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Empirical Abstraction on Concrete with Partly Substitution of Cement and Sand with Glass Powder and Stone Dust for M-25 Grade of Concrete

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Abstract— The fundamental target of this examination is to explore the utilization of Glass Powder and other is smasher sand as fractional 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 smasher sand. The Glass Powder is utilized as 20% supplant by weight of concrete and smasher sand as the halfway substitution of Fine Aggregate from 0%, 10%, 20%, 30% and 40%. The evaluation of the solid here is M-25 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 done 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 done with 20% substitution of concrete by glass powder. It is seen that the glass powder improve the quality and smasher sand can be utilized as sand. Test, for example, explicit gravity trial of smasher sand by pycnometer technique, dampness substance of sand and smasher sand by broiler drying strategy, 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 usefulness of concrete and after then compressive quality was checked. Therefore smasher sand is suitable substitute of fine totals in solid blend for development. This is extraordinary sparing in exorbitant material.

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

I. INTRODUCTION

The solid is helpful materials in the development business. It isn't just utilized in building development yet additionally in different regions like scaffolds, streets, harbors, dam, Railways and some more. It is nearly affordable, simple to make offers progression strength and in reality 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 crisp cement can be form into any longing shape. The life of the solid is high so it tends to be utilized as flexible material. In the solid the concrete is utilized as the fastener material which has the coupling inclination. Because of increment in exercises for various districts and utilities startling of the normally accessible assets is being constrained because of it's over misuse. This is the risk to the earth. Additionally the utilization of regular material turns out to be exorbitant step by step. Thus protection of the normally accessible material is incredible test for the structural architects. By utilizing the elective materials which decreased in part, 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 halfway for completely substitution of traditional material for example Rice husk debris, fly-debris, sugarcane bagasses debris, coconut shell, squashed sand, reused total and so forth. Here we utilize the two waste materials which is effectively accessible.

The smasher sand delivered from stone squashing zones appers as an issue for successful removal. Which is utilized here as partily substitution as fine total. Likewise the glass powder created from ventures is additionally a waste material which can be utilized as halfway substitution as concrete. Sand is a material utilized in concrete as fine total.

II. LITERATURE REVIEW

Numerous works have been complete to investigate the advantages of utilizing different waste materials, for example, rock dust, smasher sand, stone residue and glass powder in making and upgrading the properties of cement. The accompanying works have done by the creators as depict beneath

Utilization of smasher sand as a fine total in solid draws genuine consideration of specialists and agents. The greatest compressive and flexural qualities were watched for examples containing a 6% squander muck when contrasted and control and it was additionally discovered that waste slime 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 incorporation of glass powder the quality of cement step by step increments up to a specific utmost however the steadily diminishes. With the

incorporation of glass powder upto10% the underlying quality addition in concrete is high. At 10% there is 27.4% expansion in beginning Split Tensile quality for 7 days. At 10% there is 11.5% expansion in introductory Split Tensile quality for 28 days. The underlying quality step by step diminishes from 15%. It was discovered that the ideal rate for supplanting of glass powder with concrete and it is practically 10% concrete for the two blocks and chambers, P. Aggarwal et al [5] completed the exploratory 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 compared 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 mostly or completely with various evaluations of solid composites. The appropriateness of squashed stone residue squander as a fine total for concrete has been surveyed by contrasting its essential properties and that of traditional cement. Two essential blends were picked for common sand to accomplish M25 grade concrete. The equal blends were gotten by supplanting common sand by stone residue halfway and completely. The test outcomes show the squashed stone residue can be utilized adequately to supplant characteristic sand in concrete. In the test 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 is table below. The 20 mm and 10 mm aggregate were mixed in the ratio of 60:40. The coarse aggregates are confirms to IS 383:1970 and having specific gravity 2.84 and fineness modulus 6.026

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 1. Sieve Analysis of Fine aggregate

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 2. Sieve analysis for coarse aggregate of 20 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			

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

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 .

Sieve size	Weight retained (gm)	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			

Table 4. Sieve analysis for Stone Dust

Glass Powder

Waste glass powder in this study was used from locally available market. Glass waste is very hard material. The glass powder if 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/cm^2 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

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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.

Designation	Grade	Type	Cement %	Sand %	CA %	C.S %	G.P. %
A_1 - 0	M - 25	Cube	100	100	100	0	Nil
A_1 - 10	M - 25	Cube	100	90	100	10	Nil
A_1 - 20	M - 25	Cube	100	80	100	20	Nil
A_1 - 30	M - 25	Cube	100	70	100	30	Nil
A_1 - 40	M - 25	Cube	100	60	100	40	Nil
A_2 - 0	M – 25	Beam	100	100	100	0	Nil
A_2 – 10	M – 25	Beam	100	90	100	10	Nil
A_2 – 20	M – 25	Beam	100	80	100	20	Nil
A_2 – 30	M – 25	Beam	100	70	100	30	Nil
A_2 – 40	M - 25	Beam	100	60	100	40	Nil
A_3 – 0	M – 25	Cylinder	100	100	100	0	Nil
A_3 – 10	M – 25	Cylinder	100	90	100	10	Nil
A_3 – 20	M – 25	Cylinder	100	80	100	20	Nil
A_3 – 30	M – 25	Cylinder	100	70	100	30	Nil
A_3 – 40	M – 25	Cylinder	100	60	100	40	Nil
A'_1 - 10	M - 25	Cube	80	90	100	10	20
A'_1 - 20	M - 25	Cube	80	80	100	20	20
A'_1 - 30	M - 25	Cube	80	70	100	30	20
A'_1 - 40	M - 25	Cube	80	60	100	40	20
A'_2 - 10	M - 25	Beam	80	90	100	10	20
A'_2 - 20	M – 25	Beam	80	80	100	20	20
A'_2 - 30	M – 25	Beam	80	70	100	30	20
A'_2 - 40	M – 25	Beam	80	60	100	40	20
A'_3 - 10	M - 25	Cylinder	80	90	100	10	20
A'_3 - 20	M – 25	Cylinder	80	80	100	20	20
A'_3 - 30	M – 25	Cylinder	80	70	100	30	20
A'_3 - 40	M – 25	Cylinder	80	60	100	40	20

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

Table 5. Details of Specimen Designation

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, 14and 28 days are shown in the Table 6 for M-25 concrete and their graphical representation in the Fig. 1 for M-25 concrete. And by replacing 20% cement with glass powder along with crusher sand is shown in the Table 12 for M-25 concrete and their graphical representation is shown in the fig.

Designation	Compressive Strength in N/mm^2			% C.S.
	7 Days	14 Days	28 Days	
A_1 - 0	21.15	24.39	32.56	0
A_1 - 10	21.60	24.76	32.30	10
A_1 - 20	21.96	25.01	34.80	20
A_1 - 30	22.50	25.08	35.40	30
A_1 - 40	23.18	25.70	37.02	40
A_1 - 0	21.15	24.39	32.56	0

Table 6. Compressive Strength of Different Mix of M-25 Concrete (without Glass Powder)

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 8 for M-25 concrete and their graphical representation in the Fig. 3 for M-25 concrete. And by replacing 20% cement with glass powder along with crusher sand is shown in the Table 14 for M-25 concrete and their graphical representation is shown in the fig.

Designation	Flexure Strength in N/mm^2			% C.S. 7 Days
	7 Days	14 Days	28 Days	
A_2 - 0	3.70	3.96	A_2 - 0	3.70
A_2 – 10	3.98	4.20	A_2 – 10	3.98
A_2 – 20	4.10	4.51	A_2 – 20	4.10
A_2 – 30	4.28	4.96	5.96	30
A_2 – 40	4.36	5.10	6.31	40

Table 7. Flexure Strength of Different Mix of M-25 Concrete (without Glass Powder)

Split Tensile Strength: The result of the split tensile strength with partial replacement of stone dust and without using glass powder for 7, 14 and 28 days are shown in the Table for M-2 5 concrete and their graphical representation in the Fig. 5 for M-25 concrete and in the Fig. And by replacing 20% cement with glass powder along with crusher sand is shown in the Table 16 for M-25 concrete and their graphical representation is shown in the fig.

Designation	Split Tensile Strength in N/mm^2			% C.S. 7 Days
	7 Days	14 Days	28 Days	
A_3 – 0	2.25	2.40	3.04	0
A_3 – 10	2.40	2.49	2.96	10
A_3 – 20	2.32	2.62	3.14	20
A_3 – 30	2.50	2.96	3.55	30
A_3 – 40	2.46	2.80	3.46	40

Table 8. Split Tensile Strength of Different Mix of M-25 Concrete (without Glass Powder)

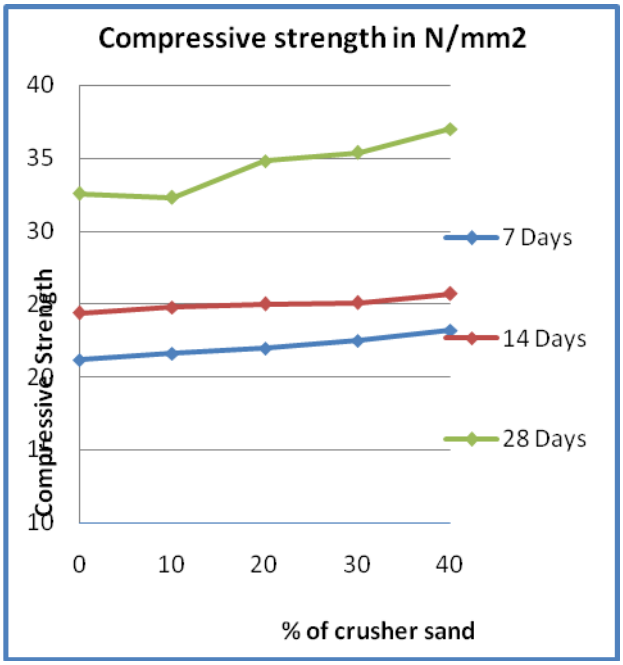

Figure 1. Compressive Strength of Different Mix of M-25 Concrete (Without Glass Powder)

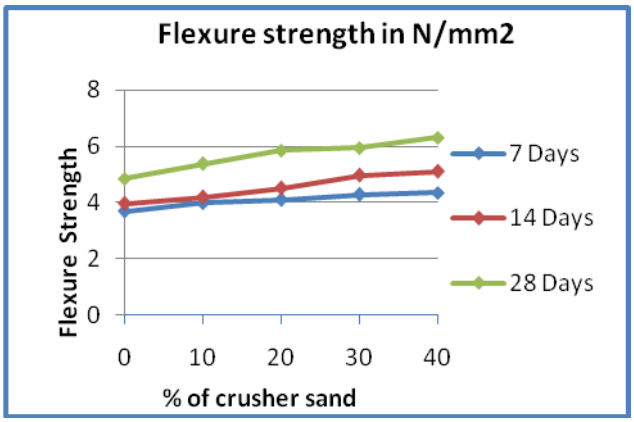

Figure 2. Flexure Strength of Different Mix of M-25 Concrete (Without Glass Powder)

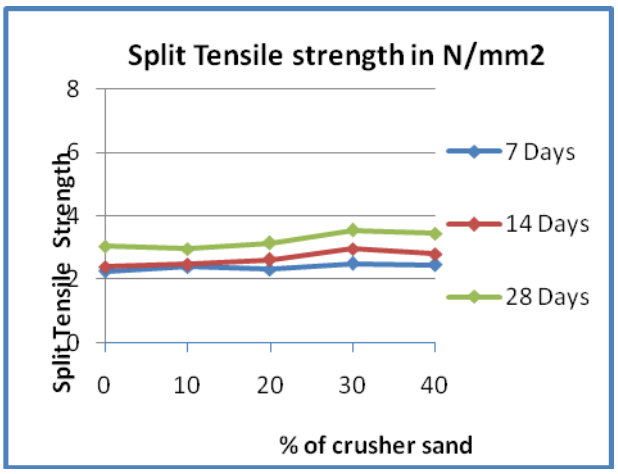

Figure 3. Split Tensile Strength of Different Mix of M-25Concrete (Without Glass Powder)

Designation	Compressive Strength in N/mm²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
A'$_1$ - 10	25.62	26.15	31.70	10
A'$_1$ - 20	26.32	27.30	33.72	20
A'$_1$ - 30	25.90	27.80	34.20	30
A'$_1$ - 40	27.12	28.12	38.40	40

Table 9. Compressive Strength Strength of Different Mix of M-25Concrete (Without Glass Powder)

Designation	Flexure Strength in N/mm²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
A'$_2$ - 10	4.48	5.10	6.40	10
A'$_2$ - 20	4.70	5.60	6.76	20
A'$_2$ - 30	4.96	5.21	6.96	30
A'$_2$ - 40	5.10	5.36	7.01	40

Tabl e 10. Flexure Strength of Different Mix of M-25 Concrete (with Glass Powder 20% & Cement 80%)

Designation	Split Tensile Strength in N/mm²			% C.S. 7 Days
	7 Days	14 Days	28 Days	
A'$_3$ - 10	2.32	2.48	3.10	10
A'$_3$ - 20	2.38	2.56	3.16	20
A'$_3$ - 30	2.60	2.68	3.30	30
A'$_3$ - 40	2.80	2.98	3.46	40

Table 11. Split Tensile Strength of Different Mix of M-25 Concrete (with Glass Powder 20% & Cement 80%)

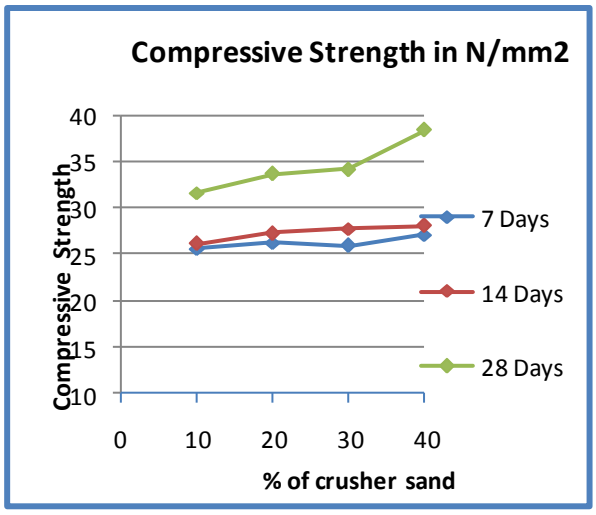

Figure 4. Compressive Strength of Different Mix of M-25 Concrete (with 20% Glass Powder & 80% Cement)

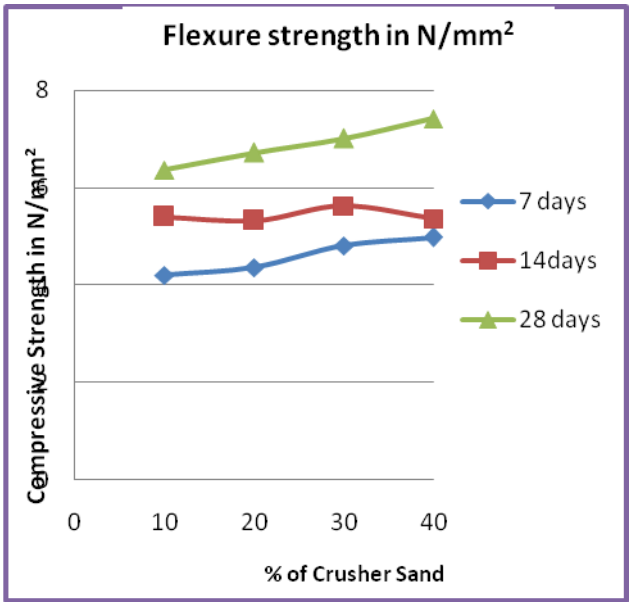

Figure 5. Flexure Strength of Different Mix of M-25 Concrete (With 20% Glass Powder & 80% Cement)

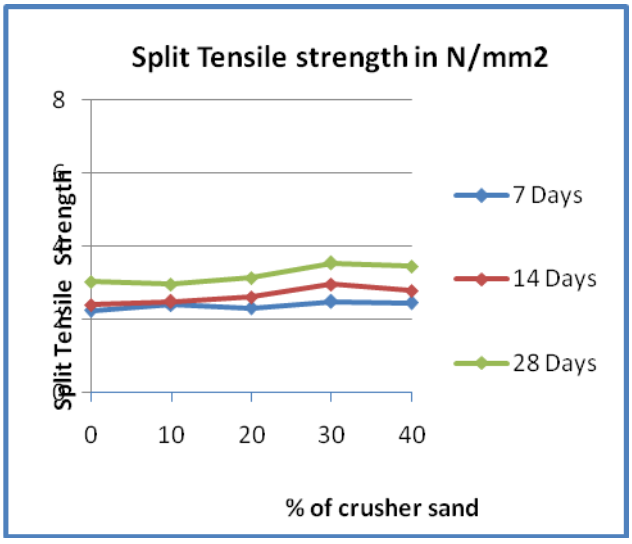

Figure 6. Flexure Strength of Different Mix of M-25 Concrete (With 20% Glass Powder & 80% Cement)

VI. RATE ANALYSIS OF MATERIALS

To know the cost of concrete mix prepared by using natural sand as well as crusher sand and Cement as well as waste glass powder, the rate analysis have been carried out. The cost is calculated for 1 cum of concrete mix for M-25

MATERIALS	QUANTITY (cum)	RATE (per cum)	COST (Rs)	T
(A) Cement	0.126cum	2460.00	Rs. 310	**(A+B+C+D)** Rs. 747.00
(B) Fine aggregate (Sand)	0.255 cum	600.00	Rs. 153	
(C) Coarse Aggregate	0.439 cum	640.00	Rs. 281	
(D) Water	0.180 cum	20.00	Rs. 3.60	
Rate per cu m — Rs. 747.00				
(E) Waste Glass Powder	0.126 cum	700.00	88.20	(C+D+E+F) **Rs.475**
(F) Crusher Sand	0.255cum	400.00	102.00	
Rate per cu m — Rs. 475.00				

Table 12. Rate Analysis of M-25 Grade of Concrete (per cum)

VII. CONCLUSIONS

This From the about experiments following conclusions are observes:

- The compressive quality by supplanting 40% sand by smasher sand the quality increments by 10, 5, 13 and 14% at 7, 14 and 28 days individually in M-25 cement. When contrasted with the regular cement. In this way smasher sand expands the compressive quality of the solid and diminish the expense of material and furthermore its incredible utilization of waste materials.
- The compressive quality of the solid by supplanting the 40% sand by smasher sand and 20% concrete by the glass powder the quality increments by 28, 15, 18 and 24% at 7, 14 and 28 days separately in M-25 cement. When contrasted with the customary cement. Hence glass powder can likewise be utilized something like 20%

which is additionally incredible sparing in expensive concrete and utilization of waste material.

- The flexure quality of the solid by supplanting the 40% sand by smasher sand increment 18, 28, 29 and 30% at 7, 14 and 28 days individually in M-25 cement. When contrasted with the ordinary cement. In this way smasher sand additionally increment the flexure quality at the later periods of the solid.
- The flexure quality of the solid by supplanting 40% sand by smasher sand and 20% concrete by the glass powder the qualities are increment by 37, 35, 44 and 43% at 7, 14 and 28 days separately in M-25 concrete and 19, 18, 42 and 44% at 7, 14 and 28 days. When contrasted with the customary cement. Consequently flexure quality is likewise increment by including the glass powder. It additionally diminishes the utilization of the concrete.
- The split elasticity of the solid by supplanting sand 40% by smasher sand the qualities expands 9, 17, 14 and 16% at 7, 14 and 28 days separately in M-25. Thus smasher sand expands the rigidity of the solid which is additionally sparing in fine total.
- The split elasticity of the solid by supplanting 40% sand by smasher sand and 20% concrete by glass powder the rigidity is increment 24, 24, 14 and 13% at 7, 14 and 28 days individually in M-25 cement. Henceforth by including the glass powder with smasher sand is likewise increment the elasticity of the solid. Consequently sparing in cost is two different ways cost of sand and concrete.
- It is discovered that the expense of solid blend arranged by including waste glass powder and smasher sand for M-25 evaluation of solid blend arranged by concrete and regular sand. For the equivalent, example of solid blend the expense gets 747.00 to 475.00 Rs for M-25 evaluation of cement Per cum utilizing concrete, sand, squander glass powder and smasher sand separately

VII. FURTHER SCOPE OF WORK

- The study can by 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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