

# Effect of Glass Powder on Properties of Concrete in Terms of Compressive and Flexural Strength

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**Abstract** – In this study M30 grade of concrete was designed and m-sand was partially replaced by waste glass powder as 0%, 10%, 20% and 30%. The characteristic strength of conventional and modified concrete mix were studied as per IS 516 – 1959. Modified mix of 20% replacement of waste glass powder gives relatively high strength when compared to other modified mixes, but 15% in compressive strength and 9% in flexural strength was reduced as compared to conventional mix.

**Key Words:** Portland Pozzalona Cement, M-sand, Glass powder, Compressive strength, Flexural strength.

## 1. INTRODUCTION

Solid waste management is a major issue in developing countries like India. The ultimate way of solid waste disposal in our country is landfill. It leads to various environmental hazards like groundwater pollution and air pollution around the waste dumping site. Recycling and reuse of the waste material will reduce the hazards and also save the resources. In this study I can use waste glass material in concrete and its properties were studied.

### 1.1 Objectives of the study

The following objectives were made for this study:

To find the characteristics strength of concrete with partially replaced m-sand by waste glass powder

To compare the strength characteristics of modified concrete with conventional concrete.

## 2. MATERIALS AND METHODS

The materials used in concrete such as coarse aggregate, fine aggregate, waste glass powder, cement, super plasticizer and water were collected and test should be conducted to find its index properties. Based on its properties mix design was done for a concrete grade of M30 as per IS 10262-2009.

### 2.1 Coarse aggregate

The nominal size of 20 mm aggregate was used for this study. The various tests such as sieve analysis, specific gravity, flakiness index, elongation index, angularity number,

water absorption for coarse aggregate were conducted as per IS 2386-1963.

**Table -1:** Properties of coarse aggregate

PROPERTIES	VALUES
Fineness Modulus	3.14
Specific Gravity	2.86
Flakiness Index	50.63%
Elongation Index	19.99%
Angularity Number	3.9
Water Absorption	0.6%

### 2.2 Fine aggregate

River sand is a non-renewable resource and availability also can be restricted. So, nowadays m-sand was widely used in concrete construction. The tests such as sieve analysis and specific gravity for m-sand were conducted as per 2386-1963.

**Table -2:** Properties of fine aggregate

PROPERTIES	VALUES
Fineness Modulus	5.44
Specific Gravity	2.43

### 2.3 Cement

Portland Pozzalona Cement of grade 57 was used for this study. The main advantage of this cement was it achieves desired strength within 14 days instead of 28 days. The properties such as specific gravity, consistency, initial and final setting time were determined as per IS 1489-1991.

**Table -3:** Properties of cement

PROPERTIES	VALUES
Specific Gravity	3.5
Consistency	34%
Initial Setting Time	33 minutes
Final Setting Time	390 minutes

### 2.4 Waste glass powder

Waste glass bottles are collected and crushed using hammer. Proper safety measures were followed during the crushing of glass powder. After that, crushed powder were sieved using

2.36 mm IS sieve, whatever glass powder passing the sieve was used in this study. The specific gravity of glass powder was determined.

**Table -4:** Properties of crushed glass powder

PROPERTIES	VALUES
Specific Gravity	2.62



**Fig -1:** Crushed waste glass powder

### 2.5 Super plasticizer

The super plasticizer used in the present study was ceraplast300, which is available in local market. The specific gravity of super plasticizer was determined.

**Table -5:** Properties of super plasticizer

PROPERTIES	VALUES
Specific Gravity	1.2

### 2.6 Proportioning of concrete

The mix proportioning of M30 is designed by referring the code books IS 10262-2009, IS 383-1970 and IS 456-2000. The designed mix proportion of M30 grade concrete is 1:1.99:4.18.

### 2.6 Preparation of specimen

The characteristics strength such as compressive strength and flexural strength were determined. For this cubical mould of size 150mm x 150mm x 150mm and beam mould of size 100mm x 100mm x 500mm were used to prepare the sample of testing compressive strength and flexural strength respectively.

## 2. RESULT AND DISCUSSION

The compressive and flexural strength test was conducted at the end of 7 days and 14 days from the casting of the specimens. The dosage of super plasticizer of 2.2% by weight of cement was added for this study. The groundwater which is available in our institution was used for mixing and curing the concrete.

**Table -6:** Different mix proportions

MIX	M-SAND (%)	GLASS POWDER (%)
MIX-1	100	0
MIX-2	90	10
MIX-3	80	20
MIX-4	70	30

**Table -7:** Number of specimens

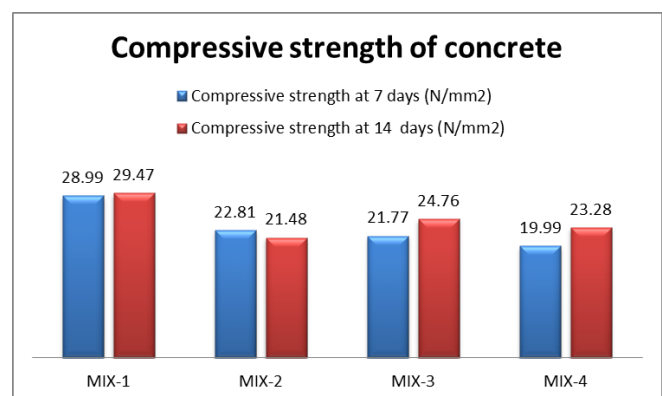
MIX	MIX-1 (0% G.P)		MIX-2 (10% G.P)		MIX-3 (20% G.P)		MIX-4 (30% G.P)	
	C.S	F.S	C.S	F.S	C.S	F.S	C.S	F.S
7 days	3	3	3	3	3	3	3	3
14 days	3	3	3	3	3	3	3	3

### 3.1 Compressive strength test

The compressive strength test will be carried out on the concrete specimen at the end of 7 days and 14 days of curing. Surface dry specimen of size 150mm x 150 mm x 150mm was placed in the compressive testing machine. The load will be applied without shock and increase gradually until the specimen was crushed.

**Table -8:** Compressive strength of concrete

MIX	Compressive strength at 7 days (N/mm <sup>2</sup> )	Compressive strength at 14 days (N/mm <sup>2</sup> )
MIX-1	28.99	29.47
MIX-2	22.81	21.48
MIX-3	21.77	24.76
MIX-4	19.99	23.28



**Chart -1:** Compressive strength of concrete

The values obtained from the compressive test on cube at 7 days and 14 days curing was given in table 8. Graphs were plotted for compressive strength and curing period. It is found that compressive strength was gradually increases for all mix. In modified mixes, mix 3 has got maximum compressive strength.



Fig -2: Compressive test on cube

### 3.2 Flexural strength test

The flexural strength test will be carried out on the concrete specimen at the end of 7 days and 14 days of curing. Surface dry specimen of size 100mm x 100 mm x 500 mm was placed in the flexural testing machine. The load will be applied without shock and increase gradually until the specimen was crushed.

Table -9: Flexural strength of concrete

MIX	Flexural strength at 7 days (N/mm <sup>2</sup> )	Flexural strength at 14 days (N/mm <sup>2</sup> )
MIX-1	3.77	3.80
MIX-2	3.34	3.24
MIX-3	3.27	3.48
MIX-4	3.13	3.38



Fig -3: Flexural test on beam

The values obtained from the flexural test on beam at 7 days and 14 days curing was given in table 9. Graphs were plotted for flexural strength and curing period. It is found that compressive strength was gradually increases for all mix. In modified mixes, mix 3 has got maximum compressive strength.

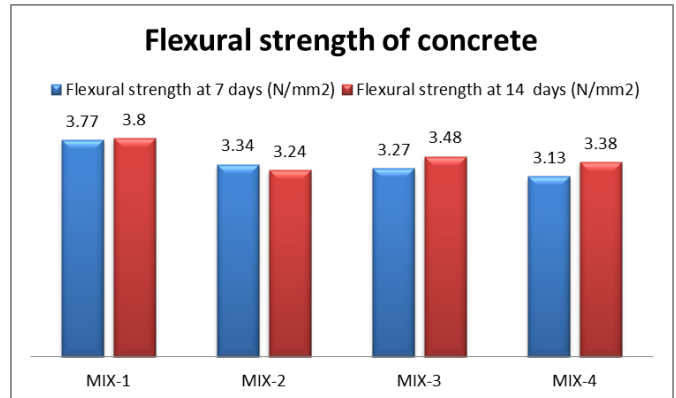


Chart -2: Flexural strength of concrete

### 4. CONCLUSION

The overall compressive strength and flexural strength of modified mix was low when compared to conventional mix. But the difference between mix 1 and mix 3 was 16% in compressive strength and 8.5% in flexural strength. Therefore this study concluded that mix 3 (20% glass powder) gives significant strength and used over conventional concrete in various constructions.

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