



Experimental Study on Partial Replacement of Coarse Aggregate with Aluminium Caps and Fully Replacement of River Sand with M-Sand and Eco-Sand

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ABSTRACT - In this modern days conventional concrete has lost its usage and it does not serve the present needs. Hence to improve the ultimate strength, durability and the workability of the concrete, we are going to design the high strength concrete of grade M50 by partially replacing the coarse aggregates with Aluminium Caps and fully replacing the river sand with M-Sand and Eco-Sand. We are also used the super plasticizers as chemical admixtures in order to achieve good workability. The study is initiated by 10% replacement of coarse aggregate. By using Aluminium caps in concrete it is also noted that up to certain limit we can reduce the corrosion effect in the structural members. By using Aluminium caps in concrete it is also noted that up to certain limit we can reduce the corrosion effect in the structural members. The M-Sand & Eco-Sand are characterized and fully replaced in the ratio (82+18)%, (79+21)%, (76+24)%, (73+27)%, (70+30)%, and (67+33)% by weight of river sand in concrete. Fresh concrete tests like compaction factor test and slump cone test were conducted as well as hardened concrete tests like Compressive strength, Split Tensile strength at the age of 7, 14 and 28 days has been done for M50 grade of concrete. Test results are compared between conventional concrete and Replaced Concrete with Aluminium Caps, M-Sand & Eco-Sand on different percentages used as partial and complete replacement.

I. INTRODUCTION

Concrete comprises of mixtures of cement, fine aggregate, coarse aggregate and water in required proportions. The hardening of concrete is caused by chemical action between water and cement due to which concrete grows stronger with time period. The strength, durability and other characteristics of concrete depends upon the properties of its ingredients, the proportion of the mix, the method of compaction and other controls during placing, compacting and curing.

Concrete have a high compressive strength and non-corrosive nature which is obtained from locally available materials. Hence, concrete is a major composite material in all present-day constructions.

II. OBJECTIVE

- To use locally available waste material.
- To reduce emission of pollutants.
- To attain the various workability, durability, strength resistance to cracks.
- To study the behavior of the concrete.
- To increase the life span of concrete.

| | |
|---------------|-----------------------|
| Density | 2.8 g/cm ³ |
| Melting point | 659.32°C |
| Boiling point | 2519°C |

TABLE: 1 PROPERTIES OF ALUMINIUM CAPS



| PROPERTIES | RESULT |
|------------------|--------|
| Specific Gravity | 2.41 |
| Fineness Modulus | 0.029 |

TABLE: 2 PHYSICAL PROPERTIES OF ECO-SAND

| SI.NO | Name of the Chemicals | Amount % |
|-------|---|----------|
| 1 | Silica (SiO ₂) | 68.1 |
| 2 | Iron (Fe ₂ O ₃) | 1.8 |
| 3 | Alumina (Al ₂ O ₃) | 10.8 |
| 4 | Potassium (K ₂ O) | 4.4 |
| 5 | Loss on Ignition (H ₂ O) | 11.4 |
| 6 | Calcium (CaO) | 2.2 |
| 7 | Sodium (Na ₂ O) | 0.7 |
| 8 | Magnesium (MgO) | 0.6 |

TABLE: 3 CHEMICAL COMPOSITION OF ECO-SAND

| SI.NO | Property of M-Sand | Value |
|-------|--------------------|--------|
| 1 | Specific Gravity | 2.69 |
| 2 | Fineness modulus | 5.3 |
| 3 | Fineness modulus | 7.1 |
| 4 | Fineness modulus | Smooth |

TABLE: 4 M-SAND PROPERTIES

III. RESULTS

Compressive strength test of conventional concrete and aluminium caps, Eco-sand and M-sand for 28 days are shown in tables and in bar charts and graphs.

Compressive strength tests and split tensile tests of conventional concrete as well as partial replacements of coarse aggregate with aluminium caps and fully replacement of river sand with M-sand and Eco-sand were conducted. The test results are presented in Tables



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COMPRESSIVE STRENGTH OF CUBE

| SI. NO. | REPLACEMENTS IN % (AC+ES+MS) | LOADS | AVG. LOAD (KN) | COMPRESSIVE LOAD (N/mm ²) |
|---------|------------------------------|-------|----------------|---------------------------------------|
| 1 | 0 | 1250 | 1250 | 55.55 |
| | | 1240 | | |
| | | 1260 | | |
| 2 | (10+18+82) | 1480 | 1470 | 65.60 |
| | | 1470 | | |
| | | 1480 | | |
| 3 | (10+21+79) | 1490 | 1490 | 66.22 |
| | | 1480 | | |
| | | 1500 | | |
| 4 | (10+24+76) | 1510 | 1520 | 67.55 |
| | | 1530 | | |
| | | 1520 | | |
| 5 | (10+27+73) | 1410 | 1420 | 63.11 |
| | | 1420 | | |
| | | 1430 | | |
| 6 | (10+30+70) | 1400 | 1390 | 61.77 |
| | | 1390 | | |
| | | 1380 | | |
| 7 | (10+33+67) | 1330 | 1340 | 59.55 |
| | | 1350 | | |
| | | 1340 | | |

TABLE: 5 COMPRESSIVE STRENGTH OF PARTIALLY REPLACED CONCRETE ON CUBES AT 28 DAYS

MAXIMUM COMPRESSIVE STRENGTH OBTAINED CUBE

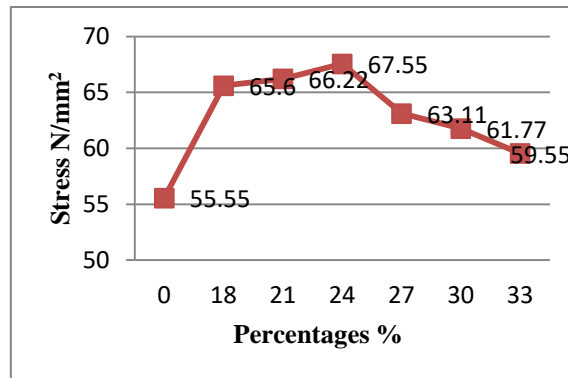


Fig 1

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ECO-SAND



Fig 2

ALUMINIUM CAPS



Fig 3

M-SAND



Fig 4

| S.NO | NO OF CURING DAYS | NO.OF SPECIMEN | AVG LOAD(KN) | COMPRESSIVE STRENGTH(N/mm ²) |
|------|-------------------|----------------|--------------|--|
| 1 | 7 | 3 | 965 | 42.86 |
| 2 | 14 | 3 | 1198 | 53.24 |
| 3 | 28 | 3 | 1412 | 62.76 |

TABLE: 6 MAXIMUM COMPRESSIVE STRENGTH OF PARTIAL REPLACEMENT OF ADMIXTURES IN CUBES



MAXIMUM COMPRESSIVE STRENGTH OF CUBE BY REPLACED CONCRETE

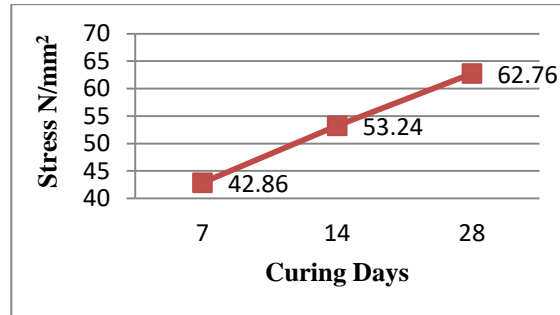


Fig 5

TABLE: 7 REPLACEMENT OF ADMIXTURES IN M50 CONCRETE

| S. NO | % OF ALUMINIUM CAPS | % OF COARSE AGGREGATE | % OF ECOSAND | % OF M SAND | % OF RIVER SAND |
|-------|---------------------|-----------------------|--------------|-------------|-----------------|
| 1 | 0 | 100 | 0 | 0 | 100 |
| 2 | 10 | 90 | 18 | 82 | 0 |
| 3 | 10 | 90 | 21 | 79 | 0 |
| 4 | 10 | 90 | 24 | 76 | 0 |
| 5 | 10 | 90 | 27 | 73 | 0 |
| 6 | 10 | 90 | 30 | 70 | 0 |
| 7 | 10 | 90 | 33 | 67 | 0 |

| SI. NO. | REPLACEMENTS IN % (AC+ES+MS) | LOADS | AVG. LOAD (KN) | COMPRESSIVE LOAD (N/mm ²) |
|---------|------------------------------|-------|----------------|---------------------------------------|
| 1 | 0 | 280 | 276 | 3.91 |
| | | 280 | | |
| | | 270 | | |
| 2 | (10+18+82) | 320 | 324 | 4.58 |
| | | 330 | | |
| | | 320 | | |
| 3 | (10+21+79) | 370 | 373 | 5.10 |
| | | 380 | | |
| | | 370 | | |
| 4 | (10+24+76) | 380 | 380 | 5.37 |
| | | 370 | | |



| | | | | |
|---|------------|-----|-----|------|
| | | 390 | | |
| 5 | (10+27+73) | 400 | 393 | 5.56 |
| | | 390 | | |
| | | 390 | | |
| 6 | (10+30+70) | 390 | 383 | 5.42 |
| | | 380 | | |
| | | 380 | | |
| 7 | (10+33+67) | 340 | 346 | 4.90 |
| | | 350 | | |
| | | 350 | | |

TABLE: 8 SPLIT TENSILE STRENGTH OF PARTIAL REPLACEMENT OF ADMIXTURES IN CYLINDERS AT 28 DAYS

SPLIT TENSILE STRENGTH OF PARTIALLY REPLACED CONCRETE ON CYLINDER AT 28 DAYS

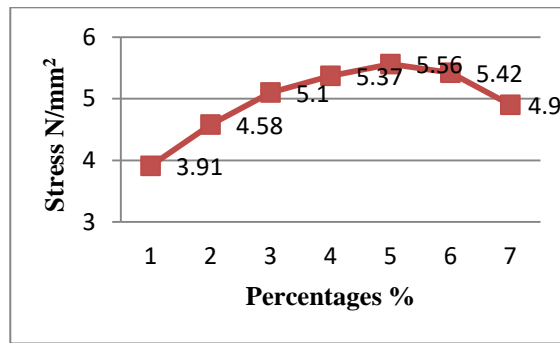


Fig 6

| S.NO | NO OF CURING DAYS | NO.OF SPECIMEN | AVG. LOAD(KN) | SPLIT TENSILE STRENGTH(N/mm²) |
|------|-------------------|----------------|---------------|-------------------------------|
| 1 | 7 | 3 | 320 | 4.53 |
| 2 | 14 | 3 | 344 | 4.86 |
| 3 | 28 | 3 | 366 | 5.18 |

TABLE: 9 MAXIMUM SPLIT TENSILE STRENGTH OF PARTIAL REPLACEMENT OF MINERAL ADMIXTURES IN CYLINDER

MAXIMUM SPLIT TENSILE STRENGTH OF CYLINDER BY REPLACED CONCRETE

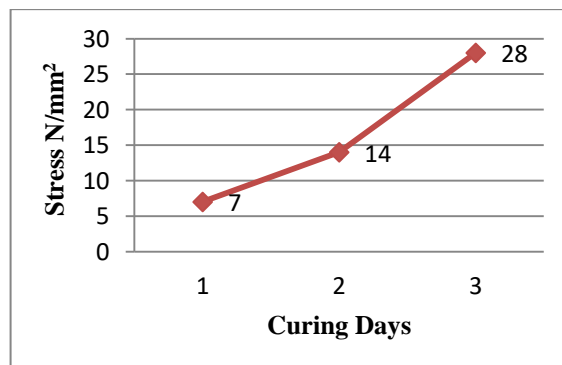


Fig 7

IV. CONCLUSION

This Study clearly indicates that 10% percentage of replacement of coarse aggregate with aluminium caps and (27+73)% percentage of river sand with eco-sand and m-sand is encouraging and the compressive strength is higher than the conventional concrete. The above 27% replacement of eco sand with 10% replacement of aluminium caps brings in a savings of about 16% of the total cost in m³ of concrete. The compressive strength value of concrete decreases while aluminium caps are kept increasing at a rate of 10%. The replacement of eco-sand and m-sand percentages increasing above (30+70)% then the compressive strength and split tensile strength of concrete are decreased.

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