Experimental study on recycled coarse aggregate in concrete by using m-sand and silica fume

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ABSTARCT: The recycled aggregate prepared from the crushing of concrete was studied. It was found that the recycled aggregate is covered with loose particles that may prevent good bonding between the new cement matrix and the recycled aggregate. Every year concrete industry using 12.6 million tons of natural resource. Recycling is most effective methods for dealing with the increasing volume of waste for preservation of the environment. Demolition waste in order to conserve the non-renewable natural resources, recycling of concrete demolition waste as coarse aggregate for new concrete would facilitate its large-scale utilization. There is a whole range application recycled material in both architecture and civil engineering. The experiments will be conducted on M20 concrete grade. Slump cone, compaction factor and vie bee test will be conducted to determine workability of concrete. Compressive strength and flexural test will be conducted to determine the strength of concrete for 28 days.

1.1 INTRODUCTION: Concrete is the premier civil engineering construction material. Concrete is considered as brittle material, primarily because of its low tensile capacity and poor fracture toughness. Concrete manufacturing involves consumption of ingredients like cement, aggregates, water and admixtures(s). Among all the ingredients, aggregates form the major part. Inert granular materials such as sand, crushed stone or gravel form the major part of the aggregates. Traditionally aggregates have been readily available at economic prices and of qualities to suit all purposes. But, the continued extraction of aggregates from nature has caused its depletion at an alarming rate. Many of the non-decaying waste materials will remaining the environment for hundreds, perhaps thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby contributing to the environmental problems. Use of this material in such a rate leads to preservation of natural aggregates sources. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete a sustainable and environmentally friendly construction material. Aggregate made by crushing demolished waste and acquiring the coarse aggregate from it for replacing the new set of new bought aggregate i.e., cost efficient.

1.2 OBJECTIVES

- For sustainable development of structures
- To reduced or utilize the waste generated from structures

- To use of recycled course aggregate waste material in construction units
- To find the alternative materials which are used in construction.

II.MATERIAL PROPERTIES

2.1 Materials

In the design of conventional concrete, the selection of proper ingredients evaluating their properties and understanding the interaction between different materials plays a major role in performance of the concrete. The ingredients used are cement, M- sand, coarse aggregate, silica fume demolished concrete waste in the form of fine aggregate and coarse aggregate.

2.2 **Demolished concrete waste:** The concrete obtained using Demolished waste aggregate satisfies the minimum requirements of New bought aggregates. Concrete using demolished waste aggregates resulted in acceptable strength required for structural concrete. Demolished waste may offer itself as a coarse aggregate as well as potential construction material in the field of construction industries and this would solve the environmental problem of reducing the generation of solid waste simultaneously. The Demolished waste-cement composite is compatible and no pre-treatment is required. Demolished waste concrete has better workability because of the smooth surface on the coarse aggregates. The demolished waste is obtained from a construction site. They are dried for few days before being crushed manually. The crushed materials are later transported to the laboratory where they were washed and allowed to dry under ambient temperature for several hours. Coarse aggregate shows a wide diversity in size, weight, shape, and colour, depending on the crushing.

2.3 **Cement:** Cement is a material, generally in powder form, that can be made into a paste usually by the addition of water and, when molded or poured, will set into a solid mass. The specific gravity of cement is 3.15.

2.4 **Fine Aggregate:** The fine aggregate was passing through 4.75 mm sieve and had a specific gravity of 2.58. The grading zone of fine aggregate was zone II as per Indian Standard specifications.

2.5 **Silica Fume:** Silica fume, also known as micro silica is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. Silica fume is added to Portland cement concrete to improve its properties, in particular its compressive strength bond strength, and abrasion resistance. These improves structure from both the mechanical properties resulting from addition of a very fine powder to the cement paste mix as well as from the pozzolanic reactions between the silica fume and free calcium hydroxide in the paste. Addition of silica fume also reduces the permeability of concrete to chloride ions, which protects the reinforcing steel of concrete from corrosion, especially in chloride-rich environments such as coastal regions and those of humid continental roadways and runways and saltwater bridges. Specific gravity of Silica Fume is 2.2.

2.6 **M-Sand:** Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word. Due to the depletion of good quality river sand for the use of construction, the use of manufactured sand has been increased. Another reason for use of M-Sand is its availability and transportation cost.

3 TESTING AND MIX DESIGN

3.1 Recycle coarse aggregate test

Table 3.1: Properties of recycled coarse aggregate

S.no	**Recycled aggregate test**	**Result**
1.	Specific gravity test	2.79
2.	Crushing test	24%
3.	Impact test	27.5%

3.2 cement test

Table 3.3 type of cement test

Type of test	**Result**	**Standard value**
Fineness	**1%**	Not more than 10%
consistency	30% by the weight of the cement	----------
Initial setting time	55 minutes	Not more than 30 mins
Final setting time	4 hours	Not more than 10 mins

3.3 River sand test and M-Sand test

Table 3.3 sand test

Type of test	River sand	M-Sand
Specific gravity	2.6	2.7
Sieve analysis	Zone 2	Zone 3

3.4 Fresh concrete test

Slump cone test

Table 3.2 slump cone test

S.NO	CONCRETE TEST	SLUMP IN mm
1.	MIX 1	35mm
2.	MIX2	10mm
3.	MIX3	10mm
4.	MIX4	10mm

4 HARDENED CONCRETE TEST

- Compressive strength
- Flexure test4.**1 compression test**

Table .4.1 compression strenght of concrete

S.NO	CURING AGE	NORMAL AGGREGATE CONCRETE	RECYCLED AGGREGATE CONCRETE
1.	7 DAYS	17.77N/mm^2	18.77N/mm^2
2.	14DAYS	22.22N/mm^2	23N/mm^2
3.	28DAYS	24.22N/mm^2	25.22N/mm^2

Fig 4.1 Compressive Strength

4.2 FLEXURE TEST:

Fig 4.2 Flexural Test

RESULT:

The strength of the concrete by using flexure test is 20.7 N/mm^2

4.3 Mix design

1.	Cement	1.48 kg
2.	Fine aggregate	2.22 kg
3.	Coarse aggregate	5.55kg
4.	Water	0. 84mlit
5.	Silica fume	10g
6.	Water ratio	0.40

5 Cost analysis

Table 5.1 cost analysis

s.no	materials	cost
1.	cement	Rs13.32
2.	M-Sand	Rs 12.75
3.	Recycled coarse aggregate	Rs 9.44

S.no	materials	cost
1.	cement	Rs 13.33
2.	River Sand	Rs 25.53
3.	Normal aggregate	Rs 11.33

Total cost for one cube:

Normal concrete =Rs 50.18

Recycled aggregate = Rs 35.5

CONCLUSION

- Use of recycled aggregate up to 30% does not affect the functional requirements of the structure as per the findings of the test results.
- Various tests conducted on recycled aggregates and results compared with natural aggregates are satisfactory as per IS 2386.
- 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.
- Recycled concrete can be used as coarse aggregate to produce new concrete mixes with reasonable strength.

- The slump value of recycled aggregate concrete was less than natural aggregate concrete due to higher water absorption capacity of recycled aggregates.
- The physical properties of recycled aggregate like specific gravity were also lower than that of natural aggregate.
- The split tensile strength curve also shows the linear dropdown variation in the strength as the quantity of recycled aggregate increases in the concrete mix.
- The flexural strength was also reduced by near about 70 % when the recycled aggregate percentage was increased from 0 to 100 %.
- . From the results obtained it is cleared that recycled aggregate can be used safely up to 25 % as there is not so much difference between the compressive strength of 0 % and 25% concrete mix. But after that great precautions should be taken while using recycled aggregate in the concrete mix due to its lower specific gravity and higher water absorption capacity.

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