International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Concrete Properties Assessment by Partial Replacement of Fly Ash, Cement & Recycled Aggregate With Natural Coarse Aggregate

Yasir Arafat[1], M.P. Verma[2]
Department of Civil Engineering
[1] M. Tech. Scholar, Madhyanchal Professional University,Bhopal, Madhya India.
[2] Prof. Madhyanchal Professional University, IBhopal, Madhya Pradesh, India.

Abstract- *The work audits the feasibility of demolished concrete as partial substitute of natural coarse aggregate respectively. In initial stage, same optimum ratio of cement is added with partly replaced natural coarse aggregate (NCA) with recycled concrete aggregate (RCA) in concrete. For test intent, recycled aggregates were accessed from crushed concrete cubes of grade M25 in laboratory. Variant composition of natural coarse aggregate and recycled aggregate adopted and test samples from this matrix were prepared for the same test as mentioned above. Observations reveal, combination of 90% NCA and 10% RCA in ratio, leads to adequate results.*

Keywords- Compressive Strength, Flexural Strength, Fly Ash, Recycled Coarse Aggregate, Replacement.

I. INTRODUCTION

Recycled concrete aggregate is produced by crushing concrete to reclaim the aggregate. Recycled aggregate can be used for many purposes. The primary market is road base for information on recycling asphalt pavement into new asphalt pavement. Aggregate resulting from the processing of inorganic material previously used in construction and principally comprising crushed concrete washed and graded for use as an aggregate in the production of further concrete. The objective of the research is to recycle and reuse the large amount of waste generated from construction and demolition due to increase in population and urbanization or natural disaster. These wastes constitute a major portion of total solid waste production in the world, and most of it is used in the landfills. Due to the shortage of dumping sites and increase in cost of transport, majority of developed/developing countries are facing problems in handling and disposal of such wastes. By considering all the aspect, it is beneficial to reuse the generated waste for effective utilization and to save environment. In India very less progress in research on the reuse and recycling of construction and demolition waste has been made. This may be due to lack of awareness and standard on recycle and reuse of recycled aggregate in the construction industry. Hence this research will carry out a systematic study of recycling the construction and demolition waste by conducting the various experiments.

II. MATERIALS & METHODOLOGY

1) MATERIALS USED

1. Cement (OPC)
2. Sand
3. Aggregate
4. Fly ash
5. Recycled concrete aggregate (RCA)

1. CEMENT: Cement is an extremely ground material having adhesive and cohesive properties which provide a binding medium for the discrete ingredients. Chemically cement constitutes 60-67% Lime (CaO), 17-25% Silica (SiO_2), 3-8% Alumina (Al_2O_3), 0.5-6% Iron Oxide (Fe_2O_3), 0.1-6% Magnesia (MgO), 1-3% Sulphur Trioxide (SO_3), 0.5-3% Soda And Potash (Na_2O+K_2O).

2. SAND: Sand is a naturally happening granular material made of finely isolated rocks and mineral particles. It is characterized by size, being finer than gravel and coarser than silt. Sand could additionally be referred as textural class of soil or soil type; i.e. a soil holding more than 85% sand-sized particles (by mass).

3. NATURAL COARSE AGGREGATE: Construction aggregate, or essentially "Aggregate", is an expansive classification of coarse particulate material utilized within construction, including sand, gravel, crushed stone, slag, recycled concrete and geo engineered aggregates. The majorly mined materials in the universe are aggregates. Aggregates comprise composite materials for example, concrete and asphalt concrete; the aggregate serves as reinforcement for overall composite material. Because of the relatively high hydraulic conductivity value as contrasted with most soils, aggregates are generally

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

utilized within waste requisitions for example, foundations and French drains, septic drain fields, retaining wall drains, and road side edge drains. Aggregates are likewise utilized as base material under foundations, roads, and railroads.

4. FLY ASH: Fly ash, otherwise called flue-ash, may be a standout amongst the residues created under combustion, and comprises those fine particles that rise with flue gases. Ash that doesn't rise is called bottom ash. In mechanical context, fly ash typically alludes with burning of coal. Fly ash is by and large caught by electrostatic precipitators or other molecule filtration gear before those pipe gasses arrive at the chimneys of coal-fired power plants. Depending upon the source and makeup of the coal continuously burned, the contents for fly ash change considerably, in any case all fly ash incorporates significant sums of silicon dioxide (SiO_2) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic parts in many coal-bearing rock strata.

5. RECYCLED CONCRETE AGGREGATE (RCA): RCA is granular material fabricated by evacuating, smashing, and preparing hydraulic cement concrete, asphalt for reuse with a pressure driven solidifying medium to deliver fresh paving concrete. The aggregate retained on the 4.75 mm sieve is called coarse aggregate; material passing the 4.75 mm strainer is called fine aggregate.

Uses: Recycled total can be utilized:

- In paved streets as aggregate base, aggregate sub-base, and shoulders.
- In gravel streets as surfacing.
- As base for building foundations.
- Keeping in mind the end goal to create high quality

III. RESULTS AND DISCUSSIONS

Table 1. Compressive Strength Result

Mix	COMBINATION (% Replacement)	Compressive Strength (N/mm^2)		
		7 days	14 days	28 days
M-1	C+S+NCA	18.17	20.63	24.13
M-2	C(75%)+S+FA(25%)+NCA(100%)	23.20	26.40	30.61
M-3	C(75%)+S+FA(25%)+NCA(90%)+RCA (10%)	23.49	27.36	31.02
M-4	C(75%)+S+FA(25%)+NCA(80%)+RCA (20%)	20.58	24.51	27.36
M-5	C(75%)+S+FA(25%)+NCA(70%)+RCA (30%)	19.91	23.02	26.52
M-6	C(75%)+S+FA(25%)+NCA(60%)+RCA (40%)	19.68	22.74	26.24

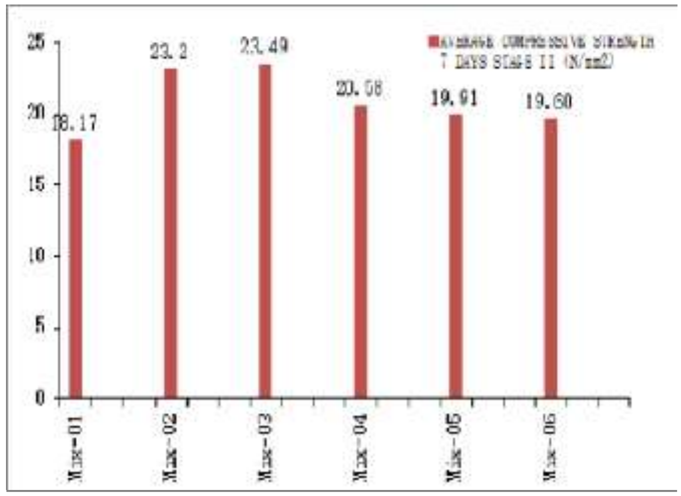

Figure 1. Compressive Strength in N/mm2 at 7 days

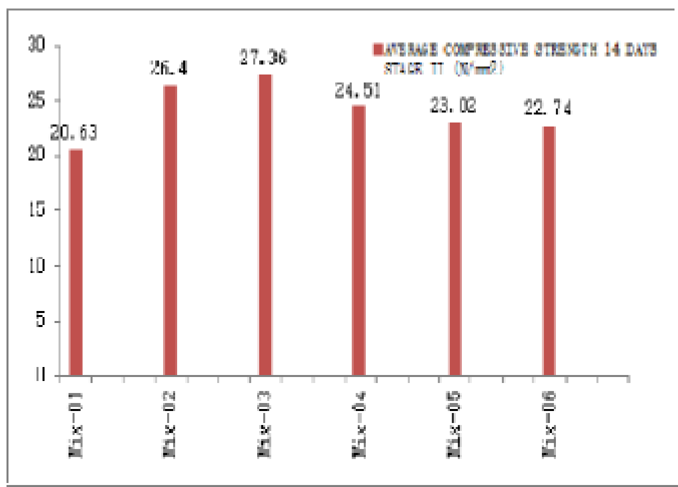

Figure 2. Compressive Strength in N/mm2 at 14 days

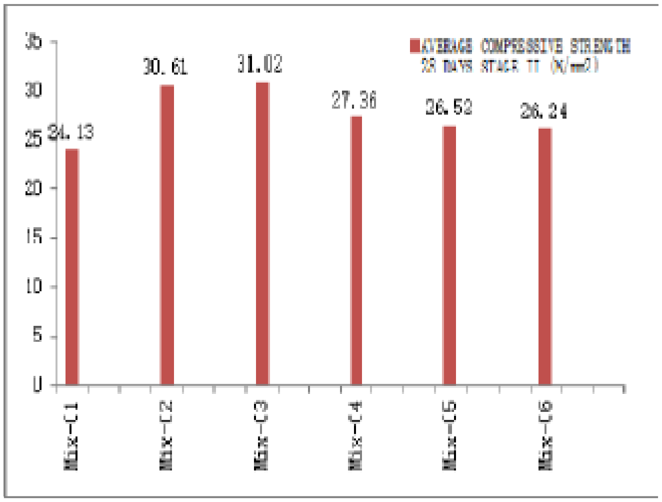

Figure 3. Compressive Strength in N/mm2 at 28 days

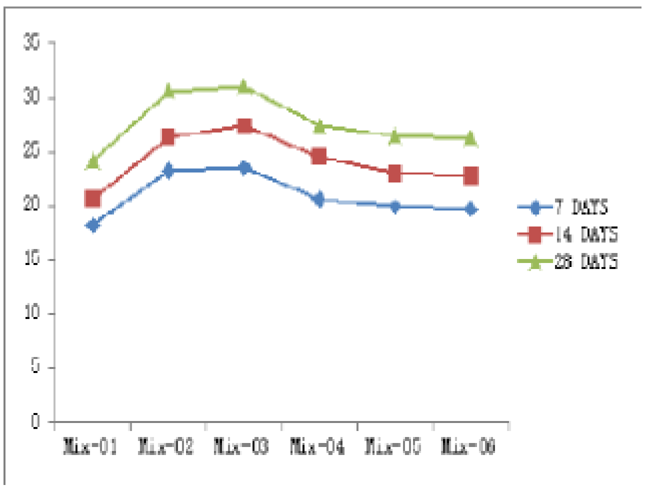

Figure 4. Compressive Strength in N/mm2 at various age (Days)

With reference of graph (7 days strength), when Mix-01 is conventional concrete, Mix-02 is the mix of stage-1 which gives optimum results of strength i.e. Mix-02 of stage-1. From graph it is seen that compressive strength is increased about 27.68% of Mix-02 but, strength of Mix-03 is increased 29.28% when compared with Mix-01. It shows, when NCA are partially (10%) replaced by RCA, somewhat more strength (1.25%) can be achieved. On further increment of RCA, a decreased strength is seen so only 10% replacement of NCA by RCA should be done. Similarly when graph (14 days strength) is analyzed, compressive strength is increased about 27.97% of Mix-02 but, strength of Mix-03 is increased 32.62% when compared with Mix-01. It shows, when NCA are partially (10%) replaced by RCA, somewhat more strength (3.64%) can be achieved. On further increment of RCA, a decreased strength is seen so only 10% replacement of NCA by RCA should be done. As shown in graph (28 days strength), compressive strength is increased about 26.85% of Mix-02 but, strength of Mix-03 is increased 28.55% when compared with Mix-01. It shows, when NCA are partially (10%) replaced by RCA, somewhat more strength (1.34%) can be achieved. On further increment of RCA, a decreased strength is seen so only 10% replacement of NCA by RCA should be done. With reference to above discussion, it can be said that an increment in compressive strength of Mix-02 nearly 27% is achieved & increment in compressive strength of Mix-03 nearly 29% is achieved as compared with conventional concrete mix i.e. Mix-01. Also it is seen that when NCA is partially (10%) replaced by RCA, better results can be expected.

Table 2. Flexural Strength Result

Mix	**COMBINATION (% Replacement)**	**Flexural Strength (N/mm^2)**		
		7 days	**14 days**	**28 days**
M-1	C+S+NCA	3.88	4.45	5.14
M-2	C(75%)+S+FA(25%)+NCA(100%)	4.85	5.58	6.43
M-3	C(75%)+S+FA(25%)+NCA(90%)+RCA(10%)	5.17	6.03	6.93
M-4	C(75%)+S+FA(25%)+NCA(80%)+RCA(20%)	4.22	4.92	5.65
M-5	C(75%)+S+FA(25%)+NCA(70%)+RCA(30%)	4.18	4.83	5.57
M-6	C(75%)+S+FA(25%)+NCA(60%)+RCA(40%)	4.12	4.74	5.32

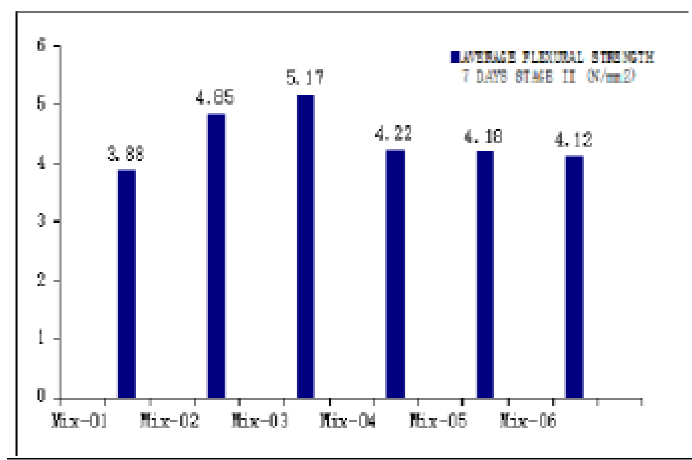

Figure 5. Flexural Strength in N/mm2 at 7 days

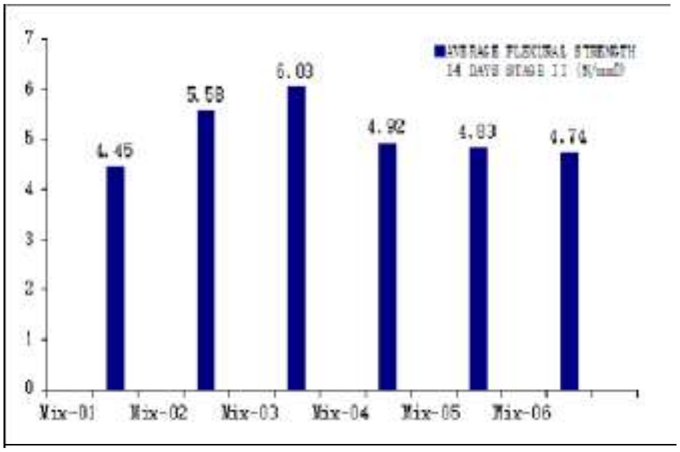

Figure 6. Flexural Strength in N/mm2 at 14 days

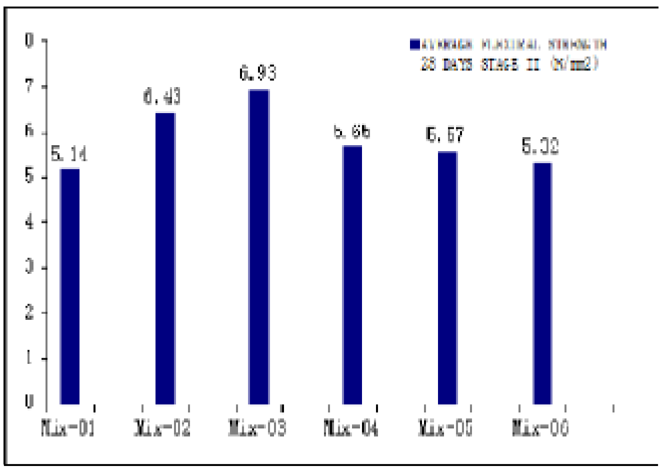

Figure 7. Flexural Strength in N/mm2 at 28 days

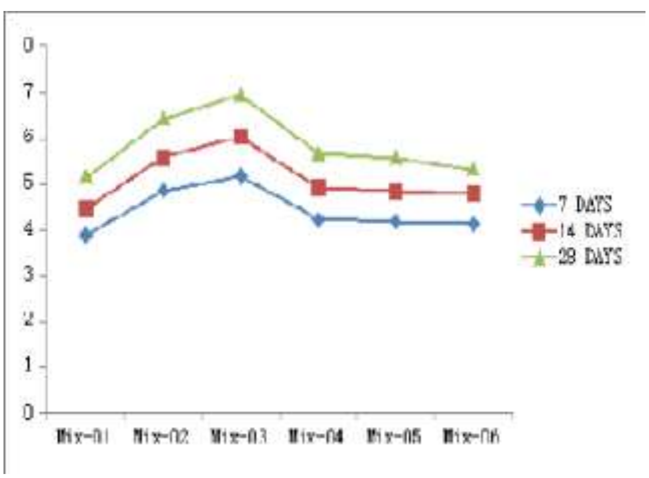

Figure 8. Flexural Strength in N/mm2 at various age (Days)

IV. CONCLUSION

From the above graphs and previous discussions, following conclusions are drawn:-

1. On increasing percentage replacement of RCA by replacing NCA, a decrease in strength is investigated. It shown, only 10% replacement of NCA by RCA gives increased strength properties.
2. A maximum compressive and flexural strength is noted when 25% cement is replaced by FA & 10% NCA are replaced by RCA for all 7 days, 14 days and 28 days curing period.
3. The increase in flexural strength is more when compared with compressive strength with replacement of conventional materials.

REFERENCES

[1] M. R. Karim, M. F. M. Zain, M. Jamil, F. C. Lai And M. N. Islam, Strength Development Of Mortar And Concrete Containing Fly Ash, International Journal Of The Physical Sciences Vol. 6(17), pp. 4137-4153, 2 September, 2011.

[2] D. N. Parekh and Dr. C. D. Modhera, Characterization Of Recycled Aggregate Concrete, International Journal of Advanced Engineering Technology E-ISSN 0976-3945 IJAET/Vol. II/ Issue IV/October-December, 2011/321-330.

[3] R. Nagalakshmi, Experimental Study On Strength Characteristics Onm25 Concrete With Partial Replacement Of Cement With Fly Ash And Coarse Aggregate With Coconut Shell, International Journal of Scientific & Engineering Research, Volume 4, Issue 1, January-2013,ISSN 2229-5518

[4] Chandana Sukesh, Katakam Bala Krishna, P. Sri Lakshmi Sai Teja, S. Kanakambara Rao, Partial Replacement of Sand with Quarry Dust in Concrete, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-6, May 2013.

[5] B. Damodhara Reddy, S. Aruna Jyothy , Fawaz Shaik, Experimental Analysis Of The Use Of Coconut Shell As Coarse Aggregate, Iosr Journal Of Mechanical And Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 10, Issue 6 (Jan. 2014), PP 06-13.

[6] Umapathy U 1, Mala C2, Siva K, Assessment Of Concrete Strength Using Partial Replacement Of Coarse Aggregate For Waste Tiles And Cement For Rice Husk Ash In Concrete, Umapathy U Et Al Int. Journal Of Engineering Research And Applications ISSN : 2248-9622, Vol. 4, Issue 5 (Version 1), May 2014, pp.72-76.

[7] P. Padma Rao, A. Pradhan Kumar, B. Bhaskar Singh, A

Study On Use Of Rice Husk Ash In Concrete, IJEAR Vol. 4, Issue Spl-2, Jan - June 2014.

[8] C. Marthong, T.P. Agrawal, Effect of Fly Ash Additive on Concrete Properties, International Journal of Engineering Research and Applications Vol. 2, Issue4, July-August 2012, pp.1986-1991.