International Journal of Research in Advent Technology, Vol.6, No.6, June 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

Comparative Study of Conventional Concrete with Binary Concrete of Recycled Coarse Aggregate

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Abstract- India has emerged as the fastest growing as well as developing country in the world; it has witnessed considerable progress in the past few decades widely in the field of constructions. Most of the infrastructure development sectors moved forward, but not to the required extent of increasing growth rate. With the increase in population, the developments have increased leading to more constructions for our own needs. Construction industry needs construction materials in a huge demand which includes cement, sand and aggregates (coarse and fine, main emphasis of this title on coarse recycle-aggregate).Also these materials are from on-renewable natural resources and costly. Use of natural resources emerges to the concern for protecting environment and to preserve these resources like recycled coarse aggregates, alternative materials should be recycled, which are rejected as waste. Use of recycled aggregate in concrete makes it economical and also solves the disposal issues. In this research, we have casted concrete blocks with partial replacement of aggregates (coarse) with recycled aggregate material and observed the variation in density, workability, compressive strength, flexural strength and cost, keeping in view the basic characteristics of concrete and found that the compressive strength increases up-to a replacement level of 25% while the workability and flexural strength decreases slightly, where the workability can be easily enhanced with the use of admixtures, the cost of conventional concrete decreases by 10% while using recycled coarse aggregate.

Index Terms- recycled coarse aggregate, unconventional concrete, workability, compressive strength, waste disposal.

1. INTRODUCTION

For thousands of years, Sand and stones were used by the people for the foundation work. During the period of the Roman Empire, aggregates were produced and used for the first time for the construction of aqueducts and road networks. The discovery of concrete, which was an important construction material created an instantaneous and un-fluctuating demand for the construction aggregates. In recent decades, we have witnessed increasing social concern over the waste management generally the waste from the construction industry which includes C&D waste, broken tiles, sanitary ware waste, recycled aggregate. These wastes are just dumped as landfills but there have been researches going on in which these waste can be used for the production of concrete by replacing waste with certain percentage of the construction ingredients with the recycled aggregate. Thus the use of recycled aggregate in concrete makes it economical and also solves the disposal issues. In addition, use of these recycled aggregate yields a series of advantages such as reduction in the use of the raw materials which furthers contributes to enhancement of the natural resources and helps in the preservation of the environment.

The most widely used construction material is concrete, commonly made by mixing Portland cement with sand, crushed rock and water. Day by day research efforts have established concrete as a versatile material. Concrete required for extensive construction activity can be made available since all the ingredients of concrete are of geological origin. The world consumption of concrete is estimated at ten billion tonnes every year or one tonne for every human being.

Coarse aggregates and cement are the most essential ingredients used in the production of the concrete in the field of construction. In excess utilization of these natural resources is having an adverse impact on the environment and climatic conditions. To preserve natural resources such aggregates; is a need to the society and its well-being and can be preserved by using suitable substitute that are rejected and are considered as waste.

2. MATERIALS AND METHODOLOGY

To study the effect of recycled aggregates as partial replacement of coarse aggregate in concrete, on the workability, compressive strength and cost of concrete .For the above 35cubes of150mm were casting the laboratory. Cubes were cast using a volume mix of 1:1.5:3 with different percentage of recycled aggregate (0%, 5%, 10%, 15%, 20%, 25%) to find the respective strength of conventional concrete at the end of 7and 28 days of moist curing.

Materials used for the study

Cement In this experimental study, Pozzolana Portland Cement (P.P.C) of Prism brand obtained from single batches throughout the investigation was used. **Coarse Aggregate:** The coarse aggregate was locally available quarry, passing through 20mm sieve and retaining on 10mm sieve. **Water:** Water that is fit for drinking (potable) is used for mixing and curing. The water cement ratio (w/c) of 0.50 for volumetric ratio 1:1.5:3. **Recycled Aggregate:** In this experimental study recycled aggregate is provided by a local vendor from Allahabad, who sells ceramic tiles of different brands and discards the damaged or broken tiles. This sample had different sizes so it was broken into smaller pieces and thus is made to pass through 20mm sieve and retains o0n 10mm sieve. **Concrete:** Volumetric concrete mix is prepared in the ratio 1:1.5:3 Good stone aggregate and Natural River sand of Zone-II were used as coarse and fine aggregate respectively. Maximum size of coarse aggregate was 20 mm.

Methods that were followed for the Specimen Preparation

Volume Mix: Concrete was prepared volumetrically in the ratio 1:1.5:3, the water cement ratio was kept as 0.50. **Setting time:** Concrete products were de-moulded 12 - 18 hours after the casting. **Mixing Process:** The mixing is the most important process of concreting and is done as per the recommendations. Even a small deviation can have a large influence on the workability of the wet concrete and so the properties and appearance of final composite 35 control specimens were cast to determine the compressive strength at 7 and 28 days respectively. The specimens were mix using a volume mix 1:1.5:3. **Vibration of Moulds:** In this process the moulds was vibrated in which the concrete mix was poured. The vibration process basically has two functions. It enables the mix to fill the mould completely and also helps in releasing the air trapped in the mix and allows compaction to take place. After the mould is completely filled, the excess concrete (if any) is removed which may interfere with de moulding when the concrete has set. The final towelling should be carried out when the concrete is green as it is easier to do this. **De-Moulding:** It took more time to de-mould, clean and re-apply release agent that it does to fill the mould. De-moulding should be carried out with lots of care. Concrete products should not be allowed to dry out after de-moulding before being put into curing. The mould was cleaned as early as possible after de-moulding it. **Release Agent:** It was considered good to use little amount of release agent as possible. Only a thin film is necessary. Discoloration can be caused if there is an excess of release agent being collecting in the bottom of the mould. Release agent was applied by leavened sponges or cloths. **Curing:** Concrete products with low water cement ratio can dry out rapidly before the complete hydration. The cement never achieves its full strength and thus the concrete properties are skeptically affected. To assure compete hydration, it was fundamental need that the products were kept damp immediately after de-moulding and during the period of curing. Several methods that are currently in use are storing it in a humid chamber or fog room, sealing in polythene bags, or by immersing it totally in the water. Concrete products will achieve a significant proportion of their ultimate strength when the main cure is carried out for 7 and 28, in humidity of greater than 95% RH and with a minimum temperature of 200C. A suitable post-curing management will allow the remainder of the strength to be attained. **Testing of the specimens:** Compressive strength of cubes are determined as per IS 516-1959 at a loading rate of about 140 kg/cm2/min (about 30 tonnes per minute) on 2000 tons AIMIL compression testing machine shown in the figure. Two dial gauges that are diametrically opposite in direction were used to measure the deflection.

3. RESULT

Compressive strength:

Three set of cubes were casted for V1, V2, V3, V4, V5, V6, V7 with the replacement of aggregates by recycled coarse aggregate percentage 0, 10, 15, 20 and 25for the time periods of 7 and 28 days with a water cement ratio of 0.50and the results of the same are as follows:

Table 1 Compressive strength of recycled aggregate concrete (W/C=0.50)

S. No.	Cube Designation	Water Cement Ratio	% of recycled aggregate	Average Weight	Average Compressive Strength At 7 days	Average Compressive Strength At 28 days	% Change in Strength
1	V1	0.50	0%	8.67	14.14	23.70	Referral
2	V2	0.50	5%	8.10	15.68	25.70	8.44%
3	V3	0.50	10%	8.13	11.92	29.25	23.42%

4	V4	0.50	15%	8.10	15.85	30.88	30.30%
5	V5	0.50	20%	7.91	15.85	29.18	23.12%
6	V6	0.50	25%	8.42	15.92	27.77	17.17%
7	V7	0.50	30%	8.15	11.46	22.18	-ve value

Flexural strength:

Three set of beams were casted for V1, V2, V3, V4, V5, V6 with the replacement of aggregates by recycled coarse aggregate percentage 0, 10, 15, 20 and 25 for the time periods of 7 and 28 days with a water cement ratio of 0.50 and the results of the same are as follows:

Table 2 Flexural strength of recycled aggregate concrete (W/C=0.50)

S. No.	Beam Designation	Water Cement Ratio	% age of recycled aggregate	Average Flexural Strength At 7 days	Average flexural Strength At 28 days	% Change in Strength
1	**V1**	**0.50**	**0%**	**8.5**	**13.50**	**Referral**
2	**V2**	**0.50**	**5%**	**5.83**	**11.67**	**-13.56%**
3	**V3**	**0.50**	**10%**	**5.33**	**13.00**	**-3.70%**
4	**V4**	**0.50**	**15%**	**5.50**	**12.50**	**-7.41%**
5	**V5**	**0.50**	**20%**	**4.83**	**9.33**	**-30.89%**
6	**V6**	**0.50**	**25%**	**5.50**	**8.33**	**-34.60%**

Workability: The workability of the replaced concrete is same as that of the referral concrete. Replacement of coarse aggregate by the recycled aggregate does not affect the workability.

Table 3: Workability of the ceramic concrete

Percentage of recycled aggregate	Workability
0%	25mm
5%	24mm
10%	25mm
15%	15mm
20%	17mm
25%	12mm

4. CONCLUSION

From the experimental work carried out on "Recycle of Concrete Aggregates", the following conclusion can be drawn:

- With increase in the percentage replacement of recycled aggregate, the compressive strength increases as compared to that of conventional.
- At 5% replacement, the compressive strength increases by **8.44 %**
- At 10% replacement, the compressive strength increases by **23.42%,**
- At 15% replacement, the compressive strength increases by **30.30%**,
- At 20% replacement, the compressive strength increases by **23.12%,**
- At 25% replacement, the compressive strength increases by **17.17%,**
- Weight or the dead load of the concrete decrease with increase in the percentage of recycled aggregate.
- The compressive strength of concrete containing 15% RCA has strength in close proximity to that of normal concrete.
- The strength of concrete is high during initial stages but gradually reduces during later stages.
- Water absorption of RCA is higher than natural aggregate.
- The cost of conventional concrete decreases by **10%** while using recycled coarse aggregate.

Due to lack of treatment process for RCA adequate strength is not achieved but by applying more advanced and sophisticated treatment process the strength can be improved.

Thus the usage of RCA in concrete mixture is found to have strength in close proximity to that of natural aggregate and can be used effectively as a full value component of new concrete.

Usage of coarse aggregate helps in reducing the degradation of the environment both by using waste materials as well as by reducing the usage of the natural resources available

Limitations of the study

Recycled aggregate can be used as replacement of coarse aggregate in concrete; however combined optimum replacement level could be changed as per the environment and work efficiency. Also the use of recycled aggregate in future depends upon the availability of material and machinery. Availability of recycled aggregate in the form of coarse and fine aggregate and coarse aggregate which is required for the above method is a limiting aspect as converting these into the desired forms may account to large amounts of labour which may result in increase in cost of the materials.

Future scope of the study

According to the test results, the performance of recycled aggregate concrete, even with the total replacement of coarse natural with coarse recycled aggregate, is satisfactory and shows that there is enormous scope of this aggregate in at present and in future, not only in terms of the mechanical properties, but also the other requirements related to mixture proportion design and production, can be used for constructing gutters, pavements etc., large pieces of crushed aggregate can be used for building revetments which in turn is very useful in controlling soil erosion. Recycled concrete rubbles can be used as coarse aggregate in concrete. Production of RAC also results in generation of many by-products having many uses such as a ground improvement material, a concrete addition, an asphalt filler etc.The recycled aggregate replaced concrete can also be analyzed for utilizing as light weight concrete. Different types and ratios of partial replacement materials can be investigated for further study. The study also revealed that, it is better to make recycled aggregate concrete bricks in place of making recycled aggregate concrete blocks, because making recycled aggregate concrete blocks are more feasible than the beam.

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