Waste Management of Demolished Construction Material

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***Abstract*—C&D waste is defined as waste that results from land clearing; the demolition of buildings, roads, or other structures; or construction.The main interest of this research is to study the suitability of the aggregate in the concrete. Next the result of all testing's water absorption, specific gravity, impact strength test, crushing and abrasion strength test while on concrete workability test, compressive strength test, split tensile strength test and flexural strength test is obtained. Lastly, this study can be used as a guide for others researchers that conducting similar studies**

***Index Terms*—Construction and Demolition waste management, reprocessed coarse aggregate, demolition techniques.**

I. INTRODUCTION

Construction industry is one of the largest consumers of energy resources in term of natural resources, man power, energy and economy. Currently, construction sector contributes to 10%of India's GDP. This percentage is growing by 10%over the last 10 years against the world's average of 5.5 % per annum. However, it is also the largest product or per year is from construction industry. In case of demolition or renovation, the amount of waste generates by new construction. Additionally, when any disaster occurs, the total amount of construction waste exceeds the amount of solid waste collected in 100 years. Even though we have a huge contribution from construction industry, we are short of way to treat the enormous amount of waste that is generated from this sector. If proper ways of treating such waste are not taken at this step, then we won't be left with any more land to construct as a major part of the land would be covered with waste.

India is one of the fastest developing countries. Infrastructure is the one of the pillar of the development model. An investigation revealed that total waste from India's construction industry could reach 12-14 metric ton per year. It is important to know about construction and demolition waste and how it can be properly disposed.

II. OBJECTIVE OF STUDY

Firstly, to study, investigate and plan about the methods and pattern of demolition and their techniques that are adopted in the project work and collect the demolished aggregate separate from the conventional concrete. Adopt the testing on aggregate and concrete, to know the strength and capacity to bear the strength and to know the durability of structure. Testing's for aggregate along with concrete are water absorption, specific gravity, impact strength test, crushing and abrasion strength test while on concrete workability test, compressive strength test, split tensile strength test and flexural strength test. The main objective of experiment is as follows

1.Recycling and reuse of demolished reprocess coarse aggregate as a replacement of conventional coarse aggregate.

2.Replacement of 100% conventional coarse aggregate by reprocessed coarse aggregate.

3.Comparison between conventional aggregate concrete and reprocessed aggregate concrete via its strength and other criteria's.

III.LITERATURE REVIEW

[1]SidamGangaram, VankadothuBhikshma, MagantiJanardhana, " Development of M20 and M30 grade of recycled aggregate concrete by replacing 100% virgin aggregates with recycled aggregates" International Journal of Advance Engineering and Research Development Volume 5, Issue 03, March -2018 reported that 100% supplanting of common total with reused coarse totals gives agreeable

outcomes for M20&M30. So the substitution is of much advantage and will be urged to accomplish higher evaluations of cement.

[2]Sung Kin Pun, Chunlu Liu, Craig Langston, Graham Treloar &Yoshito Itoh,

"Promoting the reuse and recycling of building demolition materials" World Transactions on Engineering and Technology Education © 2006 UICEE Vol.5, No.1, 2006 reported that, environmentally, building material reuse after destruction enables the business to continue its material inventory, just as to bring down common asset utilization. Vitality utilization by the business is additionally directed. Circumstances should be improved so as to encourage building waste material R&R, including government support, auxiliary structure material market, modern normalization, building destruction strategies and the board draws near, and expanded network consciousness of the business.

[3]D V Lokesh, I Jagruthi, Ch Naga Sathis Kumar, "Experimental Study on the Torsional Behavior of Recycled Aggregate Concrete Beams" IC-ISE 2015 proceedings pp 1380-1388 ,Volume 5, Issue 03, March -2018

Detailed that, the torsion diminishes with increment in the level of reused totals and furthermore found that up to half substitution of totals the quality decrease is less and not in any case 10% if there should arise an occurrence of torsion quality and finished up the use of reused totals up to half can be worthy.

[4]Bravo M., De Brito J., Pontes J., Evangelista L. Durability performance of concrete with recycled aggregates from construction and demolition waste plants. Construction and Building Materials, Elseveir-77 (2015) 357–369

In explore C&D squander from five distinctive reusing plant in Portugal was acquired.

The impact of RA in strength execution of cement were tried both for the coarse and fine total supplanting with RA. It was presumed that carbonation profundity expanded up to 180% concerning normal total cement. It was likewise discovered that chloride dissemination coefficient expanded up to 130% w.r.t reference concrete. Anyway these outcomes were for 100% substitution of normal fine total mind reused fine total. Different scientists have likewise discovered the high chloride conductivity in scope of 40% to 87% higher when reused totals were utilized when contrasted with common total cement.

[5]R. Kamala, B. Krishna Rao (2012) Reuse of Solid Waste from Building Demolition for the Replacement of Natural Aggregates (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-1, October 2012

He studied in this industrial world, recycling construction material plays an important role to preserve natural resources. These studies seek to greener environment since it seeks to develop recycle waste material for construction. The use of recycle aggregates and solid wastes from construction and demolition waste is showing a prospective application in construction and as alternative to primary and natural aggregate. It conserves natural resources and reduces the space required for land fill disposal. In the laboratory the crushed tile aggregate has been tried as partial replacement substitute to convectional coarse aggregate in concrete making of cubes, cylinders, beams. These were cast and tested for compressive strength, split tensile and flexural strength after a curing period of 7, 28, 56 days. The results indicate effectiveness of crushed ceramic waste as partial replacement of conventional coarse aggregate up to 40 percent, without affecting the design strength.

[6]Shishir Bansal1, S K Singh, A Sustainable Approach towards the Construction and Demolition Waste International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 2, February 2014

Concluded that there are less amount of natural construction resources so It is necessary to reduce C&D waste generation and increase reuse/recycling as the construction industry .in view of international experiences, shortage of aggregate from natural sources being discovered in many parts of the country, so now recycled aggregate can use in constructions processes. The government Municipal waste laws are required to modify and prepare effective plans and strict rules and regulations are important forget out of this problem. And recycled products are important to promote the use.

[7]De-Brito J., Saikia N., Recycled concrete in aggregate, Springer-Verlag London (2013).

In this investigation as for shrinkage it was accounted for that 100 % coarse RCA in cement can expand shrinkage by up to 80% when contrasted and

ordinary total cement. Comparable outcomes were acquired by number of creators between 60-90 % higher shrinkage when 100% substitution is accomplished for common totals with Recycled totals. This high shrinkage trademark lead to terrible showing of cement because of more noteworthy degree of splitting, thus poor toughness to forceful situations.

IV. MATERIALS AND METHOD

1. Methods to Demolition
1.Non-explosive demolition
i.Top Down- Manual Method
ii.Top Down- By Machines
iii.Wrecking Ball Method
iv. Excavators and Bulldozers
v. High Reach Excavators
2.Explosive demolition.
i. Implosion Method

4.1 Demolition of building by Top Down- Manual Method-Top down method proceeds from the roof to ground in a general trend, there are particular sequences of demolition which may vary, depending on site conditions and structural elements to be demolished.

For reinforced concrete buildings, jack hammers are commonly used to break down the concrete. Oxy-acetylene torch could be used to cut the reinforcements. The structural elements shall be broken down gradually or by alternate methods as described in the following sub-section. The reinforcements shall remain until all the concrete connecting to or supported by the reinforcement is broken away or when its support is no longer required. Cantilevered canopies, balconies and exterior walls are critical elements in building demolition. In congested areas, these features could critically impact on the safety of the public. Demolition of these features shall be performed with extreme caution. If rope or tie wires are used to pull down the structural elements, the pulling wire must be at least 4 times stronger than the anticipated pulling force. In addition, workers shall be shielded from the rope or tie wires. The rope or tie wires shall be checked at least twice per day.

4.2 Procedure for Waste Construction material Collection from Site

As demolition there are lots of methods available, but due to requirement adopted top down demolition method. After that collected required demolished material from site which was an old residential building. Then collected material gets crushed in jaw crusher and segregates the material in the form of reprocessed and non-reprocessed material. The jaw crusher used on site utilizes 1000x650mm jaw power with nearly 168.00 kw (225hp) engine.

The reprocessed material is coarse aggregate having size <20mm.Further it is used in the replacement of conventional aggregate in the concrete directly 100%. Whereas the total replacement of conventional coarse aggregate with reprocess coarse aggregate and all required test performed on aggregate and concrete as well. Then remaining non reprocessed material dumped on other sites as per requirement for leveling and filling

The demolition of building required 2 and half month, whereas demolition starts in the September starting and the required duration of demolition distributed as follows:

Plot area: 1500 sq ft
Built area: 1100 sq ft
Labours: 4 or 5

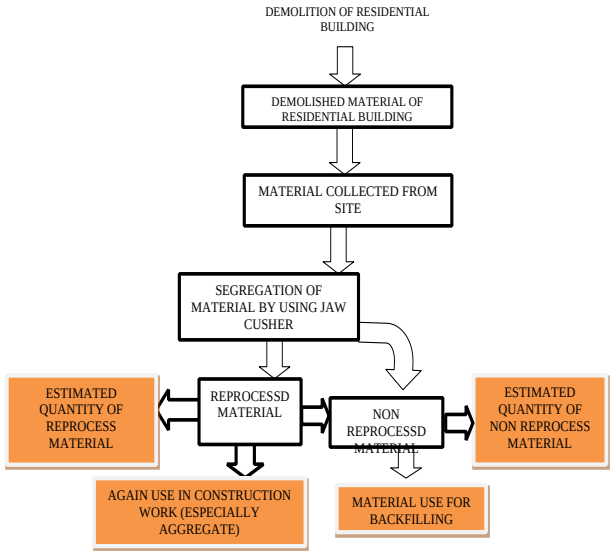


Fig1 Execution of project work

4.3 Materials

1.Cement-The cement used is fresh and without any lumps. The cement procured was tested for physical requirements in accordance with IS: 12269-1987 and for chemical requirements in accordance with IS:

4032-1977. The specific gravity, normal consistency, initial and final setting time of cement was found as per Indian standard specifications.

2. Fine Aggregate: The river sand, passing through 4.75 mm sieve and retained on 600 μm sieve, conforming to Zone II as per IS 383-1970 was used as fine aggregate in the present study. The sand is free from clay, silt and organic impurities. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk modulus in accordance with IS: 2386-1963.

3. Natural Coarse aggregate: The course aggregate used in this present study is 20 mm and 10 mm down size locally available crushed stone obtained from local quarries. The physical properties have been determined as per IS: 2386-1963. The specific gravity of coarse aggregate is found to be 2.68. The water absorption is 0.25%. The bulk density of coarse aggregate in loose and compact state is 1471 kg/m3 and 1565 kg/m3 respectively.

4. Reprocessed Coarse aggregate: Reprocess coarse aggregates is the aggregate which is generated from crushing of demolished construction waste and by recycling and segregating in variable sizes. The aggregate used in this present study is 20 mm and 10 mm down size crushed concrete obtained from demolished structural quarries.

5. Water-In this project clean potable water is used and curing as per IS: 456-2000.The water quality for construction shall be tested or monitored regularly, as it affects the overall strength of concrete.

V.TESTS TO BE PERFORMED

1.Water absorption test: IS code used for determining water absorption is IS: 23863(1963) this test is carried out on reprocessed coarse aggregate as well as natural coarse aggregate which is generated from demolished material.

2.Specific gravity test: IS code used for determining Specific gravity is IS: 23863(1963) this test is carried out on reprocessed coarse aggregate as well as natural coarse aggregate which is generated from demolished material.

3.Impact value test: IS code used for determining Impact value is IS: 2386-4(1963) this test is carried out on reprocessed coarse aggregate as well as natural coarse aggregate which is generated from demolished material.

4.Crushing value test: IS code used for determining Crushing value is IS: 2386-4(1963) this test is carried out on reprocessed coarse aggregate as well as natural coarse aggregate which is generated from demolished material.

5.Fineness test:-IS code used for determining fineness isIS: 2386-1(1963) sieve analysis is done on reprocessed coarse aggregate which is generated from demolished material.

6.Slump cone test: -IS code used for determining slump of concrete is IS: 1199 - 1959.

This test was performed to know the high workability of concrete.

1.Compressive strength test for concrete: - IS code used for determining fineness isIS: 516-1959. Compressive test were carried out reprocessed coarse aggregate of concrete and natural coarse aggregate of concrete.

2.Split tensile strength test: - IS code used for determining fineness is IS: 516-1959. Split tensile strength test were carried out reprocessed coarse aggregate of concrete and natural coarse aggregate of concrete.

3.Flexural strength test: - IS code used for determining fineness is IS:516-1959. Flexural strength test were carried out reprocessed coarse aggregate of concrete and natural coarse aggregate of concrete.

5.1 Concrete Preparation

•Mixing of cement sand and aggregate for M20 mix proportion that is in the ratio 1:1.5:3 with addition of water in ratio of 0.5 by weight of cement.

•The type of curing selected is Immersion curing.

Average of the result is taken for 7 days, 14 days as well as 28 days.

5.2Mix proportioning

The blend configuration was done according to IS 10262 (2009) [10] for M20. Additional water of 3.4% (by weight of concrete) was added to deliver reused total concrete as the reused totals assimilate moderately higher water contrasted with virgin total. Properties of concrete, fine total, common and reused totals were researched. For both M20 evaluations of cement considered in this paper, 100% reused total was utilized rather than virgin totals.

VI. RESULTS AND DISCUSSION

Tests on natural aggregate

Sr.No	Tests	Results
1	Impact test	15.05%
2	Crushing test	15.13%
3	Water absorption	1.2%
4	Abrasion value	12.39%
5	Specific gravity	2.63

Tests on Reprocessed aggregate

Sr.No	Tests	Results
1	Impact test	13.28%
2	Crushing test	22.30%
3	Water absorption	3.90%
4	Abrasion value	16.20%
5	Specific gravity	2.63

Compressive strength test

Sr.No	Type of concrete	Strength in Days in Mpa		
		7days	14 days	28 days
1	Conventional aggregate concrete	16.70	23.03	25.05
2	Reprocessed aggregate concrete	15.50	20.75	23.03

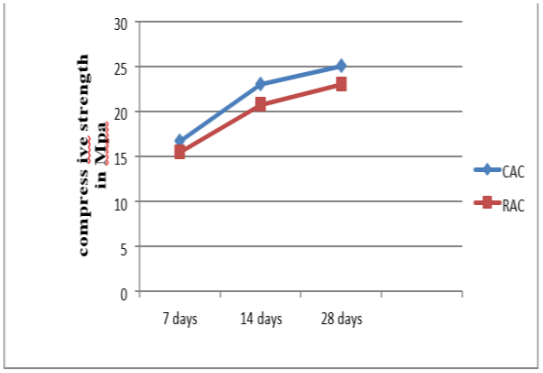
Split tensile strength test

Sr.No	Type of concrete	Strength in Days in Mpa		
		7 days	14 days	28 days
1	Conventional aggregate concrete	1.72	2.42	3.10
2	Reprocessed aggregate concrete	1.61	2.29	2.97

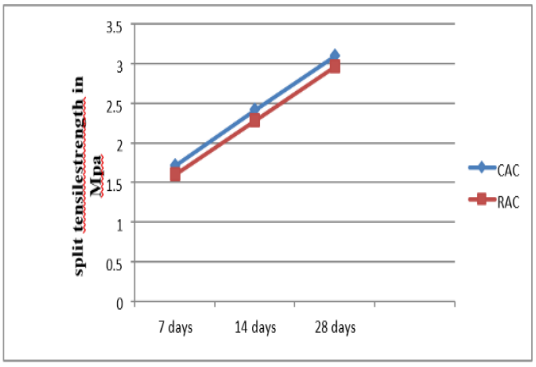
Flexural strength test

Sr.No	Type of concrete	Strength in Days in Mpa		
		7 days	14 days	28 days
1	Conventional aggregate concrete	2.32	3.03	3.51
2	Reprocessed aggregate concrete	1.80	2.28	3.10

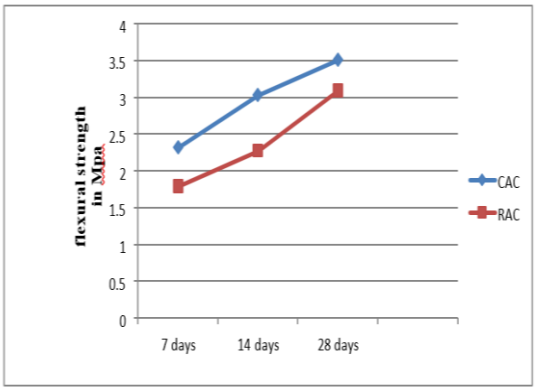
Graphical representation:-



Differential Representation of Compressive Strength



Differential Representation of split tensile Strength



Differential Representation of flexural Strength

VII. CONCLUSION

I.The demolished reprocessed coarse aggregate having high porosity as compared to natural aggregate.

II.Water absorption capacity of reprocess coarse aggregate is more.

III.The specific gravity of reprocessed coarse aggregate is nearly same or less than that of natural coarse aggregate.

IV.Due to this there is effect on shrinkage capacity of reprocessed aggregate concrete.

V.Use of reprocessed aggregate in concrete effect durability due to chloride content.

VI.Reprocessed aggregate generates harsh concrete at constant w/c ratio which results low workability.

VII.Crushing value of aggregate is acceptable to use in construction.

VIII.Natural coarse aggregate can replaced by reprocess coarse aggregate
IX.Water requirement directly proportional to reprocess aggregate, if it increases water will be increase.
X.There are possibilities of 100% replacement by reprocess coarse aggregate concrete in M20 grade concrete having proportion (1:1.5:3).
XI.After replacement of conventional concrete totally with reprocess coarse aggregate concrete then the compressive strength up to 90.00-94.00%.
XII.As per study the durability of reprocessed coarse aggregate when use in concrete as a replacement of natural aggregate is decreases with increase in duration.
XIII.Comparison of 100% demolished aggregate replacement and conventional aggregate replacement is between 92-94% in split tensile strength.
XIV.Where split tensile strength of reprocessed aggregate concrete is less than that of conventional aggregate concrete after 28 days.
XV.Similarly the bending strength of demolished reprocessed aggregate and conventional aggregate concrete is lies between 92-93%.

VIII. LIMITATION OF PROJECT

I. Due to porous nature of reprocessed aggregate, crushing value is less of aggregate
II.Quality of concrete decreases due to addition of reprocessed coarse aggregate in concrete.
III.Reduction in workability due to use of reprocessed aggregate in concrete.
IV.Durability of reprocessed coarse aggregate concrete decreases.
V. Decrease in compressive strength of concrete.
VI. Performance was carried out on just one standard grade M20.

IX. ACKNOWLEDGMENT

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