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A STUDY ON USE OF RECYCLED AGGREGATES IN PAVEMENTS

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ABSTRACT:

The availability of natural aggregates is get decreased and the demolished building materials is get increased in now a days. These demolished materials can be get recycled and can be used as construction materials in both buildings and pavements. The recycled aggregates can used in the pavement construction. For assessing the suitability of using recycled aggregates in pavement construction three test were conducted. The results obtained from the aggregate crushing test, impact test and specific gravity test are within the desirable limit. From the test result, the recycled aggregates can be used in both base course and the surface course of a pavement.

Keywords: Pavement, Recycled concrete, aggregates, gravity.

1. INTRODUCTION

In developing countries like India nearly12million tons of Construction and Demolition wastes are producedper annum. The use of recycled C&D material would greatly reduce the demand for landfill sites and for virgin resource materials by re-using what would be normally regarded as a waste material. In manycountries, particularly as populations in urban areas continue to grow, the natural resources are exploited at rapid rate in view of escalating construction activities. The use of quarry materials is furthermore unsustainable from an environmental perspective manner. The most ambitious recycling construction target is, using waste aggregates, to create a new product with similar properties to the original. This is to make new concrete with old concrete, for this purpose it is needed recycled aggregates with high quality. The demolition of concrete structures, after having completed their useful life or having

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suffered collapse, could be an excellent source of recycled aggregate, provided that there is a quality control in the recycling process [3].In recent years certain countries have considered the reutilisation of construction and demolition waste as a new construction material as being one of the main objectives with respect to sustainable construction activities[5].In some Industrially Developed or Developing nations, the recycled concrete aggregates (RCA) are suggested as a replacement to the natural aggregates (NA) in road and building construction activities. Some of these countries have specific codes dealing with the handling and use of RCA in such activities. However, the use of RCA in construction activities in many developing countries is still limited largely due to insufficient knowledge database, policies and specifications [4]. The Natural aggregate sources and the environment are preserved due to reducing a number of mining areas and disposal landfill areas. Additionally, using RA for concrete can reduce fuel consumption for transport and construction cost, while natural aggregate consumes a huge energy at each step of processing. It is estimated that using RA as a replacement of NA in concrete can save up to 60% [2]. RCA is important because it helps to promote sustainable development to save the natural resources and reduces the disposal of demolition waste from old concrete.Generallyrecycled concrete aggregateshaving high absorption of water and low specific gravity. The density of recycled aggregates is lower than the density of natural aggregates. Fresh concrete is a sophisticated composited material which is constantly undergoing improvements and modifications [7]. Severalattempts have been made to utilize Construction and Demolition Waste (C&DW), in order to produce concrete aggregates since the World War II and possibly even before. Though it is important to note that the Recycled Concrete Aggregate (RCA) derived from C&DW is inhomogeneous unlike Natural Coarse Aggregate (NCA) derived from a rock. Recycled aggregate contains other deleterious materials, which make it difficult for complete replacement of a good quality natural aggregate for concrete and, therefore, restricting its many applications such as in reinforced concrete structural elements

OVEER VIEW:

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

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properties ñ 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 ñ 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. Road Connectivity is one of the key components for rural development, as it promotes access to economic and social services, generating increased agricultural income and productive employment. While building rural roads, the provisions based on the parameters that affect the sustainability are to be made, but at minimum cost the conventional methods and specifications tend to recommend technology and materials, however difficult and distance away they may be, which normally result in higher cost of construction. It is the duty of the engineers to spend every rupee of the taxpayer's money with optional utility particularly under resource constraints. The Recycling of aggregate is a process in which used aggregate is reused for new construction. Use of recycled aggregate is not very common in India and other developing countries. There is huge requirement of the aggregate because of fast development in the infrastructure area. In order to reduce the usage of fresh aggregate, recycled

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aggregate can be used as a replacement materials. Recycled aggregate used

AGGREGATES:

Aggregates are necessary materials for building and repairing residential and commercial spaces, roads, and even railways. They come in many different shapes, but they tend to fall into either one of two categories: virgin or recycled.

Virgin aggregate refers to products that have been newly mined from the ground. These are typically granular or crystalline rocks, and sand, gravel, and stone are all examples of virgin aggregate. Most of the virgin aggregate will come from a local mine or quarry, but it's not unlikely that companies will have certain aggregates shipped to their project. Instead of being mined, recycled aggregate material is made from crushed concrete. Unused concrete is returned to the plant, and the product is then crushed to an aggregate specification to create a new recycled product.

USES:

Aggregates can be used for a variety of applications, including backfill, pipe bedding, sub base, shoulder stone, under paver bricks and driveways. Some people prefer to use virgin aggregate because they believe it has a higher performance rating than recycled; however, from a product performance perspective, recycled aggregates are just as durable and strong as virgin. The recycled aggregates tool has been used to calculate the impacts of one ton of recycled aggregate production as well as one ton of each product that follows a different production process stream. The impact allocation to specific products was based on attributing the impacts of each unit process to the relevant product stream only.

2. LITERATURE SURVEY

Janani Sundar et al [1] 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 [2] 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 [3] 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 [4] studied the Effect of Use of recycled concrete aggregates in bituminous concrete surface course. Today, science and technology have a responsibility of innovating new trends which are both economical and

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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. Marshallís 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 balls, chlorides, glass, gypsum board, sealants, paper, plaster, wood, and roofing materials. Recycling of C&D wastes can take place either at the site where the material is sourced, or the material may be transported to a central recycling facility, where large stockpiles may be accumulated an increase in the binder content for which there is a need to study the economic value of the replacement.

3. RELATED STUDY

Recycling of Concrete from C&D Wastes:

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. The quality of concrete with RCA is very much dependent on the quality of the recycled material used. Reinforcing steel and other embedded items, if any must be removed and care must be taken to prevent contamination by other materials that can be troublesome such as asphalt, soil and clay

Fig.3.1. Recycling of Concrete from C&D Wastes.

4. METHODOLOGY

The methodology of the study is described and explained based on the objectives and the aims of the study. The use

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of recycled aggregates increasingly complex issues has prompted a refinement of methodologies. Products are high quality aggregate, processed in steps with time and effort involved in crushing, pre-sizing, sorting, screening and contaminant elimination. The denominator is to start with clean; quality rubble in order to meet design criteria easily and ultimately yield a quality product that will go into end use. Crushing and screening systems start with primary jaws, cones and/or large impactors taking rubble from 30 inches to 4 feet. A secondary cone or impact or may or may not need to be run and then primary and secondary screens may or may not be used, depending upon the project, the equipment used and the final product desired. A scalping screen will remove dirt and foreign particles. A fine harp deck screen will remove fine material from coarse aggregate. Further cleaning is necessary to ensure the recycled concrete product is free of dirt, clay, wood, plastic and organic materials. This is done by water floatation, hand picking, air separators, and electromagnetic separators. Occasionally asphalt overlay or patch is found. A mixture of concrete is not recommended but small patches are not detrimental. The more care that is put into the quality, the better product you will receive. With sound quality control and screening you can produce material without having to wash it as with virgin aggregate which may be ladened with clay and silt.

Working Sub-Group on construction and demolition waste:

Effective recycling and reusing of waste building materials reduces the need for new materials, reduces materials to be disposed in the MSW landfill, transportation cost of disposal and creates a cleaner and safer project site. It also avoids mixing of C & D waste with bio-degradable waste and avoids nuisance of its potential for spoiling processing of biodegradable as well as other recyclable waste. Most importantly, C & D waste management reduces dependence on natural resources such as trees, oil, and minerals plus creates less pollution by reducing manufacturing and transportation related emissions. Reduction of the energy and water required to produce building materials from virgin materials contributes to reduced greenhouse gasses related to the manufacturing and transportation of those materials. Thus, the environmental impact of the project can be reduced. Segregation of C & D waste at source increases the efficiency of waste

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materials for reuse and recycle and increases salvage value of the same. Presence of Construction & Demolition waste and other inert material (e.g. drain silt, dust and grit from road sweeping) is significant about a third of the total municipal solid waste generated. Construction & Demolition waste needs to be focused upon in view of:

- The potential to save natural resources (stone, river sand, soil etc.) and energy.
- Its bulk which is carried over long distances for just dumping.
- Its presence spoiling processing of bio-degradable as well recyclable waste.

Construction & Demolition waste has potential use after processing and grading. Utilization of Construction & Demolition waste is quite common in industrialized countries but in India so far no organized effort has been made.

AGGREGATE CRUSHING TEST:

Aggregate crushing value test on coarse aggregates gives a relative measure of the resistance of an aggregate crushing under gradually applied compressive load. Coarse aggregate crushing value is the percentage by weight of the crushed material obtained when test aggregates are subjected to a specified load under standardized conditions. Aggregate crushing value is a numerical index of the strength of the aggregate and it is used in construction of roads and pavements. Crushing value of aggregates indicates its strength. Lower crushing value is recommended for roads and pavements as it indicates a lower crushed fraction under load and would give a longer service life and a more economical performance. The aggregates used in roads and pavement construction must be strong enough to withstand crushing under roller and traffic. If the aggregate crushing value is 30 or higher' the result may be anomalous and in such cases the ten percent fines value should be determined instead.

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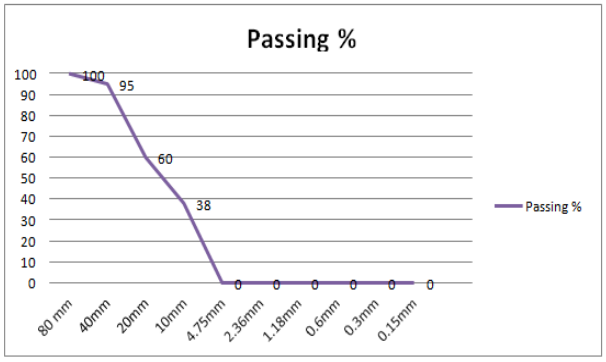
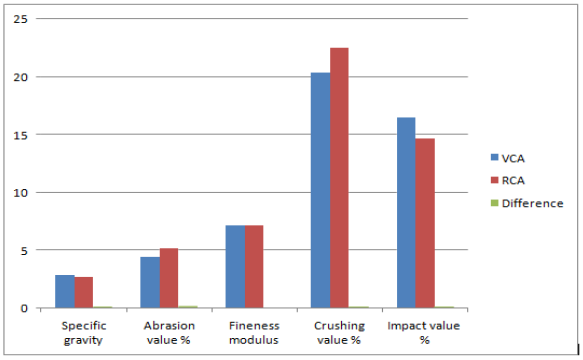
Fig.4.1. **Aggregate Crushing Value Test**

The particle size distribution of a mass of aggregate should be such that the smaller particles fill the voids between the larger particles. The proper grading of an aggregate produces dense concrete and needs less quantity of recycled aggregate and cement waste, therefore, it is essential that coarse and recycled aggregates be well graded to produce quality concrete. Recycled Aggregate size 20mm were used in this investigation. The specific gravity of recycled aggregate was 2.72 for the fractions. Result of sieve analysis of 20 mm recycled aggregate is given in Table respectively.

Sieve size	Weight retained (g)	Cumulative weight retain	Cumulative % weight retained	Passing %
80 mm	0	0	0	100
40mm	250	250	5	95
20mm	1750	2000	40	60
10mm	1600	3600	72	38
4.75mm	1400	5000	100	0
2.36mm	0	5000	100	0
1.18mm	0	5000	100	0
0.6mm	0	5000	100	0
0.3mm	0	5000	100	0
0.15mm	0	5000	100	0





5. CONCLUSION

The strength recommended for this experimental study was 30N/mm2..In the experimental investigation done it was shown that (70%NCA+30%) got the maximum strength of 32.10.This strength is much more than the required strength hence (50%NCA+50%RCA) is taken as the required strength 30.69

When the water cement ratio used in recycled aggregate mix is reduced, tensile strength and modulus of elasticity are improved. The RCA replaced mixes have greater water absorption and porosity than normal mix but within the permissible

limits. These properties can be modified by reducing the w/c ratio. abrasion clearly indicate that RCAs are of lower quality than VCAs as they contain mortar From past studies it is cleared that 10% extra water and 5%extra cement should be preferred to produce a rich mix by using RCAs .Recycled aggregate materials produce harsh mixes with lower workability than VAs. New standards should be introduced for recycled aggregates so that these materials can be used successfully in future.

FUTURE SCOPE:

That proper design mixes with different percentage of recycled concrete aggregates with virgin aggregates should be prepared to achieve the adequate strength of the concrete and to reduce the consumption of VA.

By using RCA the burden of construction wastes can be reduced to a suitable extent. A suitable code of practice for recycled concrete aggregates should be prepared in which strength parameters about RCA are described.

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