

# Experimental Studies on Concrete with Bentonite as Mineral Admixture

**M. Chandrakanth**

*Assistant Professor*

*Department of Civil Engineering*

*SIR C R Reddy College of Engineering, Eluru.*

**N. S. Poorna Chandra Rao**

*Assistant Professor*

*Department of Civil Engineering*

*SIR C R Reddy College of Engineering, Eluru.*

**K. Srinivasa Rao**

*Assistant Professor*

*Department of Civil Engineering*

*SIR C R Reddy College of Engineering, Eluru.*

## Abstract

The present investigation deals with effect of bentonite clay on concrete. The concrete was produced by partial replacement of OPC with mineral admixture bentonite clay in percentages of 0%, 5%, 10%, 15% and 20%. The M20 grade of concrete was designed. The compressive strength, split tensile strength and flexural strength were found for the specimens. The present investigation is to study the effect of bentonite clay on concrete. The results indicate that the concrete with 5% Bentonite Clay replacement shows better performance when compared to other samples. The compressive strength, split tensile strength and flexural strength at 5% bentonite clay replacement and it was less for the remaining samples.

**Keywords-** Bentonite clay, flexural strength, compressive strength, split tensile strength etc.

## I. EXPERIMENTAL INVESTIGATION OF MATERIALS

In this project 53 Grade KCP Cement is used. The following tests are conducted on Cement, experimental results are tabulated below.

### A. Test Results of Cement:

Table – 1 Test Result of Cement

S.No.	Test Conducted	Test Result
1	Fineness	3%
2	Consistency	28.5%
3	Initial Setting Time	55 min
4	Final Setting Time	5 hr
5	Specific gravity of cement	2.936
6	Compressive Strength	53 MPa

According to the code IS 456-2000 provisions satisfying the permissible limits

### B. Test Results of Fine Aggregate:

The fineness modulus of fine aggregates experimental results are tabulated given below, these results are satisfied the IS code provisions.

Table – 2: Test Results of Fine Aggregate

IS sieve size (mm)	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % weight retained	Cumulative % passing
4.75	2.98	2.98	0.298	99.70
2.36	4.77	7.75	0.775	99.225
1.18	22.10	29.81	2.981	97.019
0.6	83.69	113.54	11.354	88.646
0.3	817.00	930.54	93.054	6.946
0.15	56.56	987.10	98.71	1.290
Pan	17.40	999.50	99.95	0

Fineness modulus of Fine aggregate= $307/100=3.07$ .

With the help of above results the zone confirmation as per IS 383-1970 zone-III, this confirmation depends on the percentage passing of the materials.

From the fineness modulus value also usefully for the nature of concrete property nothing but the higher fineness value results more amount of water is required for the mobility of the concrete.

**C. Sieve Analysis of Coarse Aggregates:**

Table – 3: Sieve Analysis of Coarse Aggregates

IS sieve size (mm)	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % weight retained	Cumulative % passing
80	0	0	0	100
40	0	0	0	100
20	1699	33.98	33.98	66.02
10	3301	66.02	100	0
4.75	0	0	100	0
2.36	0	0	100	0
1.18	0	0	100	0
600 micron	0	0	100	0
300 micron	0	0	100	0
150 micron	0	0	100	0

Fineness modulus of coarse aggregate=733.98/100=7.33

**II. MIX DESIGN**

As per 10262-2009 mix design code using for the design of the M20 grade of concrete, below mentioned details are mix design proportions. Number of trial and error mix design we can get the target strength results, in this mix design the standard slump value is 50mm and 20mm nominal aggregate size the water content is maintained 186 lit according to the IS 10262-2009 code. From the test results water cement ratio is 0.47.

Table – 4: Mix Design

W	C	FA	CA
186	395.5	640.07	1185.08
0.47	1	1.62	2.99

**III. RESULTS AND DISCUSSIONS**

**A. Test Results for Compressive Strength of Concrete Cubes:**

Table – 5: Test Results for Compressive Strength of Concrete Cubes

S.No	W/C Ratio	Percentage of cement	Percentage of bentonite	Compressive strength at 7 days MPa	Compressive strength at 28 days MPa
1	0.47	100	0	21.33	25.77
2	0.47	95	5	22.66	26.67
3	0.47	90	10	22.22	25.77
4	0.47	85	15	21.72	25.10
5	0.47	80	20	21.33	24.44

Average compressive strength at 7 days at 5% bentonite clay is 22.62Mpa

Average compressive strength at 28 days at 5% bentonite clay is 26.67Mpa

**B. Test Results for Split Tensile Strength of Cylinder:**

Table – 6: Test Results for Split Tensile Strength of Cylinder

S.No.	W/C ratio	Percentage of cement	Percentage of bentonite	Split tensile strength at 7 days (MPa)	Split tensile strength at 28 days (MPa)
1	0.47	100	0	2.5	3.5
2	0.47	95	5	2.96	3.8
3	0.47	90	10	2.8	3.67
4	0.47	85	15	2.65	3.49
5	0.47	80	20	2.5	3.25

Average Split Tensile strength at 7 days at 5% bentonite clay is 2.96Mpa

Average Split Tensile strength at 28 days at 5% bentonite clay is 3.8Mpa

**C. Test Results for Flexural Strength of Beam:**

Table – 7: Test Results for Flexural Strength of Beam

S.No	W/C ratio	Percentage of cement	Percentage of bentonite	Flexural strength at 7 days	Flexural strength at 28 days
1	0.47	100	0	12.5	20
2	0.47	95	5	17.5	25
3	0.47	90	10	15	20

4	0.47	85	15	13.75	17
5	0.47	80	20	12.5	15

Average flexural strength at 7 days at 5% bentonite clay is 17.5Mpa

Average flexural strength at 28 days at 5% bentonite clay is 25Mpa

When the tests were conducted on the specimens casted keeping the water cement ratio constant and varying the percentage of Bentonite Clay is the partial replacement with cement, the above results were obtained out of all the percentages attempted, the cube casted with 5% replacement has got the maximum results. Similarly split tensile strength of cylinder and flexural strength of beams also gives the maximum strength results at 5% of bentonite clay. Hence more than 5% bentonite clay strengths of the above mentioned tests are reduced, actually the above calculation 70 percent of strength is arrived in seven days at 5 % bentonite clay.

**D. Strengths Variation Charts:**

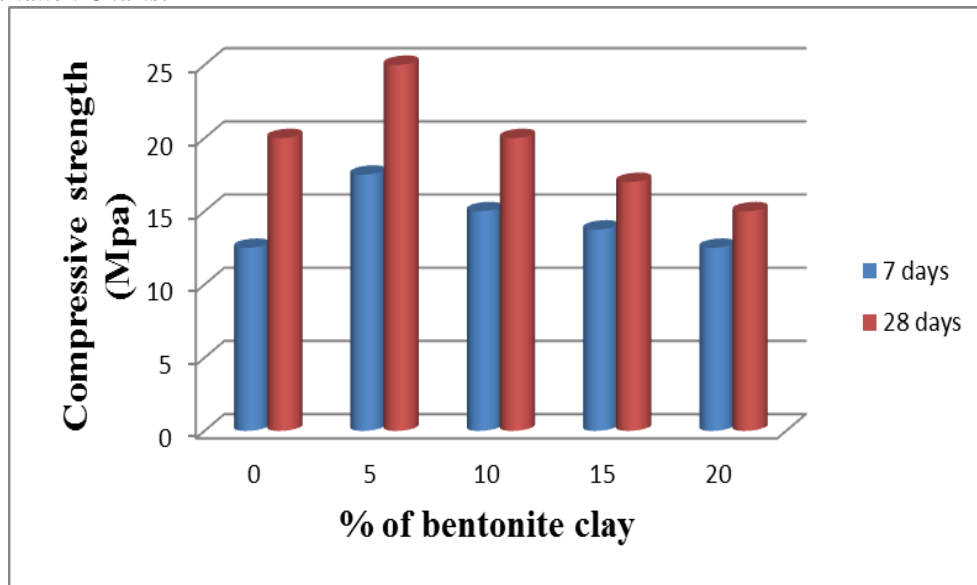


Fig. 1: compressive strength variation for 7 and 28 days

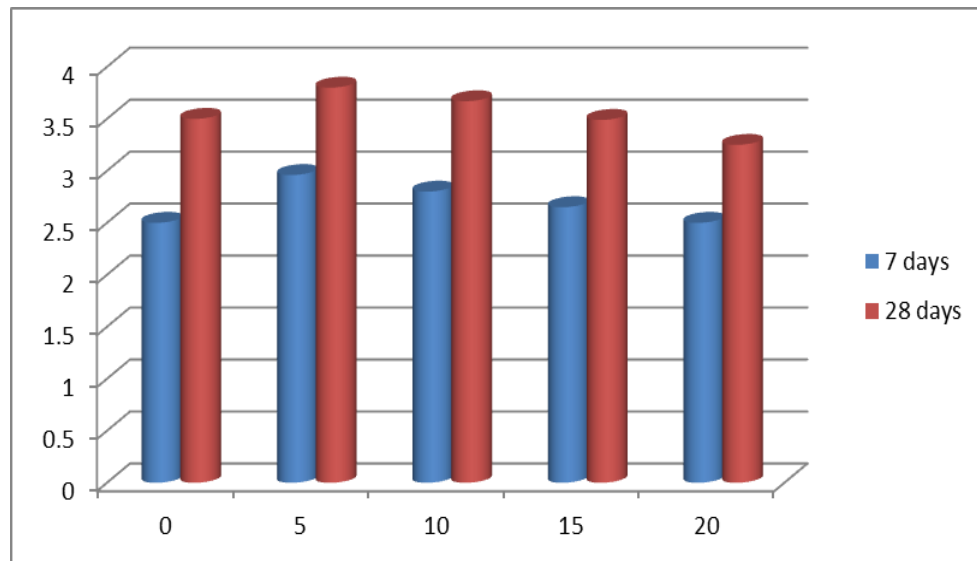


Fig. 2: Flexural strength variation for 7 and 28 days

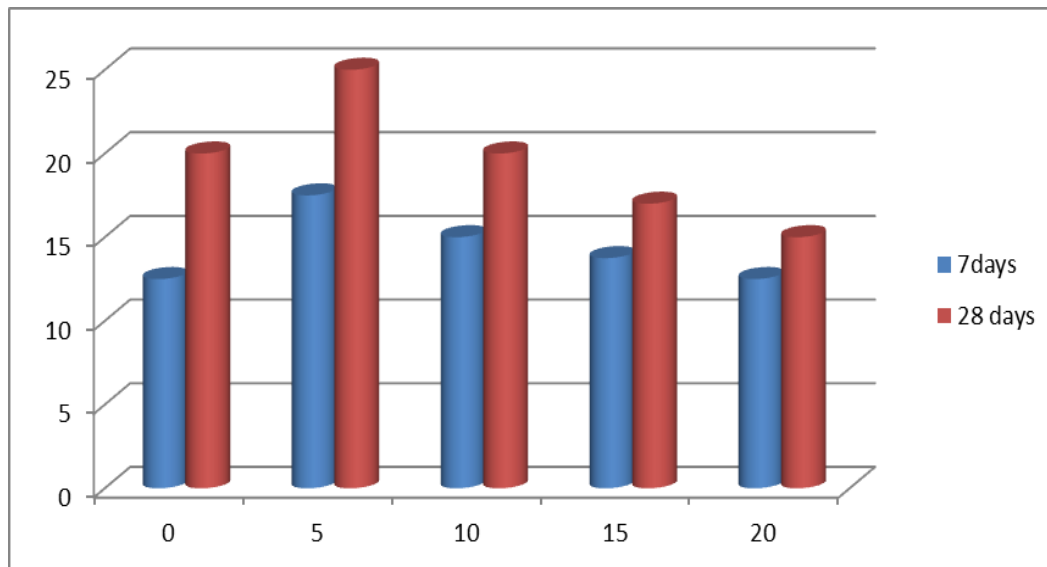


Fig. 3: Split tensile strength variation for 7 and 28 days

#### IV. CONCLUSIONS

The following conclusions were drawn from the present investigation.

- The results show that, as the Bentonite clay content is increase from 0 to 20% in concrete, the workability decreases.
- The results show that when 5 % Bentonite clay is added to the concrete, it achieves higher compressive strength compared to other percentages (i.e., 0%, 10%, 15%, and 20%)
- The results show that when 5% Bentonite clay is added to the concrete, it achieves higher flexural strength compared to other percentages (i.e., 0%, 10%, 15%, and 20%)
- The results show that when 5% Bentonite clay is added to the concrete, it achieves higher split tensile strength compared to other percentages (i.e., 0%, 10%, 15%, and 20%)

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