

## **“Experimental study of strength relationship of concrete cube and concrete cylinder using ultrafine slag Alccofine”**

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### **ABSTRACT:**

This paper presents a comparison between cubical strength and cylindrical strength of normal concrete and with partial replacement of cement with ultra fine slag (Alccofine). Ultra fine slag materials are very much important for improving the durability and workability of concrete to sustain a longer life span and producing a greener and quality concrete. Incorporating ultra fine slag as a mineral admixture improves the workability and pump ability of fresh concrete. The ultra fine slag acts as filler thus also reduces permeability. In this paper mechanical strength development of high strength concrete (M50) with partial replacement of cement by ultra fine slag (alccofine) is carried out. Comparison is done between cubical strength and cylindrical strength of M50 grade concrete using ultra fine slag.

Key words: Alccofine, ultra fine slag, durability, segregation.

### **I INTRODUCTION:**

Creating quality concrete in the present climate does not depend solely on achieving high strength property. Improving the durability of the concrete to sustain a longer life span and producing a greener concrete are becoming one of the main criteria in obtaining a quality concrete. Compressive strength of concrete is important because the main properties of concrete such as elastic modulus, tensile strength are related to this property. Concrete compression strength also plays a vital role when we focus more on load bearing capacity of structures. Compression test is the most common test conducted on the hardened concrete because it is an easy test to perform and most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. In this work the effect of ultra fine slag (Alccofine) replacement on the mechanical properties of high strength concrete is studied. It has been found that use of ultra fine slag not only improves the compressive strength of concrete but also improves the workability and fluidity of the mix. It also shows segregation resistance and improved reliability and durability of the reinforced concrete structures

## II MATERIALS:

**Cement:** 43 Grade OPC conforming to IS: 8112:1989

Properties: specific gravity = 3.15

Normal consistency (P) = 26.5%

Fineness = 4%

**Aggregate:** sieve analysis of coarse and fine aggregate was performed and their fineness modulus was determined. Zone of the fine aggregates was found out to zone III.

Table 1: Sieve analysis of fine aggregate:

Sieve analysis of fine Aggregates conforming to IS:383-1970					
IS sieve size	Weight retained(gm)	Cumulative weight retained	Cumulative percentage retained	Cumulative percentage passing	conclusion
4.75mm	14.2	14.2	1.42	98.58	<b>As per IS:383-1970 this sand conforms to Zone IV</b>
2.36mm	57.4	71.6	7.16	92.84	
1.18mm	109.4	181	1.81	98.19	
600μ	90.8	271.8	2.71	97.29	
300 μ	175.6	447.4	44.7	55.3	
150 μ	452.8	900.2	90.2	9.8	
Less than 150μ	99.5	999.7	99.7	NA	
	Total= 1000gm				

From Table 1 we get fineness modulus (F.M) of fine aggregates = **2.477**

Table 2: Sieve analysis of coarse aggregate:

IS sieve size	Weight retained(gm)	Cumulative weight retained	Cumulative percentage retained	Cumulative percentage passing
80mm	0	0	0	100
40mm	0	0	0	100
20mm	0	0	0	100
12.5mm	1387.3	1387.3	69.36	30.64
10mm	430.09	1817.39	90.87	9.13
6.30mm	182.56	1999.95	100	0
4.75mm	0	1999.95	100	0

### III EXPERIMENTAL WORKS

For the experimental work mix prepared was of M50 grade concrete. The cubes were cast in steel moulds of 150mm×150mm×150mm (IS 10086:1982). The cylinders were also cast in steel moulds of dia 150mm and height 300mm (IS 10086:1982). Mix proportions (Kg/m<sup>3</sup>) for grade M50 has been determines as per IS: 10262-1982 and IS: 456-2000. water cement ratio was taken 0.40 which is less than maximum w/c ratio as per IS 456:2000 for moderate exposure condition

Table3: Mix proportion (Kg/m<sup>3</sup>) for grade M50 (w/c= 0.40)

Grade	water	cement	Fine aggregate	Coarse aggregate
M50	174	436	338	1395

Concrete was prepared under moderate exposure condition and quality control was good. It was poured into cubical and cylindrical moulds and placed on vibrating table to minimize air entrapped which would otherwise affect the compressive strength. After 24 hrs the moulds were removed and the specimens were kept for curing at room temperature until taken out for testing.

Specimens were tested at different ages i.e. 3 days, 7 days and 28 days compressive strength. The load is applied at a constant rate thus ensuring progressive increase in stress as failure approached. For the cylinders the top surface of the cylinder was kept in contact with the platen of the existing machine (fig1). For evolution of performance of concrete using ultra fine slag (Alccofine) different mixes were produced using partial replacement of cement using Alccofine are proposed. These are subdivided into eight as follows groups

1. Control concrete without alccofine.(C0)
2. Control concrete with 3% alccofine(C3)
3. Control concrete with 5% alccofine(C5)
4. Control concrete with 7% alccofine (C7)
5. Control concrete with 10% alccofine (C10)
6. Control concrete with 13% alccofine (C13)
7. Control concrete with 15% alccofine (C15)
8. Control concrete with 18% alccofine (C18)

Similarly for cylindrical strength it is designated as S0, S3, S5, S7, S10, S13, S15, and S18



Fig1: cube kept in CTM before testing (left) cube kept in CTM after testing (right)

#### IV RESULTS AND DISCUSSION:

Hardened properties of concrete for both cubical and cylindrical strength for different percentages of alccofine is tabulated below

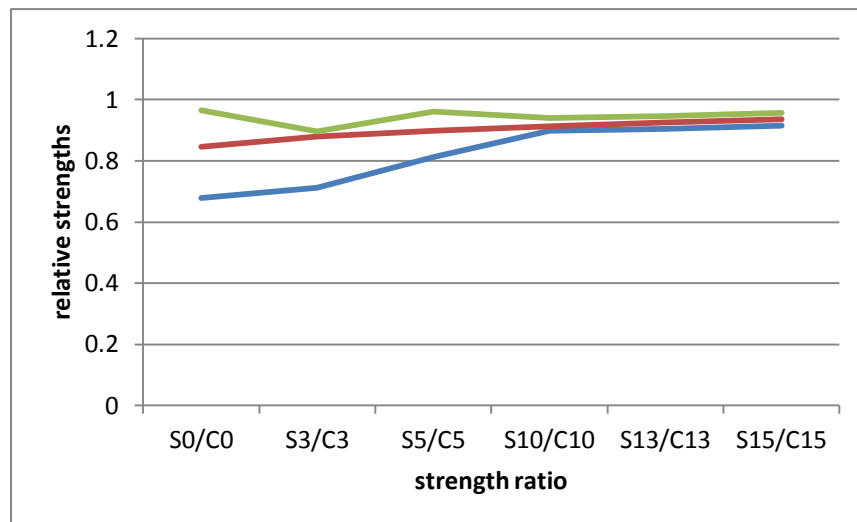
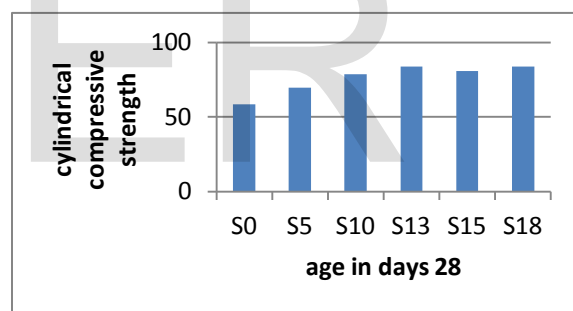
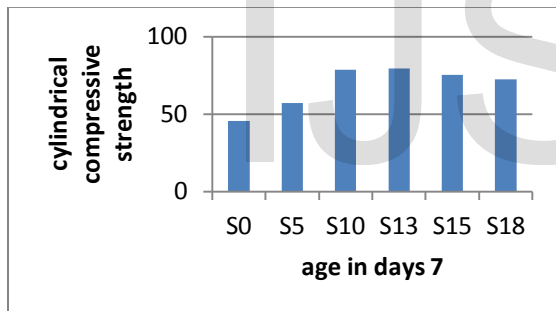
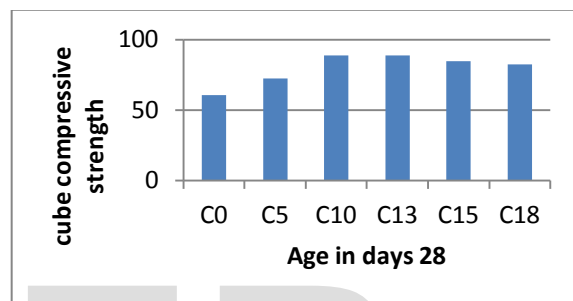
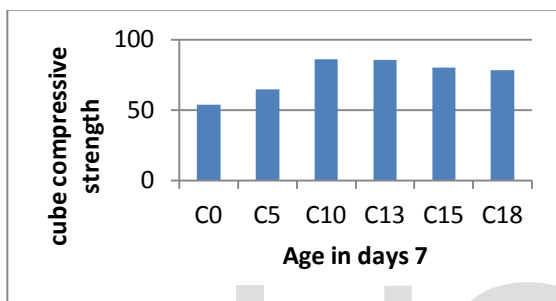
Table3: cubical and cylindrical compressive strength

Mix Name	Average compressive cube strength in (MPa) at		
	<b>3 days</b>	<b>7 days</b>	<b>28 days</b>
C0	27.1	54	60.46
C3	29.8	59.5	64.5
C5	31.4	64.8	72.4
C7	33.6	66.2	75.6
C10	38.6	86.2	88.6
C13	37.6	85.6	88.8
C15	32.7	80.1	84.7
C18	29.4	78.5	82.6

Mix Name	Average compressive cylinder strength in (MPa) at		
	<b>3 days</b>	<b>7 days</b>	<b>28days</b>
S0	18.40	45.6	58.40
S3	21.23	52.35	61.30
S5	25.60	57.30	69.80
S7	30.10	59.64	72.40
S10	34.66	78.70	83.80
S13	34.02	79.30	83.90
S15	29.70	75.20	80.60
S18	26.20	72.50	78.60

Table4: Relative strength of specimens

Ratio of cylinder to cube strength	Relative strengths of specimens		
	3days	7 days	28 days
S0/C0	0.678	0.845	0.965
S3/C3	0.712	0.879	0.897
S5/C5	0.812	0.898	0.960
S10/C10	0.898	0.913	0.940
S13/C13	0.905	0.926	0.946
S15/C15	0.915	0.936	0.956



## V CONCLUSIONS

Compressive strength on concrete using different properties of alccofine are evaluated. Compressive strength between cubical and cylindrical of concrete are compared. From the limited experimental investigations following conclusions can be drawn

- 1) Hardened properties of concrete with alccofine are enhanced.
- 2) Optimum alccofine percentage which enhances the hardened properties of cube and cylindrical concrete is 13%.
- 3) After 10% replacement of alccofine there is very nominal change in the strength of conventional concrete.
- 4) Cylindrical strength of concrete increases after addition of alccofine but always less than its cubical counterpart.

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