PERFORMANCE OF HIGH STRENGTH RECYCLED AGGREGATE CONCRETE USING METAKAOLIN

K. RANI[1], BANDELA MEGHANA[2], MEDARI MERINA[3] MEKALA MANJU SUHASRI [4] NALLA ANITHA[5]

[1]Assistant Professor Department of Civil Engineering, Anu Bose Institute of Technology, K.S.P.Road, Paloncha, Khammam Dist, 507115

[2, 3, 4, 5]Scholar, Department of civil engineering, Anu Bose Institute of Technology, K.S.P.Road, Paloncha, Khammam Dist, 507115

Abstract- *Replacement or Partial replacement of Concrete in the construction is one of the major areas of today's field of Civil Engineering. Attempts have been made to replace the concrete partially by using the materials like fly ash, Rice husk ash, silica fumes etc.*

In India a huge quantity of construction and demolition wastes is produced every year. These waste materials need a large place to dump and hence disposal of wastes has become a severe social and environmental problem. The possibility of recycling demolition wastes as coarse aggregate in the construction industry is thus of increasing importance. In addition to the environmental benefits in reducing the demand of land for disposing the waste, the recycling of demolition wastes can also help to conserve natural resources. The physical, mechanical properties of concrete with the Recycled Coarse Aggregate (RCA) are to be evaluated to access its application as structural concrete. The present work is directed towards the evaluation of concrete using partial replacement of natural coarse aggregate (NCA) with 25%, 50%,75% and 100% Recycle Coarse Aggregate and Cement is partially replaced with Metakaolin at 5%, 10%, 15% and 20%. The experimental results of Strength properties are evaluated and compared with NCA concrete. RCA was obtained from the tested laboratory concrete specimens. Tests were carried out to obtain the compressive strength of RCA concrete.

I. INTRODUCTION

Recycled demolished concrete are contained pounded, reviewed inorganic particles handled from the materials that have been utilized in the developments and obliteration garbage. These materials are for the most part from structures, streets, spans. With the sharp improvement of development and increment of individuals' familiarity with ecological assurance, squander control and administration winds up one of the immense difficulties of current society for the mission of practical advancement.

Kaolin clay is used as the primary raw material in the production of Metakaolin. Kaolin is a fine, white clay mineral that has been used in the production of porcelain for centuries. Kaolins are clay mineral classes that, like other clays, are phyllosilicates (layer silicate minerals). Change is denoted by the Meta prefix in the word.

Objectives of the study

From this study the following objectives are made

1. The main objective of this research is to replace the natural coarse aggregates by recycled coarse aggregates and cement by metakolin for M40 Grade concrete.
2. The main aim of this work is utilization of construction and demolition (C&D) wastes as Coarse aggregates and cement with metakolin which are mixed with Concrete to investigate the

affect of these waste materials on various parameters of concrete grade i.e. M40.

3. To evaluate and compare the results of workability, compressive strength, split tensile strength, flexural strength and durability of M40 grade of concrete by using construction and demolition (C&D) wastes and metakolin with standard concrete.
4. To compare the engineering properties of so improved concrete for M40 specimens with controlled mix concrete.

II. LITERATURE REVIEW

Gurpreet Singh and Rafat Siddique (2011) carried performed an experiment to test the strength and durability of concrete mixes in which natural sand was partially replaced with artificial sand (WFS). Natural sand was substituted with five percent (0, 5 percent, 10%, 15%, and 20%) WFS by weight. At the ages of 7, 28, and 91 days, compression and splitting tensile strength tests were performed to determine the strength qualities of concrete. The use of WFS as a partial replacement for fine aggregate in plain concrete resulted in a modest gain in strength qualities.

Neelam Pathak and Rafat Siddique(2012) When subjected to extreme temperatures, the effects of spent foundry sand and fly ash on the parameters of Self-Compacting-Concrete (SCC), including compressive strength, splitting tensile strength, modulus of elasticity, fast chloride permeability, porosity, and mass loss. The characteristics of SCC are examined using fly ash as a partial replacement for cement and wasted foundry sand as a partial replacement for sand. When the fly ash percentage was reduced from 50% to 30% in Ordinary Portland cement, there was a 24–25% improvement in compressive strength and an 18–22% rise in splitting tensile strength after 28 days. At higher temperatures and with a larger proportion of fly ash, the rate of splitting tensile strength and modulus of elasticity loss was faster than the rate of compressive strength loss.

III MATERIALS USED FOR THE RESEARCH

Portland cement

Ordinary Portland cement (OPC) of 53 Grade (UltraTech cement) from a single lot was used throughout the course of the investigation. It was fresh and without any lumps. The physical properties of the cement are determined from various tests conforming to Indian Standard IS: 8112:l1989 are listed in table below Cement is carefully stored to prevent deterioration in its properties due to contact with moisture.

OPC 53 Grade Cement

Aggregates

Aggregates constitute the bulk of a concrete mixture and give dimensional stability to concrete. To increase the density of resulting mix, the aggregates are frequently used in two or more sizes. The most important function of the fine aggregate is to assist in producing workability and uniformity in mixture.

Coarse aggregates

Those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen, are called **coarse aggregate.** The coarser the aggregate, the more economical the mix. Larger pieces offer less surface area of the particles than an equivalent volume of small pieces. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements.

Coarse aggregates

Fine aggreagtes

Those particles passing the 9.5 mm (3/8 in.) Sieve, almost entirely passing the 4.75 mm (No. 4) sieve, and predominantly retained on the 75 µm (No. 200) sieve are called fine aggregate. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

Fine aggregates

Recycled aggregates

The demolition and construction trash come from a nearby structure that was dismantled and rebuilt. The aggregates that pass through an IS sieve of 20mm and are held on a 12.5mm sieve are collected. Tile aggregates have a specific gravity of 2.64 and a fineness modulus of 7.358. The bulk densities of the loose and compacted materials are 1356 kg/m3 and 1510 kg/m3, respectively, with a water absorption of 0.55 percent. The aggregate crushing value (percentage) and aggregate impact value (percentage) of coarse aggregate are respectively 29.58 and 18.36.

Recycled coarse aggregates

Metakaolin (MK)

The sample of Metakaolin used in this present experimental study is shown in Fig., obtained from ASTRRA Chemicals, Chennai.

Metakolin

Water

Generally potable water ought to be used. This is to make sure that the water is cheap unfastened from such impurities as suspended solids, organic depend and dissolved salts, which may additionally adversely affect the residences of the concrete, especially the placing, hardening, energy, sturdiness, pit fee, and many others.

Admixture

To acquire workability of clean Concrete, Sulphonated napthalene polymer based totally wonderful plasticizer Conplast SP430 in the shape of a brown liquid right away dispersible in water, Use of superplasticizer lets in the discount of water to the quantity up to 30 percentage without lowering the workability, in assessment to the feasible reduction up to fifteen percentage in case of plasticizers. The use of superplasticizer is practiced for production of flowing, self leveling, self compacting, and for production of excessive strength and high performance concrete.

IV MIX DESIGN

Final trial mix for M40 grade concrete is 1:1.63:2.54 at w/c of 0.45

Mix Trials used for the study

M0 - 0%RCA+0%MK

M1 - 25%RCA+5%MK

M2 - 50%RCA+10%MK

M3 - 75%RCA+15%MK

M4 - 100%RCA+20%MK

Test to be conducted on the specimens

Compressive strength

- 7 days specimens age
- 14 days specimens age
- 28 days specimens age
- 56 days specimens age
- 90 days specimens age

Split tensile strength of specimens

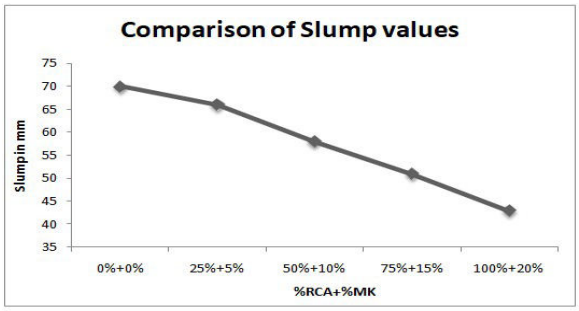
- 7 days specimens age
- 14 days specimens age
- 28 days specimens age
- 56 days specimens age
- 90 days specimens age

Flexural strength of specimens

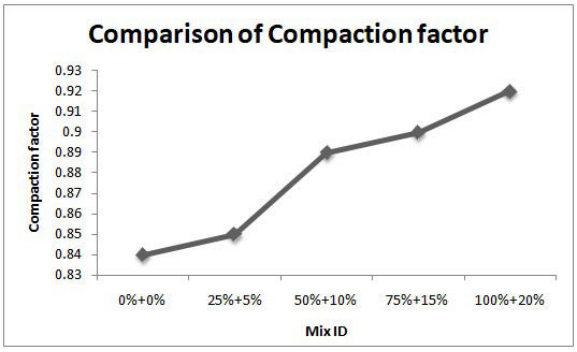
- 7 days specimens age
- 14 days specimens age
- 28 days specimens age
- 56 days specimens age
- 90 days specimens age

V RESULTS AND ANALYSIS

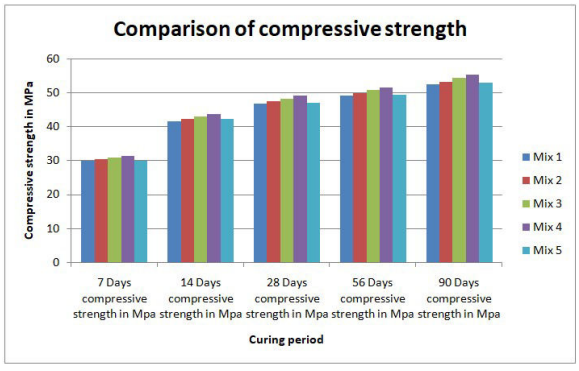
Slump cone test



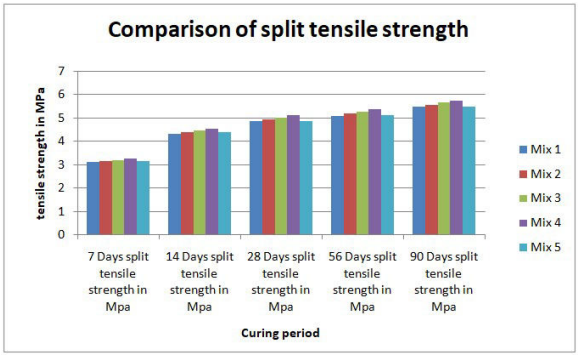
Compaction factor test



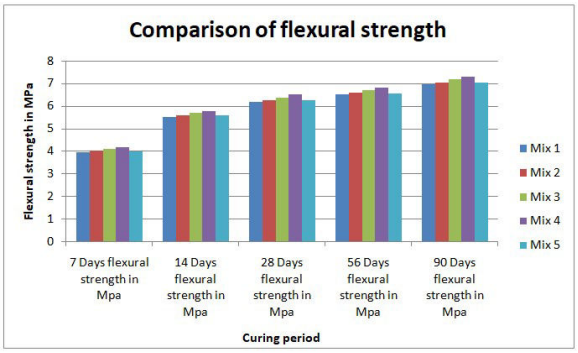
Compressive strength



Split tensile strength



Flexural strength



VI CONCLUSIONS

From the experimental investigation on recycled coarse aggregates as a partial replacement of coarse aggregate and Metakaolin as partial replacement of cement on strength properties of concrete, the following conclusions are drawn.

1. When percentage of Recycled coarse aggregates was increased beyond 15% the mix started gaining its workability.
2. When cement replaced with recycled aggregates and Metakaolin for concrete cubes strength increased up to 75% recycled aggregates and 15% metakolin replacement and then decreased. So, 75%RCA+15%MK replacement is optimum here.
3. Replacement of fine aggregate with waste foundry sand showed increase in the compressive strength of plain concrete of grade M40 up to 40% and then there was a considerable decrease in the strength. Maximum strength was achieved at 40%.
4. For Plain Concrete mix at 60% replacement of fine aggregate strength of 46.66 MPa was achieved at 28 days which is less than the target strength.
5. 15% replacement of cement with Metakaolin was found to be optimum for M40 grade of concrete.
6. For Binary Blended Concrete mix at 75%RCA+15%MK replacement, strength of 49.1 MPa was achieved at 28 days which is more than the target strength.
7. Binary Blended Concrete incorporating Metakaolin showed better performance when compared to plain concrete.
8. Metakaolin which is taken from amarphus chemicals pvt ltd can be opted for replacement of cement for a considerable percentage (15%) only.

REFRENCES

[1] Shafeeq ahamed, brijbhushan s, maneeth p.d, “an Prof. Veena G. Pathan1 , Prof. Md. Gulfam Pathan2) etcal..,(2014)FEASIBILITY AND NEED OF USE OF WASTE MARBLE POWDER IN CONCRETE PRODUCTIONe- ISSN: 2278-1684, p-ISSN: 2320-334X.

[2] M. Shahul Hameed1 and A. S. S. Sekar2 VOL. 4, et al.., (2009).PROPERTIES OF GREEN CONCRETE MARBLE SLUDGE POWDER AS FINE AGGREGATE),volume 4, june 2009.

[3] G V Vigneshpandian1, E Aparna Shruthi2, C.Venkatasubramanian3 and D.Muthu4 et al..,(2017),UTILISATION OF WASTE MARBLE DUST AS FINE AGGREGATE IN CONCRETE,ICCIEE 2017.

[4] Bhupendra Singh Kalchuri1,Dr. Rajeev Chandak2, R.K.Yadav3 Vol. 5 et al.. (2015), STUDY ON CONCRETE USING MARBLE POWDER WASTE AS PARTIALREPLACEMENT OF SAND *Vol. 5, Issue 4,(Part -6) 2015,*

[5] Rishi1,Dr.Vanita Aggarwal2,EFFECT ON PARTIAL REPLACEMENT OF FINE AGGREGATE AND CEMENT BY WASTE MARBLE POWDER/ GRANULES ON FLEXURAL AND SPLIT TENSILE STRENGTH. .Volume 11,Issue 4,(2014)

[6] Ramkumar1,ankhith2,AN EXPERIMENTAL STUDY OF MARBLE POWDER ON THE PERFORMANCE OF CONCRETE. Volume 7, Issue 4, 2016.

[7] PoojaJ.Chavhan , Prof. S. D. Bhole.TO STUDY THE BEHAVIOUR OF MARBLE POWDER AS SUPPLEMENTRY CEMENTITIOUS MATERIAL IN CONCRETE. Vol. 4, Issue 4 ,et al..,(2014).

[8] Nitisha Sharma1 , Ravi Kumar2,REVIEW ON USE OF WASTE MARBLE POWDER AS PARTIAL REPLACEMENT IN CONCRETE MIX et al..,(2015) (SSRG-IJCE) .

[9] Anne Mary J 1, Robin B2,Prashanth M3&Ranganathan C,AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY WASTE MARBLE POWDER,Vol. 3, Special Issue 35,2017.