

COMPARATIVE STUDY OF SELF COMPACTING CONCRETE USING ARTIFICIAL CRUSHED SAND WITH CONVENTIONAL CONCRETE WITHOUT USING ARTIFICIAL CRUSHED SAND

¹ DR. M. B. VARMA, ² S. B. MAGARE

¹ Applied Mechanics Department, Government Engineering College, Aurangabad.,
Maharashtra - 431005, India.

² Applied Mechanics Department., Government Engineering college, Aurangabad,
Maharashtra - 431005, India

ABSTRACT - *Self-compacting concrete is “one of the most revolutionary developments” in concrete because of its several advantages in technical, economic and environmental terms. Especially on the environmental aspects moves the research towards use of artificial sand. Scarcity of good quality Natural River sand due to depletion of natural resources and restriction of environmental consideration has made concrete manufactures to look for suitable alternative fine aggregate. One such alternative is “Artificial Sand”. This paper presents the result of a study that investigated the influence of properties of fresh and hardened self-compacting concrete as substitutes to natural sand. The experimental work is mainly concerned with the study of mechanical properties like compressive strength, split tensile strength and flexural strength of concrete then the results are compared with the natural sand concrete.*

Keywords- *Natural Sand, Artificial Sand, SCC, Compressive strength, Flexural Strength, Split Tensile Strength.*

I. INTRODUCTION

Making concrete structures without vibration have been done in the past, Mass concrete and shaft concrete can be successfully placed without vibration. But the above concrete are generally of lower strength and difficult to obtain consistent quality. European Federation of national trade associations representing producers and applicators of specialist building products (EFNARC) has drawn up Specification and Guidelines for self-compacting concrete to provide a framework for design and a use of high quality SCC, during 2002. [8] A SCC (self-compacting concrete) is a concrete that flows and sets up in the most complex and scrapped Forms under the effect of its own weight. It is important to note that the material should not undergo any form of segregation and should have qualities similar to those of conventional vibrated concrete. [5]

Natural sand is excavated from river bed impacts on environment in many years. Due to digging of the sand from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. Due to limited supply of natural sand, cost is very high and its consistent supply cannot be guaranteed. Under these circumstances use of crushed fine aggregates becomes unavoidable. [4]

Artificial sand is a process controlled crushed fine aggregate produced from quarried stone by crushing or grinding and classification to obtain a controlled gradation product that completely passes the 4.75 mm sieve. Artificial sand generally contain more angular particles with rough surface textures and flatter face than natural sand that are more rounded as a result of weathering. Over the time some investigations have shown that angular particles, rough surface of artificial sand influences the workability and finish ability in fresh concrete. The artificial sand have to satisfy the technical requisites such as workability, strength and durability of concrete and hence it has become necessary to study these properties in order to check the suitability and appropriate replacement level of artificial sand in comparison with the natural sand for producing concretes in an economical way. [3]

II. LITERATURE REVIEW

A brief review of the past literature carried by different researchers in Comparative Study of Self Compacting Concrete Using Artificial Crushed Sand with Conventional Concrete without Using Artificial Crushed Sand is discussed below:

Dr.S.Elavenil, B Vijaya [1] focused on Manufactured Sand, A Solution And An Alternative To River Sand And In Concrete Manufacturing. Manufactured sand has been use in concrete manufacturing in India, the percentage of its contribution is still very negligible in many parts of the country. Except in Kerala and in some pockets in Southern and Western India, real processed manufacture sand is not available and this makes manufacturing of good quality of concrete very difficult. The application of concrete meeting the specification is of paramount importance, to ensure construction of durable R.C.C. structure. Hence durable concrete covers and bears the responsibility of sustaining the entire R.C.C. structure throughout it service life. A well processed manufactured sand as partial or full replacement to river sand is the need of the hour as a long term solution in Indian concrete industry until other suitable alternative fine aggregate are developed.

M. R. Chitlange, Dr. P. S. Pajgade, Dr. P. B. Nagarnaik [2] focused on Experimental Study of Artificial Sand Concrete. Conventionally concrete is a mix of cement, sand and aggregate. There is a large variation in the strength of concrete due to variation in the strength of aggregates used. There is scarcity of natural sand due to heavy demand in growing construction activities which forces to find the suitable substitute. The cheapest and the easiest way of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade which would be free from all impurities. This paper presents the feasibility of the usage of artificial sand obtained by crushing basalt over natural sand considering technical, environmental and commercial factors. For the purpose of experimentation concrete mixes are designed for M20, M30 and M40 grades by 100% replacement of natural sand to artificial sand. Compressive and flexural tests are conducted to study the strength of concrete using artificial sand and the results are compared with that of natural sand concrete.

Vinayak R.Supekar, Popat D.Kumbhar [3] studied that the Properties of Concrete by Replacement of Natural Sand with Artificial Sand. Concrete is considered to be the most widely used and versatile material of construction all over the world. In recent years, concrete technology has made significant advances which have resulted in economical improvements in strength of concretes. This economic development depends upon the intelligent use of locally available materials. One of the important ingredients of conventional concrete is natural sand or river sand, which is expensive and scarce. In India, the conventional concrete is produced by using natural sand obtained from riverbeds as fine aggregate. However, due to the increased use of concrete in almost all types of construction works, the demand of natural or river sand has been increased. To meet this demand of construction industry excessive quarrying of sand from river beds is taking place causing the depletion of sand resources. The dwindling sand resources have not only posed the environmental problems but also have caused the rivers to change their flow direction. This fact has forced the Government to lay down restrictions on sand quarrying process resulting in the scarcity and significant increase in its cost. Thus the scarcity of natural sand has forced to find the suitable substitute. The cheapest and the easiest way of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade which would be free from all impurities. The promotional use of artificial sand will conserve the natural resources for the sustainable development of the concrete in construction industry. In the present an attempt has been made to discuss the properties such as workability and compressive strength of concrete prepared by replacing natural sand with artificial sand at different replacement levels (0%, 20%, 40%, 60% and 100%). The development of cracks and their measurement is also studied. The results have shown that the natural sand can be replaced with artificial sand up to a maximum replacement level of 60% in order to produce concrete of satisfactory workability and compressive strength and also with cracks of lesser areas.

Prof. Wakchaure M. R., Er. Shaikh A.P., Er. Gite B.E [4] focused on Effect of Types of Fine Aggregate on Mechanical Properties of Cement Concrete. This paper presents the effect of the use of artificial sand as fine aggregate in concrete as substitutes to natural sand. The experimental work is mainly concerned with the study of mechanical properties like compressive strength, split tensile strength and flexural strength of concrete by full replacement of natural sand by artificial sand as fine aggregate. Tests were carried out on cubes, cylinders and unreinforced beams to study the mechanical properties of concrete sing artificial sand and compared with conventional concrete.

Leila Zeghichi, Zeid Benghazi and Laid Baali [5] studied the Comparative Study of Self-Compacting Concrete with Manufactured and Dune Sand. Sand is an inert element essential in the composition of concrete; its use ensures granular continuity between the cement and gravel for better cohesion of concrete. This paper presents the results of a study that investigated the influence of sand quality on the properties of fresh and hardened SCC (self-compacting concrete). The dune sands are very fine materials characterized by a high intergranular porosity, high surface area and low fineness modulus; on the other hand crushed (manufactured) s and has a high rate into thin and irregular shapes which influence the workability of concrete. The amount of dune sand varies from (0%, 50% to 100%) by weight of fine aggregates. The results show that the

rheological properties favour the use of dune sands; however the mechanical properties support the use of crushed sand.

B.P. Hudson [6] developed the Manufactured Sand for Concrete. As environmental, transportation and other constraints make the availability and use of natural sands less attractive for the concrete producer, a substitute or replacement product for the concrete industry needs to be found. Manufactured sands have been around for a considerable time. However, manufactured sand people around the world generally try to synthesize natural sands, rather than taking advantage of the many properties that good manufactured sand can offer to enhance the performance of concrete.

Nimitha Vijayaraghavan and A S Wayal [7] focused on Effects of Manufactured Sand on Compressive Strength and Workability of Concrete. A huge amount of concrete is consumed by the construction industry. About 35% volume of concrete is comprised of sand. A good quality concrete is produced by careful mixing of cement, fine and coarse aggregates, water and admixtures as needed to obtain an optimum quality and economy. Generally cement and coarse aggregates is factory made products and their quality and standards can be easily controlled and maintained. Water used for mixing of concrete is usually tap water. The fine aggregates or sand used is usually obtained from natural sources specially river beds or river banks. Now-a-days due to constant sand mining the natural sand is depleting at an alarming rate. Sand dragging from river beds has led to several environmental issues. Due to various environmental issues Government has banned the dragging of sand from rivers. This has led to a scarcity and significant increase in the cost of natural sand. There is an urgent need to find an alternative to river sand. The only long term replacement for sand is manufactured sand.

A. Navaneethakrishnan, Prof. V.M. Shanthi [8], studied the Experimental Study of Self Compacting Concrete (SCC) Using Silica fume. Construction of durable concrete structures requires skilled labor for placing and compacting concrete. Therefore, there is a need to render the durability of the concrete structures to be independent of the quality of the construction worker. For the above, self-compacting concrete is an obvious answer. The proposed experimental program is aimed to evaluate performance of SCC by varying percentage of silica fumes as replacement of cement. An attempt has been made to study the fresh and hardened properties of self-compacting concrete with silica fume as mineral admixture. A simple mix design of SCC proposed by Nan su et al., is used for fixing the trial mix. The trial mix which satisfies the fresh concrete properties as per EFNARC guidelines and the one which gives maximum compressive strength is used in the present work. Cement is replaced with various percentages of silica fumes (0%, 10%, 15% and 20%). Self-compacting concrete with 15% silica fume showed better results when compared to other replacements. Hence silica fume can be effectively used for cement replacement.

B. H. Shinde [9] studied the Shear strength of self compacting concrete with crushed sand and fly ash. Fine Aggregate is one of the important ingredients of concrete. River sand is commonly used as fine aggregate in making concrete. However dredging of sand from river beds is hazardous to the environment. This has made the Government to restrictions on the use of river sand in construction. Such cases leads use of crushed sand as an alternative to river sand, due to angular shape and rough textures it gives better bond strength. Compaction of normal concrete is impossible at the place of dense reinforcement where needle vibrator can not reach, at that place Self Compacting Concrete is effective to reach at every corner of formwork, and get compact due to its self weight. Shear failure in concrete is known to be brittle and catastrophic. In structural design, shear is accounted for providing shear reinforcement such as stirrups in beam and dowels in slabs. Shear strength of concrete is very important for calculating the quantity of shear reinforcement. Shear strength of concrete is depend Compressive strength. In this present work an attempt is made to develop Self Compacting Concrete with Crushed sand as fine aggregate and compares its fresh properties for different w/c ratio. Compressive and shear strength of River Sand Self Compacting Concrete and Crushed Sand Self Compacting Concrete also studied ,with varying the percentage of shear reinforcement by 0%, 0.25% and 0.50% at shear plane of push-off specimen. Load deflection variations of Self Compacting Concrete with River sand compression and shear test, cube specimen of 100 mm side and 150mm*150mm*450mm size push-off specimen were used. In this experimental study compressive and shear strength of CSSCC becomes more than RSSCC at same w/c ratio and percentage of shear reinforcement.

SUMMERY

From the literature review it has been observed that, the mixes with artificial sand as a fine aggregate gives consistently higher strength than the mixes with natural sand. The sharp edges of the particles in artificial sand provide better bond with cement than the rounded particles of natural sand resulting in higher strength.

The test results obtained from well planned and carefully performed experimental program encourages the full replacement of natural sand by artificial sand considering the technical, environmental and commercial factors.

The replacement of natural sand with artificial sand will help in conserving the natural resources of sand and

maintain the ecological balance of the nature. Results show that the river sand can be fully replaced by manufactured sand.

FUTURE SCOPE

The main aims of this report are to present state-of-the-art knowledge regarding production and utilization of manufactured sand. The overall objective is to develop a technology Platform for the shift from natural to manufactured aggregates based on hard rock. This includes knowledge of resource management, cost effective production, use of manufactured aggregates in concrete and mix design concepts for concrete. Current specifications in many countries still are based on the use of natural sands, where several specifications do not allow high percentages of fines to be used in concrete. A new understanding of the properties of manufactured sand and the need to treat it differently is require.

The purchase cost of artificial sand is about 70% to that of natural sand and considering cost of screening, washing and wastage due to oversize particles of natural sand, the artificial sand concrete may be 20% cheaper than that of natural sand concrete. As natural aggregate resources near urban centres terminate, the transport distances increase. Even though production of manufactured sand requires more energy than corresponding production of natural sand, the vicinity to the market, with less transport, will make manufactured sand environmentally Favourable. It must be our ambitions for the future to enable 100% use of manufactured aggregate in Concrete, producing high quality concrete, both in the fresh and hardened state.

REFERENCES

- [1] Dr. S. Elavenil, Prof. B. Vijaya, “Manufactured Sand, A Solution and Alternative to a River sand and In Concrete Manufacturing”.
- [2] Prof. M.R.Chitlange, Dr. P.S. Pajgade, Dr. P.B. Nagarnaik, “Experimental Study of Artificial Sand Concrete”, First International Conference on Emerging Trends in Engineering and Technology.
- [3] Vinayak Supekar, Dr.Popat Kumbhar. “Properties of Concrete by Replacement of Natural Sand with Artificial Sand”, International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 7, September - 2012.
- [4] Prof. Wakchure, M.R., Er Shaikh A.P. “Effect of Types of Fine Aggregate on Mechanical Properties of Cement Concrete”, International Journal of Modern Engineering Research (IJMER), ISSN: 2249-6645, Vol.2, Issue.5, Sep-Oct. 2012 pp-3723-3726.
- [5] Leila Zeghichi, Zeid BENGHAZI and Laid BaaliForman, “Comparative Study of Self Compacting Concrete with Manufactured and Dune Sand”, Journal of Civil Engineering and Architecture, ISSN 1934-7359, USA, Oct. 2012, Volume 6, No. 10 (Serial No. 59), pp. 1429–1434.
- [6] B.P. Hudson, Manufactured Sand for Concrete.
- [7] Nimitha Vijayaraghavan and A S Wayal, “Effects of Manufactured Sand on Compressive Strength And Workability Of Concrete”, International Journal of Structural and Civil Engineering Research, ISSN 2319 – 6009, Vol. 2, No. 4, November 2013.
- [8] A. Navaneethakrishnan, Prof. V.M. Shanthi, “Experimental Study of Self Compacting Concrete (SCC) Using Silica fume”, International Journal of Emerging Trend in Engineering and Development, ISSN 2249-6149, Issue 2, vol. 4, (May 2012).
- [9] B.H. Shinde, Dr. S.S. Jamkar. “Shear strength of self compacting concrete with crushed sand and fly ash”, Journal of Research in Engineering, Science & Technology. (Special issue-1- civil engg.) July 2011.