A Review on "Flexural Behaviour of RCC Beam with Partial Replacement of Fine Aggregate by Manufactured Sand."

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Abstract— The flexural behavior of RCC beams of under loading the corresponding deflections are examined such that flexural behavior of RCC beam of under reinforce, balanced and over reinforced sections are analysed. In the present study analyse the flexural behavior of RCC beam in replacement of natural sand as M-sand.

Key words: Compressive Strength, Flexural Strength, Natural Sand, Manufactured Sand

I. INTRODUCTION

The Natural sand is one of the main constituents of the concrete making about 35% of volume of concrete used in building construction industry. It is mainly excavated from the riverbeds. Due to the construction of dams on river. These natural resources are erasing fast .in hilly areas and other such places where sand is not abundantly available this becomes a good substitute. Natural sand always contains high percentage of inorganic salts of chlorides, sulphate sand other deleterious organic salts and impurities. Chlorides and sulphate adversely effect on the strength and durability of concrete and reinforcing steel thereby reducing the life of structure. Due to excessive excavation silt in natural sand has been found more in volume. Excessive silt causes reduction in strength of concrete affecting durability. Manufactured sand (M-sand) is different in shape, grading and content of very fine sand as compared with river sand and it is well known that the material properties of M-sand concrete are also different from those of river sand concrete.

A. Compressive strength

The compressive strength is the resistance of material to breaking under compression. Concrete specimens are a cast and tested under the action of compressive loads to determine the strength of concrete. The compressive strength of concrete strength of 150mm size cubes tested at 28 days (FCK). The characteristic strength is defined as the strength of concrete below which not more than 5% of the test results are accepted to fall. Average 28 days compressive strength of at least three 150 mm concrete cubes prepared with water proposed to be used shall not be less than 90% of average of strength of three similar concrete cubes prepared with distilled water. For compressive strength test prepare cubes with 25%, 50% and 75% replacement levels and with 100% natural sand to compare the results. From these compressive strength results find out the max strength for replacement and that replacement level is used to find out flexural strength of beam.

B. Flexural Strength

Flexural strength also known as modulus of rupture or bend strength or transverse rupture strength is a material property defined as the stress in a material just before it yields in a flexure test. The transverse bending test is most frequently employed, in which a specimen having either circular rectangular cross-section is bent until fracture or yielding using two point loading. The flexural strength represents the highest stress experienced within the material at its moment of yield. It is measured in terms of stress. To estimate and analyze the basic properties of and behavior of RCC an experimental study is needed. In the present study an experiment in which flexural behavior of RCC under various constrains is the major criteria. For experimental analysis simply supported beams of under reinforced, balanced and over reinforced sections are considered. When the beam is simply supported and is subjected to some external loading the corresponding deflections are examined such that the flexural behavior of RCC beams of under loading the corresponding deflections are examined such that flexural behavior of RCC beam of under reinforce, balanced and over reinforced sections are analyzed. In the present study analyze the flexural behavior of RCC beam in replacement of natural sand as M-sand.

II. RELEVANCE

Concrete is the most material being used in infrastructure development throughout the world. Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. Natural or river sand are weathered and worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. Now a day's good sand is not readily available, it is transported from long distances. Those resources are also exhausting very rapidly. The non-availability or shortage of river sand will affect the construction industry, hence there is a need to find the new alternative material to replace the river sand such that excess river erosion and harm to environment is prevented. Many researches are finding different materials to replace sand. This study aimed to investigate the suitability of using M-sand in concrete. Three replacement levels 25%, 50%, 75% will compared with control. The under reinforced, over reinforced and balanced sections are casted with sand replacement in various levels. The flexural test will be carried on the beams. This study will give the results of flexural strength of RCC beams by partial replacement of natural sand with M-sand.

III. LITERATURE REVIEW

B Balapgol, S.A.Kulkarni, K.M.Bajoria (2002), this paper presents the results of an experimental study on strength and durability of concrete with crushed basalt stone fine aggregates as a substitute to diminishing natural sand. The strength and durability properties of concrete viz. compressive strength, flexural strength and permeability of hardened concrete where investigated. An experimental study was performed to observe the performance of concrete

incorporating crushed basalt stone fine aggregates replacing the natural sand. The test results indicate that performs of concrete crushed basalt stone fine aggregates were excellent. The compressive strength of concrete for different grades increased from 8% to 26 %, the flexural strength was increased from 1% to 5% and coefficient of permeability was decreased significantly. The test result indicated that strength and durability of concrete would be better with crushed sand replacing the natural sand. The flexural strength of concrete was determined by bending test in accordance with Indian standards [4]. To find flexural strength three beam specimens of size 700x150x150 mm for each of 8 mixes were tested after 7 days and 28 days curing under universal testing machine with two -point loading. The average flexural strengths for concrete with crushed sand and natural sand were reported and compare the results. The concrete with crushed sand performed better than concrete with natural sand as the grade of concrete mix increased. The flexural strength of concrete with crush sand was marginally increased on strength of concrete with natural sand.

SunilaaGeorge, Jino John, P.N.Magudeswaran and R. Thenmozhi (2008), The river sand is used as fine aggregate in concrete. Large scale construction activities have led to increased cost of river sand which leads to illegal sand mining. Hence, several state governments have imposed restrictions on sand quarry. Another problem noted is environmental degradation. For the past 4-5 years, the crushed sand has not been used much in India as the ordinary crushed sand is flaky, badly graded with rough texture (Prithvi et al. 1991). It produces harsh concrete; but now many improved types of equipment's are set up in India to produce crushed sand of acceptable quality at project site. With manufactured sand as a fine aggregate, the Pune-Mumbai express highway, one of biggest projects undertaken in India, has been completed. The total quantity involved was 20,000,00 m3 of concrete. In this study, concrete mix M30 has been designed using quarry dust and manufactured sand by replacing the river sand. Four mixes proportions were made to test the effect of inclusion of quarry dust and manufactured sand in concrete and the results were compared with the control specimens. It was found that the strength of the concrete is enhanced in both types of replacements.

R.G.Delalibera, J.S.Giongo (2008), this paper discusses the use of confinement in over-reinforced concrete beams. This reinforcement consists of square stirrups, placed in the compression zone of the beam cross-section, in order to improve its ductility. A parametric numerical study is initially performed, using a finite element computational program that considers the material nonlinearities and the confinement effect. To investigate the influence of the transverse reinforcing ratio on the beam ductility, an experimental program was also conducted. Four over-reinforced beams were tested; three beam specimen with additional transverse reinforcement to confine the beams, and one without it. All specimens were fabricated with a concrete designed for a compressive strength of 25MPa. The experimental results show that the post-peak ductility factor is proportional to the confining reinforcement ratio, however the same is not observed for the pre-peak ductility factor, which varied randomly with changes in the confining reinforcement ratio.it was also observed for the experiments that the confinement effect tends to be smaller close to beam neutral axis.

Anil Kulkarni, Rajeeb Kumar, Vikram Kumar (2011), from crushed stone sand is manufactured sand, which is better in terms of quality and fulfils the requirements of suitable material for use in concrete. M-sand is manufactured by any of the methods by crushing of coarse aggregate (20mm & 10mm) in separate sand plants or using 3 stage vs/ crushed then this material is further processed either by washing with water or dry sieving. If required to improve the grading & reduce fine powder content. This comparison study gives an insight into the various characteristics of fine aggregate playing role in making good pumpable concrete along with other important hardened concrete properties.

T.Shanmugapriya,R.N.Uma (2012),This paper represents the optimization of partial replacement of manufactured sand by natural sand with silica fume in high performance concrete (HPC). The OPC was partially replaced with silica fume by 1.5%, 2.5% and 5% and the natural sand is replaced with M-sand by four proportions (i.e. 10%, 30%, 50%, and 70%). The results indicated that there is an increase in compressive and flexural strength of HPC nearly 20% and 15% respectively with the increase of manufacturing sand percentage addition of up to 50% of M-sand as a sand replacement yielded comparable strength with that of control mix. However further additions of M-sand caused reduction in the strength. The optimum percentage of replacement of natural sand by M-sand is 50% results also revealed that increase in percentage of partial replacement of silica fume increased compressive and flexural strength of high performance concrete.

G.Balamurugan, Dr.P.Peruaml (2013), this experimental study presents the variation in the strength when replacing sand by quarry dust form 0% to 100% in steps of 10%. M20 and M25 grades of concrete are taken for study keeping a constant slump of 60mm.The compressive strength of concrete cubes at age 7 to 28 days is obtained at room temperature. Split tensile strength and flexural strength of concrete are found at the age of 28 days. Form the test results it is found that the maximum compressive strength tensile strength and flexural strength are obtained only at 50% replacement. This result gives clear picture that quarry dust can be utilized in concrete mixtures as a good substitute for natural river sand at 50% replacement with additional straight than control concrete. Maximum flexural strength is also at 50 % replacement. The percentage of increase compared with control concrete is 17.58 and 12.02 for M20 and M25 respectively. Maximum flexural strength of RCC beam is obtained at 50% sand replacement by quarry dust. The percentage of increase in strength compared with control concrete is 9.31 and 8.34 for M20 and M25 concrete respectively.

Manguriu,G.N.Karugu,Oyawa,W.O.Abuodha,S.O. and Mulu, P.U. (2013),The use of crushed rock sand as a partial replacement of river sand in concrete production was investigated . Water cement ratio varied between 0.55and0.59 for 0% to 100% natural sand replacement. The slump ranged between 49 and 60mm for 0% to100% natural sand replacement. The average compressive strength of the control concrete (C20) was 22.5 N/mm2.the effective natural sand (RS) replacement ranged between 0 and 60% with the best

results achieved at 20% replacement. The peck compressive strength and indirect tensile strength values of 23.2 N/mm2 and1.42N/mm2 respectively were obtained .modulus of elasticity of concrete increased from 22KN/mm2 with 20% replacement of natural sand .also ,the indirect tensile strength increased from 1.28N/mm2 to N/mm2 with 20%river sand replacement. The bean deflection ranged between 0.25 mm and 0.4 mm with the lowest deflection recorded at 20% CRS and highest deflection of 0.4 mm with the control mix (0%CRS). The whole range of natural sand replacement (0 to 100%) improved the beam deflection. The 20% CRS content recorded the highest flexural strength of 686.7 N/mm2 beyond which the strength decreased to 80% CRS after which there was a constant value in strength up to 100% CRS.

Engr. Muritala Ashoal ADIGUN (2013), the economic gain of replacing sand with crushed granite fines in the production of concrete was investigated. Compressive strength and slump tests were performed on fresh and hardened concrete use two nominal mixes of 1:1:2 and 1:1.5:3 with sand component being partially replaced with crushed granite fines. Compressive strength values above 30 N/mm2 were obtained for nominal mixes of 1:1:2 and 1:1.5:3 respectively when sand was partially replaced with 25-37.5% crushed granite fines. Based on the economic analysis of the test result, replacement of sand with 25-37.5% crushed granite fines is recommended for use in concrete production. The test results and the cost analysis reported in this paper showed that there are good prospects of obtaining a good concrete strength at relatively cheaper cost even will replacing part of the sand with crushed granite fines. Compressive strength of 30N/mm2 and 35N/mm2 can be obtained using a nominal mix ratio hitherto required for compressive strength of 25N/mm2 and 30N/mm2 respectively. Higher water- cement ratio is required when crushed granite fine is used in replacing sand during concrete production. Also, where there are abundant supplies of crushed granite fines, replacement up to 100% may be used when the strength desired is not at variance with normal mix ratio.

ShabhazShamim, Vikas Srivastava, V.C. Agarwal (2014), Plain cement concrete is made by mixing cement, fine aggregate, coarse aggregate, water and admixture in appropriate proportion. The main constituents of concrete such as sand, stone and water are naturally available. These resources of natural aggregates (sand, stone) are limited and day by day the dependency on them must be minimized. The aim of this study was to investigate the possibility of using stone dust as partial replacement of fine aggregate and recycled aggregate as partial replacement of coarse aggregate. In the present study cubes and beams were cast to determine the compressive and flexural strength of concrete made using stone dust and recycled aggregate as replacement of natural aggregate. Concrete of M25 grade was designed for a W/C ratio 0.48 for the replacement 10% coarse aggregate with recycled coarse aggregate and replacement of 50%, 60%, 70% of fine aggregate (sand) with stone dust. The test results indicate that stone dust can effectively been used as partial replacement of fine aggregate in concrete. It is found that the compressive and flexural strength of concrete increases on use of stone dust. It is observed that the compressive strength of concrete made using 10% of recycled aggregate and 60% stone dust as replacement of coarse aggregate and fine aggregate respectively is about 11% more than that of concrete at 28d. However, the replacement of fine aggregate by stone dust improved considerably the flexural strength of concrete especially at 28d.

S Tejaswi, J Eeshwar Ram (2015), Paper represents concrete is the material which is rapidly used in various conditions which sustain the compression loads and the corresponding bending and shear stress due to the applied compressive loads. The major drawback in concrete is that it is poor in tension through it is very efficient in compression. Hence to overcome this major drawback the concrete must be reinforced such that to make a homogeneous substance which can sustain both tension and compression. Steel is the material use as reinforcement for concrete. The stress strain behavior for both concrete and steel are mostly similar. Hence in the combination of both that is an reinforced cement concrete the maximum stress point within the elastic will reach simultaneously .Reinforce cement concrete is a general material which is widely used for various types constructions and structural element. For the efficient use of RCC it is necessary to know the properties and the behavior of RCC elements under various constrains. To estimate and analyze the basic properties and behavior of RCC under various constrains was the major criteria. For the experimental analysis simply supported beams of under reinforced, balanced and over reinforce sections are considered. When the beam is simply supported and is subjected to some external loading the corresponding deflections are examined such that the flexural behavior of the RCC beams of under reinforce, balanced and over reinforced sections analyzed. In order to study the flexural behavior of any material one had need some basic constant conditions as there limitations. In the present study analyze the flexural behavior of RCC beam in replacement of natural sand as M-sand.

Rajendra.P.Mogre,Dhananjay.K.Parbat,Shirish.D.D hobe (2015),The paper present experimental results based analysis of compressive and flexural strength of concrete acquired with combination of artificial sand and natural sand utilizes indigenously prepared concrete mixture in the laboratory the experimental plan has been organized on 125 orthogonal array design parametric analysis has made based on Taguchi methodology the mathematical models have also been developed to correlate compressive strength (6fs)and average flexural strength (6fs)with different three parameters.

Umashankar A, Shashikumar,A, G.Narayana(2016), The main objective of the this paper is to re-use the used foundry sand (produced at foundry industries) as a partial replacement to fine aggregate in different percentage (15 to 50 %) that can be adopted in concrete along with normal river sand designed to meet the requirements of concrete of grade of M50, using foundry sand with OPC have been considered in the study. Though the main investigation is to be carried out is on the flexural behavior of reinforced foundry sand concrete beams, to facilitate proportioning of foundry sand concrete, compressive strength studies are also carried out. The tests are to be carried out on around (18) singly reinforced beams of size 150mm x 250mm and overall length 2000mm, simply supported over effective span 1800mm under pure bending. The beams will be provided with adequate shear reinforcement so that the failure of the beams

may due to pure flexure. The grade of concrete M50 generally with three foundry sand replacement levels (FSL) in each grade i.e. 15%, 25%, & 35% FSL are considered.

IV. OBJECTIVES

- The main aim of this investigation is to examine flexural test of RCC beam with partial replacement of Fine Aggregate by M-sand.
- To evaluate the ultimate load carrying capacity of RCC beam with partial replacement of M-sand.
- To study the cracking characteristics and Design Over-Reinforce, Under-Reinforce, Balanced sections of RCC beam.
- To study the behavior of beam deflection under two point loading.
- To compare the experimental results of M-sand with natural sand.

V. METHODOLOGY

- Collection of required data to carry out the analysis from journals, technical magazines, reference books and web source.
- Casting of RCC beam with M40, M50 Concrete.
- Preparation of RC beam with number of specimen for Natural sand and M-sand.
- Comparison to be made between these analyses to know possibility and feasibility.
- From the results of Experimental analysis the final conclusion will be drawn.

VI. CONCLUSIONS

It is expected that study gives such an analytical data which helps for determination of Possibility and feasibility of manufactured sand in concrete as partial replacement of fine aggregate.

REFERENCES

[1] B Balapgol, S.A.Kulkarni, K.M.Bajoria (2002)"Strength and Durability of concrete with Crushed sand ",27th conference on our world in Concrete and Structures, Singapore.
[2] Sunilaa George , Jino John, P.N.Magudeswaran and R. Thenmozhi (2008)"Replacement of River sand using Manufactured sand and Quarry dust in cement concrete", Nature Environment and Pollution technology, techno science publication Vol.7,No.3.
[3] R.G.Delalibera, J.S.Giongo(2008)" Theoretical and Numerical analysis of reinforced concrete beams with confinement reinforcement" ,IBRACON Structures and materials journalVol.1.
[4] Anil Kulkarni, Rajeeb Kumar, Vikram Kumar (2011)"Comparison study on natural river sand and crushed stone sand-Evaluation for pumpablity and durability of concrete " ,Ultratech cement Ltd (Unit: Ultratech concrete).
[5] T.Shanmugapriya ,R.N.Uma (2012)"Optimization of partial replacement of M-sand by natural in high performance concrete with silica fume ", International Journal of Engineering science & emerging technologies, Vol.2, Issue.2.
[6] G.Balamurugan ,Dr.P.Peruaml (2013) "Behavior of concrete on the use of Quarry dust to replace sand –An experimental study", Engineering science and technology: an international journal (ESTIJ) , Issue:2250 Vol.3.No.6.
[7] Manguriu , G.N.Karugu, Oyawa , W.O.,Abuodha, S.O.andMulu, P.U. (2013)" Partial replacement of Natural River sand with crushed rock sand in concrete production",Global Engineers and Technologist review , Vol.3,No.4.
[8] Engr.MuritalaAshoal ADIGUN (2013)"Cost effectiveness of replacing sand with Crushed Granite Fine(GCF) In the mixed design of concrete",IOSR Journal of Mechanical and Civil Engineering (IOSR. JMCE) , Vol.10 Issue.1.
[9] ShabhazShamim, Vikas Srivastava, V.C. Agarwal,(2014)"Compressive and flexural strength of concrete using stone dust and recycled aggregates as partial replacement of natural aggregate", Journal of Academiaand Industrial Research (JAIR) Vol.3,Issue.7.
[10] S Tejaswi , J EeshwarRam (2015)"Flexural behavior of RCC Beams ", International Journal innovations in Engineering and Technology(IJIET), Vol.5, Issue-1.
[11] Rajendra.P.Mogre, Dhananjay K. Parbat, ShirishD.Dhobe (2015)"Modelling of compressive and flexural strength for incremental replacement of natural sand with artificial in concrete", The Indian concrete journal.
[12] Umashankar A, Shashikumar A,G Narayana (2016),"Flexural behavior of RC beams using foundry sand as partial replacement of fine aggregate", International journal of research in Engineering and Technology Vol.05 Issue:08.
[13] "Plain and Reinforced Concrete - Code of Practice" IS 456-2000

