

Investigations on Concrete by Partial Replacement of crusher sand and Glass Powder for M-30 Grade of Concrete

PRIYANKA DUBEY

Department of Civil Engineering, Dr. A. P. J. Abdul Kalam University, Indore
Corresponding Author Email: priyankadubey1105@gmail.Com

Abstract—Utilization of Glass Powder and other is Crusher sand as incomplete substitution of concrete and solid creation. Right now break down the quality of cement made with utilizing these waste materials one is Glass Powder and other is Crusher sand. The Glass Powder is utilized as 20% supplant by weight of concrete and Crusher sand as the incomplete substitution of Fine Aggregate from 0%, 10%, 20%, 30% and 40%. The evaluation of the solid here is M-30 evaluation. It has been utilized as a substitution of fine totals in numerous writing works yet this paper exhibits the practicality of the substitution of Glass Powder for concrete to accomplish economy and condition sparing. Droop Test was completed for the crisp cement while Compressive Strength, Flexure Strength and Split Tensile Tests were conveyed for the Hardened cement. All tests are done at 7-day, 14 - day, and 28 days with 0 to 40% substitution of sand at an interim of 10%. Again above tests are completed with 20% substitution of concrete by glass powder. It is seen that the glass powder improve the quality and Crusher sand can be utilized as sand. Investigation, for example, explicit gravity trial of Crusher sand and sand by pycnometer strategy, dampness substance of sand and Crusher sand by stove drying technique, typical consistency of concrete, and starting setting time of concrete, were performed to decide the physical property of cement. On new solid droop test was preformed to check functionality of concrete and after then compressive quality was checked. Consequently stone residue is proper substitute of fine totals in solid blend for development. This is incredible sparing in exorbitant material.

Keywords— Compressive Strength, Glass Powder, Crusher sand, Mix Design, Test, Flexure Test, Split Tensile Test

I. INTRODUCTION

The development business isn't just utilized in building development yet in addition in different territories like extensions, streets, harbors, dam, Railways and some more. It is relatively prudent, simple to make offers congruity robustness and surely it lays the job of creating and improving or present day life. It is a composite material which is comprised of sand, concrete, total and water. The new concrete can be form into any craving shape. The life of the solid is high so it tends to be utilized as adaptable material. In the solid the concrete is utilized as the folio

material which has the coupling inclination. Because of increment in exercises for various locales and utilities

terrifying of the normally accessible assets is being constrained because of it's over abuse. This is the risk to the earth. Additionally the utilization of regular material turns out to be expensive step by step. Subsequently protection of the normally accessible material is incredible test for the structural specialists. By utilizing the elective materials which diminished halfway, there is best way to look through materials which can completely or incompletely supplanted normally accessible material in the development field. The different elective materials are utilized as fractional for completely substitution of ordinary material for example Rice husk debris, fly-debris, sugarcane bagasses debris, coconut shell, squashed sand, reused total and so on. Here we utilize the two waste materials which is effectively accessible. The Crusher sand delivered from stone pounding zones appers as an issue for compelling removal. Which is utilized here as partly substitution as fine total. Additionally the glass powder created from enterprises is likewise a waste material which can be utilized as fractional substitution as concrete. Sand is a material utilized in concrete as fine total.

II. LITERATURE REVIEW

Numerous works have been do to investigate the advantages of utilizing different waste materials, for example, rock dust, marble dust, Crusher sand and glass powder in making and improving the properties of cement. The accompanying works have done by the creators as portray beneath Utilization of Crusher sand as a fine total in solid draws genuine consideration of analysts and specialists. The most extreme compressive and flexural qualities were watched for examples containing a 6% squander muck when contrasted and control and it was likewise discovered that waste slop up to 9% could successfully be utilized as an added substance material in concrete could adequately be utilized as an added substance material in concrete. With the consideration of Marble powder the quality of cement progressively increments up to a specific cutoff yet the bit by bit diminishes. With the incorporation of Marble powder upto10% the underlying quality increase in concrete is high. At 10% there is 27.4% expansion in starting Split Tensile quality for 7 days. At 10% there is 11.5% expansion in introductory Split Tensile quality for 28 days. The underlying quality slowly diminishes from 15%. It was discovered that the ideal rate for supplanting of marble powder with concrete and it is practically 10% concrete for the two 3D shapes and chambers, P. Aggarwal et al [5] completed the trial examinations on the impact of

utilization of that material of debris as a substitution of fine totals. The quality advancement for an assortment of rates (0-half) supplanting of fine totals with base debris can without much of a stretch be likened the quality improvement of ostensible cement at various ages. Dr. Lalit Kumar, Er. Arvinder Singh. have research the plausibility of utilizing squashed stone residue as fine total incompletely or completely with various evaluations of solid composites. The appropriateness of squashed stone residue squander as a fine total for concrete has been evaluated by contrasting its essential properties and that of traditional cement. Two fundamental blends were picked for common sand to accomplish M25 and M30 grade concrete. The equal blends were gotten by supplanting common sand by stone residue halfway and completely. The test outcomes shows the squashed stone residue can be utilized successfully to supplant regular sand in concrete. In the exploratory investigation of solidarity qualities of solid utilizing squashed stone residue as fine total it is discovered that there is increment in compressive quality, flexure quality and rigidity.

III. MATERIAL USES

Cement

In the present work locally available Portland Pozzolana Cement (fly ash based) brand name Birla Gold confirming to IS: 1489 (Part 1) -1991 was used. Having specific gravity 3.12 and normal consistency 33%

Fine Aggregate

The fine aggregate in this research work are used from locally available and confirms to zone II of IS 383:1970. Having specific gravity 2.67 and fineness modulus 2.87.

Coarse Aggregate

Two aggregate of sizes 20 mm and 10 mm were used from local available from Bhopal in this work. The specific gravity of coarse aggregate was 2.72 for both the fractions. The sieve analysis of 10 mm and 20 mm coarse aggregate is given in table below. The 20 mm and 10 mm aggregate were mixed in the ratio of 60:40. The coarse aggregates are confirmed to IS 383:1970 and having specific gravity 2.84 and fineness modulus 6.026

Table 1. Sieve Analysis of Fine aggregate

Sieve Size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative Percentage weight retained	% Passing
4.75 mm	-	-	-	100
2.36 mm	55	55	5.5	94.5
1.18 mm	228	283	28.3	71.7

600 μ	348	631	63.1	36.9
300 μ	285	916	91.6	8.4
150 μ	75	991	99.1	0.9
Pan	5	996	100	0
Total 1 Kg	Fineness Modulus = $287.6/100 = 2.87$			

Table 2. Sieve analysis for coarse aggregate of 20 mm size

Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative Percentage weight retained	% passing
40 mm	-	-	-	100
20 mm	484	484	9.68	90.32
10 mm	4165	4649	92.98	7.02
4.75 mm	345	4994	100	-
1.18 mm	0	4994	100	-
600 μ	0	4994	100	-
300 μ	0	4994	100	-
150 μ	0	4994	100	-
Total = 5 Kg	Fineness modulus = $602.66/100 = 6.026$			

Table 3. Sieve analysis for coarse aggregate of 10 mm size.

Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % weight retained	% passing
20 mm	-	-	-	100
10 mm	2856	2856	57.12	42.88
4.75 mm	1394	4250	85	15
2.36 mm	744	4992	100	-
1.18 mm	0	4992	100	-
600 μ	0	4992	100	-
300 μ	0	4992	100	-
150 μ	0		100	-
Total = 5 Kg	Fineness modulus = $642.12/100 = 6.42$			

Crusher sand

Crusher sand produced from stone crushing zones appears as a problem for effective disposal. Hence in this work crusher sand is used in the concrete as partial replacement of the sand. The main purpose of this work is to waste minimization. The study focuses to determine the relative performance of concrete by using crusher sand. crusher sand was collected from local stone crushing units .

Table 4. Sieve analysis for Stone Dust

Sieve size	Weight retained	Cumulative weight retained	Cumulative percentage weight retained	% passing
4.75 mm	-	-	-	100
2.36 mm	24	24	2.4	97.6
1.18 mm	158	182	18.2	81.8
600 μ	185	367	36.7	63.3
300 μ	385	752	75.2	24.8
150 μ	197	949	94.9	5.1
Pan	46	995	100	0
Total = 1 kg	Fineness modulus = 227.40/100 = 2.27			

Glass Powder

Waste glass powder in this study was used from locally available market. Glass waste is very hard material. The glass powder is ball pulverized and particles size are less than 150 μm and sieved through 75 μm.

Water

The clean portable water is used in this experimental work without any visible impurities.

IV. EXPERIMENTAL DETAILS

Mix design

In this experiment we select the grades of concrete M-25. The mix design was carried out as per IS: 10262-2009. The trials have been prepared and finally we find for M-25 grade was design for this experiment having the mix proportion 1:1.40:3.05 and the water cement ratio are 0.43. All locally available materials are used during the preparation of the mix proportion.

Mixing and casting of samples

The mixing and casting were done with proper care and all materials were weighted properly and mixed in laboratory concrete mixer. The water is added after all materials are

feed into in mixer in proper order. The cubes were filled and compacted by using table vibrating machine and the cylinder and beams were compacted using the tamping rod for around 25 times. The moulds were leveled properly. The specimens were kept for 24 hours and then it is removed from mould and kept in curing tank till the testing days. All specimens are tested at 7, 14, 28, and 28 days.

Compressive Strength Tests

The compressive strength tests were done by using the cubic specimen of sizes 150x150x150 mm. The moulds are confirming to the IS specification. For each test three specimens were taken and their average value is considered. The load should be applied gradually at the rate of 140 kg/cm² per minute till the specimens fails. The load at the failure divided by area of specimen gives the compressive strength of concrete. The cubes were tested at 7, 14, 28, and 56 days of curing.

Flexure Strength Tests

The flexure strength also known as modulus of rupture, bends strength, or fracture strength. The value of modulus of rupture depends on the dimensions of the beam and manner of loading. The value of the flexural strength is about 10 to 20 percent of compressive strength depending on the type, size and volume of coarse aggregate used. In these tests the beams were casted having the size 150x150x700 mm. For this the moulds of the same sizes are taken which are confirming to the IS specification. During the casting it is compacted by using the tamping rod of around 25 times the diameter of the tamping rod is 16 mm. The flexure strength was tested at the age of 7, 14, and 28 days curing.

Split Tensile Tests

We know that the concrete is weak in tension. The tensile strength is one of the important properties of the concrete. The tensile strength tests the cylinders were casted having the size 150 mm diameter and 300 mm lengths. This is the indirect method of the testing the tensile strength of the concrete. For this the moulds of the same sizes are taken which are confirming to the IS specification. It is also casted by using the 16 mm tamping rod of around 25 times. The split tensile tests were carried out at 7, 14 and 28 days curing.

Table 5. Details of Specimen Designation

Designation	Grade	Type	Cement %	Sand %	CA %	C.S %	G.P. %
B ₁ -0	M - 30	Cube	100	100	100	0	Nil
B ₁ -10	M - 30	Cube	100	90	100	10	Nil
B ₁ -20	M - 30	Cube	100	80	100	20	Nil
B ₁ -30	M - 30	Cube	100	70	100	30	Nil
B ₁ -40	M - 30	Cube	100	60	100	40	Nil
B ₂ -0	M - 30	Beam	100	100	100	0	Nil

B ₂ -10	M-30	Beam	100	90	100	10	Nil
B ₂ -20	M-30	Beam	100	80	100	20	Nil
B ₂ -30	M-30	Beam	100	70	100	30	Nil
B ₂ -40	M-30	Beam	100	60	100	40	Nil
B ₃ -0	M-30	Cylinder	100	100	100	0	Nil
B ₃ -10	M-30	Cylinder	100	90	100	10	Nil
B ₃ -20	M-30	Cylinder	100	80	100	20	Nil
B ₃ -30	M-30	Cylinder	100	70	100	30	Nil
B ₃ -40	M-30	Cylinder	100	60	100	40	Nil
B' ₁ -10	M-30	Cube	80	90	100	10	20
B' ₁ -20	M-30	Cube	80	80	100	20	20
B' ₁ -30	M-30	Cube	80	70	100	30	20
B' ₁ -40	M-30	Cube	80	60	100	40	20
B' ₂ -10	M-30	Beam	80	90	100	10	20
B' ₂ -20	M-30	Beam	80	80	100	20	20
B' ₂ -30	M-30	Beam	80	70	100	30	20
B' ₂ -40	M-30	Beam	80	60	100	40	20
B' ₃ -10	M-30	Cylinder	80	90	100	10	20
B' ₃ -20	M-30	Cylinder	80	80	100	20	20
B' ₃ -30	M-30	Cylinder	80	70	100	30	20
B' ₃ -40	M-30	Cylinder	80	60	100	40	20

CA= Course Aggregate, C.S = crusher sand, G.P = Glass Powder

V. RESULTS AND DISCUSSION

Compressive Strength: The result of the compressive strength with partial replacement of Crusher sand and without using glass powder for 7, 14 and 28 days are shown in the Table 6 for M-30 concrete and their graphical representation in the Fig. for M-30 Concrete. And by replacing 20% cement with glass powder along with Crusher sand is shown in the Table 10 for M-30 concrete and their graphical representation is shown in the Fig 2 and Fig 4.

Table 6. Compressive Strength of Different Mix of M-30 Concrete (without Glass Powder)

Designation	Compressive Strength in N/mm ²			% C.S.
	7 Days	14 Days	28 Days	
B ₁ -0	23.06	27.50	37.50	0
B ₁ -10	23.80	28.05	38.42	10
B ₁ -20	24.16	28.70	39.30	20
B ₁ -30	24.86	29.30	40.06	30
B ₁ -40	25.10	29.82	42.10	40
B ₁ -0	23.06	27.50	37.50	0

Flexure Strength: The result of the flexure strength with partial replacement of Crusher sand and without using glass powder for 7, 14 and 28 days are shown in the Table 7 for

M-30 concrete and their graphical representation in Fig. 2 for M-30 Concrete. And by replacing 20% cement with glass powder along with Crusher sand is shown in the Table 15 for M-30 concrete and their graphical representation is shown in the Fig 9 and Fig 5.

Table 7. Flexure Strength of Different Mix of M-30 Concrete (without Glass Powder)

Designation	Flexure Strength in N/mm ²			% C.S.
	7 Days	14 Days	28 Days	
B ₂ -0	4.20	4.98	5.20	0
B ₂ -10	4.36	4.90	6.31	10
B ₂ -20	4.42	5.01	6.70	20
B ₂ -30	4.83	5.10	6.86	30
B ₂ -40	4.72	4.92	6.20	40

Split Tensile Strength: The result of the split tensile strength with partial replacement of Crusher sand and without using glass powder for 7, 14 and 28 days are shown in the Table 8 for M-30 concrete and their graphical representation in the Fig. 5 for M-30 concrete and in the. And by replacing 20% cement with glass powder along with Crusher sand is shown in the able 11 for M-30 concrete and their graphical representation is shown in the Fig 3 and Fig 6.

Table 8. Split Tensile Strength of Different Mix of M-30 Concrete (without Glass Powder)

Designation	Split Tensile Strength in N/mm ²			% C.S.
	7 Days	14 Days	28 Days	
B ₃ -0	3.05	3.70	4.12	0
B ₃ -10	3.21	3.61	4.31	10
B ₃ -20	3.15	3.47	4.16	20
B ₃ -30	3.42	3.68	4.44	30
B ₃ -40	3.50	3.76	4.49	40

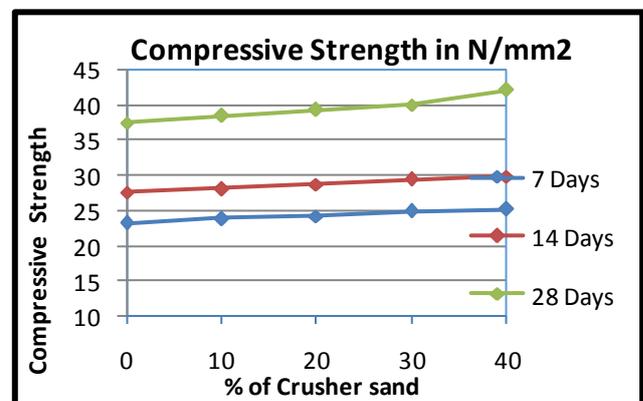


Figure 1. Compressive Strength of Different Mix of M-30 Concrete (Without Glass Powder)

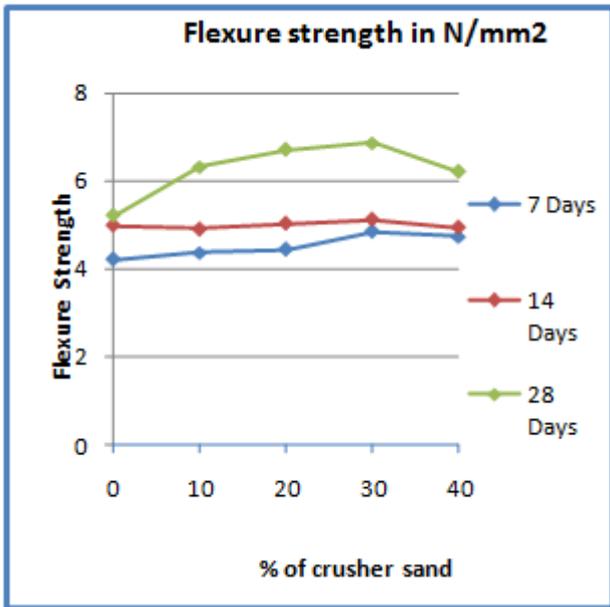


Figure 2. Flexure Strength of Different Mix of M-30 Concrete (Without Glass Powder)

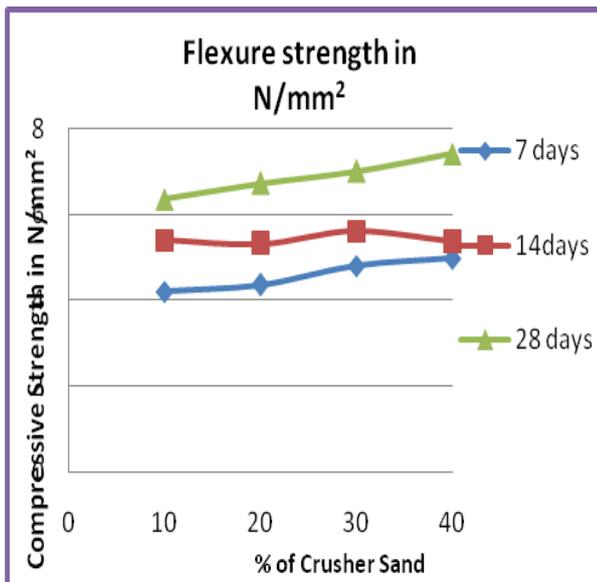


Figure 3. Split Tensile Strength of Different Mix of M-30 Concrete (Without Glass Powder)

Table 9 Compressive Strength of Different Mix of M-30 Concrete (with 20% Glass Powder & 80% Cement)

Designation	Compressive Strength in N/mm ²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
B' ₁ - 10	28.70	28.40	39.36	10
B' ₁ - 20	28.96	29.90	39.80	20
B' ₁ - 30	29.14	30.21	40.26	30
B' ₁ - 40	30.00	31.60	41.96	40

Table 10. Flexure Strength of Different Mix of M-30 Concrete (with Glass Powder 20% & Cement 80%)

Designation	Flexure Strength in N/mm ²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
B' ₂ - 10	4.20	5.40	6.36	10
B' ₂ - 20	4.36	5.32	6.72	20
B' ₂ - 30	4.80	5.62	7.01	30
B' ₂ - 40	4.98	5.36	7.42	40

Table 11. Split Tensile Strength of Different Mix of M-30 Concrete (with Glass Powder 20% & Cement 80%)

Designation	Split Tensile Strength in N/mm ²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
B' ₃ - 10	3.12	3.72	4.20	10
B' ₃ - 20	3.18	3.58	4.26	20
B' ₃ - 30	3.06	3.70	4.32	30
B' ₃ - 40	3.20	3.93	4.46	40

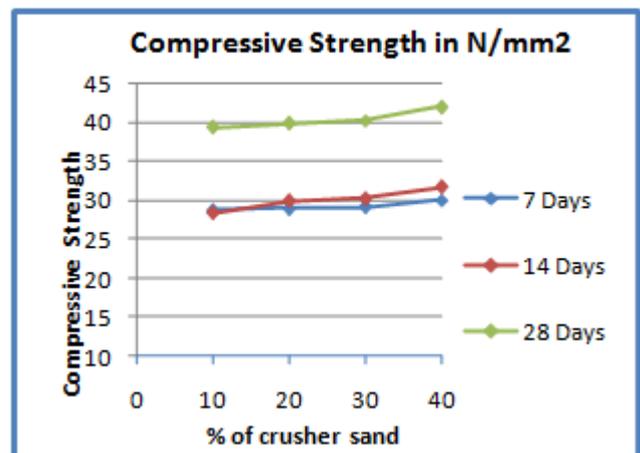


Figure 4. Compressive Strength of Different Mix of M-30 Concrete (with 20% Glass Powder & 80% Cement)

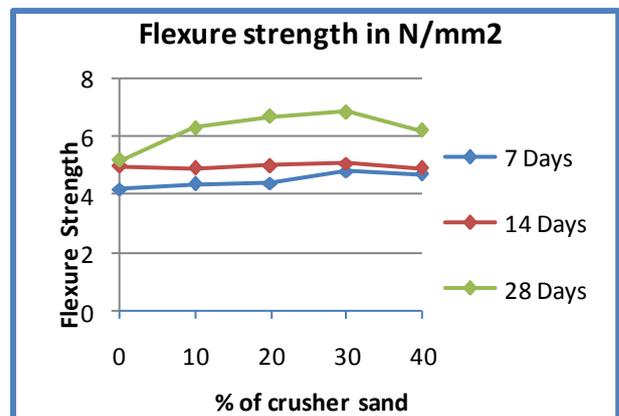


Figure 5. Flexure Strength of Different Mix of M-30 Concrete (With 20% Glass Powder & 80% Cement)

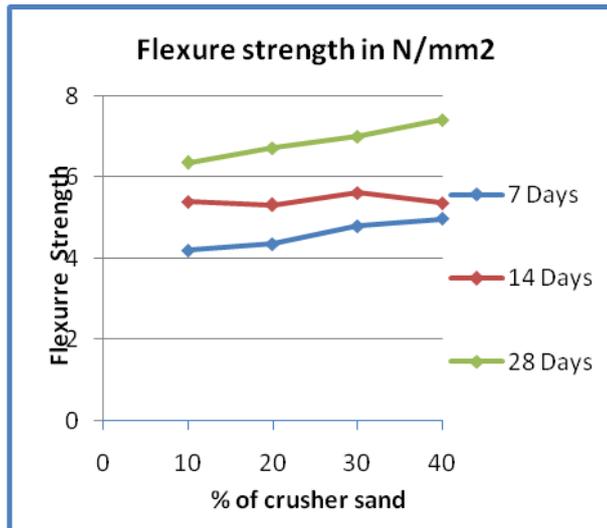


Figure 6. Split Tensile Strength of Different Mix of M-30 Concrete (With 20% Glass Powder & 80% Cement)

VI. CONCLUSIONS

From the about experiments following conclusions are observes:

- The compressive quality by supplanting 40% sand by Crusher sand the quality increments by 10, 5, 13 and 14% at 7, 14 and 28 days separately 10% at 7, 14 and 28 days individually in M-30 cement. When contrasted with the regular cement. In this manner Crusher sand expands the compressive quality of the solid and diminishes the expense of material and furthermore its incredible utilization of waste materials.
- The compressive quality of the solid by supplanting the 40% sand by Crusher sand and 20% concrete by the glass powder the quality increments by 28, 15, 18 and 24% at 7, 14 and 28 days separately M-30 cement. When contrasted with the regular cement. Subsequently glass powder can likewise be utilized something like 20% which is additionally extraordinary sparing in exorbitant concrete and utilization of waste material.
- The flexure quality of the solid by supplanting the 40% sand by stone residue increment in M-30 solid it expands 12, 19 and 23% at 7 and 28 days individually and decreased by 1.2% at multi day. When contrasted with the traditional cement. Subsequently Crusher sand additionally expands the flexure quality at the later times of the solid.
- The flexure quality of the solid by supplanting 40% sand by Crusher sand and 20% concrete by the glass powder the qualities are increment by 19, 18, 42 and 44% at 7, 14 and 28 days separately in M-30 cement. When contrasted with the regular cement. In this manner flexure quality is likewise increment by including the glass powder. It likewise lessens the utilization of the concrete.
- The split tractable strength of the solid by supplanting sand 40% by Crusher sand the qualities M-30 concrete and 15, 2, 9 and 10% at 7, 14 and 28 days separately in M-30 cement. Consequently Crusher sand builds the

elasticity of the solid which is likewise sparing in fine total.

- The split elasticity of the solid by supplanting 40% sand by Crusher sand and 20% concrete by glass powder the rigidity is increment in 8% at 7, 14 and 28 days individually in M-30 cement. Thus by including the glass powder with Crusher sand is likewise increment the elasticity of the solid. Consequently sparing in cost is two different ways cost of sand and concrete.

VII. FURTHER SCOPE OF WORK

- The study can be carry out by increasing the percentage of crusher sand up to 100% and fully replacement of the fine aggregate.
- The study can also be carry out by increasing the percentage of glass powder up to maximum level with or without crusher sand.
- The engineering properties like water absorption, reduction in weight of concrete and density of the concrete can be study by using the crusher sand and glass powder.
- The effect temperature and humidity can also be study.
- The study can also be carry out by using higher grade of concrete.

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