Mixed Design of Concrete Partially Replacement of Natural Sand with Robosand

Saiprakash Bhukya[1], Prashanth Enugula[2], Naveen K[3], Venkatesh Gundekari[4], Prashanth Kumar Pothuganti[5], K. Anjaneyulu[6], S. Swetha[7]

[1,2,3,4,5]UG Student, [6,7]Assistant Professor, Department of Civil Engineering
Kommuri Pratap Reddy Institute of Technology, Ghatkesar, Hyderabad, Telangana, India

ABSTRACT

Common river sand is expensive due to excessive cost of transportation from natural sources. Also, large scale depletion of these sources creates environmental problems. as environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or a replacement product for concrete industry needs to be found. River sand most used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has stared posing serious problems with respect to its availability, cost, and environmental impact. In such a situation Robosand can be economical alternative to the river sand. The Robosand is the by-product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes. Mix design has been developed for both conventional concrete and Robosand concrete. Tests are conducted on cubes for the cylinders to study the strength of concrete made of quarry dust.

Keywords: Concrete, natural sand, Robosand.

1. INTRODUCTION

Concrete is the most popular building material in the world. However, the production of cement has diminished the limestone reserves in the world and requires a great consumption of energy. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increase in the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably by-products. Fly ash (pulverized fuel ash) is used extensively as a partial replacement of cement. However, though the inclusion of fly ash in concrete gives many benefits, such inclusion causes a significant reduction in early strength due to the relatively slow hydration of fly ash. Nevertheless, fly ash causes an increase in workability of concrete. Robo sand has been proposed as an alternative to river sand that gives additional benefit to concrete. Robo sand is known to increase the strength of concrete over concrete made with equal quantities of river sand, but it causes a reduction in the workability of concrete. When examining the above qualities of fly ash and Robosand, it becomes apparent that if both are used together, the loss in early strength due to one may be alleviated by the gain in strength due to the other, and the loss of workability due to the one may be partially negated by the improvement in workability caused by the inclusion of the other.

1.1. ROBO SAND

Robo sand can be an economic alternative to the river sand. The Robosand is the by-product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes. Quarry dust, a by-product from the crushing process during quarrying activities is one of such materials. Granite fines or rock dust is a by-product obtained during crushing of granite rocks

and is also called quarry dust. In recent days there were also been many attempts to use Fly Ash, an industrial by product as partial replacement for cement to have higher workability, long term strength and to make the concrete more economically available.

This present work is an attempt to use Robosand as partial replacement for Sand in concrete. Attempts have been made to study the properties of concrete and to investigate some properties of Robosand the suitability of those properties to enable them to be used as partial replacement materials for sand in concrete.

1.2. NEED FOR THE REPLACEMENT OF SAND

Large scale efforts are required for reducing the usage of the raw material that is present, so that large replacement is done using the various by-product materials that are available in the present day. Materials like fly ash especially Class F fly ash is especially useful as the fine aggregates. The fly ash is obtained from the thermal power plants which is a by-product formed during the burning of the coal. The other material that can be used is Robosand which is made while in the processing of the Granite stone into aggregates, this is formed as a fine dust in the crushers that process the coarse aggregates, which is used a earthwork filling material in the road formations majorly. Many studies are made with several other materials which gave the concrete to be a material made of recycled material but the parameters that are primary for the material was not satisfied. The properties of concrete in fresh and hardened state are studied in the various papers that are used as a reference for this. Some of the properties are workability, compressive strength is the major one that are considered.

2. LITERATURE REVIEW

The use of sheet glass powder as fine aggregate replacement in Concrete: Sheet galas powder in concrete making leads to green environment. Using SGP in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. Efforts have been made in the concrete industry to use waste glass as partial replacement of coarse or fine aggregates and cement. In this study, finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. This work examines the possibility of using Glass powder as partially replaced as 10%, 20%, 30% and 40% and tested for its compressive, Tensile and flexural strength up to 60 days of age and were compared with those of conventional concrete; from the results obtained, it is found that glass powder can be used as cement replacement material up to particle size less than 75μm to prevent alkali silica reaction.

Performance of high strength concrete: This research study was conducted to investigate the performance of high strength concrete (HSC) made with copper slag as a fine aggregate at constant workability and to study the effect of super plasticizer addition on the properties of HSC made with copper slag. Two series of concrete mixtures were prepared with different proportions of copper slag. The first series consisted of six concrete mixtures prepared with different proportions of copper slag at constant workability. The water content was adjusted in each mixture to achieve the same workability as that for the control mixture. Twelve concrete mixtures were prepared in the second series. Only the first mixture was prepared using super plasticizer whereas the other eleven mixtures were prepared without using super plasticizer and with different proportions of copper slag used as sand replacement. The results indicated that the water demand reduced by almost 22% at 100% copper slag replacement compared to the control mixture. The strength and durability of HSC were generally improved with the increase of copper slag content in the concrete mixture. However, the strength and durability characteristics of HSC were adversely affected by the absence of the super plasticizer from the concrete paste despite the improvement in the concrete strength with the increase of copper content. All concrete mixtures did not meet the strength and durability design requirements due to the segregation and dryness of the concrete paste. Therefore it can be concluded that the use of copper slag as sand substitution improves HSC strength and durability characteristics at same workability while super

plasticizer is very important ingredient in HSC made with copper slag in order to provide good workability and better consistency for the concrete matrix.

Recycling of waste glass as a partial replacement for fine aggregate in concrete: Waste glass creates serious environmental problems, mainly due to the inconsistency of waste glass streams. With increasing environmental pressure to reduce solid waste and to recycle as much as possible, the concrete industry has adopted several methods to achieve this goal. The properties of concretes containing waste glass as fine aggregate were investigated in this study. The strength properties and ASR expansion were analysed in terms of waste glass content. An overall quantity of 80 kg of crushed waste glass was used as a partial replacement for sand at 10%, 15%, and 20% with 900 kg of concrete mixes. The results proved 80% pozzolanic strength activity given by waste glass after 28 days. The flexural strength and compressive strength of specimens with 20% waste glass content were 10.99% and 4.23%, respectively, higher than those of the control specimen at 28 days. The mortar bar tests demonstrated that the finely crushed waste glass helped reduce expansion by 66% as compared with the control mix.

3. REVIEWS ON EXPERIMENTS OF CONCRETE BY REPLACING FINE AGGREGATES WITH SAND

Investigations on Robosand and Ceramic scrap as aggregate replacement in concrete: Conservation of natural resources and preservation of environment is the essence of any development. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste materials are found suitable in concrete making, not only cost of construction can be cut down, but also safe disposal of waste materials can be achieved. So, in the present paper, an attempt has been made to assess the suitability of stone dust and ceramic scrap in concrete making. In the laboratory stone dust has been tried as fine aggregate in place of sand and ceramic scrap has been used as partial/full substitute to conventional coarse aggregate in concrete making. Cubes, cylinders, and prisms were cast and tested for compressive strength, split tensile strength and modulus of rupture after a curing period of 28 days. The results indicated effectiveness of stone dust as fine aggregate and partial replacement of conventional coarse aggregate by ceramic scrap up to 20 percent, without affecting the design strength.

Table 1: Physical properties of ordinary portland cement (OPC)

S. No.	Property	Test Method	Test Result
1.	Normal consistency	Vicat apparatus(IS 4031-Part IV)	32%
2.	Fineness	By sieving	9.2%
3.	Specific gravity	Specific gravity bottle (IS 4031-Part-II)	3.08

Table 2: Specific gravity of Coarse aggregate (20mm):

S. No.	Weight of Empty Bottle (w1) (gms)	Weight of Empty Bottle + sample (W2) (gms)	Weight of Empty Bottle + sample + Water (w3)	Weight of Empty Bottle + Water (W4) (gms)	Specific Gravity
1	431	824	1502.5	1246	2.879
2	431	826.5	1505.5	1246	2.89

The Specific gravity of coarse aggregate = 2.8

The Specific gravity of Fine aggregate = 2.59

4. TEST RESULTS

The test results of the experimental investigations are presented in the following tables.

COMPRESSION TEST:

Table 3 and Table 4 shows 7 days, 14 days, and 28 days compressive strength values of M40 and M30 grades concrete made using natural sand, Robosand of zone-2 and the variation of the strength represents in the graphs.

Table 3. M40 grade observations

No. of days	0%	10%	20%	40%
7	26	28.333	35.667	37.444
14	36.888	40.444	44.83	49.666
28	41.88	45.111	47.333	52.111

Compression testing values (cubes)

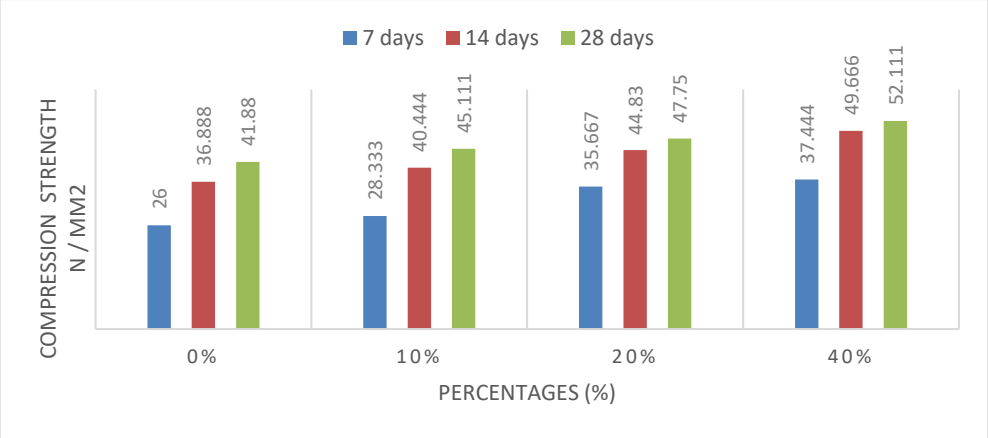

Figure 1. Graph representation of compression test (cubes)

Table 4. M30 GRADE OBSERVATIONS

No of days	0%	10%	20%	40%
7	21.222	27.555	30.32	35.778
14	29	32	38.333	41
28	37.32	40.333	44.778	48.667

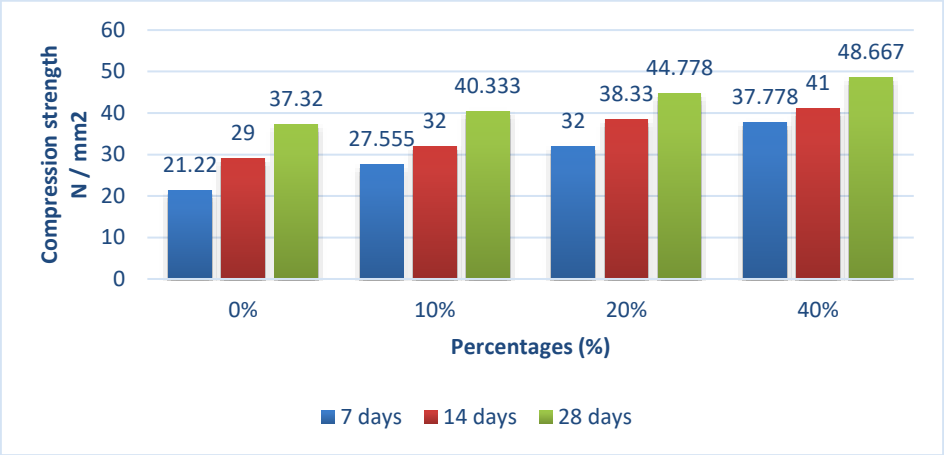

Figure 2. Graph representation of compression test (cubes)

SPLIT TENSILE TEST:

Table 5 and Table 6 shows 7 days, 14 days, 28 days split tensile strength test results of M40 and M30 grade concrete made with natural sand, Robosand and the variation of the strength represents in the graphs.

Table 5. M40 GRADE

No of days	0%	10%	20%	40%
7	9.6200	10.1859	10.751	12.166
14	10.050	10.186	11.034	12.166
28	11.317	11.883	12.166	13.01

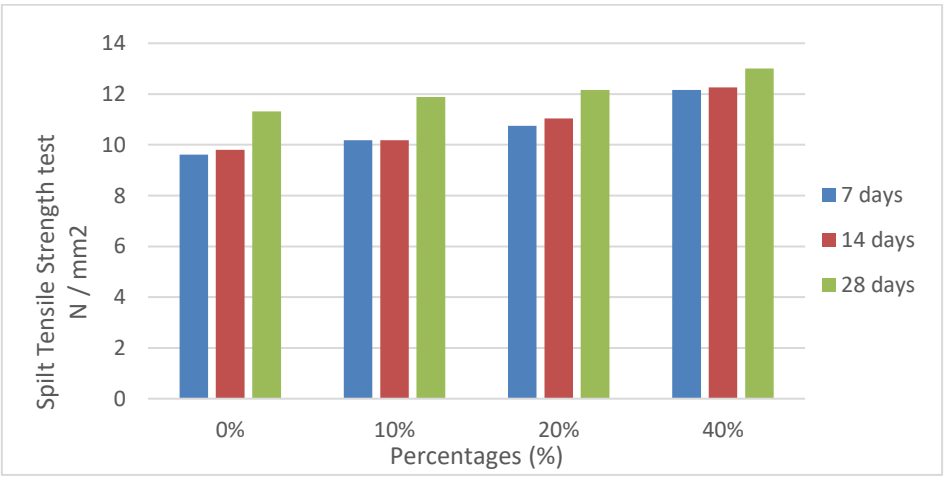

Figure 3. Graph representation of split tensile test (cylinders)

Table 6. M30 GRADE

No of days	0%	10%	20%	40%

7	9.903	10.186	11.600	12.166
14	10.67	11.317	11.03	12.167
28	12.166	12.449	12.732	13.01

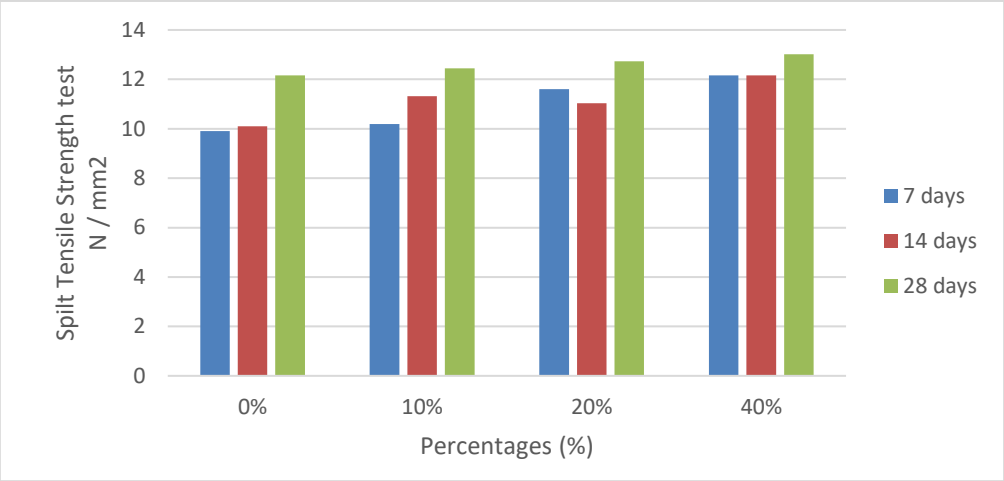

Figure 4. Graph representation of split tensile test

Effect of compressive strength: Tables shows the results of compressive strength values for 7days, 14days, and 28days for Robosand as a replacement of sand of proportions 0%, 10%, 20%, 40%. Finally, from the results the compressive strength is increasing from 0 to 40 percent and then decreasing up to 100 percent with reference to conventional concrete

Effects of split tensile strength: From Tables the split tensile strength values of Robosand used as fine aggregate are increased while compared to sand for 7 days, 14 days, and 28 days. Also, replacement of sand proportions is 0%, 10%, 20%, 40%. Finally, from the results the split tensile strength of concrete is decreasing when compared to conventional concrete.

5. CONCLUSIONS

Based on results obtained, the conclusions are:

- The replacement of sand as has been done up to 40 percent as a fine aggregate in concrete by using quarry dust.
- The results have been highly encouraging in the case of concrete with natural sand and its replacement with Robosand up to 40 percent.
- Coming to workability it is observed that workability is increasing when compared to conventional concrete.
- A compressive strength result there is a nominal increase in the Robosand concrete up to 40 percent replacement.
- From the split tensile strength results there is a nominal increase in the Robosand concrete with reference to conventional concrete at 28 days.
- This indicates that Robosand can be replaced for fine aggregate without any correction while designing the concrete mix.

REFERENCE

[1] M.S. Shetty "CONCRETE TECHNOLOGY", 3rd Edition , S. Chand and company limited, New Delhi ,1992.
[2] The "Indian concrete journal" published by ACC limited.
[3] IS 383-1970: "Specifications for coarse and fine aggregates from material sources for concrete ", Bureau of Indian standards, New Delhi.
[4] IS 516-1959:"Methods of tests for strength of concrete ", Bureau of Indian standards, New Delhi.
[5] IS 10262-2009:"Concrete mix proportioning –Guidelines ",Bureau of Indian standards, New Delhi.
[6] IS 456-2000:"code of practice for plain and reinforced concrete ",Bureau of Indian standards ,New Delhi.
[7] Strength and durability properties of concrete containing Robosand as fine aggregate, R. Ilangovana, N.Mahendrana and K.Nagamanib, Pg.No. 20 to 26, ARPN Journal of Engineering and Applied Science, Vol.3,No.5, October 2008.
[8] Compressive strength of concrete using lateritic sand and Robosand as fine aggregates, Joseph O. Ukpata, Maurice E. Ephraim and Godwin A. Akeke, Pg.No. 81 to 92, ARPN Journal of Engineering and Applied Science, Vol.7, No.1, January 2012.
[9] Study of Properties of SCC using 'Quarry Dust' and 'Fly Ash', M.V. Rama Raju, K.V.Vivek, Dr.T.Siva Shankar Reddy and P. Srinivas Reddy, Pg.No. 323 to 332, International Journal if Engineering Science Research, Vol 02, Issue 04, August-September 2011.
[10] Characteristic studies on the mechanical properties of Robosand addition in conventional concrete, A.Sivakumar and Prakash M, Journal of civil engineering and construction technology, vol. 2(10), Pg.No. 218 to 235, October 2011.
[11] Comparative long term study of concrete mix design procedure for fine aggregate replacement with fly ash by minimum void method and maximum density method, A.D.Pofale and S.V.Deo, Pg.No. 759 to 764, KSCE journal of civil Engineering (2010).
[12] Mechanical properties of structural concrete incorporating a high volume of class F fly ash as a partial fine sand replacement, Dan Ravina, Materials and structure/ materiaux et construction, vol.31, march 1998.