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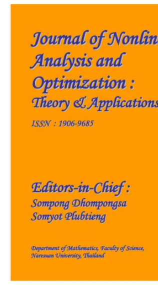

MANUFACTURING CONCRETE WITH HIGH COMPRESSIVE STRENGTH USING RECYCLED AGGREGATES

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Abstract:

A method of developing high-strength concrete from recycled aggregates is proposed based on reducing debris or waste produced and make environment ecofriendly.
Some samples of concrete manufactured using 100% recycled aggregates and natural aggregates were analyzed and tested at 3 days.[1,2,3] On comparing the natural concrete aggregate (NCAs) and recycled concrete aggregates (RCAs), it was found that the water absorption in aggregates was time dependent, which affected the workability of the fresh concrete for low water–cement ratio (W/C).[4,5] It was found that, the recycled aggregates (RAs) prior to concrete manufacture results in concrete with higher compressive strengths.[6,7] The average compressive strengths achieved for the recycled aggregate concrete (RAC) was approximately 83.0 MPa. [8,9,10]From the literature reviewed, this might be the highest ever recorded compressive strength from concrete manufactured using 100% recycled coarse aggregates.

Keywords:*Recycled Aggregate, Recycled Aggregate concrete cubes, Compressive strength*

1. INTRODUCTION

After demolition of old roads and buildings, the removed concrete is often considered worthless and disposed of as demolition waste.[11,12] By collecting the used concrete and breaking it up, recycled concrete aggregate (RCA) is created. [13,14]Research into the use of recycled concrete aggregates (RCAs) continues to be a topic of great interest due to the positive impacts of its use in terms of sustainability and cost effectiveness. [15]Though there has been an impressive increase in the use of recycled concrete, these recycled aggregates (RAs) are basically used as fillers in road construction and in low-level applications due to impurities and defects associated with recycled aggregates, it was found that all these authors agreed that many benefits that promote sustainability were offered from producing recycled aggregate concrete (RAC). [16,17,18]Some of these benefits include reduction in the amount of natural aggregates (NAs) required due to coarse recycled aggregate replacement and converting tons of building construction and demolition wastes from landfill. [19,20]Despite the economic and environmental benefits of concrete produced with RCAs and steadily increased usage of the material, the construction industry has not totally embraced it, especially for structural applications, partly due to previous findings that have [21,22,23]concluded that RCA concrete is inherently inferior to conventional concrete made with natural aggregateconventional concrete made with natural aggregate.

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. [24,25]This cement is a finely ground powder that hardens into a hard mass when mixed with water. 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. [26,27]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.[28,29] 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. 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.[30] 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.[31] , 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. 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. Recycled Coarseaggregate

- The recycled coarse aggregate contains original aggregate attached with mortar. The attached mortar is light and porous in nature. [32]Therefore, it is obvious that the specific gravity and density of recycled aggregate are relatively less when compared to natural aggregate

3. MIX CALCULATION

A. Design mix (M25 for 1m3)

1) Calculation of target mean strength

f’ ck = f ck + 1.65x (from IS 10262-2009 table-1 x=5)

= 30 + 1.65*5

=38.25N/mm2

Water-cement ratio

(From IS 10262, table-5, severe)Adoptedwatercementratio=0.45

2) *Sizeof aggregates*

Coarse aggregate = 20mmFineaggregate =4.75mm m

3) *Selectionofwatercontent*

Maximum water content for 20mm aggregate (from table 2, IS 10262)withslump value of25 to 50 = 186 litres

4) *Calculationofcementcontent*

(From table 5, IS 456:2000)Cementcontent = 186.3/0.45 =414 Kg/m^3

5) *Mixproportions*

Cement =414 Kg/m^3
Water =186 litersCoarse aggregate = 1173KgFineaggregate=55 2Kg

B. Weightofingredients

Fromtheabovemixdesignobtainedmixratiois1:1.34:2.83

1) *Volumeof cube* =length*breadth*height
=0.15*0.15*0.15
=0.003375 m^3

2) *Weight of cement = 0.003375*442 = 1.39725Kg*

3) *Weight of fine aggregate = 0.003375*552 = 1.863 Kg*

4) *Weight of coarse aggregate = 0.003375*1173 = 3.95 Kg*

4. METHODOLOGY

A. Materialsand grade of mix

- Forthismixrequiredmaterialsarecement,fineaggregates,recycled coarseaggregates.[33,34]
- Selecttheappropriatedesignmixandcalculatetheproportioningofmaterialsinthefor mof ratios.
- In this mixing M25 grade should be taken and the mix proportions are mentionedintheabovecalculations.

B. Measuringofmaterials

- Calculatetherequired quantityofmaterials forthecubes asperdesign mixratio.
- Nextmeasurethe materialsquantityandcastthecubesaccordingly.[35,36]

C. Preparingthe concrete

- First,takethe requiredamount of thematerials asperthedesign mix.
- Casttherecycled concretecubes of size150mmx150mmx150mm.
- Dry them for 24 hours and then remove the moulds. Place the cubes in water forcuring.

- Testthecubesfor7daysand 28daystoobtainthe results

D. 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.
- Fastmixingmakesgoodstrengthandtakinglongtimeformixingreducestheslumpalso .

E. Placingofconcrete

- Then place the concrete in the moulds of which are previously prepared within30minsofmixingandfixedthemouldstightlytoavoidtheleakageofwaterbeforeplacingof concrete.
- Delay in placing makes the concrete harden and reduces the properties of concretelikeworkability, strength,durability, resistancetoweather etc.,

F. 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.

G. Demouldingandcuring

- After24hrs demouldthe mouldsand removethe cubes.
- Then curing takes place, here curing should be done by placing the cubes in thewaterand maketheburlaps wetduringcuringperiod of 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. [37]During the test, the specimen iscompressed, and deformation versus the applied load is recorded[38]. It is one of the most importantpropertiesofconcrete and mortar.

B. Apparatus

Specimen(concretecube),CTM(Compressiontestingmachine)

C. Procedure

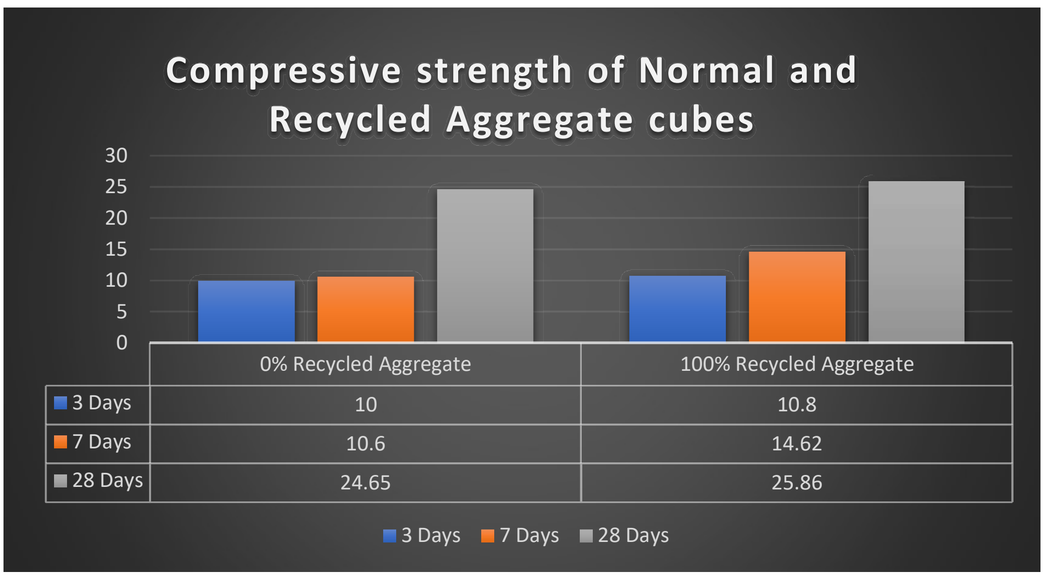
1) Cleanthecubewithdrycloth toremovewater contentonthe surfaceafter curing.
2) Removeexcess concrete on the surfacebytroweland makethecubeeven.
3) Liftthecube[39]carefullyand placeit in themiddle oftheCTM.
4) Settheloaded springtomake incontact withthe surface.
5) Aftercontact ismadesetthe loadingdegreeto0.
6) Then applythe loadgraduallyonto thecube.
7) Notethereadings[whenthefirstbreak(crack)formedand finalbreakage(ultimateload)was.

5. RESULT

Table–1:Compressivestrengthofconcretecubeswhenbiocharispartiallyreplacedwithcementindifferentpercentages

% of Recycle aggregate	Compressivestrengthfor3 daysof curing (inN/mm^2)	Compressivestrengthfor7 days ofcuring (in N/mm^2)	Compressivestrengthfor28 days ofcuring (in N/mm$^{2)}$
0	10	10.6	24.65
100	10.8	14.62	25.86

Fig.1COMPRESSIVESTRENGTHOFNORMALANDRECYCLED AGGREGATE CUBES



6. CONCLUSION

- Based on this analysis we conclude that the replacement of the recycled aggregate has resulted in greater strength.
- And we had observed that the strength has also increased rapidly.
- The cost has been reduced and waste can also be recycled.
- This, also resulted in the increase in its strength
- As based on result compare to natural aggregates have less strength than recycled aggregates

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