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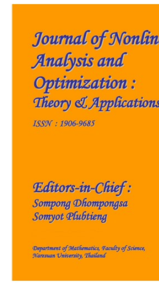

MANUFACTURING CONCRETE WITH HIGH COMPRESSIVE STRENGTH USING RECYCLED COURSE AGGREGATES

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ABSTRACT:

Population growth has an impact on construction operations, which has increased demand for various building materials in recent decades. Because of this and the overuse of finite natural resources, the ecosystem has suffered. One such material that is widely used in the building sector is aggregate, which is made by first quarrying rocks and then crushing them into various appropriate sizes [1]. It is necessary to discover alternatives to natural aggregates because this process disturbs the ecology and poses major occupational hazards in addition to air, noise, and deforestation pollution [2]. Conversely, millions of tons of concrete are wasted annually as a result of demolishing already-existing structures, which are then carelessly disposed of in landfills or used to fill in lower regions. Because concrete functions as a solid, hardened.The replacement of 0, 50%, and 100% of the RAC has been carried out, and the outcomes have been compared with the normal aggregate and IS code [3,4].The results demonstrated the applicability of combining normal aggregate and RAC in a proportionate ratio for pavement and building construction [5].

Keywords:*Buliding Materials,Natural Aggregates,RAC-recycled Aggregate Concrete.*

1.INTRODUCTION

- The most often utilized material in the construction business worldwide is concrete. Concrete is essentially a produced product made up of water, admixture, aggregates, and cement. The majority of the combination is made up of inert granular elements called aggregates, which include crushed stones, sand, and gravel [6,7]. More than 80% of the aggregate market is made up of construction aggregates, which are mostly utilized for pavement and building construction. The Latin word "concretus" (meaning compact or condensed) is the source of the English word "concrete." It is the perfect passive participle of the verb "concrescere," which combines the words "con" (together) and "crescere" (to grow).In essence, recycled aggregate concrete (RAC) is a concrete mix made from concrete that has previously been utilized in construction projects and crushed aggregates [8]. The primary responsibility of an engineer in the field of construction engineering is to produce sufficient, high-quality goods with the resources at hand. The products must to be affordable and environmentally friendly so that they can withstand any unfavorable circumstances. Because it might be expensive and require a lot of energy and natural resources, using high-quality materials all the time is not a sign of good engineering [9]. The concept of recycling concrete to create recycled aggregate (RA) is developed from this perspective. In the current era of advanced civilization, there are a plethora of new opportunities presented by the usage of recycled aggregate concrete.Recycled Aggregate Concrete (RAC) is concrete in which course aggregate is replaced entirely or partially with recycled aggregate (RA) [10,11]. Among these advantages are the reduction in the quantity of natural aggregates (NAs) needed as a result of the replacement of coarse recycled aggregate and the conversion of tons of waste from building development and demolition from landfills. Recycled Aggregate Concrete (RAC) is essentially a concrete mix made from concrete that has previously been used in construction projects and crushed aggregates [12].Since the quantity of CDW (construction and demolition waste) has expanded dramatically over the past few years, recycled aggregates are gathered from CDW. An estimate from a study states that the annual production of CDW is close to 70 million tons. When a building has reached the end of its useful life, it must be demolished.Since the quantity of CDW (construction and demolition waste) has expanded dramatically over the past few years, recycled aggregates are gathered from CDW. An estimate from a study states that the annual production of CDW is close to 70 million tons. When a building has reached the end of its useful life, it must be demolished. For the sake of the ecology, CDW recycling and reuse are now essential [13,14]. Numerous main aggregates are required in large quantities because to the rapid advancement of industrialization and civilization. Sustainable developments must use recycled aggregates since they preserve natural aggregates and cut down on the amount of space needed for the disposal of demolition waste. It also lowers energy consumption. Concrete recycling is cost-effective since it lowers costs by 34%–41% [16]. It also lessens.

2.MATERIALSUSED

A. Cement

Cement is generally a binder in general, but in a narrower sense it also includes adhesives used in architecture and civil construction. This cement is a finely ground powder that hardens into a hard mass when mixed with water. [17,18]Hardening and hardening occur due to hydration, the chemical bonding of cementitious compounds with water, resulting in the creation of microscopic crystals or gel-like substances with large surface areas. Construction cements that set and harden in water due to their moisturizing properties are often called hydraulic cements. The most important of these is Portland cement.

B. Fineaggregate

Sand is usually used as the fine aggregate. The size of the sand varies from 70 microns to 4.75 mm, and the most common mineral found in the sand is quartz (also known as silicon dioxide), which makes it highly weather resistant. [19,20,21]It is produced by the combination of silicon and oxygen. Feldspar is the most abundant mineral group on the Earth's surface, making up approximately 65% of Earth's rocks. When wind and sea blow up on the coast, these tiny particles are carried onto the beach, where the combination forms sand. Sand is a non-renewable resource that will never exist again. It is available from a variety of sources, including desert sand, river sand, sea sand, beach sand, volcanic sand, and olivine sand, and comes in a variety of colors, including white, black, red-orange, white-gray, and light brown. , The sand used in construction must be inert and not react with other ingredients, since sea sand is not used in concrete, but mainly river sand and sea sand. Sand also mixes concrete evenly, fills the gaps between concrete, and increases the strength of concrete. Using sand in concrete prevents shrinkage, improves the structure and provides a smooth surface. Construction costs are reduced due to increased concrete volume. Sand reduces the porosity of concrete. [22]This reduces the amount of voids and reduces the occurrence of cracks. Sand increases the permeability of the concrete, helping gases and heat to escape evenly from the concrete without pressure buildup, thereby reducing the tendency of the concrete to crack.

C. Natural Coarseaggregate

Gravel is the most commonly used coarse aggregate. Size varies between 4.75 and 37.5mm. There are two types of aggregate: round aggregate and square aggregate. Round aggregates require a lower w/c ratio and the use of these aggregates improves the workability of concrete. However, this type of aggregate has fewer interlocking mechanisms and weak bonding strength, making it undesirable when strength is the main requirement.[23,24,25] The use of edged aggregate increases the cement content, but also increases the strength of the concrete. Coarse aggregates increase density, strength, hardness, durability, and toughness, but aggregate size also affects these properties.

D. Recycled Aggregate

Crushed concrete and other materials recovered from building sites or demolition sites are referred to as recycled aggregate. These materials are treated and used again in future construction projects rather than being thrown away.[26] Utilizing recycled aggregate lowers the reducing the need for natural resources like sand and gravel, preserving energy, and garbage that is dumped in landfills. It is frequently utilized in drainage systems, road construction, and as a foundational substance for new construction. [27,28,29]Aggregate recycling encourages sustainability and lessens the effect of construction activities on the environment.

E. Mould

Because they give concrete a temporary framework to ensure proper curing and the preservation of its intended shape and structural integrity, moulds are crucial in the building industry. Additionally, they aid in achieving precise measurements and surface treatments, enabling to ensure that exact engineering and architectural requirements are fulfilled. [30,31,32]Furthermore, molds enable quick and economical concrete casting to promote efficient building components.

3. MIX CALCULATION

A. Design mix (M30)

By reference of IS 10262-2009 CODE BOOK $ IS 456-2000
Volume of cube =0.15*0.15*0.15 =0.003375m^3
Water cement ratio =0.45
Slump value = 100mm
Max Water Content For 20mm Aggregate = 186liters (for 20-50mm slump)
Max Water Content For 100mm slump = 186 + 6/100 x 186
= 197 litres
Cement Content = 197/0.45
= 437 Kg
Cement in m3 = 437/3.15 x 1/1000
= 0.138 m^3
Water in m3 = 197/1000 = 0.197 m3
Total Aggregates = 1- (0.138 + 0.197)
= 0.665 m^3
Fine Aggregate = vol x% of volume in concrete x Gs x 1000
= 0.665 x 0.3 x 2.072 x 1000
= 542.64 kg

Coarse Aggregate = 0.665 x 0.4 x 2.8 x 1000
= 744.8 kg
Dry Concrete = 1m^3
Wet Concrete = 1 x 1.52
= 1.52 m^3
Cement content = 0.138 x 1.52
= 0.209 m^3
Mass of cement = 660.744 kg
Water = 0.197 x 1000 x 1.52
= 299.44 litres
C.A = 744 kg
= 1132.096 kg
F.A = 542.69 x 1.52
= 824.88 kg

Quantities For 1 Cube:

Vol. Of Cube = 0.003375 m^3
Cement content = 0.003375 x 660.744
= 2.23 kg
Water content = 0.003375 x 299.44
= 1.01 litres
C.A = 0.003375 x 1132.096
= 3.8 kg
F.A = 0.003375 x 824.88
= 2.8 kg

METHODOLOGY

A. **Methodology for recycled aggregate concrete** The methodology for recycled aggregate concrete typically involves the following steps:

A. ***Aggregate selection:*** Identify and sort suitable construction and demolition waste materials such as concrete rubble, bricks, and tiles to be used as recycled aggregates.

B. ***Aggregate processing****:* Crush and screen the recycled aggregates to remove contaminants like wood, plastic, and other non-concrete materials.[33,34] Size reduction may also be necessary to meet desired gradation requirements.

C. ***Materials and grade of mix***

- For this mix required materials are dry rice-straw, RSB, cement, fine aggregates,
- Coarse aggregates. Select the appropriate design mix and calculate the 20 proportioning of materials in the form of ratios.
- In this mixing M20, M25 and M30 grade should be taken and the mix proportions are mentioned in the above calculations.

D. Measuring of materials

- Calculate the required quantity of materials for the cubes as per design mix ratio.
- Next measure the materials quantity and cast the cubes accordingly.

E. ***Preparing cubes*** : for M20, M25 and M30

- First, take the required amount of the materials as per the design mix
- Cast the normal aggregate and recycled aggregate cubes of size 150mm x 150mm x 150mm in 0% 50% and 100%.
- Dry them for 24 hours and then remove the moulds. [35,36,37]Place the cubes in water

for curing.

- Test the cubes for 7 days, 14 days and 28 days to obtain the results

B. Mixingofconcrete

1) Drymix:-

- First dry mixing should be done by placing and mixing all the ingredients withoutpouringwater.
- Drymixmakes theingredientsuniform.

2) wet mix:-

- Afterdrymixingplacethewaterasperthew/cratioandmixtheingredientswithin5mins of pouringthe water.
- Fastmixingmakesgoodstrengthandtakinglongtimeformixingreducestheslumpals

C. Placingofconcrete

- Then place the concrete in the moulds of which are previously prepared within30minsofmixingandfixedthemouldstightlytoavoidtheleakageofwaterbefor eplacingof concrete.
- Delay in placing makes the concrete harden and reduces the properties of concretelikeworkability, strength,durability, resistancetoweather etc.,

D. Compactionandfinishing

- Compaction should be done to makes the mix dense, to avoid pores and goodcompaction improves the strength of concrete, it should be done with machinecompaction.
- For smooth finishing of surface, finishing should be done by using trowels andremovingaccess concreteto makeeven surface.

E. Demouldingandcuring

- After24hrs demouldthe mouldsand removethe cubes.
- Then curing takes place, here curing should be done by placing the cubes in thewaterand maketheburlaps wetduringcuringperiod of 3 days, 7days and 28 days.
- Proper curing should be maintained throughout the entire time because propercuring leads to increase in strength, reduces shrinkage cracks and improves goodhydrationprocess.

I.EXPERIMENTATION

A. Compressiontest

Compression strength test is used to measure the force required to compress thematerial. Compression tests are conducted by loading the test specimen between two plates, and thenapplying a force to the specimen by moving the crossheads together.[38,39] During the test, the specimen iscompressed, and deformation versus the applied load is recorded. It is one of the most importantpropertiesofconcrete and mortar.

B. Apparatus

Specimen(concretecube),CTM(Compressiontestingmachine)

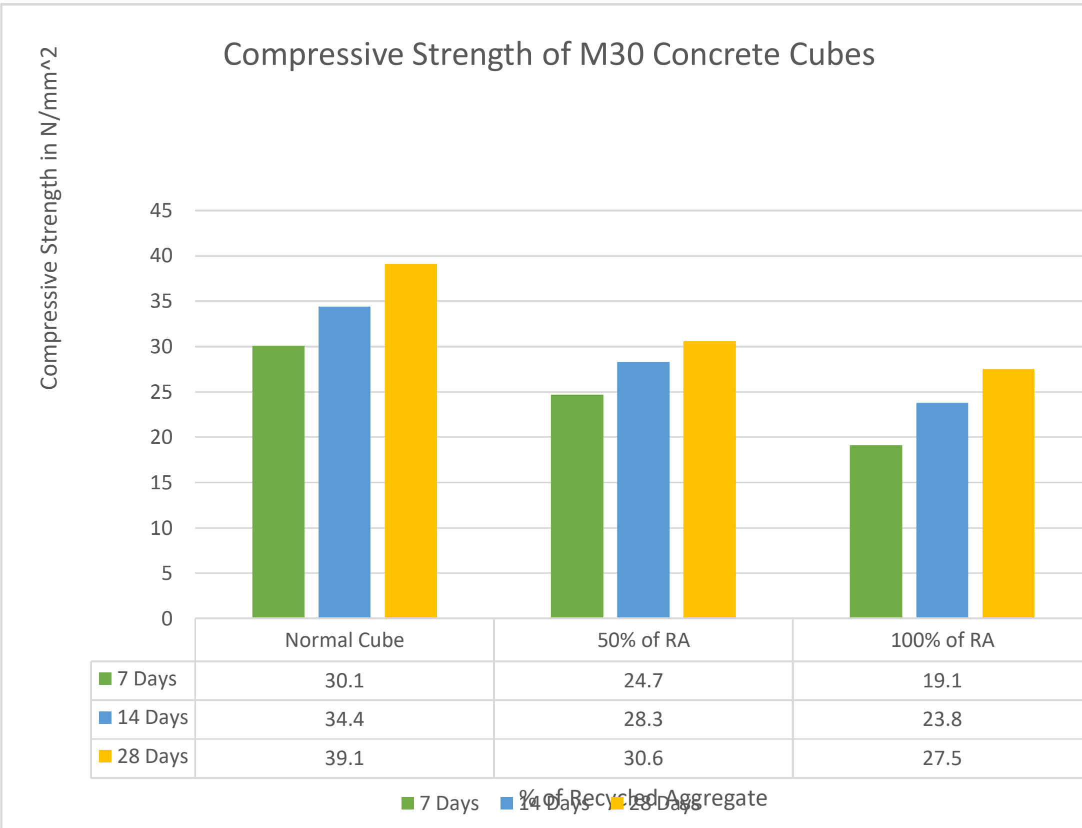
C. Procedure

1) Cleanthecubewithdrycloth toremovewater contentonthe surfaceafter curing.
2) Removeexcess concrete on the surfacebytroweland makethecubeeven.[40]
3) Liftthecubecarefullyand placeit in themiddle oftheCTM.
4) Settheloaded springtomake incontact withthe surface.
5) Aftercontact ismadesetthe loadingdegreeto0.
6) Then applythe loadgraduallyonto thecube.
7) Notethereadingswhenthefirstbreak(crack)formedand finalbreakage(ultimateload)was.

4.RESULT

Table–1:**Compressive strength of M30 concrete cubes with replacement of recycled Course aggregate with different percentages**

% of Recycled Aggregate	Compressive Strength of cube for 7 Days Curing	Compressive Strength of cube for 14 Days Curing	Compressive Strength of cube for 28 Days Curing
Normal Cube	30.1	34.4	39.1
50% Recycled Aggregate	24.7	28.3	30.6
100% Recycled Aggregate	19.1	23.8	27.5



CONCLUSION

Compared to natural aggregate, RCA absorbs more water. As the percentage of garbage that is demolished rises, so does the amount of water needed to achieve the same workability. Adequate strength is not attained because there is no treatment procedure for RCA; instead, by Strength can be increased by using a more complex and comprehensive therapy method. NCA is capable of achieving high RAC compressive strength. There are other non-structural uses for recycled aggregate concrete, such as base and sub-base layers in pavements, drainage systems, and low to applications for medium-strength concrete, where stringent performance criteria are not crucial.Recycled aggregates may provide cost savings.Concrete with recycled aggregate may have somewhat reduced flexural and compressive strengths. compared to regular aggregate concrete because of the remnants of ancient mortar that are still attached to repurposed aggregates.

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