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Demonstrates the Physical Properties of the Materials used in Concrete to be Made by Two – Stage Mixing Approach (TSMA)

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ABSTRACT: The use of recycled aggregate has been caused by the depletion of the redevelopment program of landfill areas in many parts of the nation. The proper quality of recycled aggregate (RA) has however limited its use to low grade applications such as sub base roadwork and pavements. Due to the reduced compressive strength and greater variability in the mechanical efficiency of recycled aggregates its use for higher grade concrete is unusual. In order to improve the quality of recycled aggregate concrete (RAC) by separating the mixing phase , a new concrete mixing method, the two – stage mixing approach (TSMA) has been advocated. The current paper explains the variation of the compressive strength & slump test by experimental study involving the adaptive mixing system with some adjustment by proportioning ingredients with the percentage of recycled coarse aggregates (RCA) and fly ash to the two – stage mixing approach (TSMA). Improvements in strength focused on experimental work and finding. This can be due to the recycled aggregate (RA) porous nature and the premixing process that fills up some of its pores and cracks, resulting in a denser aggregate and concrete. A higher intensity than the normal mixing approach (NMA) is provided by an improved interfacial zone around recycled aggregate (RA).

Keywords: Recycled aggregate, Fly ash, Concrete, Two – stage mixing approach (TSMA), Normal mixing approach (NMA).

I. INTRODUCTION

Construction is the cornerstone of infrastructural growth. Production material is concrete, which forms the basic building material, which can be considered after water as the second most commonly used object in the world. Natural resources, such as stone, aggregate, sand and water are the fundamental components of concrete, indicating that this industry has a degrading effect on these environmental properties. In addition, aggregate quarrying and transport further contribution to ecological imbalance and emissions. Not only has this, due to the scarcity of landfill sites, the disposal of the rubble of demolished concrete buildings also become a major problem in different cities.

These environmental challenges are a driving force in creation of an urgent and thoughtful appropriate approach to our natural resource to which the recycling of the aggregate appears to be an appropriate solution. The paper presents a comparison of the concrete's compressive strength provided by NMA and TSMA. The idea of the use of recycled aggregate in concrete is that no new study has been carried out around the world on recycled aggregate. However, it was not possible to use recycled aggregates in high – strength concrete production in India to become famous.

II. LITERATURE REVIEW

The technique of adjusted mixing of concrete was introduced by Tam V.W.Y et. Al (2005)[6]. The researchers concluded that higher water absorption, higher porosity, weaker interfacial transition zone (ITZ). Between recycled aggregates (RA) and new cement mortar hindered the application of RAC for higher grade applications due to the law quality of RAC. In this study, the two – stage mixing approach to strengthening the weak connection of RAC, which is located at the ITZ of the RA, is proposed in this report. The two –stage mixing technique offers a way to gel up the RA for the cement slurry, producing a better ITZ by filling up the RA cracks and pores. The compressive strength has been strengthened by laboratory studies. This two – stage mixing techniques can provide an efficient

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way to increase RAC's compressive strength and other mechanical efficiency, and thus the method opens up a wider range of RAC applications.

Yong P, according to. The C and Teo D.C.C. Strong compressive strength, split tensile strength as well as flexural strength can be achieved by recycled aggregate concrete (RAC)[9]. Compared to natural concrete, RAC has a higher compressive strength of 28 days and greater split tensile strength of 28 days, while RAC's flexural strength of 28 days is lower than that of natural concrete.

In their recycled coarse aggregates paper, Patil S.P et al (2013)[4] concluded that the compressive strength of concrete containing 50 percent RCA has a strength similar to that of regular concrete. This tensile splitting test shows that when replaced by 25 – 50%, concrete has strong tensile strength. During the initial phases, the strength of concrete is high, but during later phases it progressively decreases. RCA water absorption is higher than normal aggregate absorption. The use of RCA in concrete mixtures is therefore found to have strength in close proximity to that of natural aggregate and can be used effectively as a part of new concrete that is of maximum value.

Marthong C and Agrawal T.P (2012)[3] have reported that with the grade of cement and fly ash content , the usual consistency improves. As the grade of cement increases, setting time and soundness decreases. The use of fly ash enhances concrete workability, and with reduction in cement grade, workability increases. Bleeding is greatly decreased in fly ash concrete. With the amount of cement, the compressive strength of concrete increases. There is a decrease in strength of concrete as the fly ash content rises in a all grades of ordinary Portland cement (OPC). In all the three OPC classes, the rate of the strength gain of concrete with age is nearly identical. Concrete at the age of 90 days with 20% fly ash content closer to that of ordinary concrete. Compared to OPC concrete, fly ash concrete is more durable in all OPC grade and fly ash rises by up to 40% with cement grade substitution. In all grades of OPC, the shrinkage of fly ash concrete is similar to pure cement concrete.

Vyas C.M and Pitroda J.K (2013)[3] worked on the combination of RCA and fly ash and concluded that the applications in the construction field of recycled coarse aggregate are very large. Reducing the use of natural resources is the primary purpose of using recycled coarse aggregate. The use of the fly ash in the recycled coarse aggregate mixing is another improving process. In recycled coarse aggregate concrete, the application of fly ash will increase the toughness of recycled coarse aggregate concrete. The use of fly ash could enhance the characteristic strength of recycled coarse aggregate concrete.

A primary objective is to minimize the use of the Portland cement, according to Bendapudi S.C.K and Saha P (2011)[1] which is easily accomplished by partly replacing it which different cement materials. Fly ash, a coal combustion residue, which is an exceptional cement material, is the best knoen of these materials. Therefore, the productive use of fly ash in concrete making draws serve considerations forms relevant technologists and government agencies, fly ash is already includes in the latest Indian standard on concrete mix proportion (IS:10262 – 2009) as supplementary material for cement. Fly ash replacement of cement is successful in improving concrete's resistance to expansion of sulfate attack. The greater the concrete compressive strength the lower the fracturing tensile strength to compressive strength ratio. Finally, this literature search showed that when the replacement of Portland cement and aggregate was done by the fly ash, the properties of concrete are improved.

III. MATERIALS USED

1. Cement:- Ordinary Portland Cement of 53 grade satisfying the requirements of IS: 8112 – 1989. The specific gravity of cement was found to be 2.84.

Density of the cement is calculated in accordance with the requirement of IS: 3535 – 1986.
Standard consistency of cement is calculated in accordance with the requirements of IS: 4031(Part–4)1996.
Fineness of the cement is calculated in accordance with the requirements of IS: 4031(Part–1)1996.
To determine the soundness of cement by Le – Chatelier methods as per IS: 4031(Part – 3)1996.

2. Fine aggregate:- The sand generally collected from Gujarat. Sand is main component grading zone – III of IS:383 – 1970 was used with specific gravity of 2.55 and water absorption ratio of 1.01%.

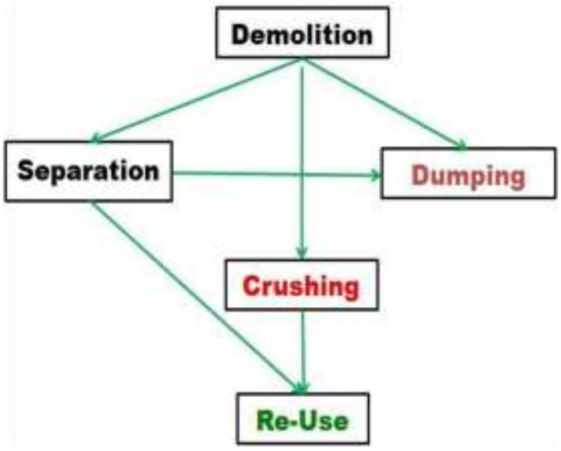
Bulk density of fine aggregate is calculated in accordance with requirement of IS: 2386–1963(Part–4).
Grading of the fine aggregate is calculated in accordance with requirement of IS: 2386–1963(Part–1).

3. Coarse aggregate:- Mechanically crushed stone from quarry situated in Gujarat with 20mm maximum size, satisfying to IS: 383–1970 was

used. The specific gravity was found to be 2.82 and water absorption ratio is 0.56%.

Bulk density of coarse aggregate is calculated in accordance with requirement of IS: 2386–1963(Part–4).
Grading of the coarse aggregate is calculated in accordance with requirement of IS: 2386–1963(Part–1).
To determine the aggregate crushing value of coarse aggregate as per IS: 2386 (Part – 4) 1963.
To determine the aggregate impact value of coarse aggregate as per IS: 2386 (Part – 4) 1963 and IS:383–1970.

4. Recycled coarse aggregate:- Aggregate collected from the processing of building and demolition waste are referred to as recycled aggregate. The recycling process is shown as follows:



5. Fly ash:- In all cases of the experiments, fly ash is used as partial replacement of cement that substitute 15% of the total cement content. Class – F fly ash is used with specific gravity as 2.31 from Gujarat as per IS:3812 – 1999.

Density of the fly ash is calculated in accordance with the requirement of IS: 3535 – 1986.
Fineness of the fly ash is calculated in accordance with the requirements of IS: 4031(Part–1)1996.

IV. CONCRETE MIX DESIGN

4.1 Concrete mix design

IS: 10262 – 2009 is used to construct the mixing ratio of ordinary grade M–30 concrete. In addition, fly ash is added at 15% for 100% of cement.

V. RESULTS

1. Cement:- This is the results of the physical properties of cement.

Characteristics	Results
Specific gravity of cement	2.84
Density of cement	3.16 gm/ml
Soundness of cement (Expansion of cement)	1.93 mm
Fineness of cement	4.33%
Standard consistency of cement	40%
Initial setting time of cement	40 min
Final setting time of cement	365 min

2. Fine aggregate:- This is the results of the physical properties of fine aggregate.

Characteristics	Results
Specific gravity of fine aggregate	2.55
Apparent specific gravity of fine aggregate	2.61
Water absorption ratio of fine aggregate	1.01%
Bulk density of loose fine aggregate	1.66 kg/lt

Bulk density of compacted fine aggregate	1.76 kg/lt
% of voids in fine aggregate	0.0035%
Fineness modulus of fine aggregate	3.77
Zone of fine aggregate	Zone – III
Silt content in fine aggregate	5.49%

3. Coarse aggregate:- This is the results of the physical properties of coarse aggregate.

Characteristics	**Results**
Specific gravity of coarse aggregate	2.82
Apparent specific gravity of coarse aggregate	2.86
Water absorption ratio of coarse aggregate	0.56%
Bulk density of loose coarse aggregate	1.51 kg/lt
Bulk density of compacted coarse aggregate	1.64 kg/lt
% of voids in coarse aggregate	0.0046%
Crushing value of coarse aggregate	14%
Impact value of coarse aggregate	13%
Flakiness index of coarse aggregate	5.97%
Elongation index of coarse aggregate	20.86%

4. Fly ash:- This is the results of the physical properties of fly ash

Characteristics	**Results**
Specific gravity of fly ash	2.31
Density of fly ash	2.77 gm/ml
Fineness of fly ash	3%
Standard consistency of fly ash	45%
Initial setting time of fly ash	44 min
Final setting time of fly ash	391 min

5. Mix design M–30:- The conclusion follows the result of the physical properties of the materials and the result of the calculation of the mixed design (M–30)

Name of materials	**Properties of materials**
Cement	393.49 kg/m3
Fly ash	69.44 kg/m3
Water	208.32 kg/m3
Fine aggregate	543.53 kg/m3
Coarse aggregate	1116.29 kg/m3

VI. CONCLUSION

- This conclusion follows the result of the physical properties of the materials and the calculation of the mixed design (M–30).
- Physical properties of materials and experiments have resulted in the conclusion that these materials can be used in construction in accordance with Indian standards.
- After the calculation of the mixed design M–30, the conclusion came in the result that how much amount of materials to be used in the mix design and how much amount of water to used in mix design.

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IS Codes

1. IS: 3812 – 1999 Specification for Fly Ash to Use as Pozzolana and Admixtures.
2. IS: 10262 – 2009 Concrete Mix Proportioning Guidelines (First Revision)
3. IS: 8112 – 1989 Ordinary Portland Cement Specifications.
4. IS: 383 – 1970 Specifications for Coarse and Fine Aggregate from Natural Sources of Concrete.
5. IS: 3535 – 1986 Methods of Sampling Hydraulic Cement (First Revision).
6. IS: 2386 – 1963 (Part – 1) Methods of Test for Aggregates for Concrete (Particle size and shape).
7. IS: 2386 – 1963 (Part – 2) Methods of Test for Aggregates for Concrete (Estimation of deleterious materials and organic Impurities).
8. IS: 2386 – 1963 (Part – 3) Methods of Test for Aggregates for Concrete (Specific gravity, density, voids, absorption and bulking).
9. IS: 2386 – 1963 (Part – 4) Methods of Test for Aggregates for Concrete (Mechanical properties).
10. IS: 4031 (Part – 1) 1996 Methods of Physical Tests for Hydraulic Cement (Part – 1: determination of fineness by dry sieving) (Second Revision).
11. IS: 4031 (Part – 3) 1996 Methods of Physical Tests for Hydraulic Cement (Part – 1: determination of soundness) (First Revision).
12. IS: 4031 (Part – 4) 1996 Methods of Physical Tests for Hydraulic Cement (Part – 4: determination of consistency of standard cement paste) (First Revision).

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