PERFORMANCE EVALUATION OF RECYCLED CONCRETE WITH GLASS POWDER AND M-SAND

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ABSTRACT:
In this project we have to evaluate the performance of recycled concrete with M-sand and glass powder. concrete is the most widely used man made construction material. Globally, the concrete industry consumes large quantities of natural resources, which are becoming insufficient to meet increasing demands. It is obtained by mixing cement, water and aggregates in required proportions. Cement manufacturing industry is one of the carbon dioxide emitting sources besides deforestation and burning of fossil fuels. recycle waste glass, one of silica-based industrial by-products ,and use it as a cement substitute for sustainable construction. Waste glass powder (WGP) and waste glass sludge (WGS) were manufactured from the waste glass and their feasibility, for use in concrete a partial replacement of cement, was evaluated. 20% of cement (by weight) was replaced with WGP and WGS and the resulting concretes were tested for mechanical properties and durability. Porosity andphaseidentification studies were also carried out. After 90-day age, the WGS incorporated concrete exhibited the highest compressive strength. Also, it was found that WGS incorporation in concrete led to reduced porosity due to their greater pozzolanic activity owing to the inherent amorphous nature of WGS. Investigations on frost resistance and chloride ions penetrability further showed that these glass wastes are better in improving these properties..

Keywords: Glass powder, recycled coarse aggregate, compressive strength, durability, flexural.

1.INTRODUCTION

Glass is principally composed of silica. Use of milled (groundwaste glass in concrete as partial replacement of cement could be an important step toward development of sustainable (environmentallyfriendly, energy-efficient and economical) infrastructure systems. When waste glass is milled down to micro size particles, it is expected toundergo pozzolanic reactions with cement hydrates, forming secondary Calcium Silicate Hydrate. With increase in glass addition mortar flow was slightly increased while a minor effect on concrete
workability was noted. The raw materials obtained from the demolition activity takes place such as, building roads, bridges, and fly over, subway, remolding cylinder and block etc. Dumping of raw material has become a problem for many countries. Construction industry in India generate around 10-20 million tons of waste annually. This technique is still not use in India. In this paper the literature related to the recycling and reuse of waste concrete aggregate is presented and conventional coarse recycled aggregate is being replaced with recycled aggregate .In this project we have to evaluate the performance of recycled aggregate with glass powder and M-sand.

2. LITERATURE REVIEW

A.N.Dabhade[1],Dr.S.R.Choudhari[2],Dr.A.R.Gajbhiye[3](1) presented a paper on " Performance Evaluation Of Recycled Aggregate Used In Concrete"This researchpresents a review

ofliterature on recycling and reuse of wasteconcrete aggregate. As the raw materialsobtained from the demolition activity takes placesuch as, building roads, bridges, and fly over,subway, remolding cylinder and block etc.Dumping ofraw material has become a problemfor many countries. Construction industry inIndia generate around 10-20 million tons ofwaste annually. This technique is still not use inIndia. In this paper the literature related to therecycling and reuse of wasteconcrete aggregateis presented and conventional coarse recycledaggregate is being replaced with recycledaggregate.The investigation was carried out usingworkability test, compressive test, split tensiletest and bulk density, water absorption, impactvalue test, crushing value test, Fineness modulus.There were total of sixth batches of concretemixes, consists of every 20% increment ofrecycled aggregate replacement from 0% to100%.Moreover, 100% of recycled aggregate mixbatches included, different water/cement ratio of0.5,0.6 and 0.7. The workability of concreteconsiderably reduced as the amount of recycledaggregate increased. For the strength ofcharacteristics, the results showed that agradually increasing in the compressive strengthup to 20%of recycled aggregate and as well asfor the tensile strength as the percentage ofrecycled aggregate.

S.Srikanth[1]Mr.S.Andavan[2](2) presented a paper on "PARTIAL SUBSTITUTE OF CEMENT WITH GLASS POWDER – RETROSPECT" Glass powder is incredibly fine powder shows pozzolanic properties, which might be used as partial replacement of cement in concrete. Glass may be a common material employed in day to day life in constructions.Its lifetime is proscribed. After use, it is recycled or sent to landfills.Since, glass is not bio-degradable.So, land filling is not eco-friendly.This paper summarizes the usage of partial glass powder replacement on the cement so as to mitigate the provision, affordability, quality and pollution problems.Mix design M20 was casted by replacement of cement with Glass powder by weight at 0%, 10%, 20%. Cubes, prisms, Cylinders(Cube-150*150*150mm,Prism– 500*100*100mm, Cylinder –300*150mm)were preparedfor testingafter seven, and twenty eight days natural process in water served as the control.Results are obtained by the tests like compressive strength,flexurestrengthand split tensilestrength.Even it is compared with the conventional concrete for the difference between them.

C.Shrianandhasaland[1] S.J.Princess Rosaline[2] (3) presented a paper on "Experimental investigation of the effect of glass powder and manufactured sand in high strength concrete "concrete is one of the most widely used construction material in the world. With growing need for multi storied buildings, High Strength Concrete has become more important. The cement, an essential constituent of concrete, during its production leads to the release of carbon di oxide gas. This greenhouse effect producing gas contributes to around 65 percentage of global warming. The other ingredients of concrete, the river sand obtained through mining from river bed have created ecological imbalances in the country. With increasing need for concrete, there arises need for replacing a portion of cement and river sand with alternate materials to save the environment. Many researches have shown that some of the industrial waste like fly ash, silica fume, blast furnace slag can be effectively used in concrete production. Waste glass, when ground to very fine powder shows some pozzolanic properties because of silica content. Similarly, Manufactured sand or msand which is a by-product during production of coarse aggregate can be used as substitute material for river sand in Concrete to reduce the impact on nature. The purpose of this study is to experimentally investigate the effect of Msand and Glass powder by partially replacing river sand and cement respectively.

K.Suseela[1]Dr. T.Baskaran[2] (4) presented a paper on "Strength analysis on concrete with M-sand as a partial replacement of fine aggregate "In general

concrete is a combination of cement, fine and course aggregate. These days, natural river sand is difficult to acquire and extraction of sand from river has represented an awesome threat to environment. In addition, government has connected limitation on extraction of sand from riverbed. Subsequently, insufficiency of natural river sand and increase in demand contemplate research seek towards alternate fine aggregate. This seek turns the research intention towards effective utilization of Manufactured sand (M-sand) for commercial purpose.This research incorporates effectiveness of M-sand by investigation compressive stress, split tensile stress and durability of concrete with various mix.

3. OBJECTIVE

The objective of the research is to find the strength parameters of glass powder with recycled coarse aggregate concrete cubes and beams by the following three,

A) Compressive strength test
B) Flexural strength test
C) Durability test

- To utilization the Recycled coarse aggregate
- To increase the strengthof concrete specimens.

4. MATERIALS AND MATERIAL PROPERTIES

a) Cement:

Ordinary Portland cement of 43 grade conforming to IS 12269 is used throught the experimental program. The specific gravity of cement is 1.918.

B)Coarse aggregate:

Crushed hard granite stone of maximum size 20mm is used for concrete. The specific gravity of coarse aggregate is found 2.77.

c)Fine aggregate

Fine aggregate used for this entire investigation for concrete is river sand. The specific gravity of fine aggregate is 1.638.

D)Glass Powder

Waste glasses are accumulated from exchange region territory and granulated it to powder or into cementations frame as to procure certain degree of concrete substitution. After that, glass powder was procured by squashing waste glass pieces in a cone crusher factory.

Fig.1 Glass powder

It has been developed that extension of finely grained glass to Portland concrete cement revives the coupling strategy amid preinduction time of hydration (2-4 min) yet blocks it in the midst of inciting period. Notwithstanding, this does not impact the mechanical strength of the concrete examples after first day of solidifying. The quality of tests with glass is higher as stood out from the control tests, because, as communicated earlier, glass included substances change cement stone structure. The execution of solid containing glass powder as incomplete substitution of Portland cement was halfway supplanted with 0-25% glass powder. Specific gravity property of waste glass powder is basic in the concrete outline.Glass powder is collected from Environ Safety Glasses, Madurai. The specific gravity of glass powder is 2.73 and the size of the particle used is 75µ.

E)Recycled Aggregate

Concrete aggregate collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Metals such as rebar are accepted, since they can be removed with magnets and other sorting devices and melted down for recycling elsewhere. The remaining aggregate chunks are sorted by size. Larger chunks may go through the crusher again. After crushing has taken place, other particulates are filtered out through a variety of methods including hand-picking and water flotation.

Crushing at the actual construction site using portable crushers reduces construction costs and the pollution generated when compared with transporting material to and from a quarry. Large road portable plants can crush concrete and asphalt rubble at 600 tons per hour or more. These systems normally consist of a rubble crusher, side discharge conveyor, screening plant, and a return conveyor from the screen to the crusher inlet for reprocessing oversize materials. Compact, self-contained mini-crushers are also available that can handle up to 150 tons per hour and fit into tighter areas. With the advent of crusher attachments those connected to various construction equipment, such as excavators the trend towards recycling on-site with smaller volumes of material is growing rapidly.

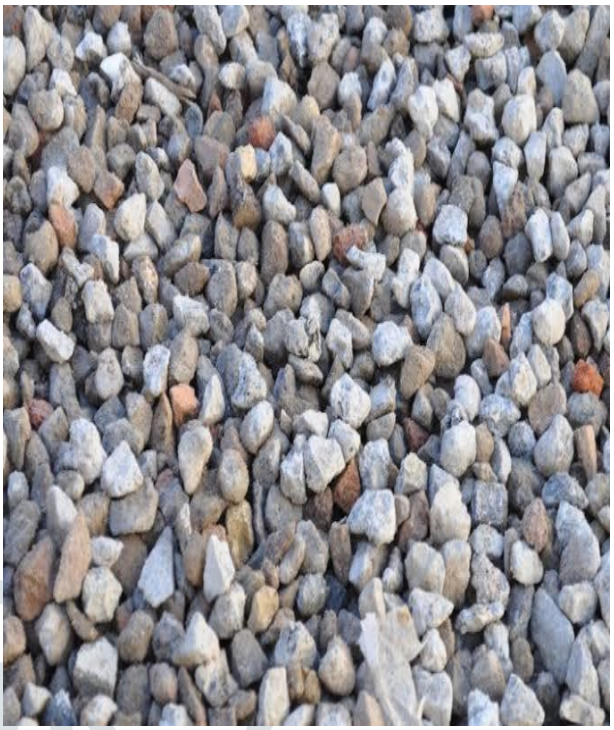


Fig.2 recycled coarse aggregate

5. CASTING OF SPECIMENS

Concrete is prepared in the mixture and put in a tray. In these tray required quantity of glass powder and recycled aggregate are added and mixed properly. Fresh properties of concrete are determined. The specimens are cast. In the next day, specimens were demoulded and put in a curing tank.

Fig.3 Casted specimens

6. TESTING

The testing of materials is a carried out to find the properties of the materials used in this project. The tests carried out on cement are specific gravity. The tests carried out on fine aggregate are specific gravity, sieve analysis, water absorption and bulk density. The tests carried out on coarse aggregate are specific gravity, sieve analysis, bulk density and water absorption test.

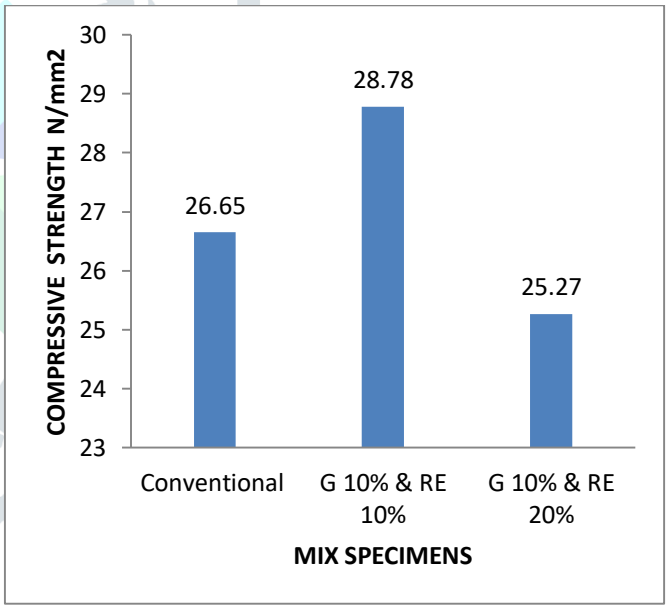
Fig.4 Testing of specimens

6.1 COMPRESSIVE STRENGTH:

Compression test is the most common test conducted on hardened concrete, partly because it is an easy to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. The compression test is carried out on specimen's cubical specimens.Cubes 150 mm × 150 mm × 150 mm in size were used. The cube moulds were cleaned thoroughly and properly oiled along their faces. The mould was then filled with concrete in three layers and compacted using a tamping rod. Further, the moulds were placed on the vibrating table for 60 seconds to achieve proper compaction and subsequently maintained on a plane and level surface in the laboratory for 24 hours. The cubes were demoulded and set aside for curing.

COMPRESSIVE SRENGTH OF CONCRETE CUBES FOR 7 DAYS

SI NO		SPECIMEN		COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
		Banana fiber	Aluminum powder		
1	Mix 1	Conventional		27.35	26.65
				26.52	
				26.09	
2	Mix 2	10%	10%	28.81	28.78
				29.02	
				28.53	
3	Mix 3		20%	25.89	25.27
				24.62	
				25.32	



COMPRESSIVE SRENGTH OF CONCRETE CUBES FOR 28 DAYS

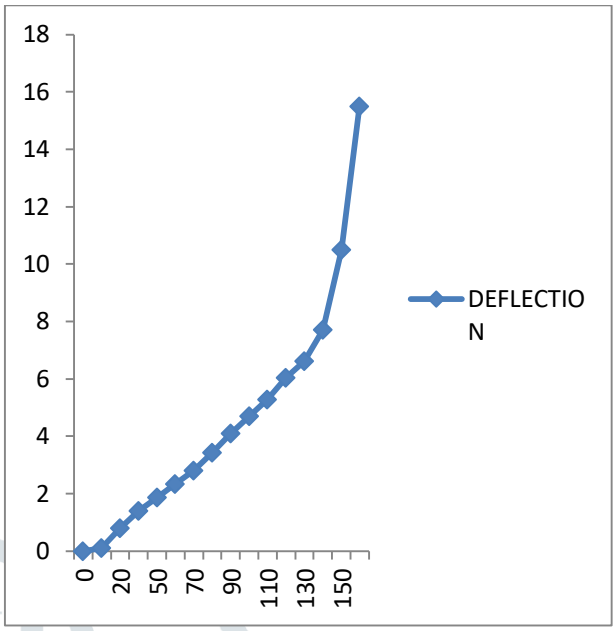
SI NO		SPECIMEN		COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
		Banana fiber	Aluminum powder		
1	MIX 1	Conventional		54.02	55.35
				56.62	
				55.42	
2	MIX 2	10%	10%	59.34	61.99
				62.43	
				64.21	
3	MIX 3		20%	54.02	53.86
				53.11	
				54.46	

oiled along their faces. The steel rods with stirrups placed in the mould before concrete placed in mould. The mould was then filled with concrete in three layers and compacted using a tamping rod. The cured specimens were tested under load frame instrument. The beam specimens were tested for midpoint loading and their deflection were observed with LVDT attached to the specimen. Gradual loading has been imposed on the specimen through a load cell 100tons capacity until failure.Beam is tested and the ultimate load carrying capacity of beam is finding out by using test results. The variation between load and deformation is plotted as a graph.

6.2 FLEXTURAL STRENGTH:

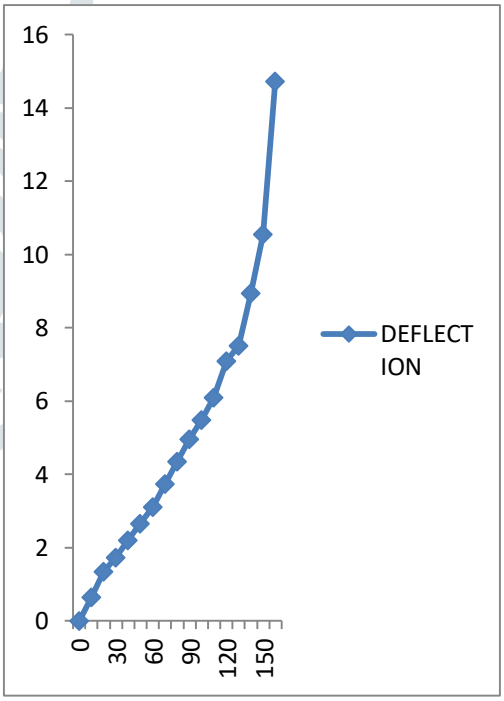
Flexural strength test is carried by using beam specimen. Beam had 1600mm length, 150mm wide and depth 220mm. The beam moulds were cleaned thoroughly and properly

SI. No.	Load (KN)	Deflection of RC beams (mm)		
		Conventional Beam	10% Glass powder & 10% recycled aggregate	10% Glass powder & 20% recycled aggregate
1	0	0	0	0
2	10	0.11	0.65	0.94
3	20	0.79	1.35	1.41
4	30	1.39	1.73	1.81
5	40	1.86	2.21	2.24
6	50	2.33	2.65	2.71
7	60	2.81	3.11	3.15
8	70	3.43	3.75	3.80
9	80	4.09	4.36	4.39
10	90	4.7	4.97	4.99
11	100	5.28	5.49	5.52
12	110	6.03	6.10	6.12
13	120	6.61	7.10	7.15
14	130	7.7	7.52	7.56
15	140	10.5	8.94	8.96
16	150	15.5	10.55	10.57
17	160	-	14.73	15.87

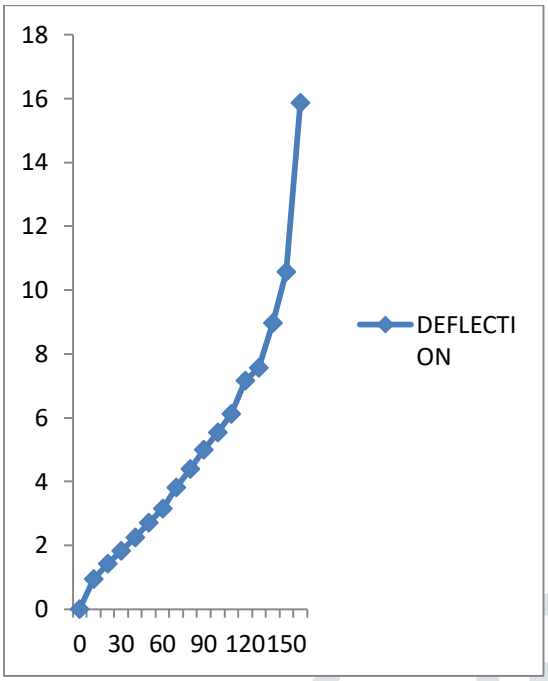


Load vs. deflection of RCC Beams

CC-28days load vs deformation curve



G 10% & RE 10% - 28days load vs deformation curve



G 10% & RE 20% -28days load vs deformation curve

;96.3 DURABILITY TESTS

The following are the various durability test carried out in this experimental study.

Acid Resistance Test

Acid attack Test

Cubes of size 150mm x 150mm x 150mm are cast for each mix. After 28 days of curing, all specimens were kept in atmosphere for 1day for constant weight. The weight of cubes were taken and then the cubes were immersed in 5% concentrated H_2SO_4.

The acid solution was replaced whenever the pH value exceeds 9.5. After the completion of age of immersing in acid solution, the specimens were taken out and were washed in running water and kept in atmosphere for 1day for constant weight. Subsequently the specimens are weighed and loss in weight and hence the percentage loss of weight was calculated. The degree of acid attack was evaluated by compressive strength were conducted at 28 days.

Acid Attack (H_2SO_4) in concrete

Fig.5 Durability

Replacement of coarse aggregate using recycled aggregate (%)	Addition of glass powder (%)	H_2SO_4			Loss in Compressive strength N/mm^2
		Initial Weight	Final Weight	Weight Loss (%)	
0		3.508	3.417	4.7	21.67
10%	10%	3.514	3.428	4.54	22.02
20%		3.523	3.44	4.4	20.74

7. CONCLUSION

1. It has been concluded that based on the test results, which showed that the utilization of recycled aggregate and glass powder has considerably increased the strength of M25 grade concrete with the combination of glass powder and recycled aggregate.

2. The specimens were casted for various proportions of glass powder 10%, recycled coarse aggregate (0%,10%,20%) and the test results indicated glass powder with recycled coarse aggregate 10 % addition gives improved result when compared to other combinations.
3. Then, glass powder added 10% by weight of cement with optimum recycled coarse aggregate and the test results compared with conventional concrete and glass powder with recycled coarse aggregate optimum percentage added concrete.
4. Since recycled aggregate is a waste material it can be utilized effectively by reducing the quantity of coarse aggregate which not only reduces the cost of concrete but also keep the environment safe and avoid dumping of waste recycled aggregate with glass powder in land.
5. The workability of concrete is increased with increased the replacement of cement using glass powder in concrete.
6. High toughness of glass powder attributes to Increased Compressive strength.
7. Compressive strength of concrete was increased 66.4% in 7 day test at 10% replacement of cement using glass powder in concrete.
8. The maximum strength of concrete obtained at 10%% replacement of glass powder for cement and 20% replacement of coarse aggregate beyond that the strength goes on decreasing.
9. But the compressive strength and Flexural strength at 10% replacement of cement using glass powder and 20% replacement of recycled coarse aggregate for coarse aggregate in concrete is also lower than the conventional concrete.
10. The important observation is that addition of glass powder definitely increase the strength of concrete.
11. The replacement of cement using glass powder in concrete shows lower resistance against Sulphate attack.

8. REFERENCE

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