

# COMPRESSIVE STRENGTH OF CONCRETE PARTIALLY REPLACING COARSE AGGREGATES BY GLASS WASTE

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## Abstract

Concrete is used as the major material in construction industries. As the population of world increase rapidly, world faces the problem for habitation and waste by-product. As the waste is proportional to the population and there are restriction of natural resources used in concrete, this construction industry need some attention to use some other material so that they can be mix in concrete to get the new product which physical properties are same as the conventional one. Every year there is several tons of waste glasses created all over the world. Waste glass can be re-used as a raw material and it presents an option to save natural and non-renewable materials. The use of waste glass powder in concrete production can make the construction industry more ecological. Waste glass material was replace with aggregate in various percentages such as 10, 20, 30 and 40%.

Test results indicated that on 20% Replacement of Waste glass material into aggregate for M30 grade concrete, the compressive strength, observed were greater than the target mean compressive strength of normal M30 grade concrete.

## Introduction

Concrete is versatile structural material in the modern construction industries. Now a day's concrete is utilized in abundance as man utilizes water for its survival. It has no doubt that with the development of world civilization the concrete will be the major construction material in the coming future.

The quality concrete will only perform best if it improves mainly upon workability, flow ability, durability & resistance to chemical attack/corrosion and reduction in uses of natural resources, w/c ratio & segregation in addition to the strength characteristic. Many researchers have performed research on mix design of concrete (normal and high strength concrete) for improving performance and strength but no researchers have performed for conventional so as to study the variation/influence/improvement/enhance performance of it by using waste glass material has

been replace in to aggregate for M30grade of concrete which grades are very much in use now a days.

Estimated cost for housing is more and some construction materials like natural sand are also becoming rare. Waste glass is one of the main causes of environmental pollution as it cannot be used as land filling in low lying areas. Recycling is one of the main solutions to use such type of waste so that it is safely converted and we can save our motherland. Aggregate is mainly finding from river and now a day's become highly expensive. In this investigation aggregate is replaced with the waste glass powder in certain known quantity and compare the results with the standard known control mix. This waste glass is collected from local market and dumped sites of Chaksu, Jaipur city, Rajasthan. The waste glass is crushed in Los Angles machine in concrete laboratory. The waste glass material was replace with aggregate in various percentages such as 10%,20%,30%,and 40%.

## Literature Review

### **KoliNishikant, AiwaleNachiket, InamdarAvadhut, Abhishek Sangar (June, 2016)**

For this project waste glass was obtained waste collector used and Experiment conducted from 15%, 30% and 45% of waste glass replacement for fine aggregate. Workability of concrete mix increases as well as durability of concrete also increases with waste glass content. Compressive strength increases with increasing the waste glass parentage from 15% to 30% replacement of waste glass and after 45% waste glass replacement onwards the strength is decreases. Strength reduces because of internal voids of waste glass increases.

### **B. Naga Niranjan Kumar, DR. M. Ashok Kumar (April, 2016)**

They carried out the test at 5% 10% 15% 20% replacement of sand by crushed waste glass .Waste glass is highly reactive Pozzolana used to improve mortar and concrete. Amorphous glass with high  $\text{SiO}_2$  contains extremely little particle size and big surface area. Normal concrete compressive strength observed as 28.5 Mpa. The compressive strength of tested cubes for 5% was 31.6, for 10% was 43.99 Mpa, and for 15% was 48.33 MPa, whereas for 20% it was found to be 54.32 Mpa. Hence they were obtain higher compressive strength at 20% replacement.

## Experimental Investigation

As concrete is strong in compression stresses and weak in tension stresses, the present experiments are done to check the performance of concrete in compression flexural and split tensile strength. Experiments are done with reference to the IS 2386-1963, IS 516-1959 and IS 5819-1999 to check the performance with the control mix. In present study nominal mix taken is M30 and glass powder is replaced with 10, 20, 30, and 40% with the coarse aggregate.

## Material Used

**Cement-** Ordinary Portland cement,43 grade specified as per the is 8112-2003 was used for casting the different grade of concrete. Potable water with pH value 7the water cement ratio w/c is fixed to 0.48 according to mix design code IS 10262:2009 and to maintain the slump

KavassuPlast SP-431/ Shalplast SP-431 admixture is used 0.8% by weight of cement. The initial and final setting time was observed by Vicat apparatus and it was found 32 and 590 minutes respectively. The soundness tested by Le-Chetelier was 8 mm.

**Fine aggregate-** Fine aggregate size range 150mc to 4.75mm.in present work Banash River (from district Tonk) sand was used with % finer 99.3 with specific gravity 2.62.

**Coarse aggregates-** Aggregate particles greater than 4.75mm, but consider range between 9.5mm to 37.5mm in dia. In this case consider aggregate range 20mm and 10mm particles size was used with specific gravity 2.73.

**Waste glass material:** Waste glass available from nearby of locality is been collected and made into waste glass cullet in very fine. Waste glass waste is very hard material. Before adding fine waste glass cullet in the concrete it has to be crushed to desired size. Glass waste specific gravity is 2.58



**Table no 1: physical and chemical properties of different material**

Material	Specific Gravity	Colour
Fine aggregate	2.62	Light brown
Coarse aggregate	2.72	Greyish white
Glass waste bottle	2.58	Dark grey
Water	PH- 7	Colourless

### **Mix Design and Experimental Work:**

In present study work the nominal mix is taken M30 and it is mix design code IS 10262:2009. As discuss earlier the W/C ratio is fixed to 0.45 and to maintain the slump a suitable 0.8 % by weight of cement admixture is used. The replacement level of glass waste cullets with fine aggregate were used in terms of,10% ,20% ,30% , and 40% and it is shown in table no 2.

**Table 2: Mix proportions for coarse Aggregate replacement for M30**

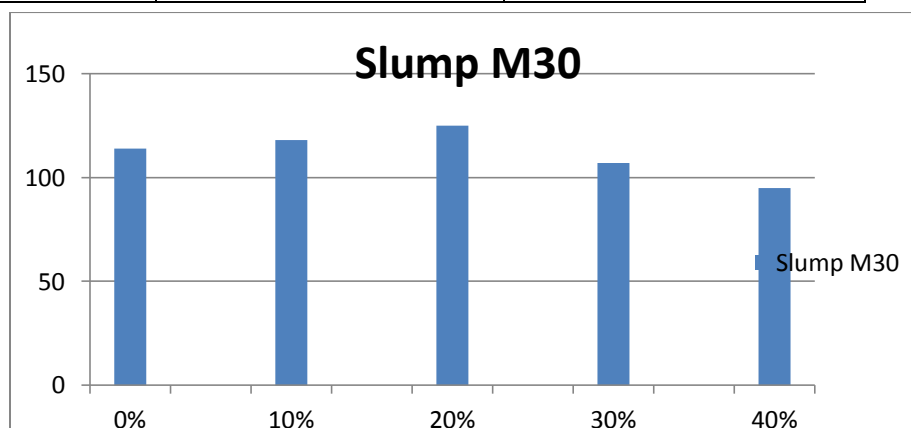
% of WGB	Cement Kg/m <sup>3</sup>	Coarse aggregates Size, kg/m <sup>3</sup>		WGB	Fine aggregates, Kg/m <sup>3</sup>	Water, Kg/m <sup>3</sup>	Admixture, Kg/m <sup>3</sup>
		10mm	20mm				
0%	384	645.80	424.06	0	780.86	173	3.84
10%	384	581.30	424.06	64.5	702.77	173	3.84
20%	384	516.80	424.06	129	624.68	173	3.84
30%	384	452.30	424.06	193.5	546.60	173	3.84
40%	384	387.80	424.06	258	468.51	173	3.84

## Results and Analysis

### Workability Test

Table 3: Slump on Replacement of Waste glass material into coarse aggregate For M30 Grade

S.No.	Mix% (WGB + FA)	Slump (mm)
1	(0+100)	114
3	(10+90)	118
5	(20+80)	125
7	30+70)	107
9	(40+60)	95

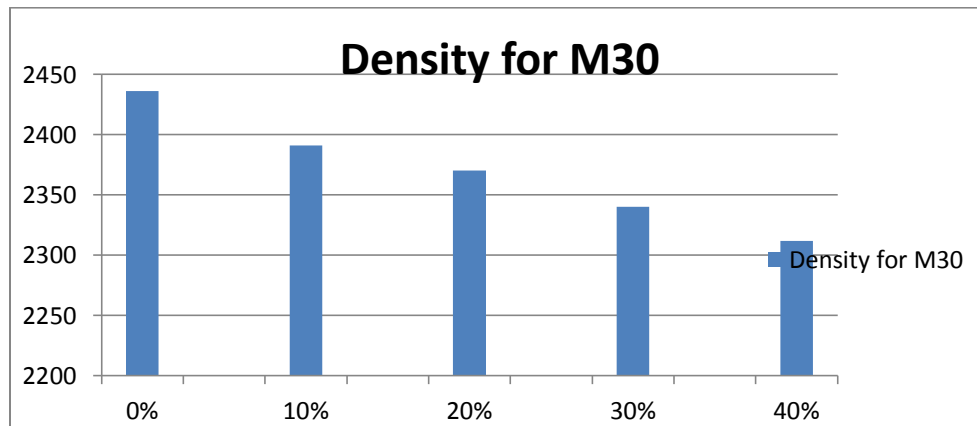
**Graph 1: Effect of bottle waste glass material on Slump of Concrete (M30) on Replacement**

### Density Test Result

The density of specimens were measured before testing the specimens. To determine density of specimens first external surface of the specimen was cleaned and swept with the help of cotton cloth.

**Table 4: Density of Hardened Concrete on Replacement of Waste glass bottle material into Fine aggregate for M30**

S.No.	Mix% (WGB + FA)	Density of Hardened Concrete (Kg/m <sup>3</sup> )
1	(0+100)	2436
3	(10+90)	2391.05
5	(20+80)	2370
7	(30+70)	2340
9	(40+60)	2311.75



**Graph 2: Effect of waste glass material on Density of Hardened Concrete (M30) on Replacement into aggregate**

### Compressive Strength

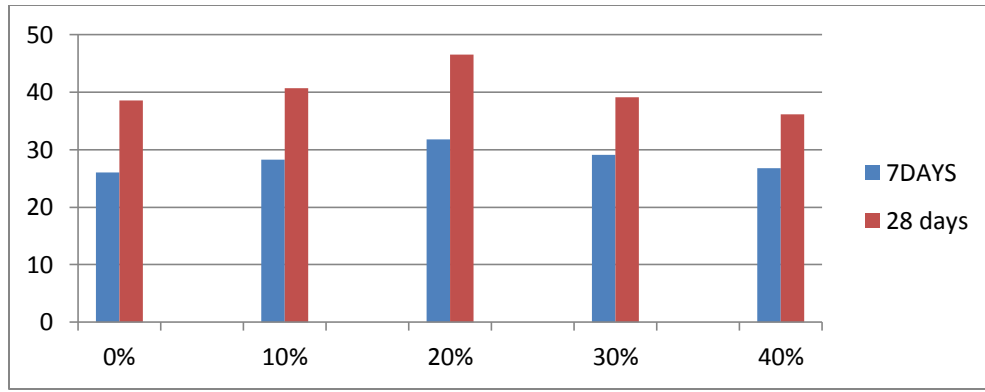
The compressive strength of all the mixes was determined with cubical specimens of size 150mm(length) x 150mm(width) x 150mm(depth). The specimens were tested after curing period of both 7 days and 28 days fully submerged in water as per IS 516:1959 for the method of tests for strength of concrete.



FIGURE 1

**Table 5: Comparison for 7 Days and 28 Days Compressive Strength of Cube on replacement of Waste glass material into Aggregate For M30 Grade**

% of WGB replacement	Average For Compressive At 7days	Average For Compressive At 28 days
	At 7 days Strength (N/mm <sup>2</sup> )	At 28 days Strength (N/mm <sup>2</sup> )
0%	26.01	38.52
10%	28.30	40.67
20%	31.75	46.50
30%	29.05	39.10
40%	26.75	36.16



**Graph 3: Effect of Waste glass replacement on Concrete of M30 Grade for 7 Days, 28 days Compressive Strength of Cube**

## CONCLUSION

1. The workability of concrete shows as slump of the concrete mix increase up to 20% replacement of control mix.
2. Super plasticizer was used up to 0.8% of Cement percentage by weight of cement.
3. Waste glass material shows a pozzolanicbehaviour.
4. Compressive strength in concrete was found to increase in strength with 20% replacement higher strength percentage variation achieved But further after increasing the waste glass bottle, the compressive strength goes to decreasing.
5. Density of concrete mix with WGB is decreasing with increase in replacement values.
6. The surface finish of cylinders and beams casted with waste glass waste concrete mix was observed to be better than the surface finish of normal control mix.

## REFERENCES

- [1].Mohammad Iqbal Malik, AarifManzoor, Barkat Ahmad, Syed Asima, Rozi Ali, Muzafar Bashir “partial replacement of fine aggregates in waste glassin concrete”. International Journal of civil engineering and Technology (IJCIET).Website: www.ijciat.asp (ISSN 0976-6308, ISSN 0976-6316, Certified Journal, Volume 5, Issue 11, November, 2014).
- [2]. Ion Dumitru, Tony Song, VasileCaprar, Phillip Brooks and Justin Moss “Incorporation of Recycled Waste glass for Durable Concrete”. International Journal of civil engineering and Technology (IJCIET).Website: www.claisse.info (ISBN 0978-1-4507-1490-7, Certified Journal, Volume 5, Issue 11, November, 2014).
- [3]. Dr. M.VijayaSekhar Reddy, P.Sumalatha, M.Madhuri and K.Ashalatha “Incorporation of Waste glass Powder as Partial Replacement of Fine Aggregate in Cement Concrete”. International Journal of Scientific & Engineering Research. Website: www.ijser.org (ISSN 2229-5518), Certified Journal, Volume 6, Issue 12, December-2015).
- [4]. T. PhaniMadhavi, V.Sampathkumar, P.Gunasekaran “partial replacement of cement and fine aggregates by using flyash and waste glass aggregates”. IJRET: International Journal of Research in Engineering and Technology. Website:http://www.ijret.org (eISSN: 2319-1163 | pISSN: 2321-7308, Certified Journal, IC-RICE Conference Issue | Nov-2013).

[5].TK.Madhangopal,B.Nagakiran,S.R.Sraddha,G.Vinodkumar,P.ThajunS.A.

Kishore Sankeerth,T.Varalakshmi“Study of Waste glass Powder on the Properties of Concrete”. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ,Website:www.iosrjournals.org(e-ISSN: 2278-1684,p-ISSN: 2320-334X), Volume 11, Issue 2 Ver. VI (Mar- Apr. 2014), PP 34-38.

[6].D.Elavarasan, Dr.G.Dhanalakshmi“study on waste glass as a partial replacing material in fine aggregate”.International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST). (ISSN 2395-695X ISSN 2395-695X )Vol. 2, Issue 3, March 2016.

[7].Sidharthan. O, Vijayaraghavan.C, Sivaraman. S, “A Study on Compressive Strength of Concrete using Crushed Waste glass as Fine Aggregate”.International journal of research in science engineering and technologies(IJRESTs).Website:www.ijrests.org(ISSN:2395-6453), Volume 2, Issue 2 Ver. VI (Apr. 2016).

[8].B.NAGA, NIRANJAN KUMAR, DR. M.ASHOK KUMAR “WASTE GLASS POWDER ON THE PROPERTIES OF CONCRETE”. IJRDO-Journal Of Mechanical And Civil Engineering). (ISSN 2456 1479)Vol. 2, Issue 4, april 2016.

[9].Sameer Shaikh,S.S. Bachhav,D.Y. Kshirsagar “Effective Utilization of Waste glass in Concrete”. Int. Journal of Engineering Research and Applications. Website:www.ijera.com (ISSN: 2248-9622.), Issue 12, (Part - 4) December 2015, pp.01-04

[10]. S.P. Gautam, Vikas Srivastava and V.C. Agarwal “Use of waste glass wastes as fine aggregate in Concrete”. Youth Education and Research Trust (YERT). (ISSN: 2278-5213.), *J. Acad. Indus. Res.* Vol. 1(6) November 2012.