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UTILIZATION OF PLASTIC WASTE MATERIAL IN CONCRETE

Ravi Mahida[1], Harshil Patel[2] ,Chirag Maheta[3]

[1]*Department Of Civil Engineering, Chhotubhai Gopalbhai Institute Of Technology, Ravi_mahida01@yahoo.com*
[2]*Department Of Civil Engineering, , Chhotubhai Gopalbhai Institute Of Technology, Hasrhilpatel.safety@gmail.com*
[3]*Department Of Civil Engineering, C.K.Pithwala Collage Of Engineering and Technology Chiragmaheta34@gmail.com*

Abstract — *Advancements in technology enhance not only human comforts but also damage the environment. Presently the construction industry is in need of finding cost effective materials for improvement the strength of concrete. Hence an attempt has been made in the present investigations to study the influence of addition of domestic waste materials like polythene waste, soft drink bottle caps, empty waste tin, waste steel powder etc. from workshop. In this project waste polythene fiber at a dosage of 0.5 to 2% by weight of cement will be used. Evaluation and comparison of the compressive and flexure strength of concrete using M30 mix and test have been carried out as per recommended procedure in relevant codes.*

Keywords*- Compressive strength, Tensile strength, Flexural Strength, Concrete, plastics*

I. INTRODUCTION

Concrete, as the Romans knew it, was a new and revolutionary material. Laid in the shape of arches, vaults and domes, it quickly hardened into a rigid mass, free from many of the internal thrusts and strains that troubled the builders of similar structures in stone or brick. They are many types of concrete available, created by varying the proportions of the main ingredients below. In this way or by substitution for the cemetitious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.

Recently the use of recycled materials as concrete ingredients has been gaining popularity because of increasingly stringent environmental legislation. The most conspicuous of these is fly ash, a by-product of coal-fired power plants. This use reduces the amount of quarrying and landfill space required as the ash acts as a cement replacement thus reducing the amount of cement required. The mix design depends on the type of structure being built, how the concrete will be mixed and delivered and how it will be placed to form this structure.

The Objective Of the present study are:

- In India domestic waste plastics are causing considerable damage to the environmental and hence an attempt has been made to understand whether they can be successfully used in concrete to improve some of the mechanical properties in the case of fibers.
- The properties of concrete compressive strength , Tensile strength studied.
- The primary objective of this investigation is to study experimentally the properties of fiber reinforced concrete containing Plastic Waste.

II. DESIGN MIX MATERIAL

A. Cement:

In this Dissertation Work, the Cement selected is Portland Pozolona Cement. The technical information is as follows:

Brand Name: **Ultratech Cement**
Coforming IS codes: **IS 1489-1991**

The Laboratory Tests Results are attached herewith. The Tests includes (i) Fineness of Cement, (ii) Standard Consistency, (iii) Compressive Strength of Mortar Cubes sq. cm/gm for P.P.C. The test results are above the limiting value.

Figure.1-ULTRATECH PPC 53 GRADE CEMENT

TABLE-1 PROPERTIES OF CEMENT

Sr.No	Physical properties of ULTRATECH PPC 53cement	Result	Requirement As per 1481(part1) : 1991
1	Specific Gravity	3.11	3.14gm/cc
2	Consistency(%)	34%	30-35%
3	Initial setting time(min)	31minute	30minimum
4	Final setting time (min)	190minute	600minimum
Compressive strength Kg/cm^2			
6	3 Days	273.5	160
7	14Days	350.67	220
8	28Days	536.33	530

B. FINE AGGREGATE:

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383. The river sand is wash and screen, to eliminate deleterious materials and over size particles.

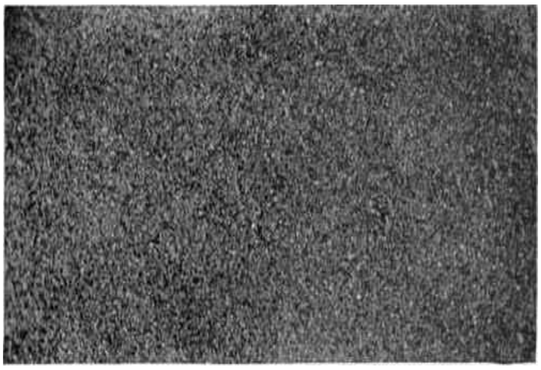

Figure.2 FINE AGGREGATE(RIVER SAND)

TABLE-2 PROPERTIES OF FINE AGGREAGATE

Sr.NO	Property	Result	As Per IS 383:1963
1	Specific Gravity	2.6	2.6 to 2.8
2	Fineness Modulas	2.9	2.2 to 3.2

C. COARSE AGGREGATE:

For high strength concrete, the coarse aggregate particles themselves must be strong. From both strength and rheological considerations, the coarse aggregate particles should be roughly equi-dimensional; either crushed rock or natural gravels, particularly if they are of glacial origin, are suitable. In addition, it is important to ensure that the aggregate is clean, since a layer of silt or clay will reduce the cement-aggregate bond strength, in addition to increasing the water demand.

Figure.3-COARSE AGGREGATE

D. WATER:

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel and provide required workability to the concrete. The quantity and quality of water is required to be looked into very carefully. Portable water is use in concrete. Since Quantity Of Water Affect The Strength it is necessary for us to go into the purity and quality of water.

E. PLASTICS:

ADVANTAGES:

- It easily binds to coarse Aggregate at medium temperature.
- The material is available in local area.
- The Disposal Of Use plastics, which is an environment problem is therby eliminated.

Figure.4-PLASTICS

Table-3CHEMICAL AND PHYSICAL PROPERTY OF PLASTICS (REF. FIBERMESH POLYPROPYLENE)

Sr.NO	Polythin Fibre	Polythin Fibre
1	Diameter µm	25-1000
2	Length mm	4-6
3	Density	0.92-0.96
4	Specific Gravity	0.91
5	Absorption	Nell
6	Tensile Strength MPa	75-790
7	Thermal conductivity	Low
8	Electrical conductivity	Low
9	Elastic modulus KN/mm^2	0.00-3.5

F. PLASTICIZER:

Requirement of right workability is the essence of good concrete. Concrete in different situations require different degree of workability. A high degree of workability is required in situations like deep beams, thin walls of water retaining structures with high percentage of steel reinforcement, column and beam junctions, tremie concreting, pumping of concrete, hot weather concreting, for concrete to be conveyed for considerable distance and in ready mixed concrete industries. The conventional methods followed for obtaining high workability is by improving the gradation, or by the use of relatively higher percentage of fine aggregate or by increasing the cement content.

Action Of Plasticizer:

When plasticizers are used, they get adsorbed on the cement particles. The adsorption of charged polymer on the particles of cement creates particle-to-particle repulsive forces which overcome the attractive forces. This repulsive force is called Zeta Potential, which depends on the base, solid content, quantity of plasticizer used. The overall result is that the cement particles are deflocculated and dispersed. When cement particles are deflocculated, the water trapped inside the flocs gets released and now available to fluidify the mix when cement particles get flocculated there will be inter-particles friction between particle to particle and floc to floc. But in the dispersed condition there is water in between the cement particle and hence the interparticle friction is reduced. Retarding Effect.

Table-4 MIX DESIGN PROPERTIES:

	Water	Cement	Fine aggregate	Coarse aggregate
By Wight	140	350	819.08	1112.72
By Volume	0.4	1	2.34	3.18

III. EXPERIMENTAL METHODLOGY

A. Testing Methodology:

After 3 days, 14days, 28 days of curing period the specimens were allowed to dry the surface for about one to two hours. Then they were tested in appropriate testing machine for the compressive strength, Flexural Strength, Split Tensile Strength, Modulus of elasticity and For workability of fresh concrete Compacting Factor test was carried out.

B. Compressive Strength Test:

The compressive strength of Grade M30 was studied on different ages of concrete, with different ages of concrete, with different proportion of waste plastics in the concrete mix. This is the long term strength study, thus we have selected different age of concrete such as 3 days, 14 days, 28 days. The cube mould of 150mm × 150mm × 150mm size is taken as per IS: 516-1959 specification.

The cubes were then tested on the required time period. Before testing, the set of cubes was surface dried in the air. All the cubes were tested on Digital Compression Testing Machine of capacity 2000kN compressive load.

Figure.5-COMPRESSIVE TEST

C. Flexural Strength Test:

The beam flexural strength was made as per IS: 516-1959 specification, Concrete Grade M30 with different waste plastics percentages. For this study the concrete beams of size 100mm×

100mm × 500mm were prepared.. Beams were tested on the Universal Testing Machine (UTM). The beams were placed normal to the casting and two point symmetrical system was adopted for the flexural tensile strength test.
Flexural Strength (fb) = PL/bd^2

Where, P=Failure/Ultimate Load on the Beam
L= span of the beam,
b= width of beam
d= Height of beam.

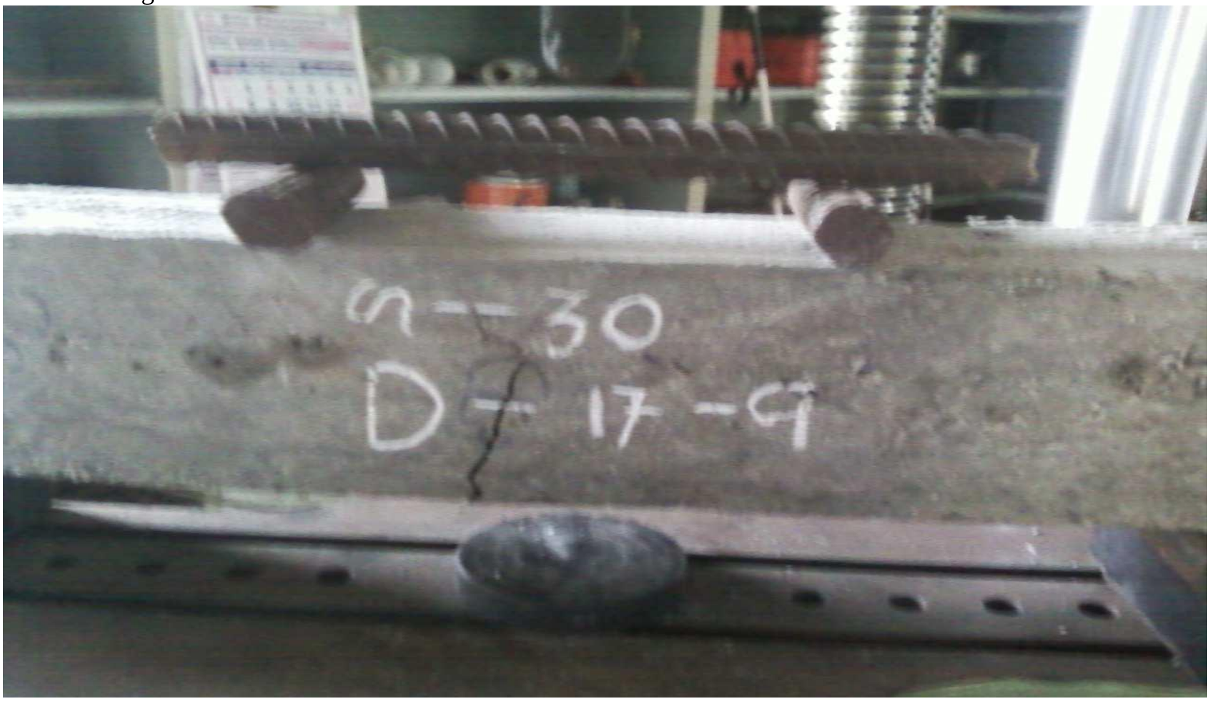

Figure.6-FLEXURAL STRENGTH TEST

D. Split tensile Strength Test:

The split tensile strength was made as per the 5816-1999 specification, on the Grade M30 with different Fly ash and Brickbats percentage. For this study the concrete cylinders of diameter 150 mm and height 300 mm were prepared. Total 1 nos. of cylinder were cast for each fly ash and brickbats proportion in concrete mix, i.e. total 5 nos. of cylinders prepared for the test. Cylinders were cured for 28 days time age.
The cylinders were tested on the compression Testing Machine of capacity 2000 kN. The cylinders were placed horizontally between loading surface of compressive testing machine and load was applied until failure of cylinder, along the vertical diameter.

Split Tensile=2P/ πLD

L = Length of cylinder

D=Diameter of cylinder

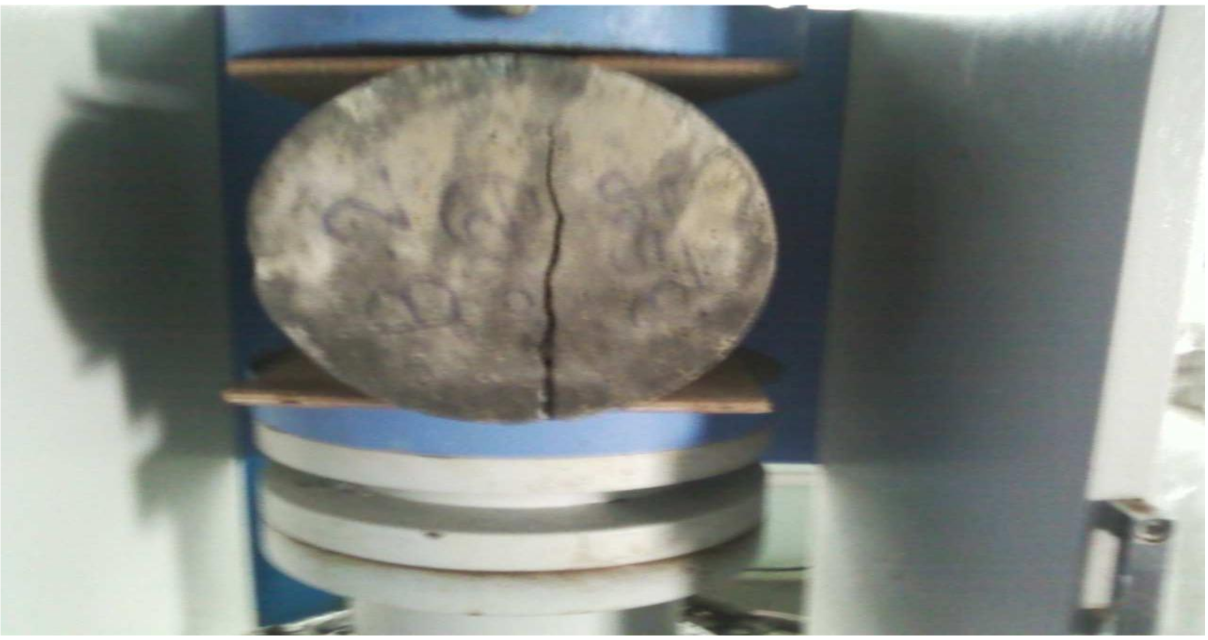

Figure.7-SPLIT TENSILE STRENGTH TEST

IV. RESULTS

Compressive strength:

Table-5 3DAYS COMPRESSIVE STRENGTH

Grade of concrete	% of waste plastics	Load(KN)	Compressive Strength N/mm^2
M30	0%	368.325	16.37
	0.6%	615.825	27.37
	1%	388.575	17.27
	1.5%	432.000	19.21
	2%	380.250	16.9

Table-6 14DAYS COMPRESSIVE STRENGTH

Grade of concrete	% of waste plastics	Load(KN)	Compressive Strength N/mm^2
M30	0%	614.925	27.33
	0.6%	786.825	34.97
	1%	428.400	19.04
	1.5%	506.700	22.52
	2%	420.075	18.67

Table-7 28DAYS COMPRESSIVE STRENGTH

Grade of concrete	% of waste plastics	Load(KN)	Compressive Strength N/mm^2
M30	0%	614.925	35.73
	0.6%	699.300	31.08
	1%	268.200	11.92
	1.5%	462.600	20.56
	2%	274.270	12.19

Table-8 COMPRESSIVE STRENGTH(N/MM^2) OF M30 GRADE

Time Period	PLAIN N/mm^2	0.6% Waste Plastic N/mm^2	1.0% Waste Plastic N/mm^2	1.5% Waste Plastic N/mm^2	2.0% Waste Plastic N/mm^2
3 Days	16.37	27.37	17.27	19.20	16.9

7 Days	27.33	34.97	19.04	22.52	18.67
28 Days	35.73	37.08	11.92	20.56	12.19

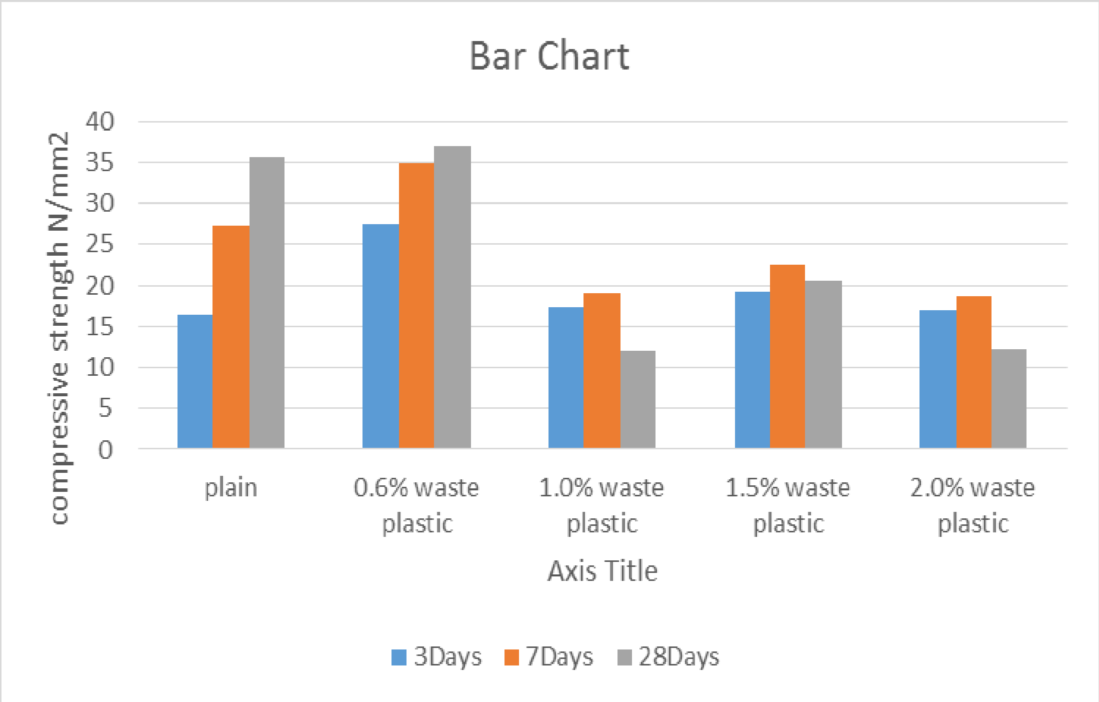

Figure.8-BAR CHART OF COMPRESSIVE STRENGTH OF M30 GRADE

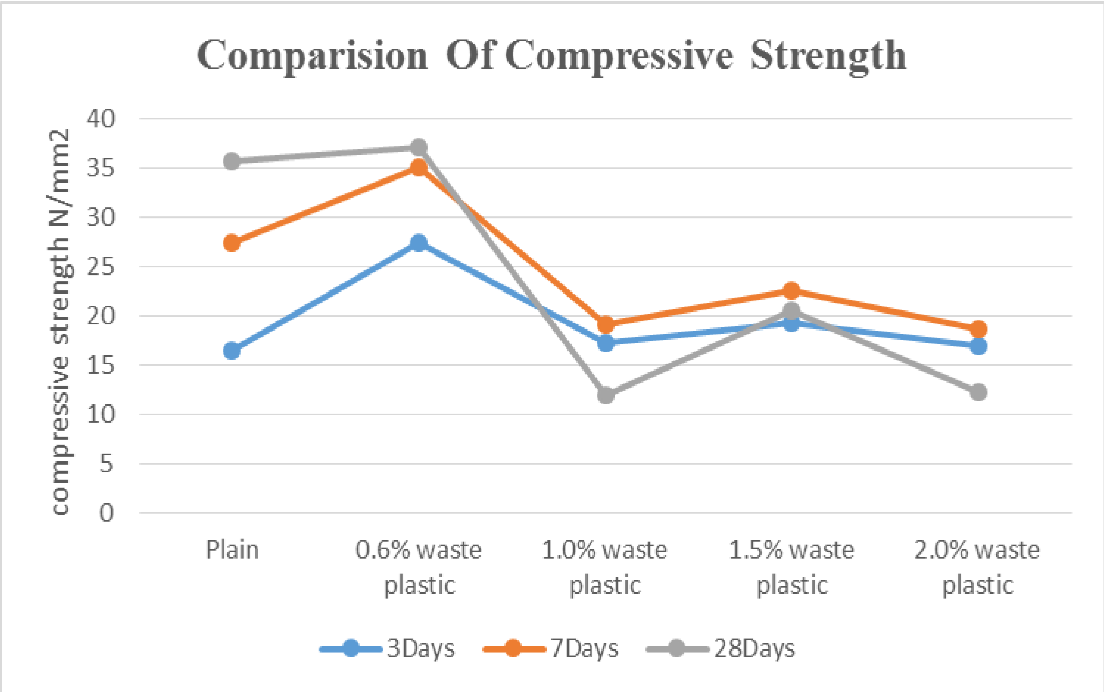

Figure.9-COMPARISION OF COMPRESSIVE STRENTGH

Table-9 RESULT OF TENSILE STRENGTH AND FLEXURAL STRENGTH

M30 grade concrete	Tensile strength	Flexural Strength
Normal Concrete	2.5	17.94
0.6% Waste Material	3.89	36.3
1.0% Waste Material	2.09	20.9
1.5% Waste Material	1.93	27.38
2.0% Waste Material	1.96	25.05

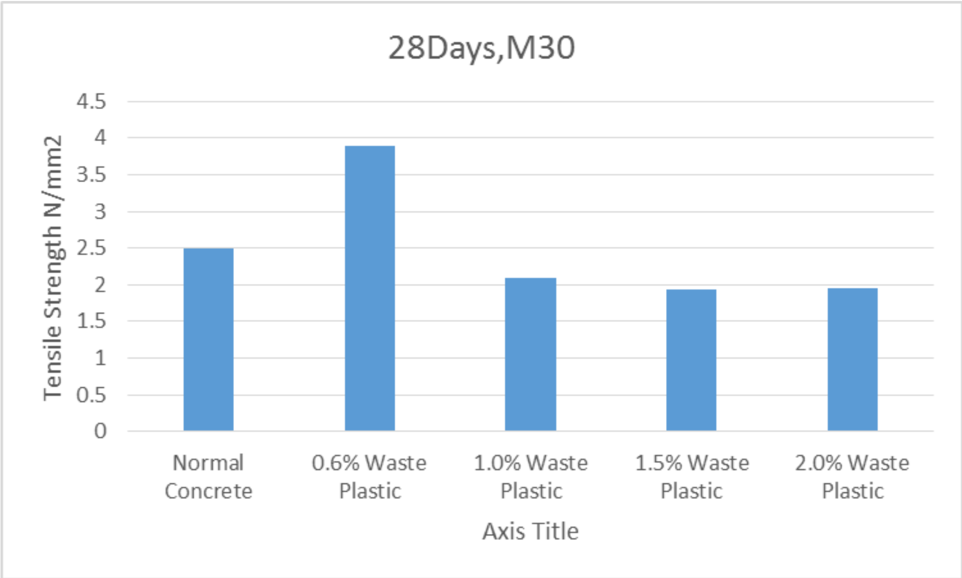

Figure.10-BAR CHART OF TENSILE STRENGTH FOR M30 GRADE

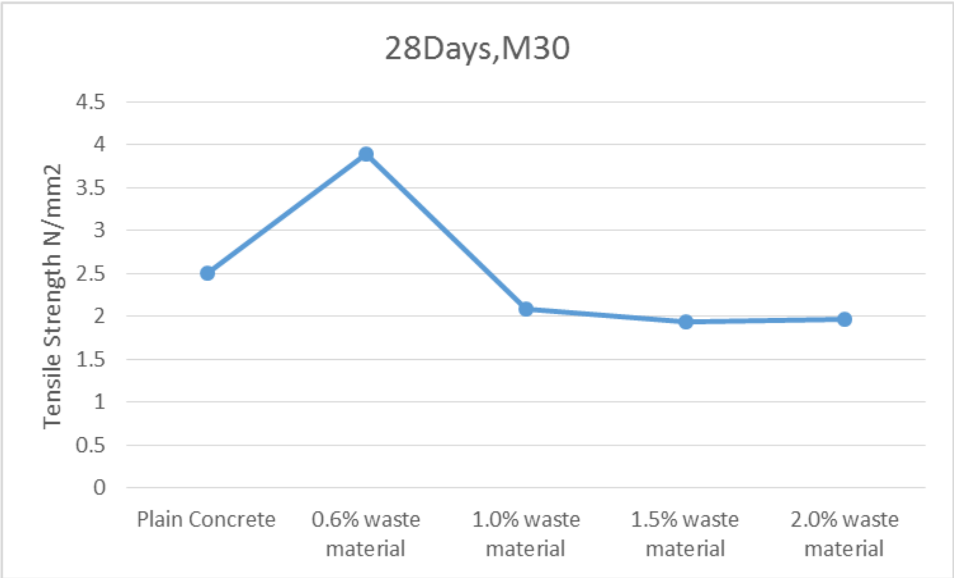

Figure.11 RESULT OF TENSILE STRENGTH

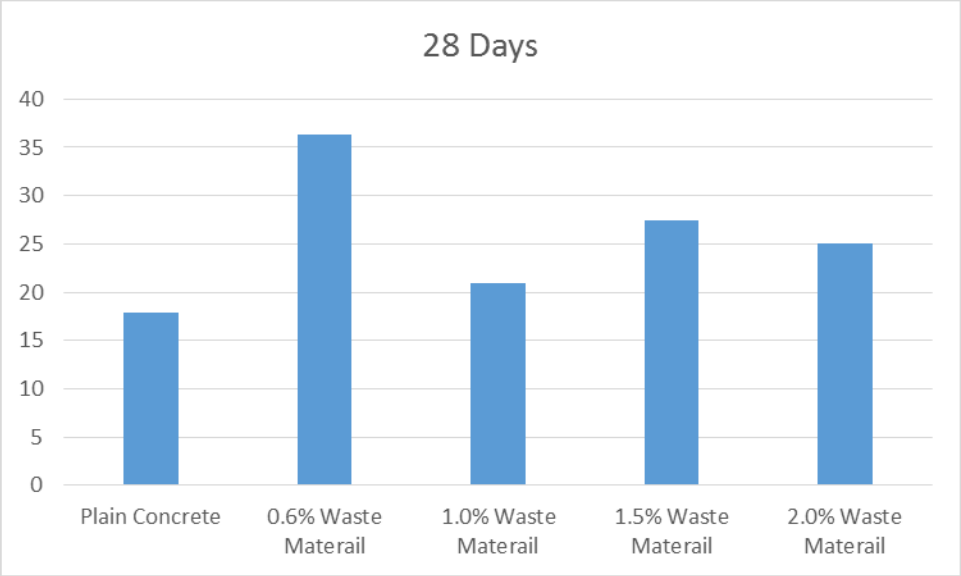

Figure.12-BAR CHART OF FLEXURAL STRENGTH

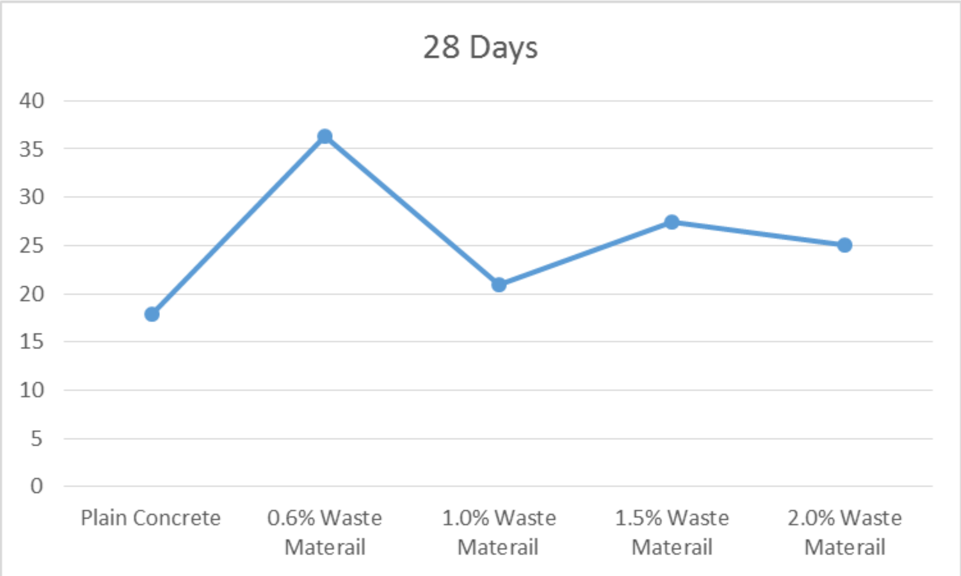

Figure.13-RESULT OF FLEXURAL STRENGTH

V. ECONOMIC FEASABILITY

Table10.COSTS OF MATERIAL:

Materials	Price(Rs)/kg	Cost per M^3
Cement	6.6	300
Fine Aggregate	0.65	532.402
Coarse Aggregate	0.7	778.904
Admixtures	1.5	6.9
Plastics	0	0

VI. CONCLUSION

Looking to the facts, observations and test results obtained from this investigation program, the following conclusions based on Properties of concrete with and without waste plastics.

Properties of concrete with and without waste plastics.

Compressive strength

During the test of compressive strength of concrete initial 3 days strength is 16.37 N/mm^2 after adding the 0.6% waste plastics by weigth of cement the strength are increased 1.8 % as compare with normal concrete of grade M30and further increase in quantity of waste plastics strength of concrete are decreased During the test of compressive strength of concrete initial 28 days strength is 35.73 N/mm^2after adding the 0.6% waste plastics by weigth of cement the strength are increased 0.48 % as compare with normal concrete of grade M30and further increase in quantity of waste plastics strength of concrete are decreased.

Split tensile strength

During the test of split tensile strength of concrete initial 28 days strength is 1.71 N/mm^2 after adding the 0.6% waste plastics by weigth of cement the strength are increased 0.034 % and further increase in quantity of waste plastics strength of concrete are decreased.

Flexural Strength

During the test of flexural strength of concrete initial 28 days strength is 17.94 N/mm^2 after adding the 0.6% waste plastics by weigth of cement the strength are increased 3.29 % and further increase in quantity of waste plastics strength of concrete are decreased.

VII. ACKLOWLEDGEMENT

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AUTHOR DETAILS

Ravi Mahida was born in 1992 in surat. He received his Diploma in Civil Engineering Degree From Government Polytechnic Valsad(2010) and Bachelor Of Engineering degree in civil engineering From Uka Tarsadia University(2013). At present he is Final Year Students Of Master’s Degree In structure Engineering. From Chhotubhai Gopalbhai Patel Institute Of Technology ,Uka Tarsadia University. He Has Papers Published In Internation Journeals.

Harshil Patel was born in 1992 in Bardoli. He received his Bachelor Of Engineering degree in civil engineering From Uka Tarsadia University(2013). At present he is Final Year Students Of Master’s Degree In structure Engineering. From Chhotubhai Gopalbhai Patel Institute Of Technology ,Uka Tarsadia University. He Has Papers Published In Internation Journeals.

Chirag Maheta was born in 1991 in Surat. He received his Diploma in Civil Engineering Degree From Vidhyabharti Polytechnic Umrakh(2011)and He received his Bachelor Of Engineering degree in civil engineering From C.K.Pithwala Collage Of Engineering and Technology(2014)At present he is in Lecturer of Mahavir Swami Collage Of Polytechnic.

