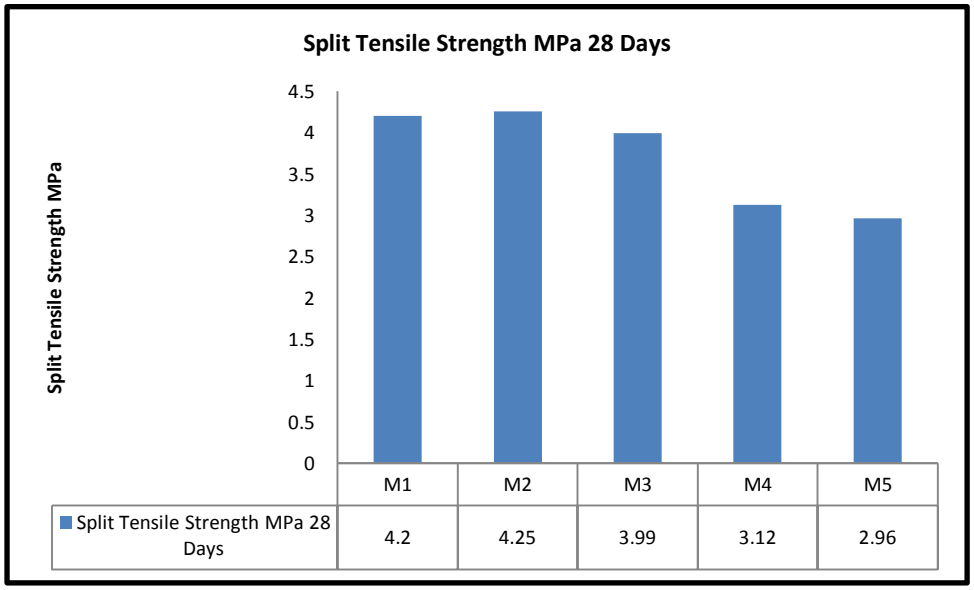
4.2 Compressive strength

For strength testing, 150 x 150 x 150 mm cubes were made. These cubes were cured for 28 days before being evaluated in a 200 T compression testing equipment. The specimens were dried in the sun for one day before being placed in the testing machine, where the load was given continuously, consistently, and without shock. The compressive strength findings of the M2 and M3 are comparable to the mix M1 based on the foregoing test results and the graphical variation displayed in Fig 4.1.



4.3 Tensile Strength

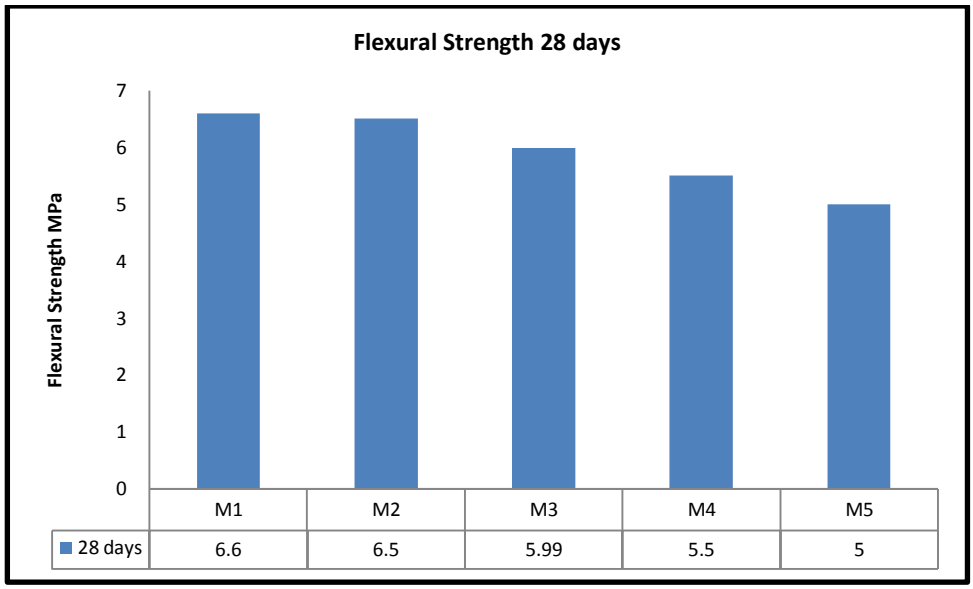
Cylinder of size 300×100mm were cast and cured for 28 days. After curing age the cubes were allowed to dry in the sunlight for 1 day and were tested under strength testing machine by placing the cubes diagonally in the centre. The load was increased until the specimen fails.



From the above test results and the graphical variation as shown in Table 4.4 and Fig 4.2, it was observed that the split tensile strength results of the M2 and M3 are comparable with the mix M1.

4.4 Flexural strength

To investigate the flexural strength of the beam specimens, two point transverse load test were performed on UTM (2000 kN capacity). The results obtained after 28 days of curing are shown in Table 4.4 it can be noted from the results that with the increase in replacement of cellulose fibres, there is decrease in the flexural strength of specimens.



5. CONCLUSIONS

In this study, the hardened and flexural properties of concrete prepared with recycled aggregates with coal bottom ash were investigated. Based on the results of this experimental study, the following conclusions can be drawn

1 It is observed that workability of concrete decrease with increase of recycled aggregate with coal bottom ash in concrete.

2 Up to 50% of natural aggregate can be replaced with recycled material to achieve the same compression and split tensile strength as conventional concrete. However, the overall study found that as replacement levels of recycled aggregates increase, both compression and split tensile strength values decrease.

3 It is observed that flexural strength of concrete gain strength up to 50% replacement of RA with NA.

4 The pozzolonic reaction by coal bottom ash in concrete enhances the both mechanical and flexural properties of recycled aggregates concrete. The use of bottom ash as a partial replacement of cement decrease the water absorption of recycled aggregate concrete.

REFERENCES

[1] p.r. silva,r.v. silva, j. de brito (2021). use of bottom ash additions in the production of concrete with recycled aggregates. *see discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/349883221*

[2] Patchara Onprom, Krit Chaimoon, and Raungrut Cheerarot(2015). Influence of Bottom Ash Replacements as Fine Aggregate on the Property of Cellular Concrete with Various Foam Contents. *Hindawi Publishing Corporation Advances in Materials Science and Engineering Volume 2015, Article ID 381704, 11 pages http://dx.doi.org/10.1155/2015/381704*

[3] R Embong, A Kusbiantoro, K Muthusamy and N Ismail (2021). Recycling of coal bottom ash (CBA) as cement and aggregate replacement material: a review: *Earth and Environmental Science 682 (2021) 012035 IOP Publishing doi:10.1088/1755-1315/682/1/012035*

[4] Esperanza Menéndez, Cristina Argiz and Miguel Ángel Sanjuán(2021). Reactivity of Ground Coal Bottom Ash to Be Used in Portland Cement. *J 2021, 4, 223–232. https://doi.org/10.3390/j4030018 https://www.mdpi.com/journal/j.*

[5] Alessandro Abbà, Maria Cristina Collivignarellia, Sabrina Sorlinib, Matteo Bruggic(2013). On the reliability of reusing bottom ash from municipal solid waste incineration as aggregate in concrete.

[6] sakthieswaran n.renisha m.(2020). mutual effect of coal bottom ash and recycled fines on reactive powder concrete. *revistaromână de materiale / romanian journal of materials 2020, 50(3), 395 – 402*

[7] Sherif Yehia, Kareem Helal, Anaam Abusharkh, Amani Zaher, and Hiba Istaitiyeh(2015).Strength and Durability Evaluation of Recycled Aggregate Concrete. *International Journal of Concrete Structures and Materials Vol.9, No.2, pp.219–239, June 2015 DOI 10.1007/s40069-015-0100-0 ISSN 1976-0485 / eISSN 2234-1315.*

[8] Indian Standard IS: 10262 : 2009, "concrete mix proportioning – guidelines", Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.