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Comparative Study of Strength Characteristics of Concrete by Two-Stage Mixing Approach and Normal Mixing Approach

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Abstract: *Construction and demolition waste constitute one of the major components of waste generated worldwide. Very large quantities of aggregates are used in construction. When the useful life of the structure is over it will be demolished and all the demolished wastes just find their way to landfills. Finding large areas for landfills is becoming very difficult. A new concrete mixing method, that is the two-stage mixing approach (TSMA), was recommended to improve the quality of RA concrete (RAC) by splitting the mixing process into two. This can allow to the porous nature of RA and the premixing process that fills up some of its pores and cracks, resulting in a denser aggregate and concrete. As the inferior quality of recycled aggregate (RA) has restricted its use to low-grade applications such as roadwork sub-base and pavements, while its adoption for higher-grade concrete is rare because of the lower compressive strength and higher variability in mechanical performance of RA. The current paper describes the variation of compressive strength by experimental analysis involving the modified mixing method with some alteration to the two-stage mixing approach by proportioning ingredients with the percentage of recycled coarse aggregates (RCA), Waste Foundry Sand and Fly ash. Based on experimental works and results, improvements in strength to RAC were achieved with TSMA.*

Keywords: Concrete, Fly Ash, Recycled Aggregate, Waste Foundry Sand Two-Stage Mixing Approach (TSMA), Normal Mixing Approach (NMA).

I. INTRODUCTION

It is known that wastage in India in the construction industry is as high as 30%. This isa large, yet relatively simple and straightforward challenge needs to be tackled by engineers. These wastages are activities that absorb man hours, resources and materials but create no value. In this project, you will use those waste materials to make something productive by making a concrete using recycled aggregate, waste foundry sand and fly ash. After making concrete you will compare the compressive as well as flexural strength characteristics of the concrete made through (NMA) Normal Mixing Approach and (TSMA) Two Stage Mixing Approach.

Backbone of infrastructural development is construction. Material for the development is concrete, which forms the indispensable material for construction, can be considered as the second most highly used item in the world after water. The basic constituents of concrete are the natural resources i.e., stone, aggregate, sand and water, suggesting this industry has degrading impacts on these environmental assets. In addition, the quarrying and transportation of aggregates further lead to ecological imbalance and pollution. Not only this, the disposal of the debris of the demolished concrete structures has also become a big problem in various cities due to paucity of landfill sites.

These environmental problems are a driving force in developing an urgent and thoughtful sustainable approach towards our natural resources to which the recycling of the aggregates seems to be a allowable remedy. The paper presents a comparison of the compressive strength of the concrete made through NMA and TSMA. Concept of use of recycled aggregate in concrete is not new, researches have been carried out on recycled aggregate all over the world. However, use of Recycled Aggregate in high strength concrete production could not become popular in India. Some researchers indicating

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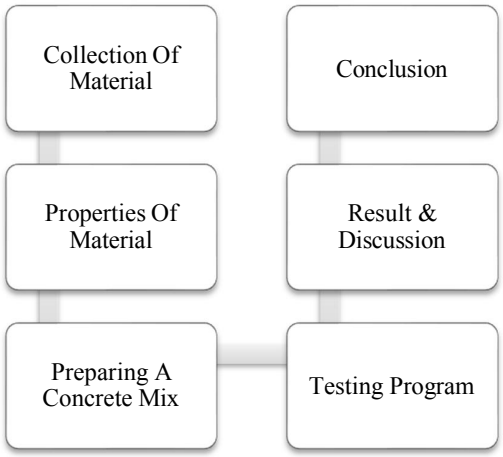
the inferiority of recycled aggregate concrete, reported that often this concrete is used in as road construction, backfill for retaining walls, low grade concrete production, drainage and brick work and block work for low- cost housing.

II. OBJECTIVE

- To compare the Strength Characteristics of Concrete by Two-Stage Mixing Approach and Normal Mixing Approach.
- To determine the compressive strength and flexural strength of concrete.
- To prepare the mix design of concrete.
- The recommendable percentage of replacement of Cement with fly ash, sand with foundry sand, normal aggregate with recycled aggregate to achieve a concrete of standard strength.

III. METHODOLOGY

In this chapter briefly explain the methodology adopted for this research



IV. MATERIAL PROPERTIES

4.1 Cement

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials to bind them together. Locally available 53 grade ordinary Portland cement is used in the present investigation for all concrete mixes.

Table 1: Properties of Cement

Sr.no.	Property	Result
1	Fineness Modulus	4.65%
2	Initial setting time	70 min
3	Final setting time	295 min
4	consistency	32%

4.2 Fine Aggregate

Aggregates for the concrete were obtained from approved suppliers conforming the specifications of IS 383:1970 and were chemically inactive (inert), spotless and robust. The fine aggregate was tested as per the limits which is specified in IS: 2386 (Part-3):1963.

Table 2: Properties of Fine Aggregate

Sr.no.	Property	Result
1	Fineness Modulus	2.54
2	Specific Gravity	2.65
3	Silt content	2%

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4.3 Coarse Aggregate

Coarse aggregates will be machine-crushed done of black trap or equivalent black tough stone and shall be stiff, robust, dense, durable, spotless or procured from quarries approved by the consultant. Coarse aggregate can be defined as inert granular materials obtained after crushing a stone. Coarse aggregate is use of size 20mm. coarse aggregates passing through 20mm sieve and retained 12.5mm sieve are used in this experiment.

Table 3: Properties of Coarse aggregate

Sr. no.	Property	Result
1	Fineness Modulus	2.84
2	Specific Gravity	2.8
3	Crushing value	15.14%
4	Impact value	5.45

4.4 Water

A good Tap water available in the Project is used for the construction purpose which conforming to the requirements of water for concreting and curing as per IS: 456-2009.Ph value of water is 8.56.

4.5 Recycled Coarse Aggregate

Demolished concrete waste of coarse aggregate getting from local crushing plant Crushed aggregates of 20mm and down size produced from plant were used. The particular specific gravity and water absorption.

Table 4: Properties of Recycled Course Aggregate

Sr. No.	Property	Value
1	Specific Gravity	2.9
2	Water absorption	0.15%

4.6 Waste Foundry Sand

Foundry sand is basically fine aggregate. It can be used in many of the same ways as natural or manufactured sands. This includes many civil engineering applications such as embankments, flowable fill, hot mix asphalt (HMA) and Portland cement concrete (PCC).

4.7 Percentage of Mixing

Sr. No.	Cement + Fly Ash(%)	Sand + Waste Foundry Sand (%)	Natural Coarse Aggregate + Recycled Coarse Aggregate (%)
1	100	100	100
2	95+5	90+10	75+25
3	85+15	80+20	50+50
4	75+25	70+30	25+75
5	65+35	60+40	0+100

V. MIX DESIGN FOR M20 GRADE OF CONCRETE

Sr. no.	Cement	Fine Aggregate	Coarse Aggregate	Water
1	394 kg/m3	679.04kg/m3	1171.24kg/m3	214.57 lit.
2	1	1.71	2.97	0.5

VI. COMPRESSIVE STRENGTH TEST

The compressive strength of concrete is the most common performance measure used in designing buildings and other structures. The compressive strength is generally measured by breaking cubical concrete specimens in a compression-testing machine. The compressive strength is calculated from the failure load divided by the cross-sectional area resisting the

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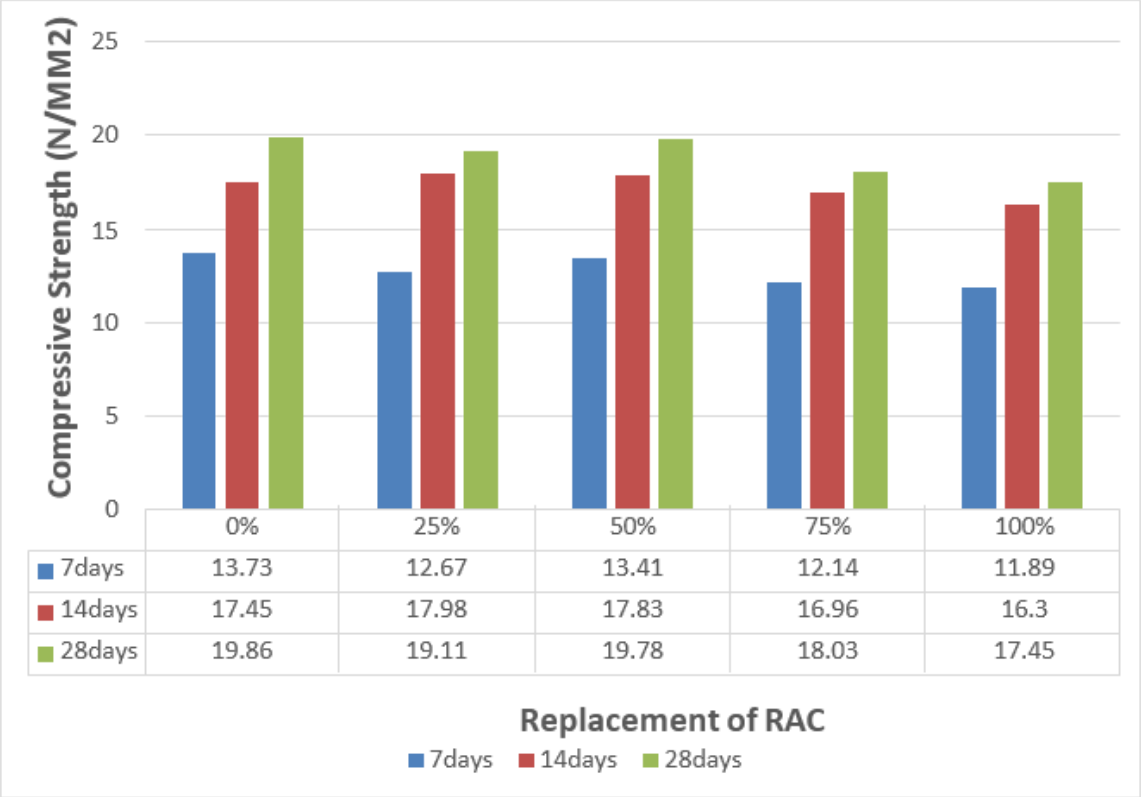
load Compressive strength test results are primarily used to determine that the concrete mixture as delivered meets the requirements of the specified strength, fck in the jobs specification

VII. Result And Discussion

The test was conducted on the cube specimen of size 150×150×150mm.



	0%	25%	50%	75%	100%
7days	13.73	12.67	13.41	12.14	11.89
14days	17.45	17.98	17.83	16.96	16.3
28days	19.86	19.11	19.78	18.03	17.45

VIII. Conclusion

The following conclusions are made based on the experimental investigations on compressive strength considering the environmental aspects also:

- The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as an alternative to primary (natural) aggregates.
- The compressive strength of recycled aggregate concrete is relatively lower than natural aggregate concrete. However, these variations are dependent on the original concrete from which the aggregates have been obtained.

The replacement of coarse aggregate by 25% and 50% of demolished waste having good compressive strength compared to normal concrete. Use of demolished waste aggregate in concrete can be an alternative to the conventional concrete.

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