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A REVIEW STUDY ON THE PROPERTIES OF RECYCLED AGGREGATE CONCRETE

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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

1.0 INTRODUCTION

The use of crushed aggregate from either demolition concrete or from hardened leftover concrete can be regarded as an alternative coarse aggregate, typically blended with natural coarse aggregate for use in new concrete. The use of 100% recycled coarse aggregate in concrete, unless carefully managed and controlled, is likely to have a negative influence on most concrete properties – compressive strength, modulus of elasticity, shrinkage and creep, particularly for higher strength concrete. Also the use of fine recycled aggregate below 2 mm is uncommon in recycled aggregate concrete because of the high water demand of the fine material smaller than 150 µm, which lowers the strength and increases the concrete shrinkage significantly. Many overseas guidelines or specifications limit the percentage replacement of natural aggregate by recycled aggregate. In general leftover concrete aggregate can be used at higher replacement rates than demolition concrete aggregate. With leftover concrete aggregate, information will generally be known about the parent concrete – strength range and aggregate source etc., whereas for demolition concrete very little information may be known about the parent concrete, and the resulting aggregate may be contaminated with chlorides or sulphates and contain small quantities of brick, masonry or timber which may adversely affect the recycled aggregate concrete. Often the sources of material from which a recycled aggregate came (and there could be more than one source), are unknown and the variability and strength of the recycled aggregate concrete could be adversely affected in comparison with a recycled aggregate concrete where the recycled aggregate came from one source with a known history of use and known strength. It is therefore necessary to distinguish between the properties of recycled aggregate concrete made using demolition concrete aggregate and that using leftover concrete aggregate.

Nevertheless, recycled aggregate concrete can be manufactured using recycled aggregate at 100% coarse aggregate replacement where the parent concrete, the processing of the recycled aggregate and the manufacture of the recycled aggregate concrete are all closely controlled.

However as target strengths increase, the recycled aggregate can limit the strength, requiring a reduction in recycled aggregate replacement.

1.1 CLASSIFICATION OF AGGREGATES

For the purpose of this report, the following classifications are adopted.

1. NATURAL AGGREGATE

Aggregates can come from either natural or manufactured sources. Natural aggregates come from rock, of which there are three broad geological classifications. Igneous rock, These rocks are primarily crystalline and are formed by the cooling of molten rock material beneath the earth's crust (magma). Sedimentary rocks, these rocks are formed from deposited insoluble material (e.g., the remains of existing rock deposited on the bottom of an ocean or lake). This material is transformed to rock by heat and pressure. Sedimentary rocks are layered in appearance and are further classified based on their predominant mineral as calcareous (limestone, chalk, etc.), siliceous (sandstone, etc.) or argillaceous (shale, etc.). Metamorphic rock, These are igneous or sedimentary rocks that have been subjected to heat and/or pressure great enough to change their mineral structure so as to be different from the original rock. Aggregates are produced in a quarry or mine whose basic function is to convert in situ rock into aggregate with specified characteristics. Usually the rock is blasted or dug from the quarry walls then reduced in size using a series of screens and crushers. Some quarries are also capable of washing the finished aggregate.

Figure 1: Natural Aggregates

2. RECYCLED AGGREGATES

Construction materials are increasingly judged by their ecological characteristics. Concrete recycling gains importance because it protects natural resources and eliminates the need for disposal by using the readily available concrete as an aggregate source for new concrete or other applications. . The states that do use recycled concrete aggregate (RCA) in new concrete report that concrete with RCA performs equal to concrete with natural aggregates. Most agencies specify using the material directly in the project that is being reconstructed. Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality.

Figure 2: Recycled aggregates

2.0 LITERATURE REVIEW

Janani Sundar et al studied the Impact of Chemical Admixture on Recycled Aggregates concrete. This research deals with reclamation of the aggregates obtained from the old concrete, and using them in creating a durable and normal strength concrete with 100% of the recycled concrete aggregate with addition of chemical admixtures of specific gravity 1.19. For this purpose the old concrete debris is broken into required aggregate size and some basic tests are carried out, then the compressive strength of this recycled aggregate concrete is compared to that of the concrete made with normal aggregate. The concept of direct percentage replacement is followed. The test results show that the density of the recycled aggregate is low compared to the normal natural aggregates, thus resulting in the decrease in density of concrete. The chemical admixture at 1.5, 1.8 and 2% of weight of cement is added and the compressive strength for 1.8% was found to be similar to that of normal aggregate concrete.

Ankit Sahay et al experimentally studied on recycled aggregate concrete in construction industry Waste Management. In this research work, a comparison between natural aggregate (NA) and recycled aggregate (RA) has been done and various proportions of NA: RA (0:100, 60:40, 70:30, 80:20 and 100:0) have been experimentally tested for efficacy of use in two concrete mixes (M20 and M25). Tests on aggregates such as Impact Value Test, Abrasion Value Test, Aggregate Crushing Test, and of concrete such as Compression Test has been carried out in both the mixes to come to a specific conclusion. The NA: RA mix of 70:30and 80:20 have consistently given better results as compared to mix proportion of 60:40 and thus, may be recommended for sustainable and economic development of concrete. So, it is still suitable for low level construction works like that of pavements etc.

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.

Gurukanth S et al studied the Effect of Use of recycled concrete aggregates in bituminous concrete surface course. Today, science and technology has a responsibility of innovating new trends which are both economical and ecofriendly. Old demolished concrete structures can be recycled to obtain recycled aggregate (RA). This can be used along with the natural aggregates effectively in various infrastructure need so that we attain a balance between demand and supply of construction material thereby reducing the impact on nature. In this investigation , the strength variation of bituminous concrete surface course in which recycled aggregates are used in partial or full replacement of natural aggregates. Marshall's method is used to study the strength variations in bituminous concrete surface course with replacement of natural aggregates with recycled aggregates. It was found that replacement of natural aggregates by recycled aggregates upto 20% is possible in bituminous concrete surface course without significant impact on the strength characteristics. However there is an increase in the binder content for which there is a need to study the economic value of the replacement.

S R Yadav et al studied the use of recycled concrete aggregate in making concrete. This paper deals with the review of the existing literature work for the use of recycled concrete as aggregates in concrete in respect of mainly the compressive strength and proposes an approach for use of recycled concrete aggregate without compromising the strength. Works on recycling have emphasized that if old concrete has to be used in second generation concrete, the product should adhere to the required compressive strength. Literature survey reveals that compressive strength primarily depends upon adhered mortar, water absorption, Los Angeles abrasion, size of aggregates, strength of parent concrete, age of curing and ratio of replacement, interfacial transition zone, moisture state, impurities present and controlled environmental condition. Some of the studies have suggested the mix design procedure for recycled aggregates in concrete, yet a simple and cost effective method of using demolished concrete, taking into account % adhered mortar and thus calculating mix composition needs to be developed. Though there has been extensive research carried out on recycling yet construction industry does not have a simple and cost effective method to use the recycled aggregates in second generation concrete.

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.

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

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