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Use of recycled concrete aggregate in high strength concrete

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ABSTRACT
Effect of recycled aggregate in concrete can be useful for environmental protection. Recycled aggregates are the materials for the future.The environmental impact of concrete constructions and improves natural resource conservation.The results of a test programme to study the use of recycled concrete aggregate (RCA) into high-strength 50 N/mm 2 or greater. The effects of coarse RCA content on the compression strength,bulk density and durability properties of such concretes have been established. The results showed that up to 30% coarse RCA had no effect on concrete strength but there after there was a gradual reduction as the RCA content increased. concrete mixes with partial replacement of natural aggregate with (0,50,100) recycled aggregate. the effects of silica fume (SF) in the concrete mix design to improve the quality of recycled aggregates in concrete are presented.Cement was replaced with SF at 0%, 5% and 10%.
At all the test age the tensile split strength gain of the natural aggregate concrete mixture (NA) with and without SF was higher than that of the recycled concrete mixtures. Continuous and significant improvement in the tensile splitting strength of recycled aggregate concretes SF was observed. Similar to compressive strength test results, concrete incorporating 10% SF and containing 4/12 mm fraction recycled aggregates showed better performance among recycled aggregate concretes.

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I.INTRODUCTION

Recycling is processing the used material for use in creating new product. The usage of natural aggregate is getting more and more advance development in infrastructure area. In order to reduce recycled aggregate can be used as the replacement materials.Recycled aggregate are comprised of crushed graded inorganic particles processed from the material that have been used in the constructions. These materials are generally from buildings, roads, bridges, and sometimes even from catastrophes, such as wars and earthquakes.High strength concrete is a premier construction material used throughout the world for the construction of the growing population in the country and requirement of land for other uses has reduced the availability of land for waste disposal. Recycling is an important strategy for management waste Apart from mounting problems of waste management, other reasons which support adoption of reuse/ recycling strategy are reduced extraction of raw reduced transportation cost,reduced capital investment on raw materials,improved profits and reduced environmental impact.

Recycled concrete aggregates mainly differ from natural aggregates in that they are composed of two different materials: natural aggregate and cement mortar attached.lower density, higher absorption, and Los Angeles abrasion . Recycled aggregates are also highly porous, as well as contain a high content of impurities.

Concrete production is the high-grade application where recycled aggregate can be used asconcrete strength decreases when recycled aggregates were used and the strength reduction could be as low as 40% .Concrete made with 100% of recycle coarse aggregates has 20–25% less compression strength than conventional concrete at 28 days, with the same effective w/c ratio 0.50) and cement quantity . When recycled aggregate was washed the negative effects were greatly improved .More adding SF as a supplementary binder material can also improve the mechanical and physical properties of concrete prepare with recycled concrete aggregate.Use of silica fume as a cement replacement in proportion to the recycled aggregate concrete. The effect of silica fume on the mechanical and physical properties such as compressive strength tensile split strength, water absorption, and ultrasonic pulse velocity, of recycled aggregate concrete .

II.LITERATURE REVIEW

1 *Faris* Mohammed

The effect of using recycled aggregate on concrete compressive strength has been experimentally investigate SF admixture also is used to improve recycled concrete aggregate compressive strength. The main parameters in this study are recycled aggregate and SF admixture. The percent of recycled aggregate ranged from 0 to 100 %. While the silica fume ranged from 0 to 10 %. The experimental results show that the average concrete compressive strength decreases from 30.85 MPa to 17.58 MPa when the recycled aggregate percentage increased from 0% to 100%. When silica fume is used the concrete compressive strength increase again to 29.2 MPa for samples with 100% of recycled aggregate.

The increase in compressive strength is observ to be about 42.5% with 50% replacement of aggregate concrete due to addition of 10% silica fume while this increase in compressive strength is 65% for 100% replacement of aggregate concrete. The decrease in compressive strength with 50% replacement of aggregate concrete is 30% while this percentage of decrease is 43% for 100% replacement of aggregate concrete.

2 Dr. M. Seethapathi

Leading to utilization of large quantity of concrete. The present technical report on investigation of high strength concrete with recycled coarse aggregate of partial replacement for conventional coarse aggregate. The tests conducted are Split Tensile Strength and Flexural Strength of concrete by replacing coarse aggregate at different percentages by 0%, 10%, 20%, 30% 40%, 50% by weight and the mixes are test for a period of 7 and 28 days. when the percentage of RCA is increased the compressive as well as split tensile strength got reduce. When w/c ratio mix was decrease the compressive strength increases.The target strength (40 MPa) can be achieve for 30 to 40% of RCA replacement by decreasing the water cement ratio and adjusting the admixture concrete mix.

3 Mohd. Zamin JUMAAT

RCA is useful as a substitute of NCA to produce concrete with acceptable properties and durability.The main problem of using RCA in new concrete is its inconsistent quality particularly when it is obtained through demolition of old concrete structures.

The use of 100% RCA is possible to produce concrete with acceptable quality. The concrete produced with RCA has generally 80to 90% of the strength of a comparable NCA concrete. The reduction in the strength of RCA concrete is caused by the adverse physical properties of RCA and inadequately dense transition zone between RCA and bulk cement paste the recycled fines reduce the strength of concrete. The replacement of sand by recycled fines up to 20% is acceptable. RCA can be used in high-quality concretes such as high-strength high performance and self consolidating concretes by appropriate materials selection and mix design. The strength and durability of RCA concrete can be improved by using suitable pozzolanic materials. use of 30% pulverized fly ash and 65% ground granulated blast furnace slag increased the compressive strength of RCA applied a two-stage mixing technique to obtain good-quality RCA concrete. They used recycled aggregate coated with pozzolanic powder to improve the properties of RCA concrete.

4 Ismail Abdul Rahman

Compressive strength is the basic mechanical properties and one of the indicators to determine the performance of a concrete. The effects of various percentages 0, 25, 50, 75, 100 of Recycled Aggregate RA on compressive strength of Recycled Aggregate Concrete RAC were investigated. RA is used toreplace natural aggregate NA as coarse aggregate in concrete mixes. This research also covered RAC mixtures at different water-cement. It was found that RAC had lower compressive strength compared to Natural Aggregate Concrete NAC. At the age of 28 days, RAC with water-cement ratio 0.5 had the highest strength. Lower water-cement ratio of Recycled Aggregate Concrete lead to higher in compressive strength.

For w/c ratio 0.4 and 0.5, the concrete mixtures prepared with 100 % replacement of RA had a decrease and the compressive strength at 28-day compared to NAC. Then, the concrete mixture with w/c ratio 0.6 that prepared with 0, 50, and 100% replacement of RA had a decrease of in compressive strength than that of NAC. RAC could increase its compressive strength by reducing the water-cement ratio of concrete.

5 T. Leelawat

The use of recycled concrete aggregate (RCA) into high-strength, 50 N/mm 2 or greater concrete . The effects of coarse RCA content on the compression strength, bulk density and durability of such concretes have been established. 30% coarse RCA had no effect on concrete strength but there after there was a gradual reduction as the RCA content increased. A method of accommodating theeffect of high RCA content involving simple adjustment to water/cement ratio of the mix is given. It is shown that high-strength RCA concrete will

have equivalent engineering and durability performance to concrete made with natural aggregates, for corresponding 28-day design strengths.

Times higher water absorption than natural aggregates in saturated surface dry state reflecting porosity of attached cement paste. The RCA concrete mixes, for a given strength were found to possess durability properties, namely resistance to chloride ingress, chloride-induced corrosion,

Freeze and abrasion similar to the corresponding natural aggregate concrete mixes.

6 Ozgur Cakir

concrete mixes with partial replacement of natural aggregate with recycled aggregate.The effect of incorporating silica fume (SF) in the concrete mix design to improve the quality of recycled aggregates in concrete was presented.Cement was replaced with SF at 0%, 5% and 10%. Specimen had manufactured by replacing natural aggregate with recycle aggregate. Two size fractions (12 mm and 22 mm) of recycled aggregates were used and four series of concrete mixture were produced. Concrete properties were evaluated by means of compressive strength, tensile splitting strength, water absorption and ultrasonic pulse velocity and it was found that, using 10% SF as a cement replacement for recycled aggregate concretes enhanced the mechanical and physical properties of concrete. At all the test ages the tensile splitting strength gain of the natural aggregate concrete mixture NA with and without SF was higher than that of the recycled concrete mixtures.Continuou improvement in the tensile split strength of recycled aggregate concretes incorporating SF was observed. Similar to compressive strength test results.

Water absorption values of concretes containing the recycled aggregates with SF were decreased significantly especiallyat later ages.This effect is more recycled aggregate concrete incorporating 10% SF rather than recycled aggregate concrete incorporating 5% SF.

7 M.V.S.S.Sastri

Study the behavior in fresh and hardened states of high strength structural concrete with recycled aggregates and synthetic fibres. In this paper is to compare fresh and hardened state properties of high strength concrete by using various proportions of recycled coarse aggregates 0, 50% and 100% along with PP fibres 0, 0.2, 0.3 and 0.4% by volume of concrete. The parameters of investigation include tests on workability compressive flexural and indirect tensile strengths and modulus of elasticity. It is observed that the workability of concrete considerably reduced with the increasing quantities of recycled aggregate and polypropylene fibres. The results showed a gradual decrease in compressive strength tensile strength and modulus of elasticity as the percentage of recycled aggregate used in the concrete mix increased.

There is a marginal decrease in the strength of concrete as 50% of conventional coarse aggregate is replaced with recycled coarse aggregate. But in both these concretes NA and RCA the strengths were found to increase with the increase in fibre content up to 0.2% of PP fibre. It is observed that the strengths for concrete were continuously decreasing even after adding the PP fibres for concrete with 100% recycled aggregate.Use of recycled aggregates upto 50% by weight of natural aggregates achieved required strength confirming the suitability of their use in high strength concrete of grade M60. The addition of polypropylene fibres improved the stiffness of the concrete while imparting ductility.

8 Mirjana Malešev

Recycled aggregate has made by waste concrete of laboratory test and concrete column. Three types of concrete mixtures has tested concrete made entirely with natural aggregate NAC as a control concrete and two types of concrete made with natural fine and recycled coarse aggregate (50% and 100%. he way of preparing recycled aggregate for concrete mixtures influences the concrete workability: Also if dried recycled aggregate is used and additional water quantity is added during mixing the same workability have being achieved after a prescribed time.Bulk density of fresh concrete is slightly decreased with increasing quantity of recycled aggregate.

Concrete compressive strength depends on the quality of recycled concrete aggregate. If good quality aggregate was used for the production of new concrete the recycled aggregate has no influence on the compressive strength.

9 James Rombi

This paper reports on an experimental study on mechanical and durability properties of concrete was casted with recycled aggregates obtained from two parent concretes, belonging to two structural elements of the old Cagliari stadium. The parent concretes on coarse recycled aggregates and on new structural concretes produced with replacement percentages of these recycled aggregates are investigated. Mechanical properties and durability properties was evaluated and analyzed as fundamental features to assess structural concrete

behavior. The results show that the mechanical performance of recycled concrete have not related to the parent concrete characteristics .

10 H. Joshi

The study shows that fresh properties as well as mechanical properties appear to be slightly inferior for concrete made with recycled aggregates. Properties can be improved by proper surface treatment to the RA addition of suitable percentage of admixtures (Silica Fume, Fly Ash, GGBS) to the fresh RAC mix.

Various performance of concrete os show that is bond strength, Flexural behaviour of RAC beams, Shear behaviour of RAC beams. NAC specimens had bond strengths that were 9–19% higher than the corresponding RAC specimens. flexural strength of 100% RA concrete is always less than the NA. Under the same load condition the width of crack was formed in RAC beams larger than that in virgin aggregate beams. We observed that there was 10% and 17% reduction in shear strength of RAC beam as compared to virgin aggregate concrete beam for 50% and 100% RA replacement.

11 Lee Yee Loon

Compressive strength is the basic mechanical properties and the important to determine the performance of a concrete. The effects of various percentages 0%, 25%, 50%, 75%, 100% of Recycled Aggregate (RA) on compressive strength of Recycled Aggregate Concrete RAC were investigated. RA was used to replace natural aggregate NA as coarse aggregate in concrete mixes. This research had covered RAC mixtures at different water-cement ratio . It was found that RAC had belower compressive strength compared to Natural Aggregate Concrete NAC. Lower water-cement ratio of Recycled Aggregate Concrete is lead to higher in compressive strength. RAC could increase its compressive strength by reducing the water-cement ratio of concrete.The relationship of w/c ratio and compressive strength of RAC is inversely proportional.

12 Anthony Quansah

There had been recorded application of recycled aggregate in a large number of construction projects. The test results of ductility and the stiffness of beams with RA equal or higher than those with natural aggregate. This difference have attached mortar paste on recycled concrete particles. Recycled aggregates had been found to have high water absorption capacity which affects various properties mainly mechanical performance of the resulting concrete mix. Water absorption Many researchers concluded that the porous nature of this residual paste is the main reason behind this behavior .

These bad behaviors can be resolved through effective removal of the mortar paste attached on recycled aggregates which consequently strengthens RAC characteristics. Also incorporating supplement admixtures materials such as fly ash, silica fume, etc. and addition of fibres can enhance the mechanical properties considering an appropriate concrete mix design.

13 Liam Butler

This study focuses on recycled concrete aggregate (RCA) sources. Numerous aggregate tests, including density, absorption, abrasion resistance, adhered mortar content, and crushing value, were performed.14 mixture proportion had developed with the use of three mixture proportion scenarios (control, direct replacement, and strength based) and two compressive strength levels (40 and 60 MPa).The effect of RCA on compressive strength and workability ware evaluated by replacement of natural coarse aggregate with RCA. Contrary to numerous studies, one of the RCA concretes RCA-1 had compressive strengths up to 12% higher than the equivalent control mixture. Mixture proportions water, cement, and w/c ratio were adjusted to ensure that the RCA concretes had compressive strength and slump values similar to the control concretes. RCA-1 concrete was required less cement and a higher w/c ratio to achieve strengths and slumps similar to the control concrete. Use of the thermal expansion method it was determined that RCA-3 has the highest amount of adhered mortar followed by RCA-2 and RCA-1.

14 M. Etxeberria

For that purpose an experimental study of the shear be haviour and strength of beams made with recycled aggregate concrete was studied. Twelve beam specimens with the same compression strength, four concrete mixturesusing different percentages of recycled coarse aggregates 0%, 25%, 50% , 100% and three different transverse reinforcement arrangements were cast and tested up to failure.. The results obtained indicate that a substitution of less than 25% of coarse aggregate scarcely affects the shear capacity of RC beams, provided that all the measure was related to dosage and durability aspects have been adopted.

15 Sellakkannu N.

Conservation of natural resources and preservation of environment has essence of any modern development.Recycled Aggregates are made from material which is usually recovered from demolition projects then crushed, screened and washed to produce the required grading. The recycled coarse aggregate can be obtained by crushed concrete were used for concrete production. Generally recycled aggregates are cheaper than quarried aggregates although this does not make them any less suitable. Recycled aggregates are the materials for the future. These are eco-friendly materials and it also reduces the cost of making concrete. inconsistently. However, it was noticed that all RAC100 mixes exhibits the lowest wear of all mixes for the same curing conditions.

III. CONCLUSION

Construction and demolition waste can be used as recycled aggregate in construction. The more waste has treated, the higher the quality of the aggregate. High-quality aggregate is expensive, and economically unavailable in countries where natural aggregate has cheaply obtained. Recycled concrete aggregates are different from natural aggregates and concrete made from these materials has specific properties. Use of recycled aggregates in concrete can be useful for environmental protection and economical aspects. Recycled aggregates are the materials for the future. The application of recycled aggregate had been started in many construction projects. Many countries are giving many infrastructural laws relaxation for increase the use of recycled aggregate.

The replacement of natural aggregates by recycle aggregates modified concrete's compressive strength and elastic modulus . In general, concrete produced with recycled aggregates have lower compressive strength, except concrete made of recycled fine aggregate The modulus of elasticity model shows that recycled coarse aggregates exert greater influence than recycled fine aggregates. The quality of the recycled aggregate can be improved by blending with natural aggregate by enhancing the manual removal of gypsum before the crushing process at the C&D waste treatment plant by immerse the aggregate in water to reduce chloride, and by particle-size adjustment. These possible solutions can be studied in future works.

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