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COMPARISON OF THE STRENGTH OF RECYCLED CONCRETE AND NATURALCONCRETE BY USING RECYCLED CONCRETE

Nikhil Yadav[1*], Ajay Patel[2], Praduman[3],Nilesh Verma[4] ,
Yooranshi Singh Chaudhari[5] ,Deepak Yadav[6]

[1,2,3,4,5] *B.Tech. Student, Department of Civil Engineering, Bansal Institute of Engineering and Technology, Lucknow*

[6]*Assistant Professor, Department of Civil Engineering, Bansal Institute of Engineering and Technology, Lucknow*

Corresponding Author Email: nikhilyadav83215@gmail.com

ABSTRACT: *However, employing recycled concrete aggregate (RCA) in concrete presents a number of challenges and contentious concerns in terms of regulating the quality of recycled concrete aggregate (RCA). The mechanical and testing of concrete under various circumstances is based on recycled concrete aggregates. Natural aggregates are more used and reduced during this period. Then Recycled concrete aggregates (RCA), which replace natural aggregates, are a solution for saving natural resources while simultaneously lowering the environmental effect of concrete. Included in the cement test are the consistency test, the first setting time test, and the final setting time test. Impact valve test, abrasion test, sieve test, and water abrasion test are also included in the aggregate test. Each batch was tested to determine its compressive strength, workability, and water absorption. The findings suggest that compressive strength is not the main determinant of RAC mechanical and durability qualities.*

KEYWORD: *Natural aggregates and recycled coarse aggregates Water absorption compressive strength, test and durability*

INTRODUCTION

The sector is driving rapid urbanisation in India. Furthermore, fast expansion in infrastructure necessitates a considerable number of resources and land needs. When we create a structure, we employ adequate materials and test its strength and longevity. And we create any structure to last a long time, require little care, and operate well. Demolished materials are deposited on landfills and foundation filling of buildings or houses in India, with no reuse. This destroyed garbage is harming the ecosystem as well as the fertility of the soil. The concrete waste generated by the manufacturing of concrete and the return of fresh concrete is more than the trash generated by demolition debris.

In Europe, almost 900 million tonnes of concrete debris are produced each year. In addition, India creates 23.75 million tonnes of concrete trash each year. According to the Central Pollution Control Board (CPCB) of Delhi, India. Every day, around 0.1 million tonnes of municipal solid trash are created in India. India generated 48 million tonnes of solid garbage, with building trash accounting for 14.5 million tonnes. And 3% of the garbage from the embankment is utilised.

In all, 47 percent of destroyed building debris is concrete, 25 percent ceramics, 3 percent plastic, 10 percent wood, 5 percent metal, and 10% miscellaneous elements. If concrete is required, 69-74 percent aggregate is required, with 60-65 percent coarse aggregate and 32-40 percent fine aggregate. In the future, worldwide aggregate consumption will approach 34 billion tonnes by 2022. And this demand comes from India, Europe, China, and the United States. In terms of the environment, the more carbon there is, the less NA is produced than RAC. As we all know, NA has finite resources that can only be used for around 50 to 60 years before they are depleted, and the RAC can also be reused appropriately. When compared to natural aggregate and porosity to water, we employ recycled aggregates to improve water absorption and reduce compressive strength of concrete. In typically, 5 to 25% of the aggregate is replaced. Concrete waste may be a concern due to improper disposal and recycling, as well as increased carbon dioxide emissions. This action generates greater carbon dioxide

[*] **Corresponding Author: Nikhil Yadav**
Corresponding author email: nikhilyadav83215@gmail.com

emissions, which contribute to global warming and land acidification.

MATERIALS USED

Natural aggregate:

Nature provides natural aggregate. Aggregate is often obtained by blasting at stone quarries or breaking it down by hand or using crusher equipment. Machine-crushed aggregate is made up of stones of varied sizes, whereas hand-broken aggregate is made up of solely single stones.

Recycled concrete aggregate

Recycling is the process of reusing old resources to make a new product. The building and demolition detritus contains recycled concrete aggregate. They also recycle waste materials from building and demolition sites. After separating the plastic, wood, iron, and recyclable aggregates, it was sieved and crushed. We also replace natural coarse aggregates in concrete, sub foundation, and pavement layers. RCA is devoid of chemical impurities and waste materials and may be crushed using primary jaw and secondary cone crushers. There are two sizes of coarse aggregate available: 20-10mm and 10-5mm. RCA absorbs double the amount of water than NA. In addition, RCA has a reduced relative density of 7 to 8%. All mechanical properties of coarse aggregate may be achieved in two sizes: 20-10 and 10-5mm. RCA has double the water absorption capacity of NA. And RCA has a lower relative density of 7 to 8%. The mechanical characteristics of RCA are all poorer than those of NA. We also test the compressive strength of RCA and NA before adding super plasticizing admixture to preserve workability and air –entraining admixture.

EXPERIMENTAL METHODOLOGY

3.1 Materials Test on Recycled Aggregates and Natural Aggregates:

Reinforced concrete demolition materials can be recycled in foundations. The demolish materials have a life span of 25 to 30 years. Crushing, sifting, and separation of demolition debris can be done manually, and it separates the iron and plastic. The test may be performed on both recycled and natural aggregates and the results can be compared using IS code 2386.

Specific Gravity:

The specific gravity of aggregates used in construction typically ranges from around 2.5 to 3.0, with an average value of about 2.68. Aggregate specific gravity is seen as an indicator of strength. Material with a greater Specific Gravity is often thought to be stronger. Aggregate water absorption is a measure of porosity. The IS code 2386 considers this value to be a measure of frost resistance as well as maintaining weathering activity (part 3).

The specific gravity of dried recycled concrete aggregate ranged from 2.35 to 2.58. If the specific gravity is less than 2.4, the production of concrete may be lowered, as well as segregation and honeycombing.

Water Absorption:

The water absorption of recycled aggregates is greater than that of native aggregate. Because cement mortar is an intrinsic element of recycled aggregates and recycled aggregates are more permeable than natural aggregates. Water absorption is defined as the amount of water absorbed by a substance and is measured as the weight of water absorbed divided by the dry material's weight. Water absorption provides information on the internal structure of the aggregate. Aggregates with higher absorption are porous in nature and are often regarded as undesirable. Recycled aggregate is often more absorbent

than natural aggregate. Water absorption ranges from 3–10% for recycled aggregate and less than 1% to 5% for natural aggregate.

Table :1

Sr.no.	Particularss	Valuess	
		Naturall Aggregate	**Recycledd Coarse Aggregatee**
1	Specificc Gravity	2.5-3.0	2.35-2.58
2	Waterr Absorption	<1%-5%	3%-10%
3	Bulkk Density	1200-1750kg/m^3	1300Kg/m^3
4	Crushingg Values:	18.5%	36.2%
5	Impactt Values:	14.9%	18.3%

Bulk Density:
Recycled aggregate has a lower bulk density than natural aggregate. The smaller bulk density of RA affects mix percentage, and it is not comparable to NA. Because of the cement mortar layer, recycled aggregates have a larger porosity than natural aggregates and a lower bulk density. Lower bulk density if the cement mortar layer is rich on recycled aggregates. And some actual experience shows that 7 to 10 percent reduced bulk density to natural aggregates.

Crushing and Impact Values:
The mechanical qualities of recycled aggregates are inferior to those of native aggregates. According to IS code 2386-part 4, the crushing and impact value of concrete cannot exceed 30%. The crushing and impact values of recycled aggregates meet BIS requirements. Recycled aggregates have a better crushing and impact value than natural aggregates.

1. Test of cement

Consistency test of cement (IS:4031 part4): Presented in Table 2.
Apparatus: Vicat mould glass plate, weight balance, stop watch, tray, trowel.
Calculation: pan weight =736 gm. cement =300 gm. (PPC)

Fig: (1) Consistency test of cement

Table :2

Sr.no.	Weight of cement	% Of water by weight of cement	Penetration of plunger, mm
1	300gm	30% =90 ml	25mm
2	300gm	33% = 99 ml	31mm
3	300gm	35% =105 ml	33mm

(Penetration of plunger value – Top to bottom)

Initial Setting time of Cement Test:

The length of time that cement may be moulded into any desired shape without losing strength. Fig 2

Table :3

SR.NO.	Penetration Time	Starting Penetration (mm)	Initial Setting (min)
1	12:25	0 mm	0 min
2	12:35	3 mm	10 min
3	12:55	7 mm	30 min

Result: Initial setting time is = 30 minute

(a) Final Setting time of Cement test:

The amount of time it takes for the cement paste to harden to the point where it can withstand modest loads.

Fig: 2 Initial and Final setting time of cement

Table :4

SR.NO.	Penetration time	Starting penetration (mm)	Final setting time (minutes)
1	12:25	0	0 min
2	12:55	7mm	30 min
3	1:30	20mm	65 min
4	2:00	35mm	100 min
5	2:45	40mm	140 min

Result: Final setting time = 140 minute

IMPACT VALUE TEST: The aggregate impact value provides a relative measure of an aggregate's resistance to abrupt shock or impact, which differs from its resistance to a gradual compressive load in particular aggregates. IS 2386 (part 4)

IMPACT VALUE OF NATURAL AGGREGATE

Aggregates can be used 12.5 mm Sieve Retained

W1= empty weight if cylinder =800 gm

W2 =weight of oven dried sample =318 gm

W3 =weight of aggregate passing throughout 2.36 mm sieve =47.5gm

Aggregate impact value:

=(w3/w2) *100

= (47.5/318) *100 =14 %

Fig :3 Impact Testing machine

IMPACT VALUE OF RECYCLED AGGREGATE:

Aggregates can be used 12.5 mm Sieve Retained

W1= empty weight if cylinder =800 gm

W2 =weight of oven dried sample =318 gm

W3 =weight of aggregate passing throughout 2.36 mm sieve =47.5gm

Impact value: = (60.73/325) *100 = 18 %

WATER ABSORPTION:

The absorption rate of demolished concrete aggregates ranges from 1.5 to 8%, which is greater than that of natural aggregates. Aggregates can be employed in accordance with IS 2386 (Part 3). Retained 12.5 mm Sieve

Fig (4) Natural Aggregate

Weight of Natural aggregate = 2 kg

After 24 hours:

Weight of Natural aggregate with absorb water = 2.00+0.036

= 2.036 kg

Water absorption % = ((wet weight – dry weight)/dry weight) *100

= (2.036-2.000/2.000) *100

= **1.8% water absorption**

Fig (5) Recycled Aggregate

Weight of Recycled aggregate =2.083 kg
Aggregates can be used 12.5 mm Sieve
Retained**After 24 hours:**
Weight of recycled aggregate with absorb water = 2.083+0.185
= 20268 kg

Water absorption % = ((2.268-2.083)/2.083) *100
= 8.8% water absorption

TESTING METHODOLOGY

The Bansal Institute of Engineering and Technology's department of civil engineering laboratories can carry out all of the tests. The compression test can be performed.

COMPRESSION TEST ON CUBE (IS 516:1959)

The capacity of a material or structure to carry stresses on its surface without cracking or deflection is referred to as compressive strength. When a material is compressed, its size decreases, and when it is tensioned, its size increases. Cubes measuring 15cm x 15cm x 15cm are often used. This concrete is poured into the mould and properly tempered to ensure that there are no voids. Molds are removed after 24 hours, and test specimens are immersed in water for curing. These specimens' top surfaces should be level and smooth. This is accomplished by applying cement paste to the whole surface of the specimen and spreading it evenly. After seven or 28 days of curing, these specimens are evaluated by compression testing machines. Load should be gradually applied at a rate of 140 kg/cm2 per minute until the specimen fails. The compressive strength of concrete is calculated by dividing the load at failure by the area of the specimen. These tests can be carried out in line with IS Code IS 516 (1959): Method of Tests for Concrete Strength.

Specimen: 9 cubes of 15 cm size Mix. M20 Grades both RCA and NAC.

Fig 6: Recycled concrete aggregates cube

Fig 7: Natural aggregates concrete cube

Fig 8 Compressive Strength of RCA **Fig 9 Compressive Strength of NAC**

Calculations of Compressive Strength of RCA and NAC

Size of the cube =15cmx15cmx15cm

Area of the specimen (calculated from the mean size of the specimen) =22500 mm^2

calculating compressive strength =F/A
F=force or load at point of failure A=initial
cross-sectional surface area

Table 5

Sr.no	Age	Strength
1	7 days	65%
2	14 days	90%
3	28 days	99%

Results of Concrete Cube Test RCA and NAC:

Compressive Strength of M20 Concrete Grades at 7, 14, and 28 Days of NAC and RCA

Table 6

Sr.no.	Grade of concrete	Minimum compressivestrength n/mm^2 at 7days	Minimum compressive strength n/mm^2 at 14 days	Specified characteristic compressive strength (n/mm^2) at 28 days
1	M20 NAC	14.07	18.95	23.56
2	M20 RCA	9.47	14.95	19.33

CONCLUSIONS

- According to IS 2386, recycled aggregates can be subjected to different tests and compared to natural aggregates.
- RCA has a lower compressive strength, higher water absorption, and a lower bulk density than natural aggregates.
- The utilisation of recycled concrete aggregates is more cost effective and environmentally friendly. When RCA is used in construction, energy and transportation costs are reduced, and natural aggregate extraction is reduced. And have no more impact on the ecosystem.
- Recycled aggregates produce a lower result than NA. Then it uses admixtures to improve the Recycled Aggregates outcome. RCA may be utilised in structures up to 30% of the time, however it has more strength, durability, and performance than natural aggregates.
- The strength of recycled aggregates decreases as the water–cement ratio increases. If recycled aggregates absorb more water, then strength has an inhibiting impact.

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