

A REVIEW ON COMPRESSIVE AND TENSILE STRENGTH OF RECYCLE CONCRETE AGGREGATE

Krushal Koshiya¹, Jasmin Gadhia², Hardik Patel³

¹Post Graduation Student, Department of Civil Engineering, CGPIT, Uka Tarsadia University, Bardoli, Gujarat, India.

²Assistant Professor, Department of Civil Engineering, CGPIT, Uka Tarsadia University, Bardoli, Gujarat, India.

³Assistant Professor, Department of Civil Engineering, CGPIT, Uka Tarsadia University, Bardoli, Gujarat, India.

Abstract— 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 tonnes of concrete waste is produced out of which 60% is utilised in landfilling and remaining 40% remains as waste only which causes lot of social, economical and environmental problem, Thus the idea of using recycle concrete aggregate (RCA) in a production of new concrete is an effective alternative of reducing the concrete waste. It can lead to the considerable saving in natural resources. It is obtained by crushing of demolished concrete and screening and removing other contaminants. Recycle concrete aggregate is used in sub-base of roads, back-filling works and also used in construction of Bungalows & low-rise building. The rate of recycle aggregate is about 550-600 Rs/ton which is less than the rate of natural aggregate i.e. 750-850 Rs/ton. There is about 15-18% reduction in compressive strength, about 20-24% increase in the water absorption capacity, about 30-32% reduction in the tensile strength when natural aggregate is fully replaced by recycle aggregate in concrete at 28 days. The partial replacement of natural aggregate with recycle aggregate is mostly in the ratio of 0%,25%,50% & 100% having an water-cement ratio in the range of 0.50 - 0.65.This paper represents the research work done in the development of recycle concrete aggregate(RCA). It's mechanical behaviour, properties, effectiveness and it's application.

Keywords— recycled aggregate, compressive strength, tensile strength, recycled aggregate concrete, natural aggregate

i. INTRODUCTION

Continuous growth in industries, construction of buildings and other such activities which involves construction industry causes huge amount of construction and demolition(C&D) waste around the world. Construction industry is the major consumer of the natural resources like sand, aggregate etc. Globally about 21 billion ton aggregate is consumed in year 2007 & In year 2014, this figure becomes doubled i.e. about 40 billion ton. The concrete waste which is obtained from construction and development(C&D) industry is only used for land-filling purpose now-a-days. Thus the idea of partial replacement of recycle aggregate with natural aggregate in the new concrete production appears to be an effective utilization of the concrete waste. It can lead to considerable saving in natural aggregate. Recycle aggregate is obtained by crushing of concrete waste and screening and removing the other contaminants.

ii. LITERATURE REVIEW

A. K.N. Rahal , Y.T. Alrefaei ("Compressive strength of longitudinally reinforced recycled aggregate concrete"), Science direct, Civil Engineering Department, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait

This review helps to compare the effect of compressive strength of concrete having partial replacement of natural aggregate with recycle aggregate in the ratio of 0%,10%,20%,35%,50%,75%,100%. Thirteen R.C beam were casted having a concrete grade of M35 for the compressive strength test. The result shows that when natural concrete aggregate (NCA) is fully replaced by recycle concrete aggregate (RCA) the reduction in the strength is about 13% to18%. For partial replacement upto 20% there is not much effect on the compressive strength but for partial replacement more than 35% there is reduction in the compressive strength.

B. Ahmed Shaban Abdel-Hay ("Properties of recycle concrete aggregate under different curing conditions"), Science direct, Structural Engineering Dept., Faculty of Engineering, Beni-Suef University, Egypt.

This paper presents the results of an experimental study to evaluate the effects of recycled concrete aggregate (RCA) under different curing conditions. The percentages of recycled aggregate replaced by natural aggregate were 0:100%, 25:75%, 50:50%, 100:0% respectively. After 24 h from mixing, the specimens were cured in three conditions open-air curing in laboratory atmosphere, standard curing and painted curing for 3, 7 and 28 days respectively. Five specimens were cured in each condition. The concrete cubes were painted using Curassol 1. The paint was sprayed on the surface of concrete after casting directly. The results shows that the compressive strength of concrete cured in water was higher than that which have been cured in air when the percentage of recycled aggregates were 0% and 100%. On the contrary, it was found that the specimens with recycled aggregate of 25% and 50%, which were cured in air, provided higher compressive

strength than that cured in water, at ages of 3, 7 and 28 days. However the case of curing using Paint material gave values of compressive strength higher than the other curing methods, in all cases and at all ages, except in the case of (100%) recycled aggregate.

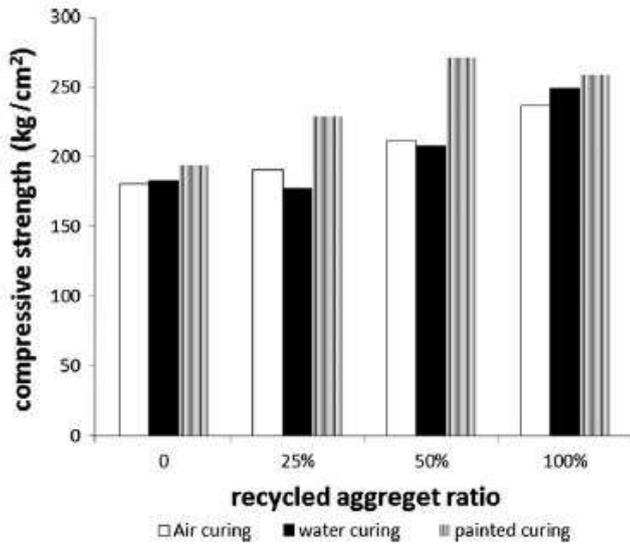


Figure 1 Compressive strength for various recycled aggregate ratio at 3 days.

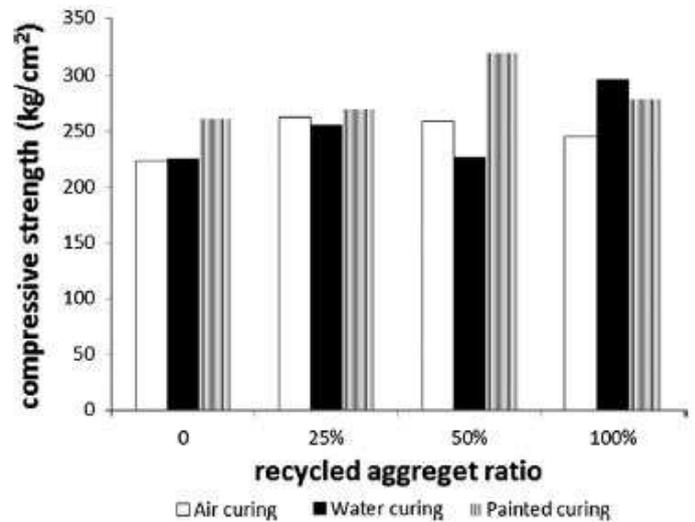


Figure 2 Compressive strength for various recycled aggregate ratio at 7 days.

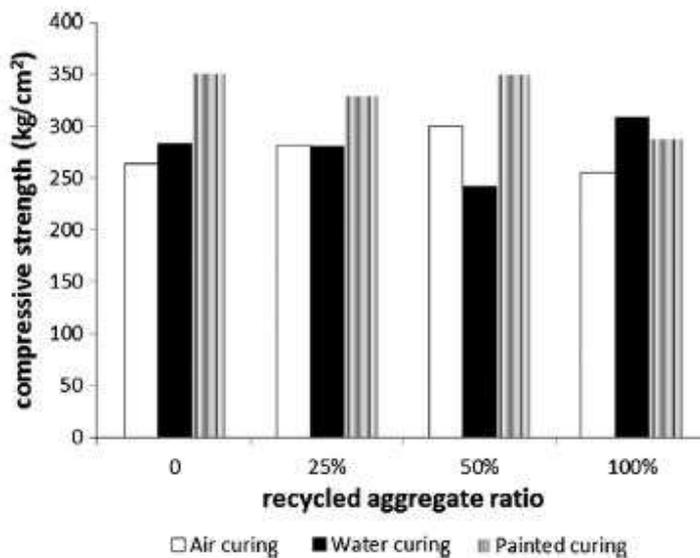


Figure 3 Compressive strength for various recycled aggregate ratio at 28 days

C. Jitender Sharma, Sandeep Singla (“Influence of recycled concrete aggregate on strength parameter of concrete”), *SSRG International Journal of Civil Engineering (SSRG-IJCE)*, *Civil Engineering, RIMT-IET/PTU, INDIA*.

In this paper, we have studied that the compressive strength of hardened concrete made with recycled concrete aggregates was compare to the compressive strength of fresh concrete made with natural aggregates. The tests were conducted by replacing the recycled concrete aggregates by 0%, 25%, 50%, 75% and 100 % replacement of natural aggregates having M20 grade of concrete. From the investigations, it was found that the compressive strength of concrete made with RCA decreases as we increases the percentage of recycled concrete aggregate. The compression test was

conducted on 150 x 150 x 150 mm cubes after 28 days. According to the results, the compressive strength of normal concrete was 31.77 N/mm² and the compressive strength of 100 % recycled aggregate concrete was 18.10 N/mm². This shows as we increase the percentage of recycled aggregate in the concrete mix, the compressive strength decreases. However, there is not so much difference between the compressive strength of normal concrete and 25% recycled aggregate concrete.

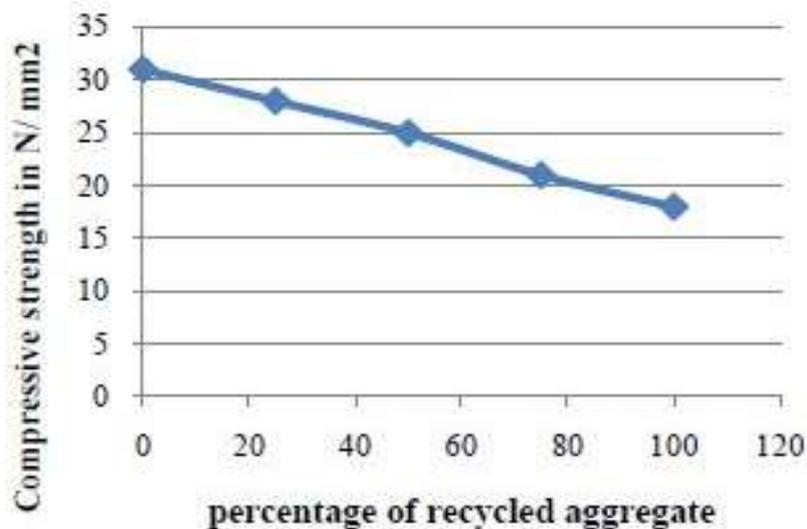


Figure 4 compressive strength of recycle aggregate at 28 days

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

- Recycled concrete aggregate shows inferior mechanical properties than the natural coarse aggregate. However, treatments on recycled concrete improve the mechanical properties of RCA significantly.
- In all the studied cases of curing i.e. air, water, painted the compressive strength led to increase with its age. The best ratio of RCA to NCA is 50% and that to when cured in air or painted, the maximum strength is achieved
- The compressive strength decreases as we increase the percentage of recycled aggregate in the concrete mix. From the study, it is cleared that as we increases the percentage of recycled aggregate from 0 % to 100 %, the compressive strength almost decreases by 15 % on average
- From the study, it is cleared that recycled aggregate can be used safely upto 20 % as there is not so much difference between the compressive strength of 0 % and 20% concrete mix. But after that precautions should be taken while using recycled aggregate in the concrete mix due to its reduction in compressive strength. Hence recycle concrete aggregate having partial replacement more than 20% is used in such work that does not require more compressive strength i.e. sub-base of road, back-filling work, etc.
- 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.

A. Jitender Sharma, Sandeep Singla (“Influence of recycled concrete aggregate on strength parameter of concrete”), *SSRG International Journal of Civil Engineering (SSRG-IJCE), Civil Engineering, RIMT-IET/PTU, INDIA.*

In this paper work we are discussing about the use of recycled concrete aggregate in the concrete and the effects on its tensile strength by progressively replacing the natural concrete aggregate (NCA) with recycled aggregate. The tests were conducted by replacing the recycled concrete aggregates by 0%, 25%, 50%, 75% and 100 % replacement of natural aggregates having M20 grade of concrete. It is the experimental study of recycled concrete aggregate (RCA) when it is compared with the natural concrete aggregate on account of its mechanical properties. Concrete mixtures were prepared by using ordinary Portland cement, fine aggregate, coarse aggregate, recycled aggregate and water in different proportions. The Split tensile test was conducted on 100 x 300 mm cylinders after 28 days. According to the study, the split tensile strength of normal concrete was 1.485 N/mm² and of 100 % recycled aggregate concrete was 0.643 N/mm². This shows as we increase the percentage of recycled aggregate in the concrete mix, the tensile strength decreases. There is a little difference between the tensile strength of normal concrete and of 25% recycled aggregate concrete.

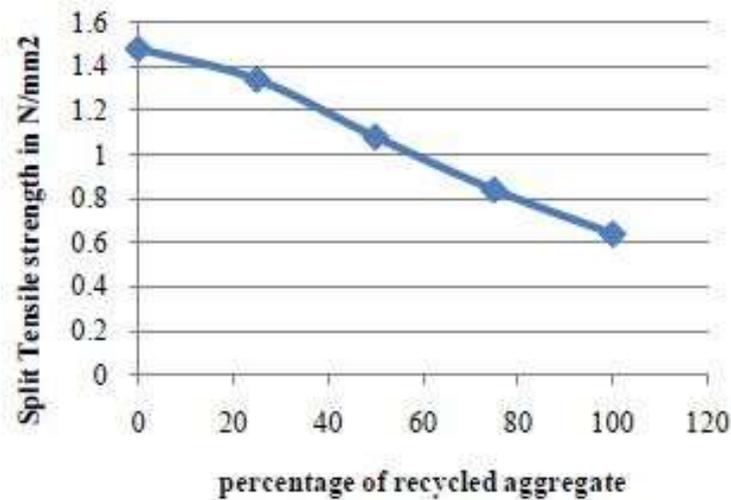


Figure 5 Tensile strength of recycle concrete aggregate at 28 days

B. Ahmed Shaban Abdel-Hay (“Properties of recycle concrete aggregate under different curing conditions”), Science direct, Structural Engineering Dept., Faculty of Engineering, Beni-Suef University, Egypt.

Huge amounts of waste materials are produced by the construction and demolition industry every year. The volume of these materials has reached an unacceptable point for environmental, economic and social reasons. These issues may be addressed by means of more proactive approaches, which include recovery, reuse and recycling techniques, and facilities. It takes many years for a waste management system to develop into a sustainable, reliable, skilful and marketable industry, encouraging the reuse and recycling of components and materials. It is necessary that all parties involved (i.e. clients, contractors, planners and manufactures) play their role in achieving a more sustainable approach. This paper presents an experimental study to evaluate the effects of recycled concrete aggregate (RCA) percentages under different curing conditions. The percentages of recycled coarse aggregate were (0:100%, 25:75%, 50:50%, 100:0%). The test result of tensile strength of the specimens showed that the case of concrete that have been cast using 50% recycled aggregate, and cured using Paint material provided the maximum value of tensile strength.

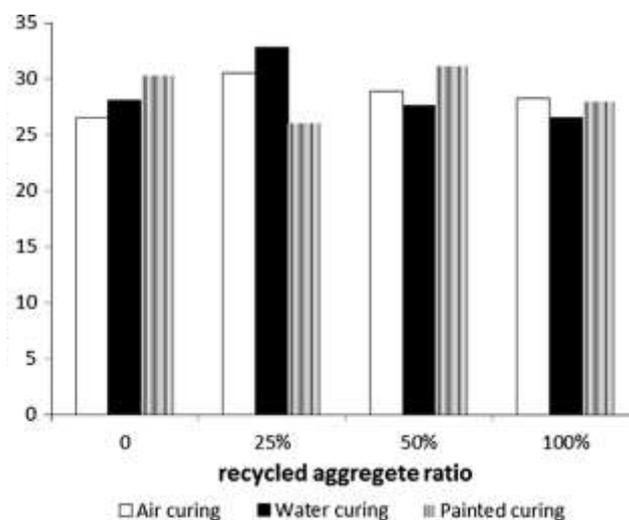


Figure 6 Tensile strength of recycle concrete aggregate at 28 days

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

The main points of this study are:

- The tensile strength is expected to decrease with increasing recycle aggregate(RA) content. Nevertheless, it is possible to control this effect by carefully selecting the RA when producing concrete. Indeed, depending on the RA’s quantity, size, type and quality, there is a higher or lower relative tensile strength loss between the NCA and RCA.
- Despite the tensile strength loss between NCA and RCA with increasing RA content, this difference can least partially offset by the use of proper mixing approaches. It is considered good practice to use RA in a saturated and

surface dried state to maintain mechanical properties. The use of super plasticizers is an effective way of offsetting the strength loss of RCA with increasing replacement levels.

- 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.
- The combined effect of mineral admixtures (fly ash and silica fume) proved to be quite significant and improved mechanical properties. Especially, the use of silica fume had a crucial impact on tensile strength.

iii. CONCLUSIONS

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

- The idea of using Recycle aggregate in a new concrete mix is probably the best alternative to the problem of concrete waste.
- Concrete mixture containing recycled aggregate generally have decrease in the specific density of concrete and have increase in water absorption, increase in abrasion loss, increase in creep.
- There are various methods to get the recycle aggregate from concrete waste. it may affect the shape, size of the aggregate i.e. more flakiness, more elongation as the recycle aggregate is obtained from concrete waste it has other contaminants attach on the surface of aggregate due to this water-cement(W/C) ratio is increases from 0.35 to 0.50
- Recycle concrete aggregate shows inferior physical properties and mechanical properties than the natural aggregate and it can be overcome by doing some treatment on it.

iv. REFERENCES

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