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COMBINED EFFECT OF WASTE GLASS POWDER, CUBIC POWDER AND STEEL FIBER ON MECHANICAL PROPERTIES OF CONCRETE

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ABSTRACT

Waste glass powder and cubic boron nitrite powder is much useable powder as a replacement of cement and fine aggregate in the concrete mixture. Waste glass powder is a waste material which is also called ground glass powder. In now a day's waste materials is very much use in replacement of ingredient of concrete. In this study we use type of replacement to make a perfect and economical mixer which gives us more strength and durability of concrete. We use waste glass powder (5%, and 8%) as replacement of cement by the weight of cement, cubic powder (10% replacement by weight of cement) and add hooked ended steel fiber (1.35% and 2% add by total volume of concrete) to make a three type of uniform mixture to check the durability and strength of concrete. Total number of 27 cubes specimen (150×150×150 mm) and 27 cylinder specimens (300mm length and 150mm diameter) were cast with different composition of glass powder, cubic powder and hook ended steel fiber. In this investigation the sample containing replacement of cement by cubic powder and waste glass powder with hook ended steel fiber and all sample of concrete mixture is designed with water cement ratio (w/b) of 0.45. The compressive strength and split tensile strength were calculated for all three type of mixture at the end of 7 days, 14 days and 28 days of curing period and compare the all result of normal concrete and waste material concrete results at testing period. It was found that the 5% replacement of cement by glass powder and adding of 1.35% steel fiber gives us 32MPA maximum compressive strength and 3MPA is maximum split tensile strength. The result revealed that incorporation of CP, GP and utilization of different types of steel fibers significant affected the mechanical properties of concrete.

KEYWORDS: *Workability, Compressive strength, Curing, Cubic powder, steel fiber, Split tensile strength, Waste glass powder*

INTRODUCTION

Concrete, a structural material in construction that contains hard, chemically heavy particulate matter, called aggregate (usually sand and gravel), is joined together by cement and water. The most commonly used relationship between the ancient Assyrians and the Babylonians was clay. Egyptians used limestone and gypsum as binders to make materials similar to modern concrete. Lime (calcium oxide) obtained from limestone, chalk, or (where available) oyster shells was the primary pozzolonic or cement-forming agent at the beginning of the 1st century. In 1224 Joseph, an English explorer named Joseph Din Spadin burned a mixture of limestone and clay. This mixture, called Portland cement, remains the major cementing agent used in the production of concrete. Collectively it is usually designated as either fine (0.025 to 6.5 mm [0.001 to 0.25 inch] in size) or coarse (6.5 to 38 mm [0.25 to 1.5 inches] or larger). All aggregate materials must be clean and free from soft particles or vegetable mixtures, as very small amounts of organic soil compounds result in chemical reactions that seriously affect the strength of the concrete. The use of concrete is indicated by the type of aggregate or cement, the specific properties manifested by it, or the methods used to make it. In ordinary

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structural concrete, the properties of concrete are largely determined by the ratio of water to cement. The lower the water content, the same as all the others, the stronger the concrete.

There must be enough water in the mixture to ensure that each cement particle is completely surrounded by the cement paste, the space between the aggregates is filled, and there is enough liquid to pour the concrete and spread it effectively. Another durability factor is the amount of cement in relation to the sea (expressed in three part proportions - total cement for cement to rock aggregation). There will be relatively low aggregation, especially where concrete is required.

Material Used

i. Cement
ii. Water
iii. Steel fiber
iv. Cubic powder
v. Waste glass powder

Cement

It is a binder material which is used in bind the other material together. Generally cement is two type, OPC (Ordinary Portland cement) and PPC (Portland Pozzolona cement). We used 53 grade PPC cement of fly ash based.

Water

We used drinkable water in the concrete mix which is ground water. Various acids, oil, alkalis, organic impurities should not be come with water which is used in construction. Hard water and soft water make the concrete weaker.

Steel Fiber

On this investigation we use hooked ended steel fiber of length 50mm and diameter 1mm. it is low cost solution for un-cracked section design of concrete members. It is used in concrete enhance the ability of structural members to carry significant stresses. The use of steel fiber increased the toughness of concrete under any type of loads. It has more ability to absorb the energy in concrete.

Chemical composition of mild steel wire

S. No	Mattel	Values
1	C	0.090
2	Mn	0.430
3	Si	0.170
4	P	0.012
5	S	0.015

Table 1 : Chemical Composition of Mild Steel Wire

Mechanical Properties of Hooked Ended Steel Fiber

S.NO	Specification	Values
1	Length	50mm
2	Diameter	1mm
3	Tensile strength	1100 MPA
4	Tolorance for diameter and length	10%

Table 2 : Mechanical Properties of Hooked Ended Steel Fiber

Cubic Powder

Cubic powder is adhesive material which size is very small as compare to cement.

Waste Glass Powder

Waste glass powder is manufactured by crushing the waste grounded glass. The waste glass powder is used in concrete as replacement of cement and fine aggregate. Waste glass powder is very harmful material for environment so this is a method to decompose this material.

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Chemical Composition of Glass Powder

S. NO.	Compound	Values (%)
1	SiO_2	71.1
2	CaO	9.2
3	Fe_2O_3	0.16
4	AL_2O_3	0.96
5	MgO	4.4
6	Na_2O	12.6

Table 3 : This Table Shows The Chemical Composition Of Waste Glass Powder

S. No	Material	Source
1	Cement(PPC)	Ambujja cement (PPC)
2	Waste glass powder	Akshar chemical
3	Steel fiber	Indiamart
4	Cubic powder	Indiamart

Table 4 Source of Material Used

EXPERIMENT AND TEST PROCEDURE

Mix design of M30 grade concrete

1. Maximum water cement ratio is 0.45.
2. Cement : PPC (Portland Pozzalona Cement)
3. Coarse Aggregate: 20mm .
4. Fine aggregate : zone 3

Mix Proportioning

Mix proportioning can be defined as the technique to select the weight of material used in the concrete mixture. In the present study work cubic powder and waste glass powder and hooked ended steel fiber is added in the normal concrete mixer make the different sample for testing.

There for, in the order to use of cubic powder 10%, waste glass powder 5%, 8% as replacement of cement weight and hooked ended steel fiber 1.35%, 2% as added total weight of concrete volume. The water cement ratio is 0.45 for each mixture or sample.

Mix Proportioning

S. No	Sample	Quantity (kg/m^3
1	**Cement**	414
2	**Fine aggregate**	608.44
3	**Coarse aggregate**	1180.41
4	**Water**	186

Table 5: This Table Shows The Quantity Uses Of Material In Concrete Mixture Sample In Kg Per Cubic Meter.

S. No.	Material Sample	Waste glass powder (%)	Cubic powder (%)	Hooked ended steel fiber (%)
1	1^{st}	0	0	0
2	2^{nd}	5	0	1.35
3	3^{rd}	8	10	2

Table 6:: This Table Shows The Added Percentage Of Steel Fiber And Replacement Of Cement Percentage By Cubic Powder And Waste Glass Powder

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Prepare Specimen

In the present study we prepare two types of specimens for three type of mix of concrete sample. For each mix we cast 9 cube specimens and 9 cylinder specimens, total number of 54 specimens. The standard size of cube mould specimen is 150mm×150mm×150mm and cylinder mould specimen size 150mm diameter and 300mm is length

Compressive Strength Test

It is ability of the material to resist the maximum compressive force before its cracking or deform. The unit of compressive strength is MPA or newtonne per milli meter square.

Formula

$$\text{Compressive strength} = \frac{\textbf{Applied force}}{\textbf{Per unit area}}$$

Split Tensile Strength Test

Split tensile strength is determined the applied compressive force along the length of cylinder specimen. by using Universal testing machine. It is indirect test for tensile strength. The unit of tensile strength is MPA.

Formula

$$\text{Split tensile strength (T)} = \frac{2P}{\Pi LD}$$

Where,

P = Maximum applied load indicated by machine, in kN

L = Length

D = Diameter,

RESULTS AND DISCUSSION

Workability Results

As shown in the below chart the results of workability for all three type mixes

Batch	% Substitute Of Waste Glass Powder	% Substitute Of Cubic Powder	% Add of hooked steel fiber	Slump value (mm)
Mix1	0	0	0	110
Mix2	5	0	1.35	90
Mix3	8	10	2.00	50

Table 7: This table shows the workability results of all mixes.

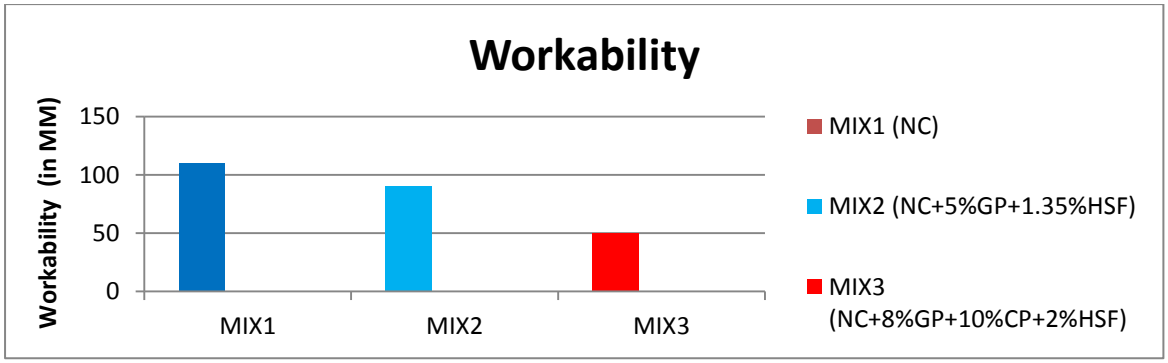

Figure 1: Workability of Mix Batches

As shown in this fig the workability of mix1 batch of much more any other mix batches. In this investigation normal concrete workability is high as compare to other mixes of this study. That's means mix1 is more workable concrete.

Compressive Strength Result

As shown in the below chart the results of compressive strength of all cube specimen for different percentage of cubic powder (10 %), waste glass powder (5%, and 8%) and steel fiber (1.35% and 2%) and for different curing period of time(7, 14 and 28 days) table8.The strength is more for 28 days for (NC+5%GP+1.35%HSF)

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S.NO	Mix batch	Compressive strength (in MPA) AFTER Curing period of		
		7 DAYS	14 DAYS	28 DAYS
1	NC	16.09	23.47	30.06
2	NC+5%GP+1.35%HSF	19	25	32
3	NC+8%GP+2%+10%CP	18.05	24	30.91

Table 8:: Compressive strength of cubes specimens after 7, 14, and 28 days of curing for all mix

Figure 2 :Test of specimen by CTM

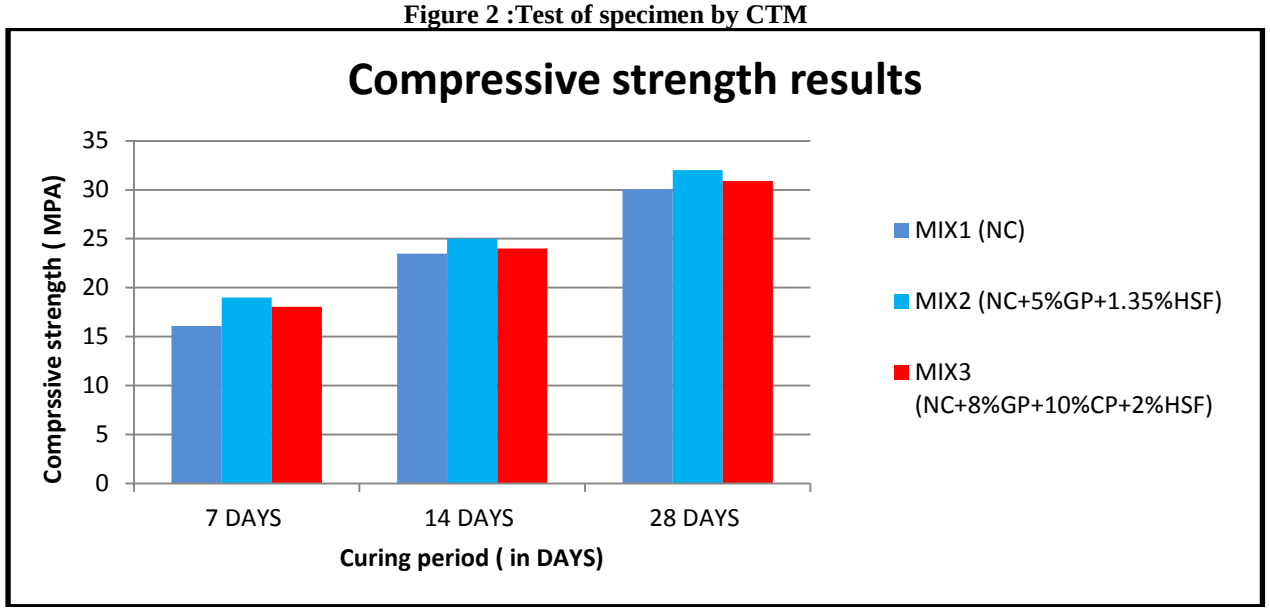

Figure 3: Variation in Results In Different Testing Time Of Period.

Split Tensile Strength

As shown in the below chart the results of split tensile strength of all cylinder specimen for different percentage of cubic powder (10 %), waste glass powder (5%, and 8%) and steel fiber (1.35% and 2%) and for different curing period of time (7, 14 and 28 days) table 9.The strength is more for 28 days for (NC+5%GP+1.35%HSF)

S.NO	Mix batch	Split tensile strength (in MPA) AFTER Curing period of		
		7 DAYS	14 DAYS	28 DAYS
1	NC	1.59	2.04	2.5
2	NC+5%GP+1.35%HSF	1.75	1.97	3
3	NC+8%GP+2%+10%CP	1.61	1.74	2.39

Table 9: Split Tensile strength of cubes specimens after 7, 14, and 28 days of curing for all mix

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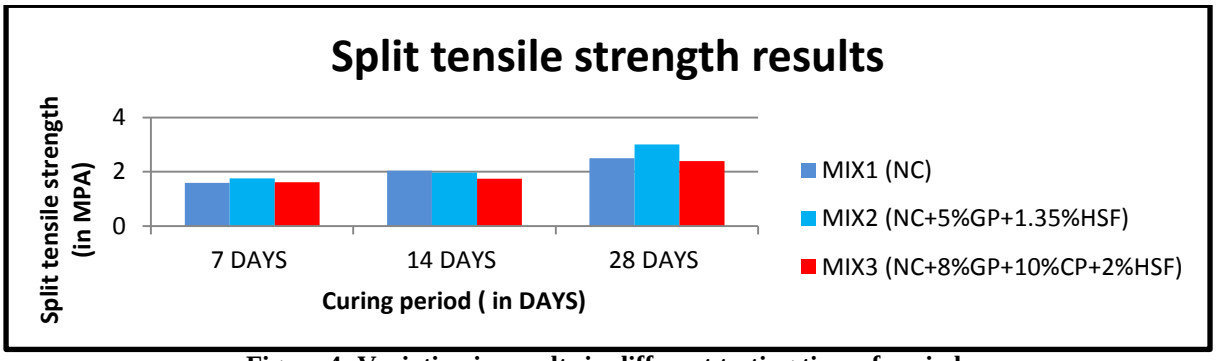

Figure 4: Variation in results in different testing time of period

CONCLUSION

This following conclusion may be drawn based on the experiment results. Use of GP and CP as a replacement material resulted in enhanced mechanical properties of concrete. In this investigation shows the effect the fiber and glass powder on workability, compressive strength and split tensile strength.

1. Increase of addition of percentage of steel fiber and glass powder, cubic powder decrease the workability of concrete
2. Addition of cubic powder and waste glass powder and hooked ended steel fiber enhanced the properties of concrete like split tensile strength and compressive strength.
3. Compressive strength of concrete is increased by 2 MPA as compare to normal concrete when 1.35% hooked ended steel fiber and 5% waste glass powder.
4. Maximum compressive strength is 32 MPA when 1.35% hooked ended steel fiber and 5% waste glass powder.
5. Maximum split tensile strength is 3 MPA Measured when 1.35% hooked ended steel fiber and 5% waste glass powder.
6. Split tensile strength is increased 0.5 MPA as compare to normal concrete mix.
7. The crack formation in the concrete is not shown earlier in the concrete member when the steel fiber is added in concrete

Acknowledgement

This study has been partially supported by my guide.

Future Scope

In this present time waste material is very useful in the concrete formation. Waste glass powder is very harmful for our environment. The use of waste glass powder in the concrete is good method for its decomposition. Because it is use as a replacement of cement and its gain more strength for concrete. This type of concrete is very useful in bridge deck and project etc.

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