

Experimental Study on the Influence of Fine Powder in Crushed Aggregates on Properties of the Concrete

Ajinkya A. Gondkar¹, Dr.A.A.Bage²

M. Tech Student, Department of Structural Engineering, Sardar Patel College of Engineering, Mumbai, India¹

Associate Professor, Department of Structural Engineering, Sardar Patel College of Engineering, Mumbai, India²

ABSTRACT: In today's day to day life the preservation of our natural ecosystem should be the main point of view for anything that is being used or is being developed. The extraction of natural sand from the river beds has resulted in developing serious problems for the natural flow of river water, which has led us to the use of man-made aggregates in the place of natural sand. Now this man-made crushed aggregate which are used now a day are not up to the mark every time, they have some fine particles such as dust, clay, etc. carried along with them while they are processed, which affect the quality of resulting concrete. Because of this the concrete containing considerable amount of fines will give an improper mix and will deteriorate at an early stage, causing damage to structural members. This present study was done to investigate the effects of presence of fine particles in crushed aggregates on the strength and durability properties of M-30 grade concrete and find an optimum percentage of fines which can be allowed in the crushed aggregates for a good quality concrete.

KEYWORDS:Crushed aggregates, fines, durability, RCPT, RCMT.

I. INTRODUCTION

Concrete as we know is conventionally a mixture of cement, sand and aggregate. Properties of aggregates have a great impact on the concrete performance and durability. Crushed aggregates play a vital role in this matter, so it is an essential element of concrete which need to be carefully considered while selecting. Aggregate are inert granular materials such as sand, gravel or crushed stone that, along with water and Portland-cement are ingredient in concrete. For a good concrete mix, aggregates need to be strong, clean, hard particles free of any absorbed chemicals or any type of clay coatings and other fine materials that could cause the deteriorate quality of concrete. Aggregates totally account for about 60 to 75 per cent of the total volume of concrete and are divided into two distinct categories such as fine aggregates and coarse aggregates. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through an IS sieve of 4.75 mm and contains only a small quantity of coarser material. Coarse aggregates are any particle retained on IS sieve of 4.75 mm. Gravels constitute the major part of coarse aggregate used in concrete with crushed stone filling for the remaining part.

Natural gravel and sand are usually dug or dredged from a pit, river, lake, or seabed. Crushed aggregate is produced by crushing quarry rock, boulders, cobbles, or large-size gravel. Recycled concrete is a viable source of aggregate and has been satisfactorily used in granular sub-bases, soil-cement, and in new concrete.

Aggregates strongly influence concrete's freshly mixed and hardened properties, mixture proportions, and economy. Consequently, selection of aggregates is an important process. The crushed aggregates which are generally used for the construction work is with some amount of fine content or dust present in it. Of which a large fraction of fines consists of clay. The presence of fines in concrete reduces the compressive strength and increases the shrinkage in the resulting concrete. And also, the chemical composition of the fines in aggregates is an important factor. So, the fines need to be studied by their chemical composition and the % by which they are present in the crushed aggregates.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

When the fines along with crushed aggregates are mixed with cement and coarse aggregate by adding design required water content, the fines will get mixed with cement paste and affect the workability of concrete. Which in turn will give an improper concrete mix which will not give its desired quality required for the job. So, in this project study it will be studied that how fines affect the strength and durability properties of concrete.

II. MATERIALS AND METHODOLOGY

A. Materials

Cement: The OPC of grade 53 is used for the experimental work with consistency of cement 29% conforming to IS 4031 part 4 1988. The average compressive strength of cement at 28 days was 54.49.

Aggregates: The aggregates which is used was obtained from a local resource near Vasai in Mumbai. Both 10mm and 20mm aggregates with crushed aggregates was obtained from the same resource.

Admixtures: Commercially available super plasticising admixture was used for preparing the concrete mix.

B. Methodology

- The characteristic strength of concrete for which the specimens were tested was 30MPa.
- Testing was done with overall 8 variations.
- The crushed aggregate was sieved through IS sieve of 150 μ which separated the fine powder from the crushed aggregates.
- The variations were done by replacement of crushed aggregates percentage by weight with fine powder in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively.
- The mix proportion was made by referring the Ambuja Cement 2002, Concrete Mix Design.
- Strength gain was checked at 7 days and 28 days of curing by performing compression test, split tensile test and flexural test on each variation.
- Durability was predicted by performing rapid chloride penetration test, rapid chloride migration test at 28 and 56 days of curing and water permeability test at 28 to 35 days of curing on each variation.

III. EXPERIMENTAL RESULTS

1. Compressive strength of concrete:

The compressive strength of M-30 grade concrete is calculated by replacement of crushed aggregates percentage by weight with fine powder in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, for 7 days and 28 days respectively. The maximum strength at 28 days was achieved by 10% replacement of fine aggregates by fine powder. The strength gain was satisfactory as specified in IS code for all the variations. The test results obtained are shown in figure 1.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

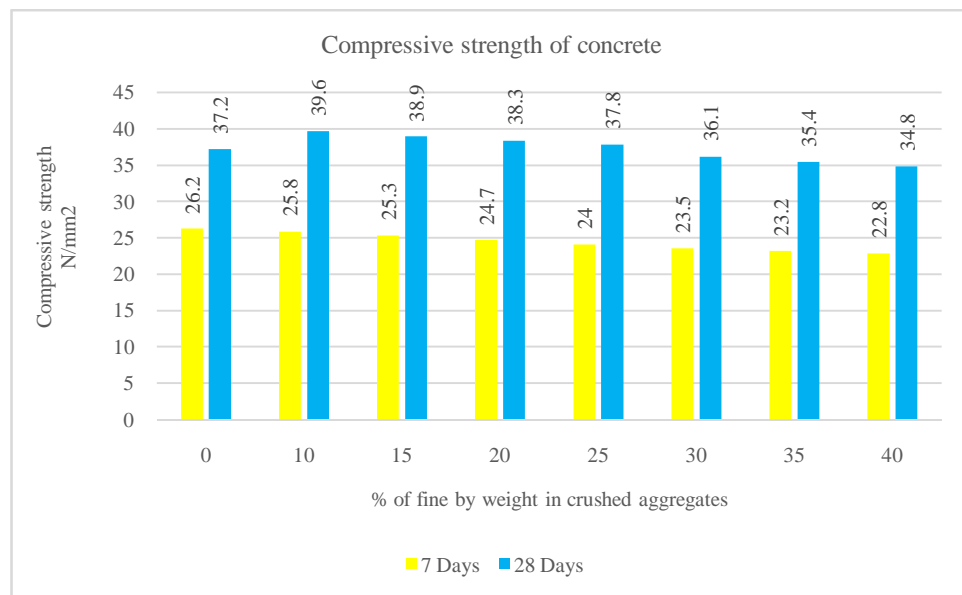


Fig 1 Graphical Representation Of Compressive Strength Of Concrete At 7 And 28 Days

2. Flexural strength of concrete:

The flexural strength of M-30 grade concrete is calculated as given in IS 516-1959 by replacement of crushed aggregates percentage by weight with fine powder in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, for 7 days and 28 days. The maximum strength at 28 days was achieved by 10% replacement of fine aggregates by fine powder. The test results are shown in figure 2

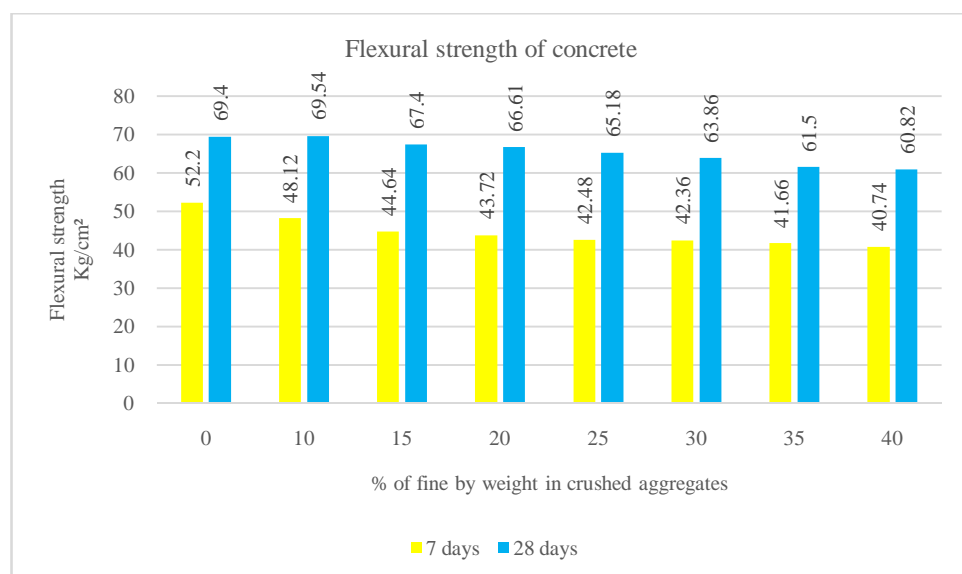


Fig 2 Graphical representation of flexural strength of concrete beams at 7 and 28 days

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

3. Split tensile strength of concrete:

The split tensile strength of M-30 grade concrete is calculated as given in IS 5816-1999 by replacement of crushed aggregates percentage by weight with fine powder in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, for 7 days and 28 days. The maximum strength at 28 days was achieved by 10% replacement of fine aggregates by fine powder. The test results are shown in figure 3

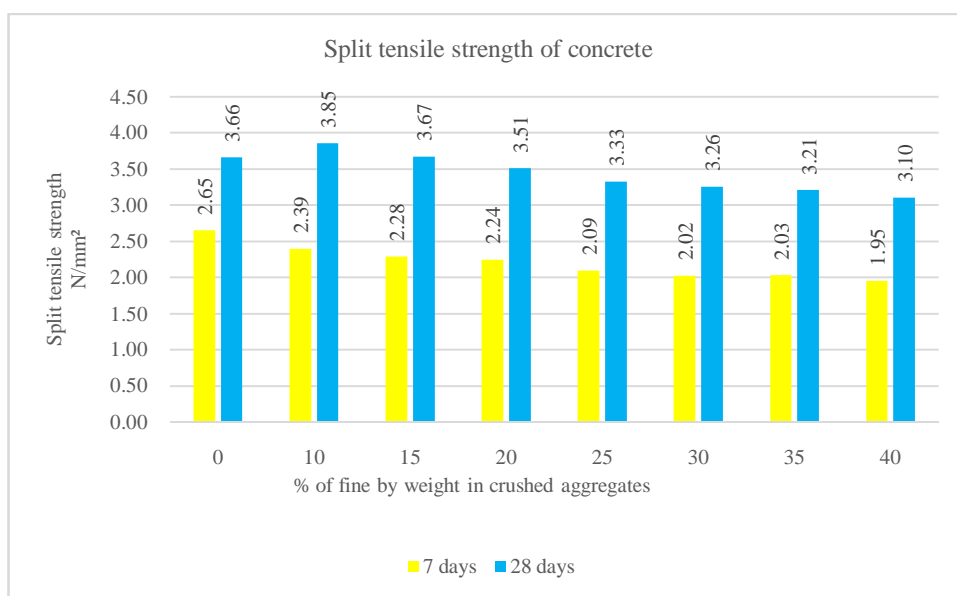


Fig 3 Graphical representation of split tensile strength of concrete at 7 and 28 days

4. Rapid Chloride Penetration Test:

The RCPT is done according to ASTM C 1202-05 on M-30 grade concrete by replacement of crushed aggregates percentage by weight with fine powder in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, for 28 days and 56 days. The penetration recorded was very low in variations with 0%, 10%, 15% and 20% replacement of fine powder, while the penetration for other variations was more as compared to first four variations. The test results are shown in figure 4

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

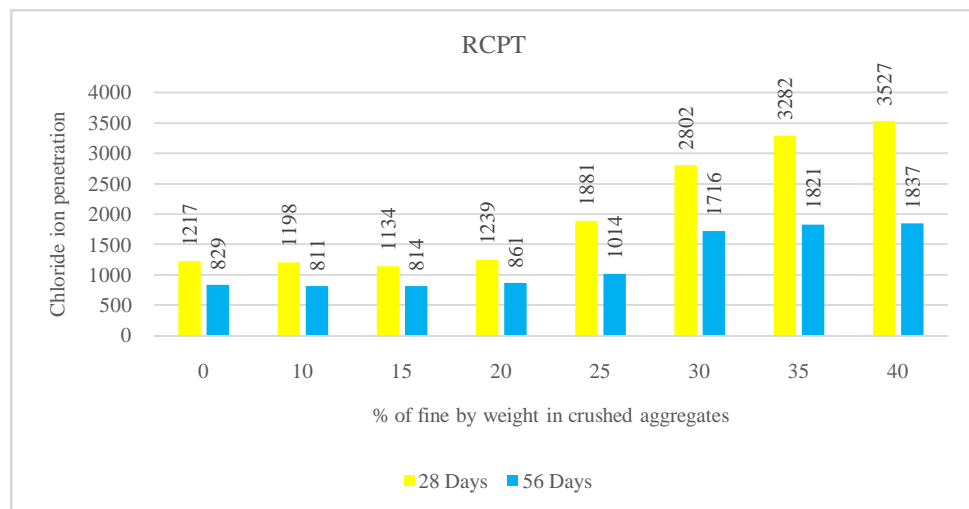


Fig 4 Graphical representation of RCPT of concrete at 28 and 56 days

5. Water Permeability Test:

The water permeability test is done according to DIN 1048 part 5 on M-30 grade concrete by replacement of crushed aggregates percentage by weight with fine particles in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, at age of 28 to 35 days. The maximum water penetration for concrete to be durable is 2.5 cm which is not reached by any of the variations, the 0% and 10% variations show minimum water penetration but for the last three variations the penetration depth is considerably more. The test results are shown in figure 5

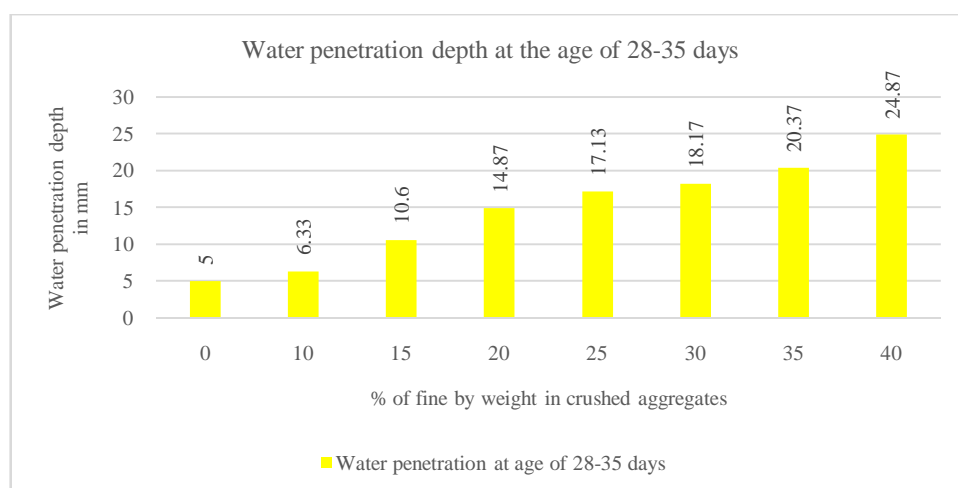


Fig 5 Graphical representation of water permeability test of concrete at age of 28 to 35 days

6. Rapid Chloride Migration Test:

The RCMT is done according to NT Build 492 on M-30 grade concrete by replacement of crushed aggregates percentage by weight with fine particles in 0%, 10%, 15%, 20%, 25%, 30%, 35% and 40% respectively, for 28 days and 56 days. The results for 0% and 10% variation showed that average

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

coefficient of migration was very less and for other variations the coefficient was in good range as per the NT Build 492 code specification. The test results are shown in figure 6

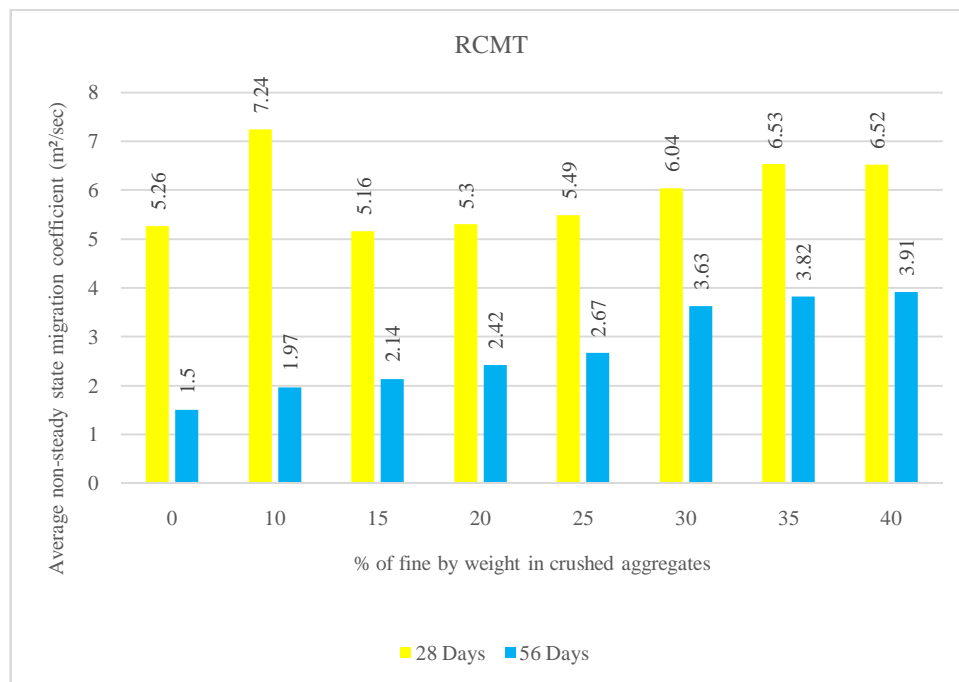


Fig 6 Graphical representation of RCMT of concrete at 28 and 56 days

IV. CONCLUSION

The optimum results were obtained at 10% replacement of fine aggregates by fine powder. This shows that if the powder content in fine aggregates must be as low as possible. The fine aggregates must be check for clay contamination if the powder content is more. The fine aggregates must be sieved before using for any construction purpose if powder is present in fine aggregates.

REFERENCES

- [1] H. Z. Cui (Ph.D), Xian Shi(2014) "Experimental Study on the Influence of Water Absorption of Recycled Coarse Aggregates on Properties of the Resulting Concretes" Journal of Materials in Civil Engineering, ASCE
- [2] M Vijaya Sekhar Reddy, I V Ramana Reddy "Durability aspects of standard concrete" International journal of structural and civil engineering research
- [3] JafarBolouri Bazaz1 and Mahmood Khayati "Properties and Performance of Concrete Made with Recycled Low-Quality Crushed Brick" Journal of Materials in Civil Engineering, ASCE
- [4] IS: 383-1970, Specifications for Coarse and Fine Aggregates for Natural Sources of Concrete, Bureau of Indian Standards, New Delhi
- [5] IS: 10262-2009, Concrete Mix Proportioning-Guidelines, Bureau of Indian Standards, New Delhi
- [6] IS: 516-1959, Methods of Tests for Strength of Concrete, Bureau of Indian standards, New Delhi
- [7] IS: 5816-1999, Splitting Tensile Strength of Concrete, Bureau of Indian standards, New Delhi
- [8] IS: 456-2000, Plane and Reinforced Concrete Code of Practice (Fourth revision), Bureau of Indian Standards, New Delhi
- [9] ASTM C 1202-05, Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- [10] DIN 1048 part 5, Testing of Hardened Concrete
- [11] NT BUILD 492, Chloride Ion Migration Coefficient from Non-Steady State Migration Experiments