A REVIEW STUDY ON THE USE OF USE OF RECYCLED AGGREGATES IN RIGID PAVEMENTS

Mir Kashif Bilal[1], Er. Deepak Kumar[2]

M.Tech Scholar In Desh Bhagat University, Mandi Gobindgarh Punjab[1], Assistant Professor In Desh Bhagat University, Mandi Gobindgarh Punjab[2]

Abstract: Today construction industry faces shortage of aggregate. Construction industry produces 40% of total waste each year. This causes the severe environmental hazards and causes land fill issue. The possible solution is to reuse recycled concrete aggregate in place of natural aggregate, which reduces landfill disposal, conserving the primary resources and reducing the transportation cost and promote the sustainable development. Hence its need to study the structural properties of recycled aggregate concrete. Recycled aggregate are easily available and economical compared to other natural resources. Demolished structures, site tested concrete, pile cap demolished concrete are the good sources of recycled aggregate. In this paper various studies done by the authors is studied.

Keywords: Natural Coarse aggregates, Recycled Coarse aggregates, Workability, Concrete

1.1 INTRODUCTION

It is estimated that 750 million cum of aggregate would be required for achieving the targets of the road sector. Researchers are looking for alternative materials for highway construction which are economical and ecofriendly. Concrete recycling is becoming an increasingly popular way to utilize the aggregate left behind when structures and roadways are demolished. . India is presently generating construction and demolition waste to the tune of 23.75 million tons annually as per the Hindu online of March 2007, which is comparable to some of the developed nations and these figures are likely to double fold in the next 7 years. The management of construction and demolition waste is a major concern due to increased quantity of demolition rubble, continuing shortage of dumping sites, increase in cost of disposal and transportation and above all the concern about environment degradation. In the past, this rubble was disposed off in landfills, but with more attention being paid to environmental concerns, with existing woes of solid waste management system and an aim towards sustainable development. Re-utilization or recycling seems to be an attractive alternative and an important strategy for management of such waste which could flourish as a good business, if done in a proper manner. For further utilization of recycled aggregates, a proper study needs to be done for its use in the construction and infrastructure projects. Recycling of concrete not only allows the reuse of the rubble, but also helps in conserving the natural resources, reducing the construction costs. Recycled aggregates (RA) can be obtained from crushed concrete rubble (from C & D wastes) comprising of crushed and uncrushed parent aggregate coated with mortar and small pieces of hardened mortar. The increasing problems associated with construction

and demolition waste have led to a rethinking in developed countries and many of these countries have started viewing this waste as resource and presently have fulfilled a part of their demand for raw material. Since concrete composes 35% of the waste as per the survey conducted by Municipal Corporation of Delhi, India may also have to seriously think of reusing demolished rubble and concrete for production of recycled construction material. Work on recycled concrete has been carried out at few places in India but waste and quality of raw material produced being site specific, tremendous inputs are necessary if recycled material has to be used in construction for producing high grade concrete. The goal of sustainable construction is to reduce the environmental impact of a constructed facility over its lifetime. Concrete is the main material used in construction in the world. Due to increase in Construction and Demolition activities worldwide, the waste concrete after the destruction of any infrastructure is not used for any purpose which is totally loss in the economy of the country because natural resource are depleting day by day. The debris is also a major problem for municipal authorities to dispose of at particular location. It is most common practice in all over the world that most of the materials (paper, plastic, rubber, wood, concrete, etc) are being recycled to save the natural resources and environment. Concrete is such a costly material but Now a day's waste concrete is only being used as a landfill material instead of recycling the concrete as a recycled concrete aggregate (RCA) to use for the construction purposes.

1.2 LITERATURE ON USE OF RECYCLED AGGREGATES

Siddique R et al reviewed the Use of recycled plastic in concrete. The use of waste products in concrete not only makes it economical, but also helps in reducing disposal problems. Reuse of bulky wastes is considered the best environmental alternative for solving the problem of disposal. One such waste is plastic, which could be used in various applications. However, efforts have also been made to explore its use in concrete/asphalt concrete. The development of new construction materials using recycled plastics is important to both the construction and the plastic recycling industries. This paper presents a detailed review about waste and recycled plastics, waste management options, and research published on the effect of recycled plastic on the fresh and hardened properties of concrete. The effect of recycled and waste plastic on bulk density, air content, workability, and compressive strength, splitting tensile strength, modulus of elasticity, impact resistance, permeability, and abrasion resistance is discussed in this paper.

Sim J et al studied the compressive strength and resistance to chloride ion penetration and carbonation of recycled aggregate concrete with varying amount of fly ash and fine recycled aggregate. This study investigates the fundamental characteristics of concrete using recycled concrete aggregate (RCA) for its application to structural concrete members. The specimens used 100% coarse RCA, various replacement levels of natural aggregate with fine RCA, and several levels of fly ash addition. Compressive strength of mortar and concrete which used RCA gradually decreased as the amount of the recycled materials increased. Regardless of curing conditions and fly ash addition, the 28 days strength of the recycled aggregate concrete was greater than the

design strength, 40 MPa, with a complete replacement of coarse aggregate and a replacement level of natural fine aggregate by fine RCA up to 60%. The recycled aggregate concrete achieved sufficient resistance to the chloride ion penetration. The measured carbonation depth did not indicate a clear relationship to the fine RCA replacement ratio but the recycled aggregate concrete could also attain adequate carbonation resistance. Based on the results from the experimental investigations, it is believed that the recycled aggregate concrete can be successfully applied to structural concrete members.

Amnon Katz studied on the Properties of concrete made with recycled aggregate from partially hydrated old concrete. Concrete having a 28-day compressive strength of 28 MPa was crushed at ages 1, 3 and 28 days to serve as a source of aggregate for new concretes, simulating the situation prevailing in precast concrete plants. The properties of the recycled aggregate and of the new concrete made from it, with nearly 100% of aggregate replacement, were tested. Significant differences were observed between the properties of the recycled aggregates of various particle size groups, while the crushing age had almost no effect. The properties of the concrete made with recycled aggregates were inferior to those of concrete made with virgin aggregates. Effects of crushing age were moderate: concrete made with aggregates crushed at age 3 days exhibited better properties than those made with aggregates of the other crushing ages, when a strong cement matrix was used. The properties of the recycled aggregates crushed at different ages were quite similar. The size distribution of the aggregates was the same for the three ages of crushing, as well as other properties such as absorption, bulk-specific gravity, bulk density, cement content and crushing value of the coarse fraction. The observations indicate that at these strength levels and structure of the old concrete the aggregates that are made of it have quite similar properties. However, some additional cementing capacity still remains in the aggregates crushed at 1 day, but it rapidly decreases within a few days.

Bruno Andre et al studied the life cycle assessment of the use of recycled aggregates in the production of concrete. A large percentage of the CDW is deposited illegally, which causes problems for human health and the environment; therefore its correct management is very important. To overcome the problems above, this study aims at analyzing the impacts of recycling aggregates used in the production of concrete. To do this, it proceeds with the analysis of the life cycle of the building materials under study, describing their production and the production of concrete aggregates and quantifying all its environmental impacts, based on the environmental production declaration of concrete. Three scenarios are analyzed in order to compare the impacts of the use of natural and re-cycled aggregates in concrete, resorting to the help of software Semipro that calculates the global environmental impact of all phases under study in each scenario, and with the help of data provided by the companies Unibetão and Ambisider. Based on the analysis performed in this study, it is found that recycled aggregates have great environmental advantages over natural aggregates during the life cycle of concrete.

Hardik Gandhi et al studied on the use of recycled coarse aggregates in Concrete. In this study recycled coarse aggregate have been used to replace virgin coarse aggregate. The properties of fresh as well as hardened concrete made of partial/full replacement of recycled coarse aggregate are found out and the results are compared with that of concrete using virgin coarse aggregate. Recycled aggregates are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. Recycled aggregates for application in high strength structural concrete, which will give a better understanding on the properties of concrete with recycled aggregate, as an alternative material to coarse aggregate in structural concrete. The experimental results show that the compressive strength of concrete made of natural coarse aggregate and recycled coarse aggregate is approximately same. Hence the recycled aggregate can be used in concrete with partial or full replacement of natural coarse aggregate.

Myle Nguyen James et al studied the use of Recycled Aggregate and Fly Ash in Concrete Pavement. This research aims to evaluate the feasibility of using concrete containing recycled concrete aggregate and fly ash in concrete pavement. Two water cement ratio (0.45 and 0.55) the compressive strength, modulus of electricity and flexural strength for concrete with recycled aggregate and fly ash with 0, 25% replacing cement in mass were considered. The material properties of recycled aggregate concrete with fly ash indicate comparable results with that of concrete with natural aggregate and without fly ash. The recycled materials could be used in concrete pavement and it will promote the sustainability of concrete. This purpose of this study was to evaluate the feasibility of using concrete containing RCA and FA for use in low-modulus concrete pavement applications.

H.S. Pietersen et al studied the performance of Concrete with Recycled Aggregates. Application of recycled aggregates in concrete contributes to closing the concrete life cycle, and reduces the impact on the landscape due to the exploitation and quarrying of natural aggregates. Recycled aggregates may be applied successfully in concrete. This is especially true for the majority of the concrete market, which consists of relatively low-demanding products. Coarse aggregate replacement levels of 20% to 100% are very well feasible, especially in case of recycled concrete aggregates. The durability of concretes with up to 100% recycled aggregates is, given the concrete quality tested, within range of concrete without recycled aggregates. Both frost-thaw resistance and chloride ingress levels are acceptable for normal use (in the Netherlands). Mix-design should be done with care and experience, since the water demand of notably mixed aggregates is rather high. Prewetting is one of the more practical precautions to be taken.

Mirjana Malesev et al studied the recycled Concrete as Aggregate for Structural Concrete Production**.** A comparative analysis of the experimental results of the properties of fresh and hardened concrete with different replacement ratios of natural with recycled coarse aggregate is presented in the paper. Recycled aggregate was made by crushing the waste concrete of laboratory test cubes and precast concrete columns. Three types of concrete mixtures were 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% replacement of coarse recycled aggregate). Ninety-nine specimens were made for the testing of the basic properties of hardened

concrete. Load testing of reinforced concrete beams made of the investigated concrete types is also presented in the paper. Regardless of the replacement ratio, recycled aggregate concrete (RAC) had a satisfactory performance, which did not differ significantly from the performance of control concrete in this experimental research. However, for this to be fulfilled, it is necessary to use quality recycled concrete coarse aggregate and to follow the specific rules for design and production of this new concrete type.

Ismail Abdul Rahman studied the assessment of Recycled Aggregate Concrete. This paper reports the results of an experimental study on the mechanical properties of recycled aggregate concrete (RAC) as compared to natural aggregate concrete (NAC). The effects of size of RA on compressive strength were discussed in this paper. The 100% of RA used in concrete mix to replace the natural coarse aggregate in concrete with 100 x 100 x 100 cube mm were cast with target compressive strength is 25 MPa. The 28-day compressive strength was crushed at 3, 14, 28 days are reported. It was found the size of 10mm and 14 mm of RA in RAC is quite similar performance with 10mm and 14mm size of natural aggregate (NA) in natural aggregate concrete (NAC). From the experimental results, it can be concluded that: The 28-day target compressive strength for all six mixes was achieved to 25 MPa even though the RAC strength is lower than NAC. The compressive strength for RAC is within the same range compared to NAC and reaching up to 25MPa at day 28 of curing & the size of RA was affected the strength in compressive strength, the results shows the 10mm and 14mm size of RA is better than 20mm size.

CONCLUSION

Based on the analysis and evaluation of the findings presented, the following set of general conclusions is drawn

1. The slump is also found to decline in the recycled aggregate concrete
    - The use of RCA decreases workability of fresh concrete at a given water content, increases the water requirement at a given consistency,
    - Increases shrinkage at a given water/cement ratio.
2. The slump is also found to decline in the recycled aggregate concrete but admixture has improved the slump.
3. It is observed that mixing of RAP reduces the rate of gain of compressive strength as compared to fresh aggregate.
4. Due to use of recycled aggregate in construction, energy & cost of transportation of natural resources & excavation is significantly saved. This in turn directly reduces the impact of waste material on environment.
5. RA extracted from good quality concrete without impurities impart higher strength than normal aggregates.

REFERENCES

1. Ankit Sahay, "Construction Industry Waste Management- An Experimental Case Study of Recycled Aggregate Concrete", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X.
2. Hardik Gandhi, "Study on Use of Recycled Coarse Aggregate in Concrete", National Conference on Recent Trends in Engineering & Technology 2011.
3. Ismail Abdul Rahman, "Assessment of Recycled Aggregate Concrete", Vol. 3, No. 10 Modern Applied Science 2009.
4. Myle Nguyen James et al, "Use of Recycled Aggregate and Fly Ash in Concrete Pavement", American J. of Engineering and Applied Sciences 4 (2): 201-208, 2011 ISSN 1941-7020.
5. K. Usha Nandhini, "Flexural Strength Properties of Recycled Aggregate Concrete", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 5, Issue 5, May 2016 ISSN 2319 – 4847.
6. S Ganesh Kumar, "APPLICATION OF GEOPOLYMER CONCRETE", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 02 Issue: 09, Dec-2015.
7. Jitender Sharma, "Study of Recycled Concrete Aggregates", International Journal of Engineering Trends and Technology (IJETT) – Volume 13 Number 3 – Jul 2014.
8. Vikas Gill, "Study on Bituminous Pavement Wastes Used As Replacement Material in Cement Concrete", International Journal for Research in Applied Science & Engineering Technology (IJRASET)
9. Ahmed, S.F.U., N. Ahmad and H. Mihashi, 2009. Restrained shrinkage-induced cracking of light weight high performance fiber reinforced cementitious composites. Am. J. Eng. Applied Sci., 2: 775-780. DOI: 10.3844/ajeassp.2009.775.780.
10. Anderson, K.W., J.S. Uhlmeyer and M.A. Russell. 2009, Use of Recycled Concrete Aggregate in PCCP: Literature Search. Transportation Research Board. http://144.171.11.39/view.aspx?id=902140 Bekoe, P.A., M. Tia and M.J. Bergin, 2010. Concrete containing recycled concrete aggregate for use in concrete pavement. Trans. Res. Record. J. Trans. Res. Board., 2164: 113-121. DOI: 10.3141/2164.
11. Chandramouli, K., P.S. Rao, N. Pannirselvam, T.S. Sekhar and P. Sravana, 2010. Chloride penetration resistance studies on concretes modified with alkali resistant glass fibers. Am. J. Applied Sci., 7: 371-375. DOI: 10.3844/ajassp.2010.371.375
12. Hamoush, S., M. Picornell-Darder, T. Abu-Lebdeh and A. Mohamed, 2011. Freezing and thawing durability of very high strength concrete. Am. J. Eng. Applied Sci., 4: 42-51. DOI: 10.3844/ajeassp.2011.42.51