Recycled Aggregate Concrete

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Abstract— 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. Total replacement of concrete is not possible due to no material plays the role of concrete in terms of strength, durability, and workability. We have to partial replace all the material to achieve desire properties of concrete in terms of workability, strength and durability. This paper includes survey of Recycled aggregate used in the concrete, from this survey we can understand the effect of Recycled aggregate and waste material on the properties of concrete.

Key words: Recycled aggregate, Compressive strength, Spilt tensile strength

I. INTRODUCTION

After demolition of old roads and buildings, the removed concrete is often considered worthless and disposed of as demolition waste. By collecting the used concrete and breaking it up, recycled concrete aggregate (RCA) is created. This paper focuses on coarse RCA which is the coarse aggregate from the original concrete that is created after the mortar is separated from the rock which is reused. The use of RCA in new construction applications is still a relatively new technique. Buck (1977) cites the beginning of RCA use to the end of World War II, when there was excessive demolition of buildings and roads and a high need to both get rid of the waste material and rebuild Europe. After the immediate need to recycle concrete, the use of RCA tapered off. In the 1970s, the United States began to reintroduce the use of RCA in non-structural uses, such as fill material, foundations, and base course material (Buck 1977). Since this time, some research has been conducted regarding how viable RCA is as an option to replace unused natural aggregate (NA) in structural concrete. One of the main reasons to use RCA in structural concrete is to make construction more ‘‘green’’ and environmentally friendly. The use of RCA on a large scale may help to reduce the effects of the construction on these factors by reusing waste materials and preventing more NA from being harvested.

II. LITERATURE REVIEW

A. M. C. Limbachiya, T. Leelawat and R. K. Dhir-(2)

Experimental study the use of recycled concrete aggregate (RCA) in high-strength, 50 N/mm2 or greater, concrete are described. 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. They have found that up to 30% coarse RCA had no effect on the ceiling strength of concrete, but thereafter this reduces with increase in RCA content. This was observed consistently for concrete mixes tested at 7, 28, 60 and 90 days. The RCA concrete mixes, for higher strength, were found to possess durability properties, namely resistance to chloride ingress, chloride-induced corrosion, Freeze/thaw and abrasion, similar to the corresponding natural aggregate concrete mixes. This suggests that coarse RCA, obtained from rejected precast elements, can be used in high performance concretes.

B. Gonzalez Andreu, and Etxeberria Miren–(3)

Investigation conducted on HPC were produced using 20%, 50% and 100% of RCA on substitution of natural coarse aggregates. Three types of RCA were used, they were produced crushing original concrete of 100, 60 and 40 MPa of compressive strength. The physical, mechanical and durability properties of the recycled aggregates concretes and conventional concrete were analyzed. The results showed that considering mechanical properties, the 100% natural coarse aggregates’ replacement would be possible when RCA were produced from original concrete with a minimum compressive strength of 60 MPa. When durability properties were considered concrete produced with up to 50% of RCA could be used in HPC production.

C. Jun Phil Hwang, Hyun Bo Shim, Sooyoung Lim, and Ki Yong Ann - (4)

Experimental conducted on concerns properties of concrete containing Recycled Aggregate (RCA). To compensate for a reduction of properties for the RCA concrete, 30% Pulverised Fuel Ash (PFA) and 60% Ground Granulated Blast furnace Slag (GGBS) were used for replacement for Ordinary Portland Cement (OPC). The compressive strength for RCA concretes was measured for 180 days, and simultaneously the durability against chloride, frost and sulphate environment was evaluated. They have found that the RCA concrete had a significant reduction of the strength at all ages, but the strength for the RCA concrete containing 30% PFA and 60% GGBS was mostly equal for OPC concrete containing natural aggregate. The cost of the RCA concrete containing 30% PFA and 60% GGBS was the lowest, compared to control concrete, as saving by about 22-24%, while the price of the RCA concrete was lower than control by about 14%.

D. WANG Zhenshuang, WANG Lijiu, CUI Zhenglong, and ZHOU Mei (5)

To investigate effect of recycled coarse aggregate on concrete compressive strength was based on the concrete skeleton theory. For this purpose, 30 mix proportions of concrete with target cube compressive strength ranging from 20 to 60 Mpa were cast with normal coarse aggregate and recycled coarse aggregate from different strength parent concretes. They have found that the 28-d compressive

strengths for different types of recycled coarse aggregate can achieve 50 Mpa whereas their observed strength was lower than the control concrete for the same mixture. The effect of the type of coarse aggregate on the compressive strength of concrete was more significant for high strength concretes.

E. Katrina McNeil, and Thomas H.-K. Kang (6)

This paper discusses the properties of RCA, the effects of RCA use on concrete material properties, and the large scale impact of RCA on structural members. They have found that Replacing NA in concrete with RCA decreases the compressive strength, but yields comparable splitting tensile strength. The modulus of rupture for RCA concrete was slightly less than that of conventional concrete, likely due to the weakened the interfacial transition zone from residual mortar. The modulus of elasticity is also lower than expected, caused by the more ductile aggregate. As far as the structural performance is concerned, beams with RCA did experience greater mid span deflections under a service load and smaller cracking moment.

F. Fernando López Gayarre , Carlos López-Colina Pérez , Miguel A. Serrano López , and Alberto Domingo Cabo (7)

Investigation conduct to assesses the influence of different curing conditions on the compressive strength of recycled aggregate concrete. Two different qualities of recycled aggregate were used to make concrete with 0.65 water/cement rate. The recycled aggregates were added with their natural moisture and they replaced different percentages of the coarse aggregate (0%, 20%, 50% and 100%). The concrete specimens were exposed to two different environments (standard curing and open-air curing) for 28 days. The results showed that the 7-days strength increases with the percentage of replacement, being this behavior more evident for the standard curing environment. The 28-days compressive strengths of concretes with recycled aggregates were found similar to the ones obtained with natural aggregate when the standard curing environment was considered. However, the recycled aggregate concrete specimens lost up to the 20% of their compressive strength when they were cured in open-air conditions. This made evident the effect of the curing conditions on the resistance of recycled aggregate concrete.

G. C. Thomas , J. Setién , J.A. Polanco , P. Alaejos ,and M. Sánchez de Juan (8)

Experiment carried out to analyses the physical, mechanical and durability properties of concrete incorporating recycled aggregate. One of the most unknown aspects of recycled aggregate concretes is related to their durability in aggressive environments. Also most of the results found in the literature are not comparable due to the heterogeneity of the recycled aggregates, water/cement ratios and types of cement used. In this Experiment , recycled aggregate concrete with partial and total coarse aggregate replacement and reference concretes with 24 water/cement ratios have been cast to study their physical and mechanical properties, behaviour under accelerated carbonation, water and oxygen permeability. The results show, for the same w/c ratio, the influence of the recycled aggregate on the concretes. The durability of the concretes made with recycled aggregate is worse due to the intrinsic porosity of them. These differences decrease for low w/c ratios, as in this case the most influential factor is the low porosity obtained in the new improved cement paste. Considering the mechanical properties, the influence of the recycled aggregate is worse for the high w/c ratios. On the basis of the results obtained, recommendable mixtures for recycled aggregates in aggressive environments will be suggested. Also, an experimental model from the recycled aggregate concretes compressive strength is proposed.

H. Patrick L. Maier , Stephan A. Durham (9)

Experimental carried out to assess the effects of using recycled materials, in varying amounts, on the fresh and hardened concrete properties. The recycled materials used in this study consisted of ground granulated blast furnace slag (GGBFS), recycled concrete aggregate (RCA) and crushed waste glass. The GGBFS, or slag cement, was used as a replacement for the cement. The RCA and waste glass were used to replace the coarse and fine aggregates, respectively. The concrete mixtures designed ranged from a 25% replacement to one 100% replacement with recycled materials. In addition, a standard concrete mixture using cement and virgin aggregates was designed for comparison purposes. Fresh and hardened concrete properties were examined including slump, air content, unit weight, compressive strength, rate of strength gain, freeze–thaw durability, permeability, and alkali-silica reactivity (ASR) potential. The 100% recycled materials concrete had very low permeability and a compressive strength of 4200 psi (29.0 MPa) with 6.5% air content. Concrete mixtures composed of 50% and 75% recycled materials achieved strengths of nearly 7000 psi (48 MPa) and 6350 psi (43.8 MPa) respectively. Beneficial and negative effects of using recycled materials in concrete mixtures were investigated, including the potential alkali-silica reactivity (ASR) of using waste glass as aggregate. The slag cement, when used at replacement levels of 50%, was found to eliminate these concerns. The use of recycled materials was beneficial with regards to strength and durability up to 50% when compared with a normal concrete made from virgin materials.

I. E. Anastasiou , K. Georgiadis Filikas, M. Stefanidou (10)

Experimental program was carried out in order to investigate the possibility of producing concrete incorporating large volumes of industrial by-products and secondary materials. The alternative materials tested were fly ash as binder for cement replacement, recycled fine aggregate originating from mixed construction and demolition waste and steel slag as coarse aggregate. Several mortar and concrete mixtures were prepared using different aggregate and binder combinations in order to identify the feasibility of producing concrete with maximum use of alternative materials. The different mixtures were tested for mechanical strength at different ages, while durability measurements such as chloride ion penetration and freeze–thaw resistance were also carried out. The results showed that the use of fine construction and demolition waste aggregate increases porosity in concrete and also reduces strength and durability, while its combination with steel slag aggregate partly recovers strength and durability loss. Concrete with mixed construction and demolition waste as fine aggregate and steel slag as coarse aggregate reached 30 MPa 28-day compressive strength and showed adequate

durability for low grade applications. Also, 50% cement replacement with high calcium fly ash and use only of steel slag and recycled aggregates resulted in concrete of adequate strength and considerable environmental gains.

III. CONCLUSION

Based on above literature survey we have concluded that materials Recycled aggregate can be used with ceramic waste, GGBS, Fly Ash, and Pulverised Fuel Ash (PFA) in varying proportion for partial replacement of concrete ingredients.

IV. REFERENCES

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