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# Mechanical Properties Of Recycled Construction And Demolition Concrete Waste As Aggregate For Structural Concrete

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**ABSTRACT**

This project mainly discus about the concrete production by mixing recycle aggregate to get the required strength for different applications by replacing the natural coarse aggregate. The Concrete which is made by replacing the recycled coarse aggregate strength can be determined by few physical and mechanical characteristics. The collected recycle aggregate is used to make a concrete such that, several concrete specimen are prepared and evaluated with the virgin concrete. This project likewise talk about the examination of reuse aggregate with constant concrete blend of M20 and water cement proportion, similar to two unique ages have been taken and the age difference between those ages are of 30 years and few samples were caste and this two types of reuse aggregate is compared with conventional cement.

## 1. INTRODUCTION

As we everyone knows that concrete is the main construction material across the world wide. As 2/3rd of the concrete consists of aggregates, the skeleton form of the concrete is formed by the presence of aggregates only. In the amount of aggregate is the major part consist of coarse aggregate, so there is a huge demand on coarse aggregate, it makes the whole world to see towards the requirement of the coarse aggregate. if we extract the natural coarse aggregate it cause to the environmental imbalance, so the whole world is looking towards the aggregates which is extracted from the solid construction waste of the old building and the roads. To manage the concrete waste the usage of recycles coarse aggregate is very important step towards the development and reservation of the environmental? The property of the

Recycled aggregate is the main problem for using it because they will not fill the desire requirement as to alternatively replace with that of naturally coarse aggregate. This property of recycled coarse aggregate are mainly depends on the recycle material quality. This recycled material quality can be get influenced by

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the collection of it and while delivering it to site. The main motto of this project is to fine the strength of cube and flexural strength by replacing the natural coarse aggregate with recycled coarse aggregate either it may be of half or completely replacement. For this we should know the basic properties of the recycled coarse aggregate like water absorption, specific gravity, shape and texture and some physical properties, so many countries are using this construction and demolition waste(recycled coarse aggregate) as the secondary reuse in the structural works. After demolition of the old buildings the material which is removed is considered as worth less and deposited as the demolition waste. By collecting the demolition waste and extracting the concrete and crushed it will produce the recycle coarse aggregate. if we use recycled coarse aggregate

Consumption of the motor content will be less and it will have some motor content on their surface, by this water absorption live water absorption. Void ratio and porosity are very top when equaled with the natural coarse aggregate. In addition the recycled coarsed aggregate also have multi number of micro cracks which are formed by crushing

## 2. LITERATURE REVIEW

**Pavan P S**:-A study on recycle concrete aggregate in this journal, the results are obtained by conducting tests on hardened concrete are discussed. The tests are explained. Compressive strength test, split tensile strength test done on concrete cubes and cylinders and left for 28days for curing .The following tests are done on concrete with recycled coursed aggregates using OPC and PSC.

**Mr. Tushar**:-Use of Recycled Aggregate Concrete have taken a study on use of recycled aggregate concrete and concluded that Utilization of reused total up to 30% does not influence the practical necessities of the structure according to the discoveries of the test outcomes. Different tests directed on reused totals and results contrasted and characteristic totals are tasteful according to IS 2386. Because of utilization of reused total in development, vitality and cost of transportation of characteristic assets and uncovering is fundamentally spared. This thus legitimately decreases the effect of waste material on condition.

**Surya, M.a , KantaRao**:- Recycled aggregate concrete for Transportation Infrastructure they have done the project on recycled aggregate for transportation and concluded that The reused total utilized in the present investigation satisfied the codal necessities for RCA with deference the physical and mechanical properties, anyway the equivalent were lower than those for common totals The regular total cement blends for example NAC, NAF and the RAC blends R50, R75 and R100 exhibited similar conduct in pressure, split strain and flexure. The flexible modulus of RAC diminished with increment in level of RCA. It infers that the distortion of structure made with RAC could be higher than the one built with NA concrete. The water assimilation of RAC expanded with increment in level of reused totals. However, the RAC had a moderately higher resistivity when contrasted with that of NAC. The higher resistivity of RAC demonstrates lower penetrability to chloride showing lower probability of fortification erosion. It might be proposed that the properties of RAC are attractive for use in cement; anyway a point by point examination on long haul

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execution of RAC is required before their genuine use in transportation foundation.

Table 3:- Properties of cement

| S.No. | Properties of F.A | Test conducted Method | Tested Result |
|---|---|---|---|
| 1. | Sp.Gravity | Sp.gravity bottle | 3.14 |
| 2. | Normal consistency | Vicat Apparatus | 30 |
| 3. | Initial setting time<br>Final setting time | Vicat Apparatus | 30min<br>600 min |
| 4. | Fineness | Sieve No. 9 | 9.43% |
| 5. | Sound ness test | Le-Chatelier apparatus | 4.5 mm |

Table 5:- Property of fine aggregate

| S.NO. | Property of F.A | Test Results for Fine Aggregate |
|---|---|---|
| 1 | Sp.Gravity | 2.64 |
| 2. | Water Absorption | 0.8% |
| 3. | Fineness modulus(F.M) | 3.05 |

Table 6:- Property of coarse aggregate

| S.No. | Property | Test Results for natural coarse Aggregate(N.C.A) |
|---|---|---|
| 1 | Sp.Gravity | 2.92 |
| 2. | Water absorption | 0.65 |

Table 7:- Property of the AGE 1 recycled coarse aggregate

| S.No. | Property | Test Results for recycled coarse Aggregate |
|---|---|---|
| 1 | Specific Gravity | 2.95 |
| 2. | Water absorption | 0.75 |

Table 8:- Property of the AGE 2 recycled coarse aggregate

| S.No. | Property | Test Results for recycled coarse Aggregate |
|---|---|---|
| 1 | Specific Gravity | 2.99 |
| 2. | Water absorption | 0.8 |

Table 9:- Proportion of the concrete mix

| Cement | Fine aggregate(F.A) | Coarse aggregate(C.A) | Water-Content | Water to cement Ratio |
|---|---|---|---|---|
| 420 kg/m³ | 630 kg/m³ | 1260kg/m³ | 210 kg/m³ | 0.5 |

Concrete mix cases:-

The concrete is mixed in such ways that there is only change in the replacement of virgin coarse aggregate with reuse coarse aggregate; the replacement is of 30 percentage, 60 percentage and 100 percentage to find the strength comparison of the recycled coarse aggregate

Casting of specimens:-

After getting the mix proportion, the concrete has to be mix with that proportion until it gets a homogeneous mix, then after it was placed in the compressive strength cubes of size 100X100X100mm and prism of size 100X100X500 mm and placed under the vibration machine to get the unique texture on all around the surface of the specimen

No of specimens casted:-

Compressive strength (CUBE 100X100X100 mm)

Table 10 :- No. of specimens casted with M20 without recycle aggregate are **3**

| Percentage replacement of recycled aggregate (%) | AGE 1 | AGE 2 |
|---|---|---|
| 30 % | 3 | 3 |
| 60 % | 3 | 3 |
| 100 % | 3 | 3 |

Total number of specimens for compressive strength test is 21

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Flexural Strength (Prism 100X100X500 MM)

Table 11:- No. of specimens casted with M20 without recycle aggregate are **3**

| Percentage replacement of recycled aggregate (%) | AGE 1 | AGE 2 |
|---|---|---|
| 30 % | 3 | 3 |
| 60 % | 3 | 3 |
| 100 % | 3 | 3 |

Total number of specimens for compressive strength test is 21

1. Required quantity of material:- :

6.1) For Cubes casting

**QUANTITY OF MATERIAL REQUIRED FOR ONE CONCRETE CUBE**IS 516: 1959 (2.8)

| Mix Design | Cement | Sand | Aggregate | Sum of Mix |
|---|---|---|---|---|
| M-20 | 1 | 1.5 | 3 | 5.5 |

| | INPUT VOLUME | DRY VOLUME |
|---|---|---|
| VOLUME OF CONCRETE | 1 | 1.54 |

CEMENT DENSITY($Kg/m^3$) = 1440

| CEMENT QUANTITY | | | |
|---|---|---|---|
| BAGS | CUM | CUF | KG |
| 8.064 | 0.28 | 9.8868 | 403.2 |

SAND DENSITY ($Kg/m^3$) = 1920

| SAND QUANTITY | | | |
|---|---|---|---|
| | CUM | CUF | KG |
| | 0.42 | 14.8302 | 806.4 |

COARSE AGGREAGTE DENSITY ($Kg/m^3$) = 1520

| AGGREGATE QUANTITY | | | |
|---|---|---|---|
| | CUM | CUF | KG |
| | 0.84 | 29.6604 | 1276.8 |

CUBE 100X100X100 (IF C.A <= 20 mm)

0.1 0.1 0.1 $0.001mm^3$

CEMENT QUANTITY = 0.402 KG/CUBE

FINE AGGREGATE QUANTITY = 1.08864 KG/CUBE

COARSE AGGREGATE = 1.2768 KG/CUBE

TOTAL QUANTITY OF MATERIAL REQUIRED FOR 1 CUBE is 2.76864 Kg/CUBE

**CUBE 100X100X100 mm REQUIRED QUANTITIES FOR R.C.A AND N.C.A OF CONCRETE CUBES**

C.A (Kg/Cube) = 1.2768

No. of specimens casted with M20 without recycle aggregate are 3 = 3.8304 kg

| | R.C.A (KG) | NO. OF CUBES | TOTAL R.C.A (KG) | NO. OF AGE SAMPLES | WEIGHT OF R.C.A REQUIRED |
|---|---|---|---|---|---|
| | | | | | |
| 30% | 0.38304 | 3 | 1.14912 | 2 | 2.29824 |
| | | | | | |
| 60% | 0.76608 | 3 | 2.29824 | 2 | 4.59648 |
| | | | | | |
| 100% | 1.2768 | 3 | 3.8304 | 2 | 7.6608 |

TOTAL QUANTITY OF R.C.A REQUIRED FOR CUBES (KG) = 14.55552

| | N.C.A (KG) | NO. OF CUBES | TOTAL N.C.A (KG) | NO. OF AGE SAMPLES | WEIGHT OF N.C.A REQUIRED |
|---|---|---|---|---|---|
| | | | | | |
| 70% | 0.89376 | 3 | 2.68128 | 2 | 5.36256 |
| | | | | | |
| 40% | 0.51072 | 3 | 1.53216 | 2 | 3.06432 |
| | | | | | |
| 0% | 0 | 3 | 0 | 2 | 0 |

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TOTAL QUANTITY OF N.C.A REQUIRED FOR CUBES (KG) = 12.25728

F.A (KG/CUBE) = 1.08864

TOTAL NO. OF CUBES ARE = 21

TOTAL QUANTITY OF F.A REQUIRED (KG) = 22.86144

CEMENT (KG/CUBE) = 0.4032

TOTAL NO. OF CUBES ARE = 21

TOTAL QUANTITY OF CEMENT = 8.4672

**100 mm3 CUBE INDIVIDUAL MATERIAL REQUIRED QUANTITIES**

FOR CASTING 3 CUBES (100 $mm^3$) BY 30% REPLACING MATERIAL REQ
TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY( |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 6 | 2.4192 |
| 2 | F.A | 1.08864 | 6 | 6.53184 |
| 3 | N.C.A | 0.89376 | 6 | 5.36256 |
| 4 | R.C.A | 0.38304 | 6 | 2.29824 |

FOR CASTING 3 CUBES (100 $MM^3$) BY 60% REPLACING MATERIAL REQUIRED
TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 6 | 2.4192 |
| 2 | F.A | 1.08864 | 6 | 6.53184 |
| 3 | N.C.A | 0.51072 | 6 | 3.06432 |
| 4 | R.C.A | 0.76608 | 6 | 4.59648 |

FOR CASTING 3 CUBES (100 $MM^3$) BY 100% REPLACING MATERIAL REQUIRED
TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 6 | 2.4192 |
| 2 | F.A | 1.08864 | 6 | 6.53184 |
| 3 | N.C.A | 0 | 6 | 0 |
| 4 | R.C.A | 1.2768 | 6 | 7.6608 |

| S.NO | MATERIAL | T.C QUANTITIES | | QUANTITY/9 CUBES |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032*3 = | 1.2096 | 8.4672 |
| 2 | F.A | 1.08864*3 = | 3.26592 | 22.86144 |
| 3 | N.C.A | 1.2768*3 = | 3.8304 | 12.25728 |
| 4 | R.C.A | 0 | | 14.55552 |

**QUANTITY OF MATERIAL REQUIRED FOR ONE CONCRETE PRISM**IS 516: 1959 (7.3)

| Mix Design | Cement | Sand | Aggregate | Sum of Mix |
|---|---|---|---|---|
| M-20 | 1 | 1.5 | 3 | 5.5 |

| | INPUT VOLUME | DRY VOLUME |
|---|---|---|
| VOLUME OF CONCRETE | 1 | 1.54 |

CEMENT DENSITY (Kg/$m^3$) = 1440

| CEMENT QUANTITY | | | |
|---|---|---|---|
| BAGS | CUM | CUF | KG |
| 8.064 | 0.28 | 9.8868 | 403.2 |

SAND DENSITY (Kg/$m^3$) = 1920

| SAND QUANTITY | | | |
|---|---|---|---|
| | CUM | CUF | KG |
| | 0.42 | 14.8302 | 806.4 |

COARSE AGGREAGTE (Kg/$m^3$) = 1520

| AGGREGATE QUANTITY | | | |
|---|---|---|---|
| | CUM | CUF | KG |
| | 0.84 | 29.6604 | 1276.8 |

| PRISM 100X100X500 ( IF C.A <= 19 mm) | | | |
|---|---|---|---|
| 0.1 | 0.1 | 0.5 | 0.005$mm^3$ |

**CEMENT QUANTITY = 2.016** KG/PRISM

**FINE AGGREGATE = 5.4432** KG/PRISM

**COARSE AGGREGTE = 6.384** KG/PRISM

TOTAL QUANTITY OF MATERIAL REQUIRED FOR 1 PRISM IS **11.8272** KG/PRISM

**PRISM 100X100X500 REQUIRED QUANTITIES FOR R.C.A AND N.C.A OF CONCRETE PRISM**

C.A (Kg/PRISM) = 6.384

No. of specimens casted with M20 without recycle aggregate are 3 = 19.152 kg

6.2 For prism casting

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| | R.C.A (KG) | NO. OF CUBES | TOTAL R.C.A (KG) | NO. OF AGE SAMPLES | WEIGHT OF R.C.A REQUIRED |
|---|---|---|---|---|---|
| | | | | | |
| 30% | 1.9152 | 3 | 5.7456 | 2 | 11.4912 |
| | | | | | |
| 60% | 3.8304 | 3 | 11.4912 | 2 | 22.9824 |
| | | | | | |
| 100% | 6.384 | 3 | 19.152 | 2 | 38.304 |

TOTAL QUANTITY OF R.C.A REQUIRED FOR PRISM (KG) = 72.7776

| | N.C.A (KG) | NO. OF CUBES | TOTAL N.C.A (KG) | NO. OF AGE SAMPLES | WEIGHT OF N.C.A REQUIRED |
|---|---|---|---|---|---|
| | | | | | |
| 70% | 4.4688 | 3 | 13.4064 | 2 | 26.8128 |
| | | | | | |
| 40% | 2.5536 | 3 | 7.6608 | 2 | 15.3216 |
| | | | | | |
| 0% | 0 | 3 | 0 | 2 | 0 |

TOTAL QUANTITY OF N.C.A REQUIRED FOR PRISM (KG) = 61.2864

F.A (KG/PRISM) = 5.4432

TOTAL NO. OF PRISM ARE = 21

TOTAL QUANTITY OF F.A REQUIRED (KG) = 114.3072

CEMENT (KG/PRISM) = 2.016

TOTAL NO. OF PRISM ARE = 21

TOTAL QUANTITY OF CEMENT REQUIRED (KG) = 42.336

**100 X 100 X 500 mm$^3$ PRISM INDIVIDUAL MATERIAL REQUIRED QUANTITIES**

FOR CASTING 3 PRISM (100X100X500 mm) BY 30% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 6 | 12.096 |
| 2 | F.A | 5.4432 | 6 | 32.6592 |
| 3 | N.C.A | 4.4688 | 6 | 26.8128 |
| 4 | R.C.A | 1.9152 | 6 | 11.4912 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 60% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 6 | 12.096 |
| 2 | F.A | 5.4432 | 6 | 32.6592 |
| 3 | N.C.A | 2.5536 | 6 | 15.3216 |
| 4 | R.C.A | 3.8304 | 6 | 22.9824 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 100% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 6 | 12.096 |
| 2 | F.A | 5.4432 | 6 | 32.6592 |
| 3 | N.C.A | 0 | 6 | 0 |
| 4 | R.C.A | 6.384 | 6 | 38.304 |

| S.NO | MATERIAL | T.C 1 PRISM QUANTITY | | QUANTITY/9 PRISM |
|---|---|---|---|---|
| 1 | CEMENT | 2.016*3 = | 6.048 | 42.336 |
| 2 | F.A | 5.4432*3 = | 16.3296 | 114.3072 |
| 3 | N.C.A | 6.384*3 = | 19.152 | 61.2864 |
| 4 | R.C.A | 0 | | 72.7776 |

**DAY 1**

FOR CASTING 3 CUBES(100 mm$^3$) OF TRADITIONAL CONCRETE TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 1.2768 | 3 | 3.8304 |
| 4 | R.C.A | 0 | 3 | 0 |

FOR CASTING 3 PRISM (100X100X500 mm) OF TRADITIONAL CONCRETE TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 6.384 | 3 | 19.152 |
| 4 | R.C.A | 0 | 3 | 0 |

| S.NO | MATERIAL | QUANTITY/9 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 22.9824 |
| 4 | R.C.A | 0 |

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## DAY 2

### DAY 2 – 30% REPLACEMENT (AGE 1)

FOR CASTING 3 CUBES(100 $mm^3$) BY 30% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0.89376 | 3 | 2.68128 |
| 4 | R.C.A | 0.38304 | 3 | 1.14912 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 30% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 4.4688 | 3 | 13.4064 |
| 4 | R.C.A | 1.9152 | 3 | 5.7456 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 16.08768 |
| 4 | R.C.A | 6.89472 |

### DAY 2–60% REPLACEMENT (AGE 1)

FOR CASTING 3 CUBES (100 $mm^3$) BY 60% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0.51072 | 3 | 1.53216 |
| 4 | R.C.A | 0.76608 | 3 | 2.29824 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 60% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 2.5536 | 3 | 7.6608 |
| 4 | R.C.A | 3.8304 | 3 | 11.4912 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 9.19296 |
| 4 | R.C.A | 13.78944 |

### DAY 2– 100% REPLACEMENT (AGE 1)

FOR CASTING 3 CUBES (100 $mm^3$) BY 100% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0 | 3 | 0 |
| 4 | R.C.A | 1.2768 | 3 | 3.8304 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 100% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 0 | 3 | 0 |
| 4 | R.C.A | 6.384 | 3 | 19.152 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 0 |
| 4 | R.C.A | 22.9824 |

TOTAL QUANTITY OF MATERIAL REQUIRD AT DAY 2

| S.NO | MATERIAL | TOTAL QUANTITY (KG) |
|---|---|---|
| 1 | CEMENT | 21.7728 |
| 2 | F.A | 58.78656 |
| 3 | N.C.A | 25.28064 |
| 4 | R.C.A | 43.66656 |

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DAY 3

DAY 3 -- 30% REPLACEMENT (AGE 2)

FOR CASTING 3 CUBES (100 mm³) BY 30% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0.89376 | 3 | 2.68128 |
| 4 | R.C.A | 0.38304 | 3 | 1.14912 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 30% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 4.4688 | 3 | 13.4064 |
| 4 | R.C.A | 1.9152 | 3 | 5.7456 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 16.08768 |
| 4 | R.C.A | 6.89472 |

DAY 3--60% REPLACEMENT (AGE 2)

FOR CASTING 3 CUBES (100 mm³) BY 60% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0.51072 | 3 | 1.53216 |
| 4 | R.C.A | 0.76608 | 3 | 2.29824 |

FOR CASTING 3 PRISM (100X100X500 mm) BY 60% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 2.5536 | 3 | 7.6608 |
| 4 | R.C.A | 3.8304 | 3 | 11.4912 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 9.19296 |
| 4 | R.C.A | 13.78944 |

DAY 3-- 100% REPLACEMENT (AGE 2)

FOR CASTING 3 CUBES (100 mm³) BY 100% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 1.2768 KG/CUBE

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 3 | 1.2096 |
| 2 | F.A | 1.08864 | 3 | 3.26592 |
| 3 | N.C.A | 0 | 3 | 0 |
| 4 | R.C.A | 1.2768 | 3 | 3.8304 |

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FOR CASTING 3 PRISM (100X100X500 mm) BY 100% REPLACING MATERIAL REQUIRED TOTAL QUANTITY OF C.A = 6.384 KG/PRISM

| S.NO | MATERIAL | QUANTITY/CUBE | NO. | TOTAL QUANTITY(kg) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 3 | 6.048 |
| 2 | F.A | 5.4432 | 3 | 16.3296 |
| 3 | N.C.A | 0 | 3 | 0 |
| 4 | R.C.A | 6.384 | 3 | 19.152 |

| S.NO | MATERIAL | QUANTITY/6 SPECIMEN |
|---|---|---|
| 1 | CEMENT | 7.2576 |
| 2 | F.A | 19.59552 |
| 3 | N.C.A | 0 |
| 4 | R.C.A | 22.9824 |

TOTAL QUANTITY OF MATERIAL REQUIRD AT DAY 3

| S.NO | MATERIAL | TOTAL QUANTITY (KG) |
|---|---|---|
| 1 | CEMENT | 21.7728 |
| 2 | F.A | 58.78656 |
| 3 | N.C.A | 25.28064 |
| 4 | R.C.A | 43.66656 |

TOTAL QUANTITY MATERIAL REQUIRED SHEET

1. 100X100X100 CUBE

| S.NO. | MATERIAL | QUANTITY (KG/CUBE) | NO. | TOTAL QUANTITY(KG) |
|---|---|---|---|---|
| 1 | CEMENT | 0.4032 | 21 | 8.4672 |
| 2 | F.A | 1.08864 | 21 | 22.86144 |
| 3 | N.C.A | 16.47072 | 1 | 16.47072 |
| 4 | R.C.A | 21.83328 | 1 | 21.83328 |

2. 100X100X500 PRISM

| S.NO. | MATERIAL | QUANTITY (KG/CUBE) | NO. | TOTAL QUANTITY(KG) |
|---|---|---|---|---|
| 1 | CEMENT | 2.016 | 21 | 42.336 |
| 2 | F.A | 5.4432 | 21 | 114.3072 |
| 3 | N.C.A | 82.3536 | 1 | 82.3536 |
| 4 | R.C.A | 109.1664 | 1 | 109.1664 |

TOTAL QUANTITY OF MATERIAL REQUIRED FOR:-
1. 100X100X 100 CUBES
2. 100X100X 500 PRISMS

| S.NO | MATERIAL | QUANTITY (KG) |
|---|---|---|
| 1 | CEMENT | 50.8032 |
| 2 | F.A | 137.16864 |
| 3 | N.C.A | 98.82432 |
| 4 | R.C.A | 130.99968 |

### 6.3 Preparation of mould:-

There are total 9 moulds for cubes of 100X100X100 mm were made and 8 prisms of 100X100X500 mm are made for casting the concrete mix

Fig 11 :- Moulds in which concrete has to be caste

### 6.4 Casting and curing of specimen:-

Totally 21 cubes and 21 prisms were moulded and tested at 28 days, out of which 9 cubes and 9 prisms are casted with one age of reused aggregate with various substitution of natural coarse aggregate like 30 percentage,, 60 percentage, and 100

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percentage. Furthermore, the other 9 cubes and 9 prisms were casted with age two of reused aggregate with same substitution of natural coarse aggregate(N.C.A) the rest of the 3 cubes and 3 prisms were moulded with the conventional concrete with of the same M20 mix

1.4.1 Total 3 cubes and 3 prisms were casted with conventional concrete with M20

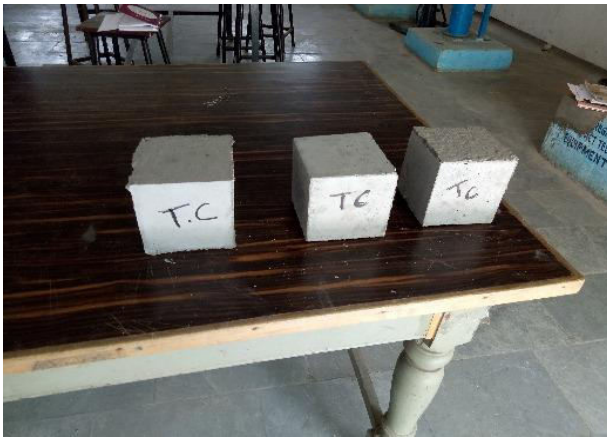


Fig 12:- 3 cubes which were casted with traditional concrete


Fig13: - 3 prisms were casted with traditional concrete

**6.4.2 AGE 1 of recycled aggregate:-**

Fig 14:- 9 cubes and 9 prisms were casted with M20 concrete mix


Fig 15: - 3 cubes casted with AGE 1 recycled coarse aggregate (R.C.A) with 30% substitution of natural coarse aggregate (N.C.A)


Fig 16: - 3 prisms casted with AGE 1 recycled coarse aggregate (R.C.A) with 30% replacement of natural coarse aggregate (N.C.A)

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Fig 17: - 3 cubes casted with AGE 1 recycled coarse aggregate (R.C.A) with 60% replacement of natural coarse aggregate (N.C.A)


Fig 18: - 3 prisms casted with AGE 1 recycled coarse aggregate (R.C.A) with 60% replacement of natural coarse aggregate (N.C.A)


Fig 19: - 3 cubes casted with AGE 1 recycled coarse aggregate (R.C.A) with 100% replacement of natural coarse aggregate (N.C.A)


Fig 20: - 3 prisms casted with AGE 1 recycled coarse aggregate (R.C.A) with 100% replacement of natural coarse aggregate (N.C.A)

1.4.3 AGE 2 of recycled aggregate:-

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Fig 21:-9 cubes and 9 prisms were casted with M20 concrete mix


Fig 22:-: - 3 cubes casted with AGE 2 recycled coarse aggregate (R.C.A) with 30% replacement of natural coarse aggregate (N.C.A)


Fig 23: - 3 prisms casted with AGE 2 recycled coarse aggregate (R.C.A) with 30% replacement of natural coarse aggregate (N.C.A)


Fig 24: - 3 cubes casted with AGE 2 recycled coarse aggregate (R.C.A) with 60% replacement of natural coarse aggregate (N.C.A)

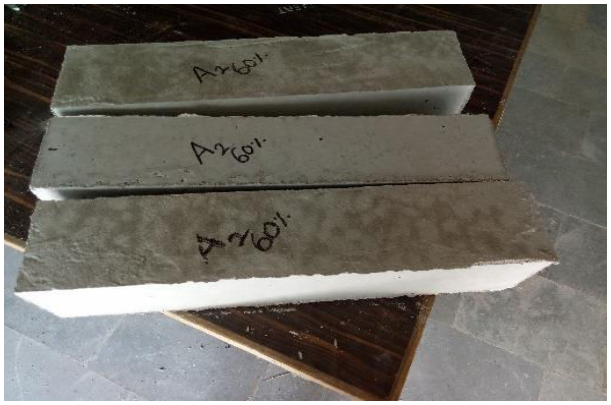


Fig 25: - 3 prisms casted with AGE 2 recycled coarse aggregate (R.C.A) with 60% replacement of natural coarse aggregate (N.C.A)


Fig 26: - 3 cubes casted with AGE 2 recycled coarse aggregate (R.C.A) with 100% replacement of natural coarse aggregate (N.C.A)


Fig 27: - 3 prisms casted with AGE 2 recycled coarse aggregate (R.C.A) with 100% replacement of natural coarse aggregate (N.C.A)

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Curing of specimen:- After casting the specimen, they were to be in the mould for 24 hours and they were unmoulded after 24 hours and submerged in the water for curing of the period 28 day

## 1.0 Test conducted on fresh concrete

Table 13:- Results of Compressive Cube Strength

| S.NO | REPLACEMENT PERCENTAGE | DAYS OF CURING | AGE 1 (10 YEARS) | AGE 2 (40 YEARS) |
|---|---|---|---|---|
| | | | CUBE (N/mm²) | CUBE (N/mm²) |
| 1 | 30 | 28 | 18.976 | 28.250 |
| 2 | 60 | 28 | 26.944 | 30.368 |
| 3 | 100 | 28 | 23.26 | 27.56 |

## 1.1 Flexural strength:-

Table 14:- Results of Flexural Strength Of A Prism Samples

| S.NO | REPLACEMENT PERCENTAGE | DAYS OF CURING | AGE 1(10 YEARS) | AGE 2(40 YEARS) |
|---|---|---|---|---|
| | | | PRISM (N/mm²) | PRISM (N/mm²) |
| 1 | 30 | 28 | 0.0119 | 0.0120 |
| 2 | 60 | 28 | 0.0247 | 0.0210 |
| 3 | 100 | 28 | 0.0441 | 0.0244 |

## 9 RESULT AND DISCUSSION:-

The results which were obtained by conducting tests on the cubes and prism made with different percentage replacement of natural coarse aggregate with recycled coarse aggregate has shown that

1. The full replacement of recycle aggregate are showing the almost same result as of specimen casted with traditional concrete at 28 days curing
2. The replacement of natural coarse aggregate by adding 30 % of recycled aggregate are reaching the strength of the mix
3. While replacing 60% of recycled aggregate with natural coarse aggregate the strength is apparently high in case of cubes and they are some difference in case of prism
4. According to the test results recycle aggregate will give the sufficient results and meet the standard strength of the specimen which were prepared with traditional aggregates
5. Mixing the natural coarse aggregate with recycle coarse aggregate with 60 % replacement are the best combination for getting more strength
6. Prism which were made with 100 % replacement will have the more strength than that of 30 % and 60 % replacement in case of prism
7. Comparing to 100% strength for age 1, age 2 and traditional concrete, the AGE 2 has given the more strength
8. For 30% and 60 % replacement the age 2 has shown the more strength than the age 1 for 28 days curing in case of cube

Chart 1:- showing the compressive strength of cube with AGE 1 recycled aggregate by replacing it with 30%, 60% and 100

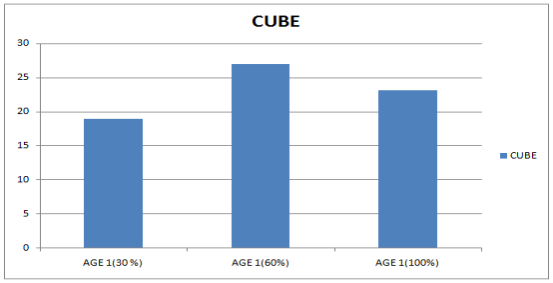


Chart 2:- showing the flexural strength of prism with AGE 1 recycled aggregate by replacing it with 30%, 60% and 100 %

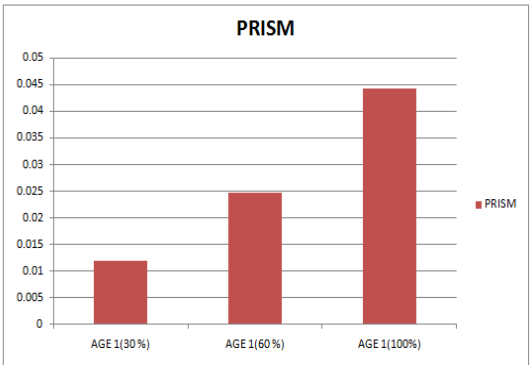

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Chart 3:- showing the compressive strength of cube with AGE 2 recycled aggregate by replacing it with 30%, 60% and 100 %

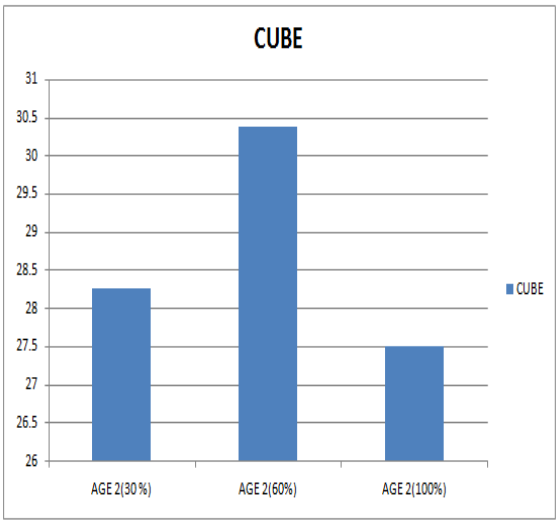


Chart 4:- showing the flexural strength of prism with AGE 2 recycled aggregate by replacing it with 30%, 60% and 100 %

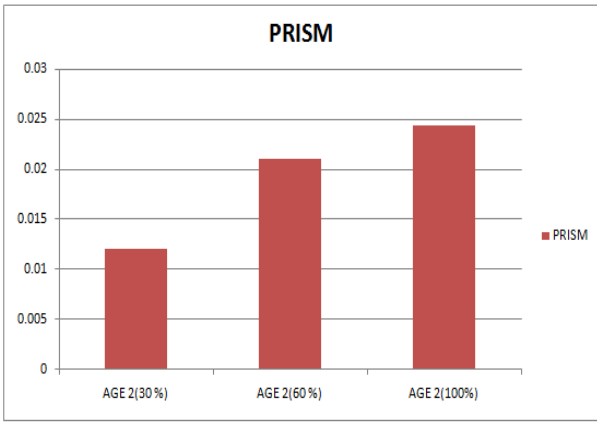


Chart 5:- comparison strength between AGE 1 and AGE 2 with 30 % recycled coarse aggregate

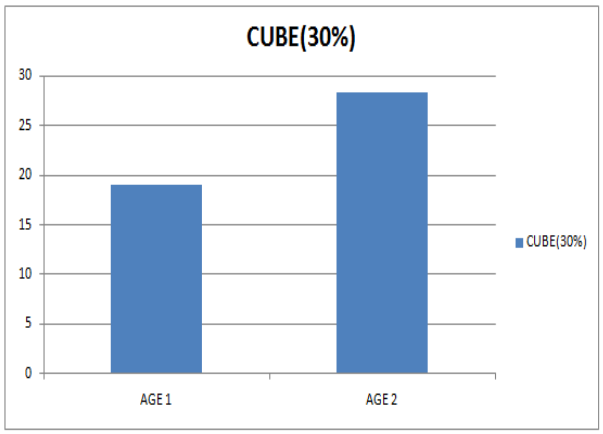


Chart 6:- comparison strength between AGE 1 and AGE 2 with 60 % recycled coarse aggregate

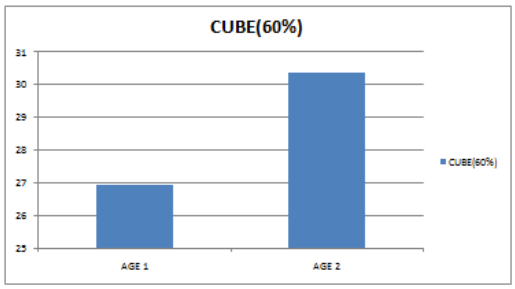


Chart 7:- comparison strength between AGE 1, AGE 2 and traditional concrete with 100% recycled coarse aggregate

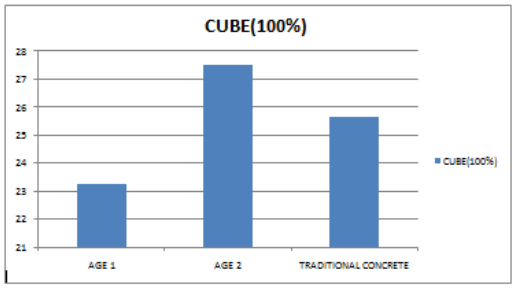


Chart 8:- comparison strength between AGE 1 and AGE 2 with 30 % recycled coarse aggregate

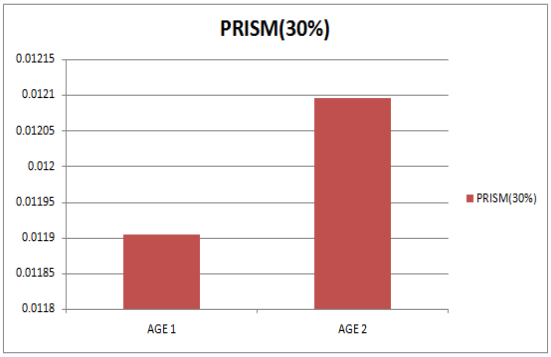


Chart 9:- comparison strength between AGE 1 and AGE 2 with 60 % recycled coarse aggregate

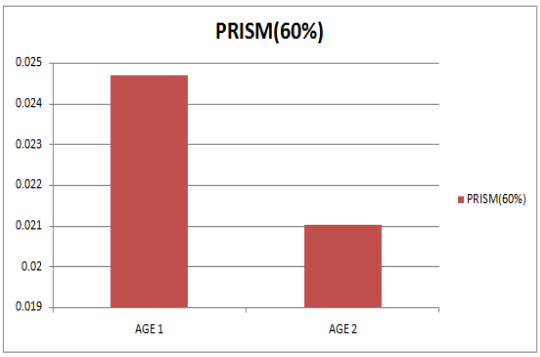

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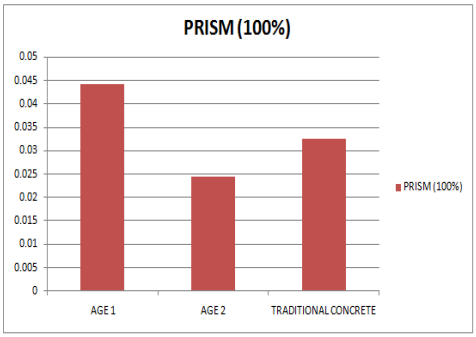
Chart 10:- comparison strength between AGE 1 and AGE 2 and traditional concrete with 100 % recycled coarse aggregate




## 10 Conclusion:-

1. Concrete which has the combination replacing the natural coarse aggregate by recycle coarse aggregate of 30 % has ha small little variant in the strength
2. Concrete mixing with the combination of replacement of natural coarse aggregate with recycle coarse aggregate of higher percentage than 30% are giving the result more than the standard one
3. As the surface of the recycle aggregate is of high angular, it also have an water absorption much higher than the natural coarse aggregate
4. The recycle aggregate has the surface which is attached with the cement particles, thus make the bond much higher than the traditional one

Compressive strength of traditional concrete = 25.67 N/mm$^2$

Table 15:- Test results for the cube

| S.NO | REPLACEMENT PERCENTAGE | DAYS OF CURING | AGE 1 (10 YEARS) CUBE (N/mm$^2$) | AGE 2 (40 YEARS) CUBE (N/mm$^2$) |
|---|---|---|---|---|
| 1 | 30 | 28 | 18.976 | 28.250 |
| 2 | 60 | 28 | 26.944 | 30.368 |
| 3 | 100 | 28 | 23.26 | 27.56 |

Flexural strength of traditional concrete = 0.0325 n/mm$^2$

Table 16:- Test results for the prism

| S.NO | REPLACEMENT PERCENTAGE | DAYS OF CURING | AGE 1(10 YEARS) PRISM (N/mm$^2$) | AGE 2(40 YEARS) PRISM (N/mm$^2$) |
|---|---|---|---|---|
| 1 | 30 | 28 | 0.0119 | 0.0120 |
| 2 | 60 | 28 | 0.0247 | 0.0210 |
| 3 | 100 | 28 | 0.0441 | 0.0244 |