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REVIEW ON BOND STRENGTH AND DUREBILITY OF RECYCLED CONCRET AGGERGATE

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Abstract*— Scarcity of natural coarse aggregate has initiated the use of recycled aggregate obtained from crushed concrete rubbles in building industry. Large quantity of concrete waste have been produced by construction & demolition industries in India and many other developing countries & it is likely to increase in future. On other hand, In past year about 30 million tons of concrete waste is produced out of which major quantity of recycled aggregate at present is used in lower end applications, however in some developed economies; it is also used in structural concrete, due to its quality which is certified and bears Confirmite Europeenne (CE) certificate. Thus the idea of using recycle concrete aggregate (RCA) in a production of new concrete is an effective alternative of reducing the concrete waste. The quality of recycled aggregate concrete (RAC) produced depends on the quality of recycled aggregate obtained from old concrete. Recycled concrete aggregate shows inferior physical properties than the natural coarse aggregate. However, treatment of recycled concrete aggregate by acid, thermal and mechanical means improve the physical properties of RCA significantly. The compressive strength of concrete made with untreated RCA is 14% less than natural aggregate concret (NAC). Treatment improves the compressive strength of RAC made with treated aggregates and is more than 95% of NAC, irrespective of the treatment method used. Acid treatment method is more effective in improving the bond strength of reinforcement and concrete. The greater creep coefficients and shrinkage strain of recycled concrete had a significant influence on the long term behaviour of structural recycled concrete. Therefore, the different time dependent properties of RAC need to be considered in structural design. This paper aims to study research work done on literature of bond strength & durability of RAC.

***Keywords*— recycled aggregate, bond strength, durability of recycled aggregate , recycled aggregate concert, natural aggregate**

I. INTRODUCTION

Population growth, continuous industrial development, construction of infrastructure and house building activities create huge amounts of the construction and demolition (C&D) waste and hence, dire need for waste recycling. Construction industry is a major consumer of natural resources and the global aggregate production almost doubled from 21 billion tons in 2007 to 40 billion tons in 2014. Countries such as China, India, Indonesia, Malaysia, Thailand, Gulf States, Turkey, Russia, Brazil and Mexico have recorded some of the strongest increases in the demand for waste recycling. Hence, progressive depletion of natural resources and growing awareness of sustainable waste management by the developed and emerging economies, have given ever-increasing relevance to recycle and re-use C&D waste in civil engineering projects.

Because of the lake of land space for good residential areas and industrial areas the demolition Is necessary. And the waste obtain from that is used as land filling now a days . but doing some process on that we can gate aggregate, sand, and cement molecule back and use them in different uses.

So by using this recycled aggregate with partial replacement of the natural aggregate is give you good solution of disposal of C&D waste.

II. LITERATURE REVIEW

A. K. Pandurangan , A. Dayanithy , S. Om Prakash "Influence of treatment methods on the bond strength of recycled aggregate concert")", Science direct, construction and building material Department of Civil Engineering, Pondicherry Engineering College, Puducherry, India Department of Civil Engineering, Vel Tech Dr. RR & Dr. SR Technical University, Avadi, Chennai, India

This paper aims to compare the effect of treatment methods on the bond strength of reinforcement with concrete. Fifteen numbers of RILEM beam specimens are prepared using natural aggregate, untreated recycled aggregate, recycled aggregate treated with acid, mechanical and thermal methods. The physical, mechanical

properties of these aggregates, their compressive strength and bond strength are determined and the optimum results are presented in this paper.

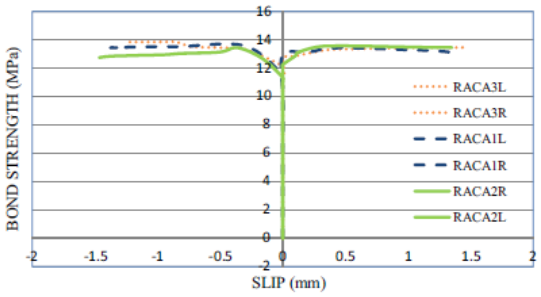

Fig. 1. Bond stress versus slip curves of acid treated RAC (RACA).

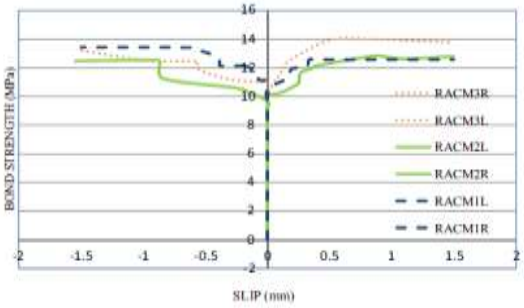

Fig. 2. Bond stress versus slip curves of mechanically treated RAC (RACM).

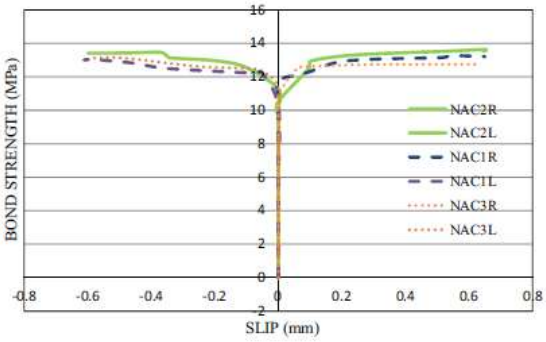

Fig. 3. Bond stress versus slip curves of NAC.

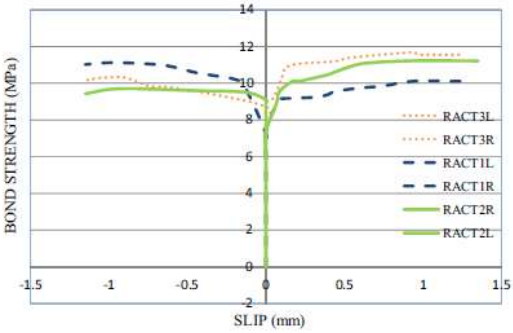

Fig. 4. Bond stress versus slip curves of thermal treated RAC (RACT).

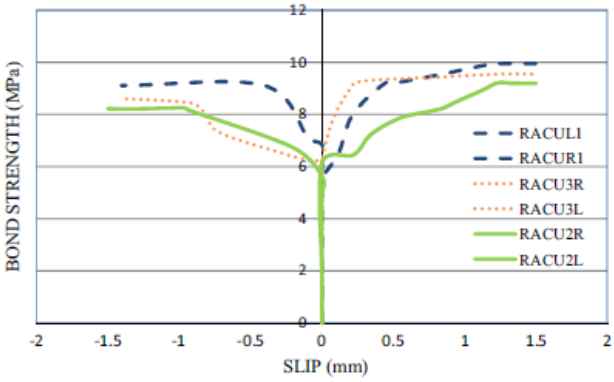

Fig. 5. Bond stress versus slip curves of untreated RAC (RACU).

From the study of above research papers it can be concluded that,

- Recycled concrete aggregate shows inferior physical properties than the natural coarse aggregate. However, treatment of recycled concrete aggregate by acid, thermal and mechanical means improve the physical properties of RCA significantly.
- Processing of RCA removes/reduces the adhered mortar in RCA. The residual adhered mortar present in aggregates treated by acid, mechanical and thermal treatment methods is 2%, 5% and 11% respectively.
- The compressive strength of concrete made with untreated RCA is 14% less than NAC. Treatment improves the compressive strength of RAC made with treated aggregates and is more than 95% of NAC, irrespective of the treatment method used.
- It is logically feasible only to replace 72%, 94%, 92% and 85% of RCAU, RCAA, RCAM and RCAT, respectively as per mix design procedure proposed earlier investigators.
- The bond strength of RCA treated with acid, mechanical and thermal treatment methods is 96% and 90% and 79% of the NAC respectively. However, mechanical treatment is found to be less time consuming, eco-friendly and economical compared to acid treatment method. Hence, it is recommended as the best treatment method to treat RCA, based on the bond tests carried out in this study.
- Of all the treatment methods used in this study, acid treatment method is more effective in improving the bond strength of reinforcement and concrete.

B. Vivian W.Y.Tam, Mahfooz Soomro Ana Catarina Jorge Evangelista. "A review of recycled aggregate in concrete application (2000 – 2017)", Science direct, construction and building material, collage of civil engineering Shenzhen university China, western Sydney university Australia, federal university of rio de janeiro Brazil.

This review may help to alleviate the concerns of consumers and encourage and further promote the use of recycled aggregate on a larger scale in civil engineering projects. Use of recycled aggregate in concrete provides a promising solution to the problem of construction and demolishing waste. The major quantity of recycled aggregate at present is used in lower end applications, however in some developed economies; it is also used in structural concrete, due to its quality which is certified and bears Confirmite Europeenne (CE) Certificate. The standards (normative documents) regulate and maintain the quality and provide producers as well as the users, an assurance of the consistent quality of the recycled aggregate. China and India at present are the major consumers of construction aggregate and hence have high potential for recycling and re-use of C&D waste, however, despite its potential, there is huge variation in the level of recycling and material recovery in various countries around the world e.g. Brazil (6.14%), Denmark (94%), Netherland (98%). This variation is due to vast differences in construction traditions, the legislation on landfills and due to the perception and acceptance level of constructors and builders. Comparison in tabulation form of the Standards (normative documents) from various countries have been presented to provide producers, consumers as well as researchers a wider outlook on the characteristics of recycled aggregate which are desired and specified in legislation of those countries. To alleviate the concerns of consumers related to durability performance of concrete produced from recycled aggregate, it is suggested that with further research and development, improvement in legislation and by inclusion of durability factors, such as deformation (shrinkage and creep) and permeability (carbonation, air and water penetration and chloride ingress) in the legislation, will help in improving the acceptance level and usage of recycled concrete applications and assist in turning recycling as one of the important components for sustainable development.

C. George Dimitriou, pericles savva, Michael F. Prtrou, "Enhancing mechanical and durability properties of recycled aggregate concrete" , Science Direct construction and building materials, Department of civial and Environmental Engineering, University of Cyprus, Cyprus .

The objective of this research is to determine whether a concrete mixture design incorporating RCA as replacement of NA and mineral admixtures as partial replacement of cement is able to achieve an adequate performance for structural applications. RCA are subjected to a treatment method to reduce the amount of the adhered mortar and improve their properties. In addition, RCA are utilized in concrete mixtures as internal curing (IC) agents in order to evaluate whether the material's performance could be further enhanced. Apart from the mechanical and durability properties, the economic aspects of the RAC are of equal importance and a comparison of NA with RCA is presented. The potential environmental and economic benefits could ameliorate RAC image to the public and boost its usage.

From the study of above research papers it can be concluded that,

Some very useful conclusions were derived from this research aiming to dispel fears regarding the utilization of RCA into structural concrete. The key conclusion of this research is that the RAC can be enhanced in such a way to be used in some major construction activities. A simple treatment method, in the recycling process of RCA, is capable to reduce the adhered mortar at such level that diminishes the negative effects and to create a better quality RAC which is competitive to normal concrete. The main findings of the research are:

- Properties of aggregates
  - RCA-F aggregates consisted of 24% adhered mortar. A simple treatment method though can reduce mortar to 9%, producing aggregates with less amount of mortar, slightly rounder and sounder (RCA-T aggregates).
  - RCA had higher water absorption values, lower density and higher LA and soundness values. Treated recycled aggregates (RCA-T) showed great improvement in all of the tests that were performed, reaching or even surpassing the properties of natural aggregates.
- Replacement ratio of NA with RCA
  - Increasing the replacement ratio resulted in lower quality of concrete compared to normal concrete. Both mechanical and durability properties are negatively affected by the increase of the replacement ratio.
- Type of aggregates
  - RCA-F aggregates provided good quality concrete, taking into account the low quality of aggregates. RCA-T aggregates provided good quality concrete, competitive to Control concrete.
  - Presoaking aggregates had some positive effect on the compressive strength, modulus of elasticity and sorptivity of concrete.
- The combined effect of mineral admixtures (fly ash and silica fume) proved to be quite significant and improved substantially the durability properties. Especially, the use of silica fume had a crucial impact on

sorptivity and chloride permeability values. The mechanical properties were relatively the same, though a low early compressive strength was presented due to the delayed pozzolanic activity of fly ash.

- The performance of concrete including RCA can be improved using the method of IC. It was shown that the RCA mixtures exhibited identical or even better properties with the conventional concrete mixture for both compressive strength and RCP values.
- RAC are cheaper than NA resulting to a slightly cheaper concrete. A 50% replacement of NA with RCA-T produces a less expensive mixture with almost the same quality as Control. In Cyprus, mineral admixtures are much more expensive than Portland cement and their utilization resulted into a higher total cost.

III. CONCLUSIONS

From the study of above research papers it can be concluded that,

- Recycled aggregate in concrete provides a promising solution to the problem of construction and demolition waste.
- By using recycled aggregate in concrete the density of concert is decreasing and water absorption of aggregate is increasing .
- Different methods for obtaining the recycled aggregate may affect the natural shape of the aggregate like become more sound and more flaky. Because of this poor shape the cement consumption is also increasing but this cement consumption can be reduced by using mechanical process.
- Recycled aggregate concrete shows inferior physical properties than the natural coarse aggregate However, treatment of recycled aggregate concrete by acid, thermal and mechanical means improve the physical properties of RAC significantly.

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