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Experimental Study on Partial replacement of Cement with Bentonite clay And Fine Aggregate with Quarry dust

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ABSTRACT
Bentonite is natural pozzolanic material have cementitious properties used as partial replacement of cement at equal interval of replacement. To reduce the cement work and use the alternative material to reduce the Co_2 emits by cement production. Bentonite will help to reduce greenhouse gas emission and gives more durability in the concrete structure. Bentonite creates perfection in pore structure of concrete mix and the ability to resist sulfuric acid attacks. Bentonite is also use as a resistance to chloride ion attack. The partial replacement of cement with bentonite clay is introduced with different percentages 5%, 10%, 15%, 20%, 25% in concrete and several tests were conducted for design mix M25.Quarry dust is choose as an alternative to river sand and gives more benefits for concrete. Quarry dust is increase the strength in concrete and use fully replacement of sand due to their very fine particle propertiesSplit tensile strength and flexural strength tests results found to be maximum strength at 10% replacement of bentonite with 75% quarry dust in split tensile and flexural strength. The compressive strength increase at 20% replacement of bentonite and 75% of quarry dust and also increase in Durablity with the ages.

KEYWORDS: Bentonite clay**,** Quarry dust, M25 Mix, Compressive strength, Split Tensile Strength, Flexural Strength and Conventional Concrete.

I. INTRODUCTION

In modern time, construction is the main part of structural development of the nation. Concrete is the most important part of the construction whose manufacturing composed of components such as cement, aggregates, water and admixtures. In the construction, concrete is used to meet all the requirements such as strength, workability, durability and fire resistance. As we know growth of industrialization is increased day by day, due to which large amount of waste is also produced this is the major drawback to dispose safely. Hence to control this problem the reuse of recycle of the waste can also be done. Hence the waste generated by the industries and agriculture field can be used as a substituent construction material, so that production of natural resources can be easily done and disposal of harmful waste can be reuse and reduced.In present, due to rising construction work, the need of raw material such as aggregates etc. also raise the increase in demand of concrete. So this is based on the reuse of the Quarry dust as waste with replacement of sand and replacement of cement with Bentonite clay in concrete.

II. MATERIAL USED:

In this research work various materials like cement, bentonite clay, quarry dust, fine aggregates, coarse aggregate are used.

2.1 CEMENT :

Cement is the most important properties of concrete and acts as a binding material and regular Portland cement is one of the maximum widely used sort of Portland cement. Ordinary Portland cement has initial setting time is not less than 30 minutes and final setting time not greater than 10 hours. Various features of OPC is classifies into three grades i.e. 33 grade, 43 grade and 53 grade. In this investigation, grade 53 OPC was used.

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Table 1: Physical Properties of Cement

SR. NO.	CHARACTERISTICS	UNITS	RESULTS	VALUE SPECIFIED
1.	Consistency		30%	25-30%
2.	Specific Gravity		2.89	3.15
3.	Setting time (1) Initial (2) Final	Minutes	 89 390	 30 (minimum) 600(maximum)
4.	Compressive Strength (1) 3 days (2) 7 days (3) 28 days	Mm2	 15.3 24.3 39.7	 23 33 43
5.	Fineness	m2/kg	268	
6.	Le-chat expansion	mm	0.5	10
7.	Autoclave expansion		0.11	0.8

2.2 COARSE AGGREGATE:

Aggregates mostly used for manufacture of concrete are sand, gravel, broken bricks, saw dust etc. coarse aggregates are those materials which is retained on IS Sieve no. 4.75. Locally available coarse aggregate were used in this investigation having the sie of 10mm and 20mm.

Table 2 : Properties of Coarse Aggregates (IS: 383-1970)

SR. NO.	CHARACTERISTICS	VALUES
1	Colour	Grey
2	Shape	Angular
3	Maximum Sie	20mm
4	Specific Gravity	2.73
5	Fineness Modulus	6.99

2.3 FINE AGGREGATE:

Fine aggregates are those materials which are passing through 4.75mm IS sieve were obtained from locally available river. The fine aggregate is classified to fall under different one i.e. one I to IV as per the recommendations of IS: 383-1970.

Table 3 : Physical Properties of Fine Aggregates

SR. NO.	PHYSICAL PROPERTIES	OBSERVATION	UNITS
1	Appearance	Dark Grey	-
2	Specific Gravity	2.65	-
3	Water absorption	1.43	%
4	Moisture Content	0.17	%
5	Bulk Density (Loose)	1672	Kg/m3
6	Bulk Density (Compacted)	1900	Kg/m3

2.4 **BENTONITE CLAY:**

In this experimental work we use sodium-calcium bentonite as a partial replacement of cement at particular ratio in design mix of concrete which is suitable for gaining in strength of concrete. Bentonite is a pozzolanic material which have cementing properties creates maximum filling pore ratio. The natural calcium bentonite as allowable swelling with 9ph value. It compose crystal structure of momtmorillonite as a 2:1 type with silicate, with low permeability and high sulfate resistance. It indicates the bentinite clay improve the structure of concrete at specific replacement of cement with bentonite clay.

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Table no. 4 Chemical composition of Bentonite clay in research work

Property	Value
Silicon dioxide (SiO_2)	54.55
Aluminum Oxide (Al_2O_3)	20.19
Ferric oxide (Fe_2O_3)	8.60
Megnesium oxide (MgO)	4.20
Calcium oxide (CaO)	7.28
Sodium oxide ($Na_2 O_3$)	1.27
Potassium oxide (K_2O)	3.92
Phosphorus pentoxide (P_2O_5)	1.107
Titanium oxide (TiO_2)	0.91
Loss in ignition (LoI)	5.42

2.5 QUARRY DUST

Quarry dust is a by-product of crushing rocks, crushing stone dust, dust pollution waste from cement industry or other construction quarry waste have more fine particles. Quarry dust is similar from sand and used as fine aggregate in concrete mix 50% to 75% replacement of sand. Quarry dust have more fine particles and minimize the pore ratio in concrete mix.

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Table No. 2 Physical properties of quarry dust

Properties	Quarry Dust	Natural sand	Test method
Specific gravity	2.50-2.60	2.60	IS2386(PART-3)- 1963
Bulk density	1720-1810	1460	IS2386(PART-3)- 1963
Absorption	1.20-1.50	Nil	IS2386(PART-3)- 1963
Moisture content	Nil	1.50	IS2386(PART-3)- 1963
Fine particles less than 0.075mm	12-15	6	IS2386(PART-3)- 1963
Sieve analysis	Zone-II	Zone-II	IS-383-1970

III. EXPERIMENTATION

Compressive Strength: To check the performance of concrete, at the compressive power of concrete 150mm cubes are cast and tested, 20mm maximum sie of aggregate are used. After casting all the specimens were placed in water tank for curing at ages of 7 days, 28 days. The test results are presented here for the compressive strength of 7 days and 28 days testing.

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Split Tensile Strength: Split tensile was performed on the cylinders 150mm dia and 300mm height on compression testing machine. The failure load was recorded to find out the split tensile strength. In cylinder combined percentage of sludge ash and adding glass fiber and recycled tyre waste in which maximum strength is obtained used t get optimized strength.

Flexural strength: Flexural strength is also referred to as modulus of rupture. In the present investigation, sie of the beam (100×100×500mm). Number of beams were casted and tested as per IS: 516-1959. The load is applied continuously at a rate of 180 kg/cm2/minute. The load is applied till the specimen fails and the maximum load at failure is recorded. The position of the crack is measured.

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IV. OBSERVATIONS

COMPRESSIVE STRENGTH

Table 14: Shows compressive strength after various ages in N/mm^2

MIX	Average compressive strength of concrete in N/mm^2	
	7 days	28 days
M	16.24	24.87
M1	16.55	25.68
M2	16.63	27.37
M3	16.74	29.21
M4	16.77	30.93
M5	16.23	21.21
M6	16.43	26.20
M7	16.66	28.02
M8	16.84	29.06
M9	16.92	29.90
M10	13.00	22.62

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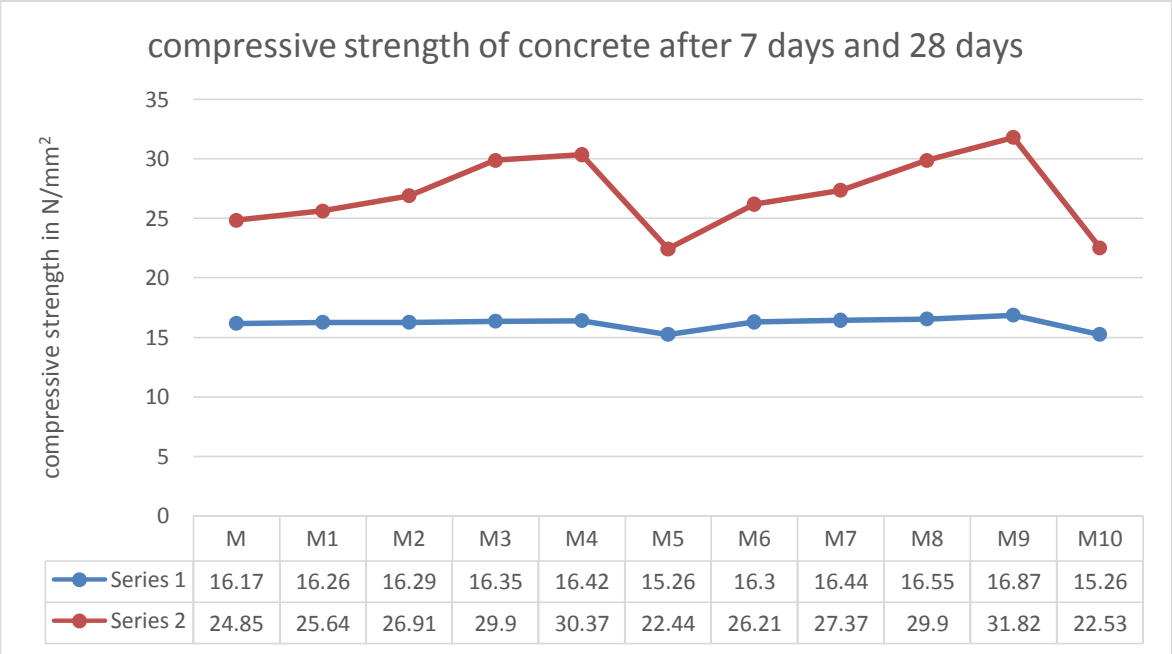

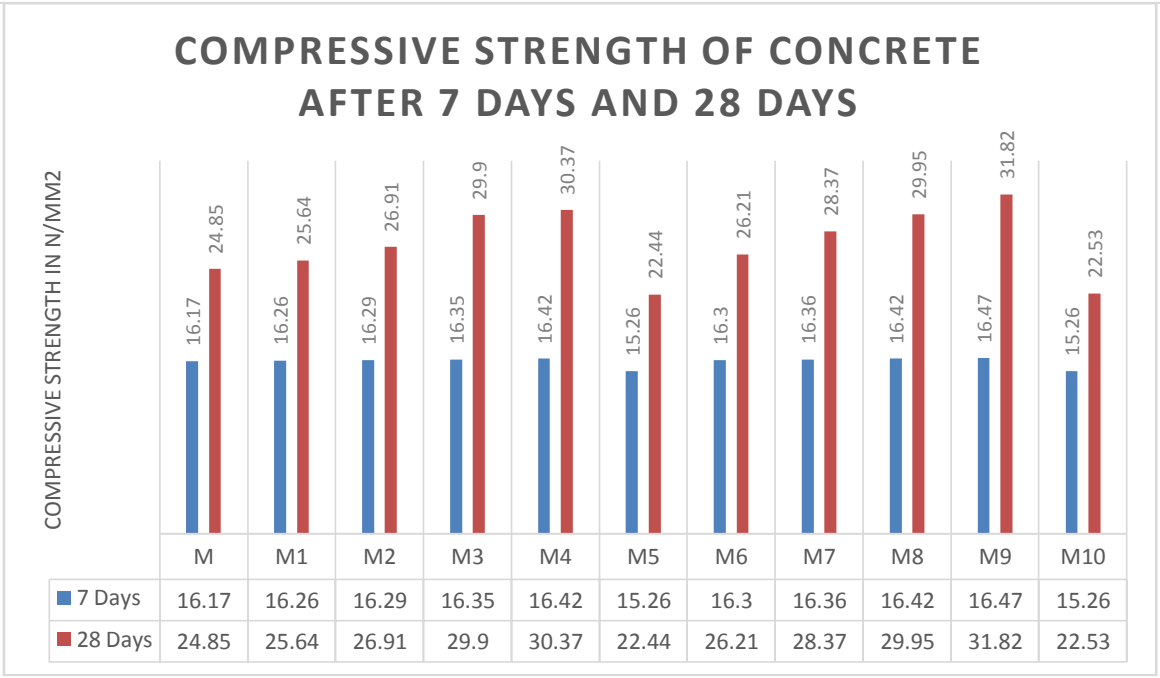

SPLIT TENSILE STRENGTH

Table : Shows Average Split Tensile strength of Concrete After Various ages in N/mm^2

MIX	Average Split Tensile Strength of Concrete in N/mm^2	
	7 Days	**28 Days**
M	1.72	3.73
M1	1.88	3.85

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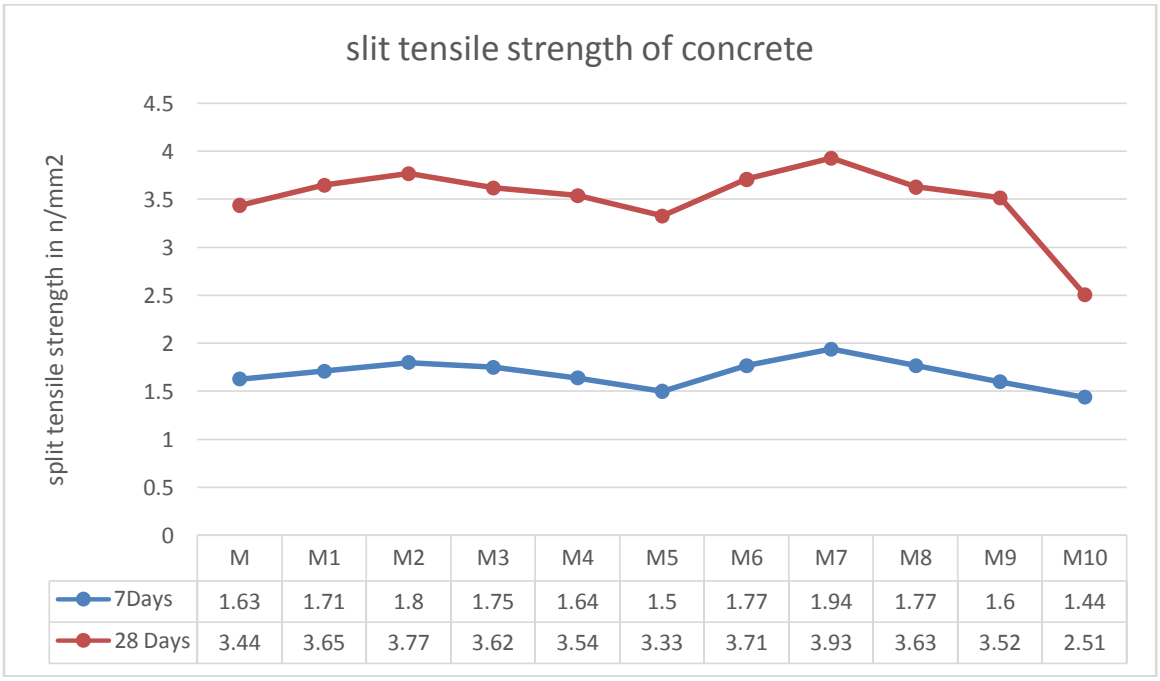
M2	1.91	3.91
M3	1.83	3.81
M4	1.79	3.76
M5	1.31	2.99
M6	1.79	3.74
M7	1.92	3.91
M8	1.87	3.86
M9	1.82	3.80
M10	1.32	3.09



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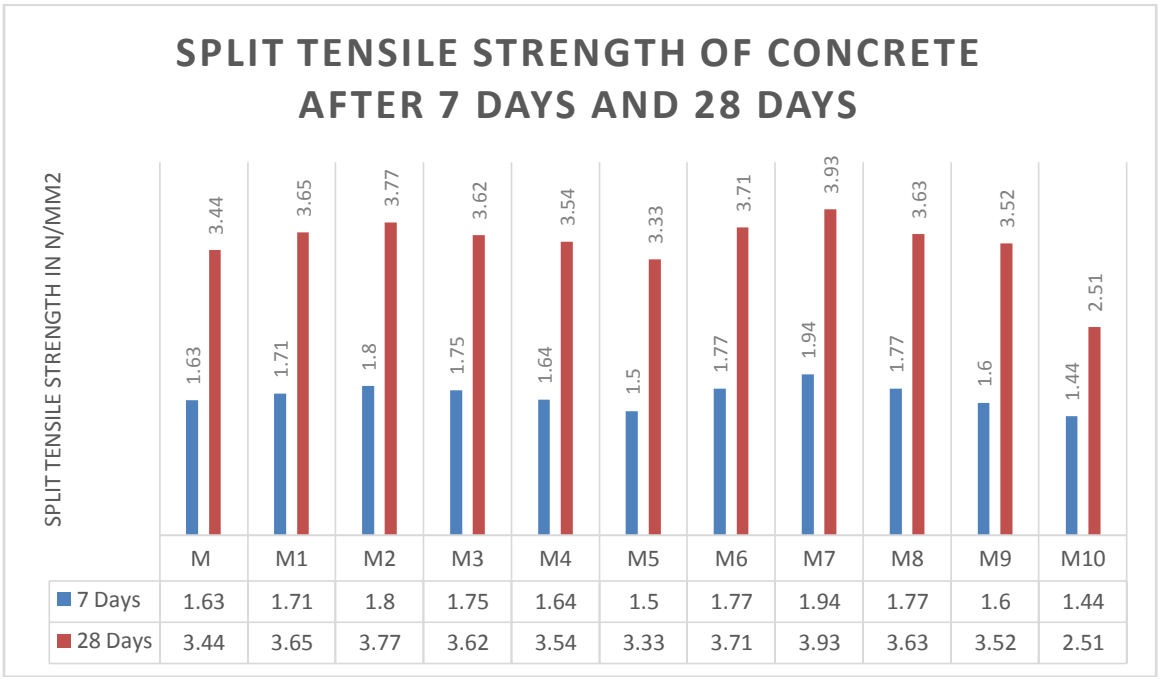

FLEXURAL STRENGTH

Table 20: Shows Average Flexural strength concrete After Various ages in N/mm^2

MIX	Average Flexural Strength Of concrete In N/mm^2	
	7 Days	28 Days
M	3.72	4.61
M1	3.83	4.76
M2	3.87	4.82
M3	3.81	4.70
M4	3.75	4.65
M5	3.61	4.38
M6	3.88	4.74
M7	3.96	4.91
M8	3.86	4.80
M9	3.79	4.69

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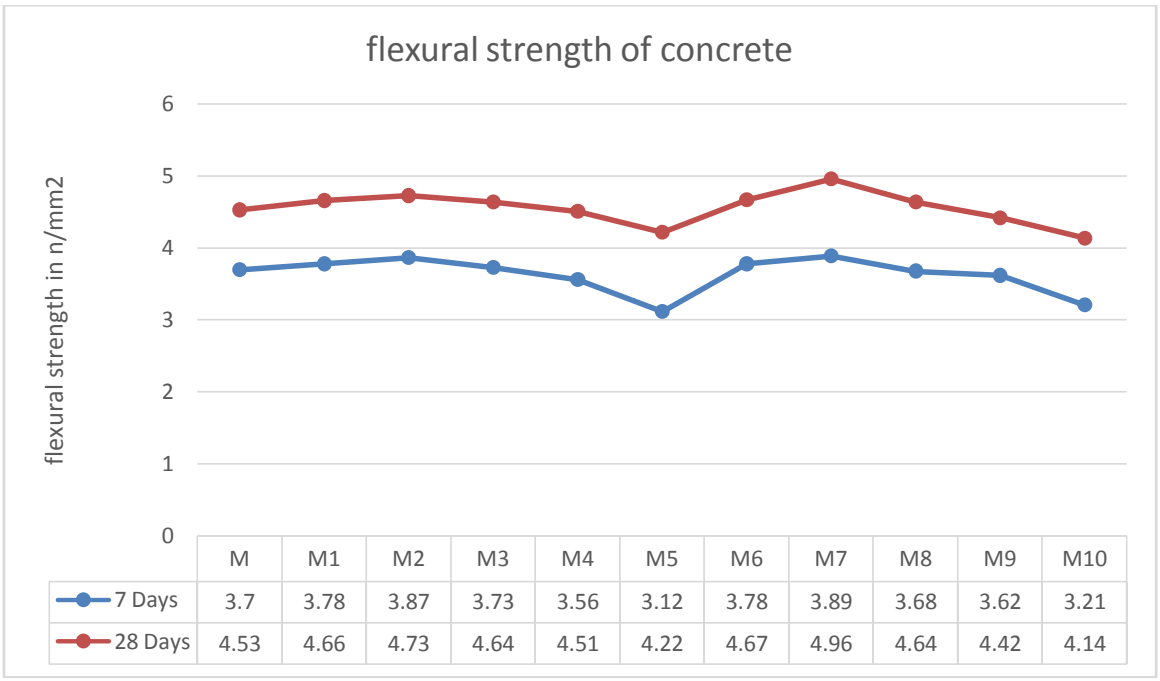
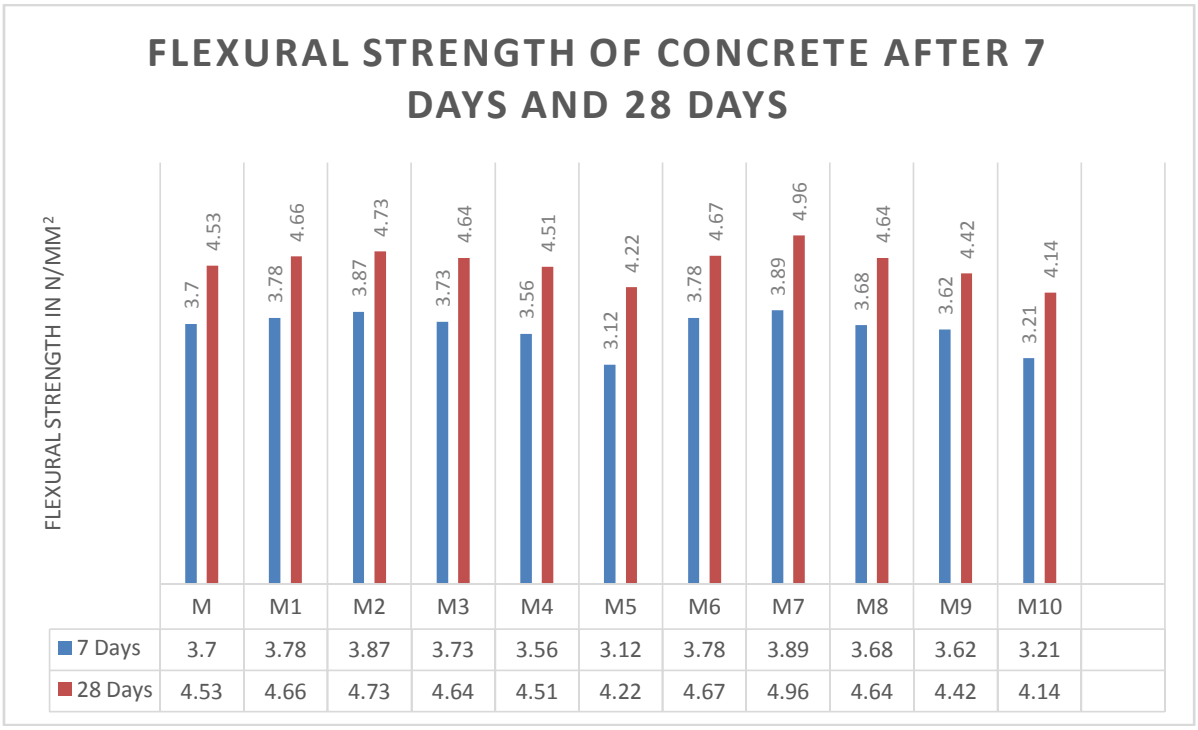
M10	3.65	4.37





V. CONCLUSION

Bentonite is low cost material as compare with cement and quarry dust is a waste material also minimize the cost of concrete. Quarry dust is also suitable for concrete construction because of its physical and chemical properties. Partial replacement of cement with bentonite clay in equal proportion 5%, 10% 15%, 20% and 25%

respectively and sand replace with quarry dust as 50% and 75% replacement of proportion with 0.42 water cement ratio in this research work.

1. Split tensile strength and flexural strength tests results found to be maximum strength at 10% replacement of bentonite with 75% quarry dust.
2. Reduces the cost of concrete used with these alternative materials in concrete mix.
3. Initial setting time and workability decrease with increase water cement ratio.
4. The compressive strength increase at 20% replacement of bentonite and also increase in Durablity with the ages.
5. Composition of bentonite and quarry dust the pozzolanic properties increase and high workability to concrete.

VI. FUTURE SCOPE

The pozzolanic material used in concrete of M25 grade of mix with partial replacement of binding material by cement with bentonite and sand with quarry dust are necessary scopes in future.

1. To make economic concrete and make balance the environmental asets the scope is find out an alternate material for concrete mix.
2. To find out how effectively we can use pozzolanic materials in concrete mix and maintaining the strengths of concrete.
3. This research determine the suitability concrete design for M25 control mix.

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