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Utilization Of Recycled Aggregate

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Abstract —*In this study recycled coarse aggregates obtained by crushed concrete were used for concrete production. Four different recycled aggregate concretes were produced; made with 0%, 25%, 50% and 100% of recycled coarse aggregates, respectively. The mix proportions of the four concretes were designed in order to achieve the same compressive strengths. Recycled aggregates were used in wet condition, but not saturated, to control their fresh concrete properties, effective w/c ratio and lower strength variability. The necessity to produce recycled aggregate concrete with low–medium compressive strength was verified due to the requirement of the volume of cement. The influence of the order of materials used in concrete production (made with recycled aggregates) with respect to improving its splitting tensile strength was analysed. The lower modulus of elasticity of recycled coarse aggregate concretes with respect to conventional concretes was measured verifying the numeral models proposed by several researchers.*

Keywords-*Recycled Aggregate; Compressive Strength; Concrete Cubes;*

I. INTRODUCTION

Now a day in any kind of construction concreting is necessary, and Generally concrete is made by mixing of cement, sand and aggregate together and water as lubricant it and admixtures are also used in concrete as requirement.

One of the major challenges of our present society is the protection of environment. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials and consumption of waste materials.The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as alternative to primary (natural) aggregates. It conserves natural resources and reduces the space.

The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. The enormous quantities of demolished concrete are available at various construction sites, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. On the other hand, production and utilization of concrete is rapidly increasing, which results in increased consumption of natural aggregate as the largest concrete component.

For example, 26.8 billion of aggregate are produced with annualy 4.7% grow in 2011 in the India according indian concrete journals.This situation leads to a question about the preservation of natural aggregates sources; many European countries have placed taxes on the use of virgin aggregates. Traditionally aggregates have been readily available at economic prices and of qualities to suit all purposes.

However, in recent years the wisdom of our continued wholesale extraction and use of aggregates from natural resources has been questioned at an international level. This is mainly because of the depletion of quality primary aggregates and greater awareness of environmental protection. In light of this, the availability of natural resources to future generations has also been realized.

II. Why should we use recycle aggregate?

- Reduce impacts to the landscape
- Conservation of virgin aggregate
- Reduce impacts to the landscape
- Metal recovery
- Defined as inert material in Solid Waste Regulations
- Economic Limit haul distance
- Reduce disposal costs
- Overall project savings

III. Compression Test

According to Cement Association of Canada (2003), compressive strength of concrete can be defined as the measured maximum resistance of a concrete to axial loading. Compression test is the most common test used to test the hardened concrete specimens because the testing is easy to make. The strength of the concrete specimens with different percentage of recycled aggregate replacement can be indicating through the compression test The specimens used in the compression test were 100 mm diameter and 200 mm height. There are three specimens were used in the compression testing in every batches. Differences of the strength among the different percentage of recycled aggregate used in the age of 7 and 28 days also indicated through the compression test.

Compressive Test Result For 7 Days:

Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(0:100)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	8.40	595	26.44	26.95 N/mm^2
Cube-2	8.35	610	26.66	
Cube-3	8.42	625	27.77	

Recycled Aggregate:Natural Aggregate(25:75)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	8.34	525	23.33	23.62 N/mm^2
Cube-2	8.39	535	23.77	
Cube-3	8.24	535	23.77	

Recycled Aggregate:Natural Aggregate(50:50)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	8.20	550	24.44	25.40 N/mm^2
Cube-2	8.18	545	24.22	
Cube-3	8.26	620	27.55	

Recycled Aggregate:Natural Aggregate(75:25)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	8.05	550	24.44	25.84 N/mm^2
Cube-2	8.10	575	25.55	
Cube-3	8.05	620	27.55	

Recycled Aggregate:Natural Aggregate(100:00)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.90	600	26.66	25.25 N/mm^2
Cube-2	7.88	540	24.00	
Cube-3	7.88	565	25.11	

Conclusion:-

From the above experiment, we determine the compressive strength for concrete having M25 grade of W/C = 0.50, which comes out to be 25.40 N/mm2 for 7 days, which is higher than 25 N/mm2 as specified in IS 456:2000. We also

conclude that the Compressive strength for concrete with recycled aggregate is also greater than 25 N/mm2 and also the value of compressive strength increase with increasing the proportion of normal aggregate over recycled aggregate

Compressive test result for 28 days:-

Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(0:100)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.48	760	33.57	34.08 N/mm^2
Cube-2	7.55	790	35.11	
Cube-3	7.48	760	33.57	

Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(25:75)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.14	660	29.33	29.47 N/mm^2
Cube-2	7.29	650	28.88	
Cube-3	7.25	680	30.22	

Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(50:50)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.20	730	32.40	32.04 N/mm^2
Cube-2	7.18	705	31.33	
Cube-3	7.26	730	32.40	

Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(75:25)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.00	700	31.11	31.03 N/mm^2
Cube-2	7.25	655	29.11	
Cube-3	7.05	740	32.88	

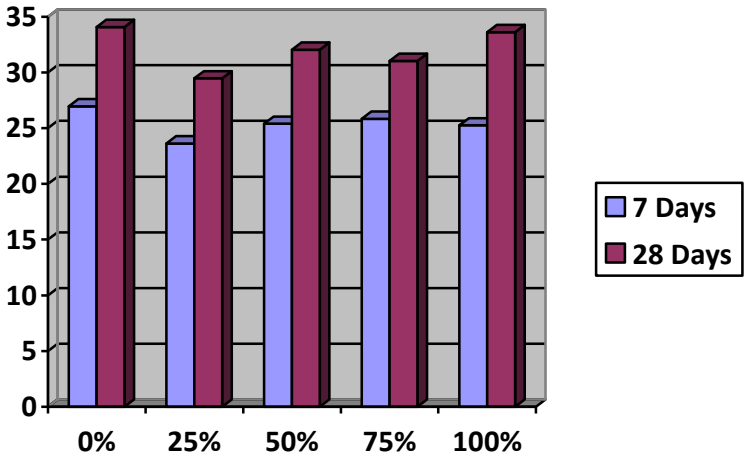
Design mix: M25(Normal) Recycled Aggregate:Natural Aggregate(100:00)

OPC 53	weight	Breaking load(KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
Cube-1	7.90	755	33.55	33.62 N/mm^2
Cube-2	7.88	755	33.55	
Cube-3	7.88	760	33.77	

Conclusion:-

From the above experiment, we determine the compressive strength for concrete having M25 grade, which comes out to be 28.51 N/mm2 for 28 days, which is higher than 25 N/mm2 as specified in IS 456:2000. We also conclude that the Compressive strength for concrete with recycled aggregate is also greater than 25 N/mm2 and also the value of compressive strength increase with increasing the proportion of normal aggregate over recycled aggregate. The higher water/cement ratios, the compressive strength of recycled concrete is similar to that of normal concrete. At lower water/cement ratios, the compressive strength of recycled concrete is much lower than that of normal concrete.

Compressive strength results chart for 7 and 28 days is shown as below where percentage shows present quantity of recycled aggregate:



IV. Slump Test And Result

Slump test is used to determine the workability of fresh concrete. It mentioned that a slump less than 25mm will indicate a very stiff concrete and a slump that more than 125mm will indicates a very runny concrete.

Australia Standard (2002) stated that slump test will not indicate well for the concrete with very high workability and also very low workability. This is because a very high workability concrete will lose the shape by flowing and collapse, where a very low workability concrete will not collapse.

Result of slump test after using recycled aggregate with proportion of natural aggregate

Recycled Aggregate: Natural Aggregate	Size of Slump in mm
0:100	20
25:75	25
50:50	25
75:25	40
100:0	40

Conclusion:

From the above experiment of slump test we determined the workability of M25 concrete mix with W/C =0.50 using the proportion by weight for mix, for which slump value comes out to be 25 mm.

V. Future recommendation

Further testing and studies on the recycled aggregate concrete is highly recommended to indicate the strength characteristics of recycled aggregates for application in high strength concrete. Below are some of the recommendations for further studies:

- Although by decreasing the water/cement ratio, recycled aggregate can achieve high strength concrete. But the workability will be very low. Therefore, it is recommended that adding admixtures such as super plasticizer and silica fume into the mixing so that the workability will be improved.
- More investigations and laboratory tests should be done on the strength characteristics of recycled aggregate. It is recommended that testing can be done on concrete slabs, beams and walls. Some mechanical properties such as creeping and abrasion were also recommended.
- More trials with different particle sizes of recycled aggregate and percentage of replacement of recycled aggregate are recommended to get different outcomes and higher strength characteristics in the recycled aggregate concrete.

VI. CONCLUSION

- Used in small scale construction
- Satisfy the demand of Natural aggregate
- Give also good strength against natural aggregate
- Save environment
- Reduce disposal cost

- They give also good stability with adding admixtures such as super plasticizer and silica fume into the mixing
- Strength of the recycled aggregate concrete can be increased by using Pozzolanic material that can absorb the water
- It is found that as the natural aggregate replace the strength of the concrete decreases.
- Natural resources are not unlimited. There is a global need to protect our environment and preserve our scarce natural resources for next generations. Recycling of Construction & Demolition materials can help reserve our public fill capacity and precious landfill space.
- It can also help reduce the need for quarrying and damage to our natural landscape
  The replacement of more water is required as compare to that of the natural aggregate, for which the admixture has to be used.
- Usage of recycled aggregates can not only preserve the finite raw materials, but Also reduce energy consumption and overall construction costs.
- Use of the waste aggregate in the new concrete as the recycled concrete aggregate reduces the environmental pollution as well as providing an economic value for the waste material.
- Hence the recycled aggregate can be used in concrete with 40% replacement of natural coarse aggregate.

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