A STUDY ON DEMOLISHED CONCRETE WASTE AS PARTIAL REPLACEMENT OF COARSE AGGREGATE IN CONCRETE

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Abstract - *Concrete is the second most used construction material in the world. Here concrete is made from composition of cement, fine aggregate (sand), coarse aggregate and demolished concrete waste generated from demolished construction. Demolished concrete aggregate is replaced as coarse aggregate in concrete. Use of demolished concrete waste as coarse aggregate in concrete leads to reduce construction cost and also it helps to reduce the percentage of coarse aggregate.*

In this project we have study on partial replacement of demolished concrete waste as coarse aggregate in concrete. Demolished concrete can be reused or recycled, by crushing it to specific size., cleaned so that we can use it in mixture as coarse aggregate in fresh concrete.

In this study 20% and 25% replacement for coarse aggregate by demolished concrete aggregate for M-30 mix is done. Compressive strength result for that demolished aggregate concrete are obtained and these results are comparable with conventional concrete.

Key Words **: Steel slag, fine and coarse aggregate, partial replacement. Concrete, demolished concrete waste, cement, fine aggregate, coarse aggregate, replacement, compressive strength, Comparison M-30 mix.**

1. INTRODUCTION

As we know that concrete is construction material which is mostly used in construction activities. The worldwide production of concrete is 4.4 billion tons annually and the demand for concrete is continuously rising. So that we not only find alternative for coarse aggregate but also provide solution for demolished concrete waste management. Simultaneously we try to reduce construction cost by using demolished waste.

In this project we have study on partial replacement of demolished concrete waste as coarse aggregate in concrete. Demolished concrete can be reused or recycled, by crushing it to particular sizes, cleaned it to remove unwanted debris from mixture, and it is reused as coarse aggregate in fresh concrete.

Demolished aggregate concrete helps to reduce landfill crowding by reusing it. And it also saves more resources from being used to create fresh concrete.

We are going to compute tests like compressive strength test, specific gravity test, Crushing value of aggregate, sieve analysis test, mix design.

2. OBJECTIVES

[1] To reduce concrete waste as coarse aggregate in fresh concrete.
[2] To use concrete waste in order to reduce construction cost.
[3] To use concrete waste as partial replacement for coarse aggregate.
[4] Comparative study of ordinary concrete and recycled concrete.

3. SCOPE

[1] To completely replace aggregate by concrete waste.
[2] To reduce landfill crowding by reusing demolished concrete as coarse aggregate.
[3] To use concrete waste as partial replacement for coarse aggregate.

4. APPLICATIONS

A. Demolished aggregate concrete is used where higher strength is not required.
B. This concrete can be used outdoor seating, decorative screen, outdoor bar, flower bed and many outdoor furniture.
C. Demolished aggregate concrete may be an alternative to conventional concrete.

5. MATERIALS USED

5.1 Demolished concrete aggregate:

Fig. 1. Demolished Concrete Aggregate

It is waste generated after demolishing any building or other structures. Demolished concrete can be reused or recycled, by crushing it to specific sizes. cleaned so that we can use it in mixture as coarse aggregate in fresh concrete.

5.2 Cement:

Fig. 2. Cement

Cement is binder material used in construction. It is mixed with fine aggregate to make mortar which is used in masonry work or mixed with sand and coarse aggregate to make concrete.

5.3 Fine aggregate:

Fig. 3. Fine Aggregate

It is the crushed sand with most particles passing through sieve of 4.75 mm and retain on sieve of 0.075mm. It is washed and properly graded.

5.4 Coarse aggregate:

Fig. 4. Course Aggregate

These are the particles that are greater than fine aggregate and retain on 4.75mm sieve. For preparation of concrete we took size of 20mm aggregate.

5.6 Water:

Fig. 5. Water

The water used for experiments was potable water Fresh portable water free from organic matter. It is transparent fluid. It should not contain any dust particles and will be clean.

6. METHODOLOGY

Actual Procedure of Concrete Block Casting

6.1 Preparing material for concrete

The material of M30 grade concrete of ratio 1:1.48:2.46 was collected and stored to an temperature of 27 ±3 degree Celsius. Also our waste product i.e. Demolished concrete aggregate was brought. Water cement ratio for M30 grade of concrete we used is 0.42 for maintained for good workability of concrete.

6.2 For 20% replacement:

Sr no.	Material	Weight
1	Cement	1500g
2	Sand	2220g
3	Aggregate	2952g
4	Demolished Aggregate	738g
5	Water	630ml

Chart -1: For 20% replacement

6.3 For 25% replacement:

Sr No	Material	Weight
1	Cement	1500g
2	Sand	2220g
3	Aggregate	2767.5g
4	Demolished aggregate	922.5
5	Water	630ml

Chart -2: For 25% replacement

6.4 Mould preparation:

We used the mould of cast iron for casting of concrete block. Then we cleaned it. And then oiled its inner surface for easy removal of concrete block.

Fig. 6. Mould Preparation

6.5 Concrete mixing

We preferred hand mixing because of there is small work. The process is done on the rectangular pan until a homogenous mix is obtained. Cement is properly mixed with trowel to avoid lumps. And the water is added as per mix design.

Chart -3: Material required for concrete mixing

Sr No	Material	Weight
1	Cement	1500g
2	Sand	2220g
3	Aggregate	2767.5g
4	Demolished aggregate	922.5g
5	Water	630ml

Fig. 7. Concrete Mixing

6.6 Casting of specimen

After concrete mixing the specimen is casted of 15cm ×15cm in cast iron mould and properly compacted in order to prevent honeycombing formation**.**

6.7 Compaction

Compaction is done with tamping bar of dimension of diameter 16mm and height of 0.6m. Compacting is done with min 35 strokes in all parts of mould for proper compaction.

Fig. 8. Compaction

6.8 Vibration

Vibrating of specimen is done on vibrating table. And this is done for removing air voids in the specimen.

Fig. 9. Compaction

6.9 Curing

Then the specimen is stored in moist air for 24 hours. Then blocks are removed from the specimen is kept submerged in clear freshwater for during for 3days, 7days, 28days.

Fig. 10. Compaction

6.10 Testing of blocks

Compression test is carried out after 3days, 7days, and 28days of curing. And results were obtained.

Fig. 11. Compaction

7. Mix design for M30 grade concrete:

Ingredients	Cement	Fine Aggregate	Coarse Aggregate	Water	Chemical
Quantity	422.85	658.37	1090.60	186	NA
Ratio	1	1.48	2.46	0.42	NA

Chart -4: Mix design for M30

7.1 Target mean strength –

$$Ft = Fck + 1.65 \times S$$
$$= 30 + 1.65 \times 5$$
$$= 38.25\ N/mm^2$$

The value of standard deviation (S) is taken from table no. 8 of IS 456

7.2 Selection of water cement ratio –

Maximum W/C ratio required for M30 grade concrete is taken from table no.5 of IS 456.
Maximum W/C for M30 is 0.45
Adopted W/C for M30 is 0.42

7.3 Selection of water content –

Maximum water content for 20mm aggregate size to achieve slump of 50mm is referred from table no.2 of IS10262.
186 L of water required to get 50 mm slump.

7.4 Calculation of cement –

Cement required = Water content/ (W/C ratio)
= 186 / 0.42
= 442.85 Kg

7.5 Calculation of fine aggregate and coarse aggregate

From the table no 3 of IS10262 for 20mm, fine aggregate of zone 2
Ratio of course aggregate = 0.62
Ratio of fine aggregate = 1-0.62 = 038
For coarse aggregate (C.A)

$$v = [w + \frac{C}{SC} + \frac{1}{1-P} + \frac{ca}{Sfa}] \times \frac{1}{1000}$$

$$(1 - 0.01) = [186 + \frac{442.85}{3.15} + \frac{1}{0.62} \times \frac{ca}{2.65}] \times \frac{1}{1000}$$ Ca = 1090.60 kg/m^3

For fine aggregate (F.A)

$$v = [w + \frac{C}{SC} + \frac{1}{1-P} + \frac{fa}{Sfa}] \times \frac{1}{1000}$$

$$(1 - 0.01) = [186 + \frac{442.85}{3.15} + \frac{1}{0.38} \times \frac{ca}{2.61}] \times \frac{1}{1000}$$ Ca = 658.37 kg/m^3

7.6 Proportion for M30

Ingredients	Cement	Fine Aggregate	Coarse Aggregate	Water	Chemical
Quantity	422.85	658.37	1090.60	186	NA
Ratio	1	1.48	2.46	0.42	NA

Chart -5: Proportion for M30

Mix ratio for M30 concrete is 1:1.48:2.46

8 TESTS ON MATERIAL AND CONCRETE BLOCK

Tests performed on materials

8.1 Specific gravity of aggregate

Specific gravity of aggregate is an test carried out on aggregate to find strength of aggregate. It is the the ratio of weight of aggregate to weight of water with equal volume. And it ranges between 2.5 to 3.0

Specific gravity :

$$= \frac{\text{Density of aggregate}}{\text{Density of water}}$$

Fig. 12. Specific gravity

8.2 Crushing value of aggregate

It is the resistance of an aggregate to compressive load. Crushing value of aggregate indicates strength of aggregate. This test is is carried out on aggregate to achieve high quality of pavement.

$$= \frac{\text{Weight of fraction passing through 2.36mm}}{\text{Weight of oven dried sample}} \times 100$$

Fig. 13. Crushing value test

8.3 Fineness modulus

It is an index number that indicates of particles in coarse aggregate. It also indicates fineness or coarseness of aggregate.

Fig. 14. Sieve analysis

9. Test Performed on Concrete blocks:

9.1 Compressive strength:

It is the characteristics strength of concrete. It is the ability of concrete to resist load without any failure like crack or deflection Usually, a compressive testing machine (CTM) is used to perform compressive strength on concrete block. After air drying the concrete block, the strength must have to be known for the more application of the concrete blocks.

$$\text{Compressive strength} = \frac{\text{Max load carried by specimen}}{\text{Surface area of specimen}}$$

Fig. 15. Sieve analysis

10 Cost COMPARISION

Sr No	Details	Cost (RS)
1	Ordinary concrete	4970.37
2	Demolished aggregate concrete (20% replacement)	4898.08
3	Demolished aggregate concrete (25% replacement)	4884.5

Chart -6: Proportion for M30

11 RESULTS

11.1 Test results of demolished aggregate:

Sr No	Description	Result
1	Specific gravity	2.68
2	Crushing value	22.71
3	Fineness modulus	2.72

Chart -7: Results

11.2 Compressive strength of concrete:

For 20% replacement of demolished aggregate

Days	Test results	Compressive strength	Average
3rd day	27000 kg	11.77 N/mm²	11.40 N/mm²
	25500 kg	11.11 N/mm²	
	26000 kg	11.35 N/mm²	
7th day	42500 kg	18.53 N/mm²	19.25 N/mm²
	44000 kg	19.18 N/mm²	
	44500 kg	19.83 N/mm²	
28th day	62000 kg	27.03 N/mm²	27.1 N/mm²
	63500 kg	27.68 N/mm²	
	61000 kg	26.59 N/mm²	

Chart -7: 20% replacement of demolished aggregate

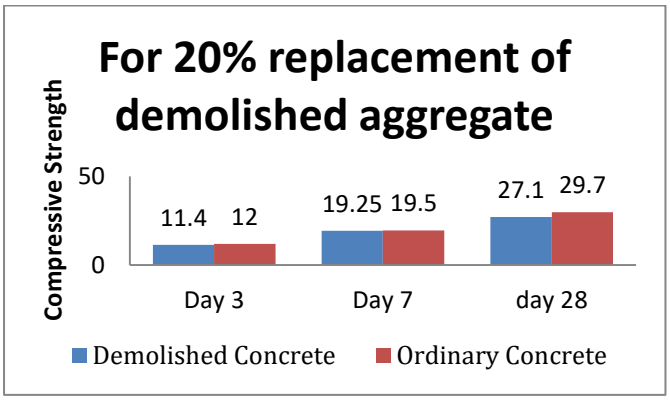

Chart -8: 20% replacement of demolished aggregate

For 25% replacement of demolished aggregate

Days	Test Results	Compressive strength	Average
3rd day	22000 kg	9.59	9.59
	22500 kg	9.81	
	21500 kg	9.37	
7th day	35000 kg	15.26	15.62
	37000 kg	16.13	
	35500 kg	15.47	
28th day	47500 kg	20.71	21.07
	48500 kg	21.14	
	49000 kg	21.36	

Chart -9: 25% replacement of demolished aggregate

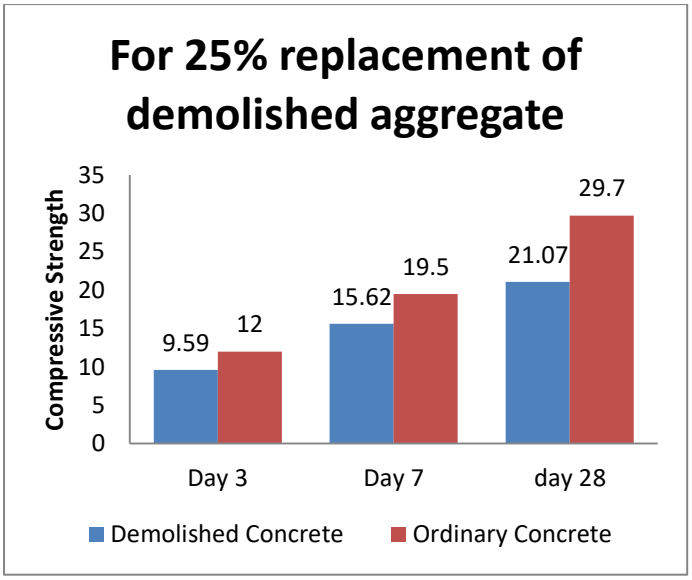

Chart -10: 25% replacement of demolished aggregate

12. CONCLUSION:

In this research compressive strengtth has been investigated for concrete with 20% and 25% replacement of aggregate by demolished concrete aggregate by volume of aggregate.
The compressive strength of demolished aggregate concrete is 10% lower for 20% replacement and 30% lower for 25% replacement by natural aggregate concrete.
The cost of demolished aggregate concrete is less as compaired to ordinary concrete.
So we can use demolished aggregate concrete where higher strength is not required.

13. FUTURE SCOPE:

To achieve the full strength of Concrete by adding the various admixtures.
To do replacement of fine aggregate also.

14. REFERENCE:

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