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Reusing of Demolished Concrete Waste as Fine Aggregate

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Abstract: The demand of Natural River Sand is increasing day by day due to the usage of concrete increased. Many Researches are made by many scientists for a suitable replacement of natural river sand as a fine aggregate. The aim of our project is to use demolished concrete waste as fine aggregate. In our project, natural river sand is fully replaced by demolished concrete waste as fine aggregate. The comparison between the properties of natural river sand and our demolished concrete waste is done. The specimens are cast and compressive strength test and split tensile strength test is done. The test results are compared to conventional concrete with demolished concrete waste. The results are shown by graphically.

Keywords: Demolished Concrete Waste, Fine Aggregate, Specimen and Casting, Compressive and Split Tensile Strength Test.

I. Introduction

Concrete is widely used material in construction industry. Because concrete having high strength, durability and serviceability in low cost compared with other materials. In this world, most of the structures are made by the concrete. But the wastes are generated due to the demolition of concrete structures. More than 200 million wastes are generated per year due to demolition of concrete structures. Nowadays time major problem arises in our construction industry is the demand of natural river sand as fine aggregate. Natural fine aggregates are mining from the river bed. It leads to affect the environment and groundwater level. So we are looking forward to overcoming the demand of natural river sand by replacement of demolished concrete waste as fine aggregate. In future, the demolished concrete waste will be a suitable replacement of fine aggregate in building construction. The present paper explores the performance of demolished concrete waste for workability and compressive strength and split tensile strength.

A. Objectives

- To reduce the waste.
- To reduce the demand of fine aggregate by the replacement of demolished concrete waste.
- The effect of natural sand mining from the river bed is reduced by demolition concrete waste.
- Waste production in demolition is to be controlled.

B. Scope of the Work

- Cost of construction of the building is to be reduced.
- Waste generation in the demolition process is to be reduced.
- Mining of sand from river beds is to be controlled.

II. Literature Review

A. Study on Replacement Level of Concrete Waste as Fine Aggregate in Concrete

Author – J. Vengadesh Marshall Raman, M. Sriram

In this experimental study to replace 30% levels of concrete containing recycled fine aggregate shows 20-40% lower compressive strength is developed at the ages of 7, 28 and 56 days. Both tensile splitting and flexural strength are slightly decreased with the increase of the replacement ratio. The reduction in strength is 15% and 20% when compared to the reference concrete.

B. Recycled construction and demolition concrete waste as aggregate for structural concrete

Author – Ashraf M. Wagih, Hossam Z. El-Karmoty , Magda Ebid , Samir H. Okba

This experiment deals with a significant reduction in the properties of recycled aggregate concrete (RAC) made of 100% RCA was seen when compared to natural aggregate concrete (NAC), while the properties of RAC made of a blend of 75% NA and 25% RCA showed no significant change in concrete properties. Replacing proportions AQ from

25% to 50% of NCA with RCA achieved a good performance of concrete mixes. Replacing 25% of NCA with RCA has no significant adverse effect on structural concrete performance. When the replacement ratio increased to 50%, the compressive strength reduction ranged from 7% to 13% with a smaller reduction in splitting and elastic modulus.

C. Utilization of Bagasse Ash as a Partial Replacement of Fine Aggregate in Concrete
Author - Prashant O Modani, M R Vyawahare
In this paper, untreated bagasse ash has been partially replaced in the ratio of 0%, 10%, 20%, 30% and 40% by volume of fine aggregate in concrete. The fraction of fine aggregates i.e. 10% to 20% can be effectively replaced with a bagasse ash (untreated) without a considerable loss of workability and strength properties. The compressive strength results represent that, the strength of the mixes with 10% and 20% bagasse ash increases at later days (28 days) as compared to7 days that may be due to pozzolanic properties of bagasse ash.

D. Replacement of Fine Aggregate in Concrete with Municipal Solid Waste Bottom Ash from Incinerator
Author – Meenakshi Dixit, Atishaya Jain, Dinesh Kumawat, Arvind Swami, Manidutt Sharma.
This experiment deals with the fine aggregate is replaced in various proportions of 0%, 5%, 10%, 15%, 20%, 30% and 40% by mass. The compressive strength of concrete is increased by 80% to 107.31% at 28 days with comparison to 7 days. The maximum 28 days compressive strength is observed on M-5 that is by replacing fine aggregate to 20% by bottom ash. The splitting tensile strength of concrete is increased by replacing fine aggregate with bottom ash. The splitting tensile strength increased by 29% to 36.04% at 28 days with comparison to 7 days. The maximum splitting tensile strength is obtained on M-4 that is by replacing fine aggregate to 15% by bottom ash.

III. METHODOLOGY

As our project is on Reuse of demolished concrete waste i.e. By Sand, the Sand which we are going to utilize for preparation of concrete by replacing River Sand. Demolished waste was collected from a Residential building which was already demolished for redevelopment purpose. And the site was found neared locality. Those wastes are included with steel reinforcement. So we are planned to separate the concrete waste and steel reinforcement by manually and semi- manually. The collected material needed to be crushed as our project is on Replacement of fine aggregate by demolished concrete waste. Then we crushed the material by Rammer and Hammer. Then crushed concrete wastes are sieving by manually. On these separated crushed concrete waste some tests were conducted in as per Indian Standard codes to determine the physical and mechanical properties and their results were compared with natural fine aggregates. The compressive strength and split tensile strength of recycled concrete was found out at 7, 14 and 28 days and results were compared with natural aggregate concrete.

IV. MATERIAL INVESTIGATION

A. Cement
Cement is the binding agent of concrete. Cement is restricted to the bonding materials used with stones, fine aggregate, coarse aggregate and bricks, etc. The ordinary Portland cement, 53 grade was used. The cement was procured from local markets.

B. Aggregate
Aggregate is the inert material such as sand, gravel, broken stones, etc. used in concrete or mortar, wherein the cement paste binds the aggregate to form concrete or mortar. Aggregates occupy 70 to 80 percent of the volume of concrete.
It is classified as two.

- Fine aggregate
- Coarse aggregate

a) Natural Fine Aggregate
Fine Aggregate is material which passes through 4.75 mm retained on 75 microns IS sieve. Fine aggregate used was cleaned dry river sand. Use of fine aggregate was free from silt, mud and organic constituent. Fine aggregate confirming to IS 383: 1970 specifications were used in the casting of the specimen.

b) Coarse Aggregate
Coarse aggregate is material which passes through 80 mm sieve and retained on a 4.75 mm sieve. Hard granite broken stone or crushed stone was used as coarse aggregate. Aggregates should be sufficiently strong, rough and free from cracks. Coarse aggregate used was free from clay lamps and chemical attack. In the project, we have used crushed stone as coarse aggregate.

C. Crushed Concrete Waste
Concrete waste is collected from old building elements such as slab, beam and column. In this waste, reinforcement bars are separated. It should free from steel properties. Then the waste was crushed in the stone crusher. The crushed waste is sieved and used. In our project crushed concrete waste are used as a fine aggregate.

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D. Water

Ordinary tap water used for mixing and curing operations.

V. TESTING

A. Test on Crushed Concrete Waste

- Sieve analysis
- Specific gravity and Water absorption test
- Silt content
- Bulking of sand

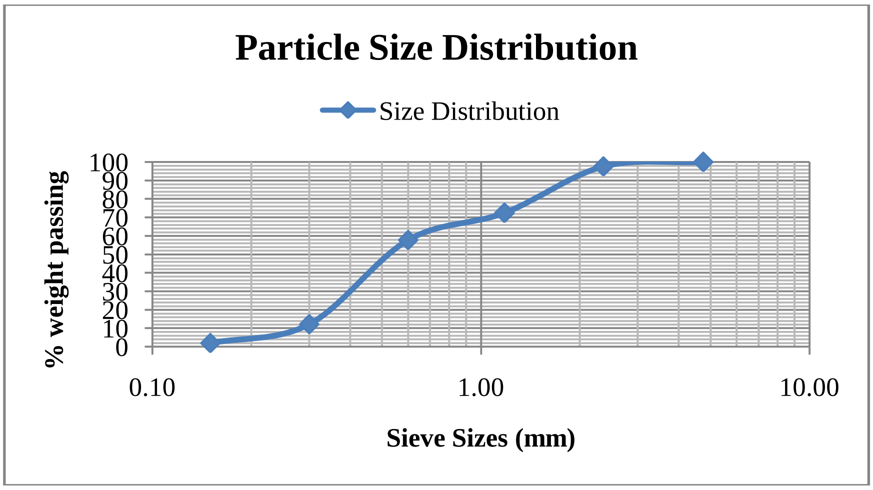
B. Concrete load bearing capacity test

- Compressive strength test
- Split tensile strength test

VI. MATERIAL TEST RESULTS

A. Sieve Analysis

IS Sieve Sizes	Fine Aggregate (Percent Passing)	Remark
4.75 mm	100	Conforming to grading Zone III of Table 4 of IS : 383-1970
2.36 mm	97.6	
1.18 mm	72.4	
600 micron	57.8	
300 micron	12.2	
150 micron	1.94	



B. Specific gravity and Water absorption test

Specific gravity (SG) $= \dfrac{D}{C-(A-B)}$

Apparent Specific gravity (ASG) $= \dfrac{D}{D-(A-B)}$

Water Absorption (WA) $= \frac{C-D}{D} \times 100\%$

Where,
A= Wt. of Pycnometer + Water + Sample
B= Wt. of Pycnometer + Water
C= Wt. of Sample taken
D= Wt. of Oven dry Sample

Trial	Weight (g)				SG	ASG	WA %
	A	B	C	D			
1	1685	1391	500	496	2.408	2.455	0.806
2	1683.2	1388	500	494	2.412	2.485	1.214
3	1685.2	1391.5	500	495	2.399	2.460	1.010
Average					**2.406**	**2.467**	**1.010**

C. Silt content

Sl.no	Trial	Volume of silt (V_1) mm	Volume of sample (V_2) mm	% of silt content (V_1/V_2) x 100
1.	1	2	188	1.064
2.	2	3	198	1.515
3.	3	2	196	1.020
Average				**1.200**

Average % of silt content = 1.200%

D. Bulking of sand

Sl.no	Trial	Value of Y mm	% of Bulking of sand [(200 – Y)/Y] x 100%
1.	1	186	7.526
2.	2	189	5.820
3.	3	188	6.383
Average			**6.576**

Average % of bulking of sand = 6.576%

VII. MIX DESIGN

The concrete mix design is done in accordance with IS: 10262 (1982).

Mix design for M25

Sl.no	Materials	Quantity	Ratio
1.	Cement	383 kg/m^3	**1:1.32:3.10**
2.	Crushed concrete waste	505.16 kg/m^3	
3.	Coarse aggregate	1190.73 kg/m^3	
4.	Water	191.60 kg/m^3	**0.5**

VIII. RESULTS AND DISCUSSION

A. Compressive strength Test Results

Strength Results of Concrete (N/mm^2)	7 Days Compressive Strength			Mean Value
	Trail 1	Trial 2	Trial 3	
Conventional Concrete	14.33	13.67	13.34	**13.78**
With Silt Content	13.15	12.98	13.20	**13.11**
Without Silt Content	12.95	12.84	12.90	**12.89**

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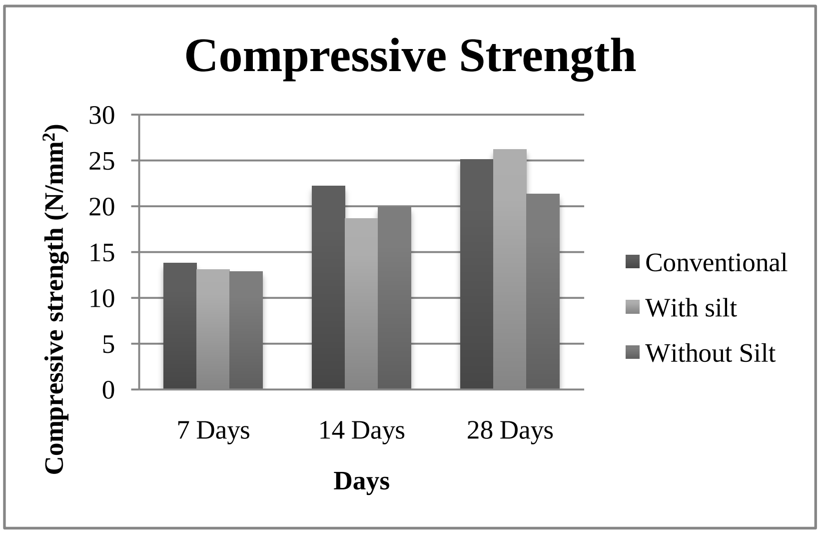
Strength Results of Concrete (N/mm^2)	14 Days Compressive Strength			Mean Value
	Trial 1	Trial 2	Trial 3	
Conventional Concrete	20.66	25.33	20.46	**22.22**
With Silt Content	19.12	17.98	18.91	**18.67**
Without Silt Content	19.24	18.82	19.27	**19.11**

Strength Results of Concrete (N/mm^2)	28 Days Compressive Strength			Mean Value
	Trial 1	Trial 2	Trial 3	
Conventional Concrete	25.17	25.38	24.78	**25.11**
With Silt Content	26.42	25.90	26.34	**26.22**
Without Silt Content	21.30	20.57	22.12	**21.33**

Interpretation of Compressive Strength Results

Compressive strength results in N/mm^2	7 Days	14 Days	28 Days
Conventional Concrete	13.78	22.22	25.11
With Silt content	13.11	18.67	26.22
Without Silt content	12.89	19.91	21.33



Split tensile strength test results

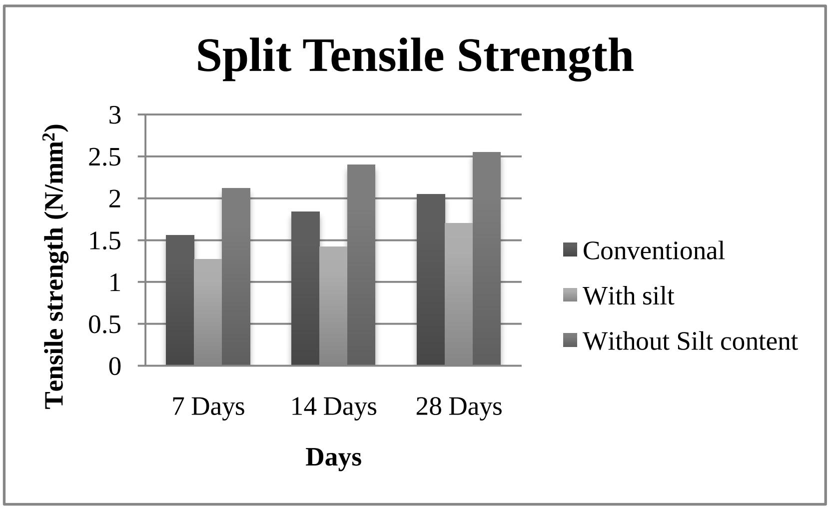
Strength Results of Concrete (N/mm^2)	7 Days Split Tensile Strength			Mean Value
	Trial 1	Trial 2	Trial 3	
Conventional Concrete	1.49	1.63	1.56	**1.56**
With Silt Content	1.29	1.31	1.21	**1.27**
Without Silt Content	1.94	2.34	2.08	**2.12**

Strength Results of Concrete (N/mm²)	14 Days Split Tensile Strength			Mean Value
	Trial 1	Trial 2	Trial 3	
Conventional Concrete	1.76	1.85	1.91	**1.84**
With Silt Content	1.43	1.45	1.38	**1.42**
Without Silt Content	2.38	2.47	2.35	**2.40**

Strength Results of Concrete (N/mm²)	28 Days Split Tensile Strength			Mean Value
	Trial 1	Trial 2	Trial 3	
Conventional Concrete	1.98	2.06	2.11	**2.05**
With Silt Content	1.70	1.73	1.67	**1.70**
Without Silt Content	2.53	2.60	2.52	**2.55**

Interpretation of Split Tensile Strength Results

Tensile strength results in N/mm²	7 Days	14 Days	28 Days
Conventional Concrete	1.56	1.84	2.05
With Silt content	1.27	1.42	1.7
Without Silt content	2.12	2.4	2.55



IX. CONCLUSION

The tensile strength of demolished concrete waste was 25% greater than the strength of normal conventional concrete for 28 days. In another case, demolished concrete waste with silt content was less strength than conventional and without silt content waste. So the material with silt content not suitable for the perfect replacement for natural fine aggregates. In another hand, the compressive strength of demolished concrete waste reached the compressive strength conventional concrete, while testing without silts compressive strength decreases. In the establishment of future work, admixtures are added to increase the strength of demolished concrete.

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