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Behaviour of Concrete with Waste Glass Fiber Powder

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Abstract— Glass is basically used in the industries, for decoration purpose in building's construction and also in our daily use items such as bottle, container and utensils etc. After the life span or use it is dumped anywhere as a waste that causes a disposal problem to environment because of its properties of non-biodegradable. Most of the glass waste are not being recycled and directly disposes to landfills. If this waste converted into aggregate after the recycling or grinding will results into the solution of disposal problem and reduces the supply of raw materials for construction. Glass can cause deleterious alkali- silica reaction problems because of alkaline environment. Due to this, it can be ground into a fine powder and used as a pozzolonic material in concrete. In laboratory experiments it can suppress the alkali-reactivity of coarser glass particles, as well as that of natural reactive aggregates. It undergoes beneficial pozzolonic reactions in the concrete and could replace up to 30% of cement in some concrete mixes with satisfactory strength development. There is a strong need in concrete industry to replace the raw materials with economic one. Most of the researcher have done experiments on the concrete by replacing constituents with waste glass powder or aggregate. After their conclusion it was found that there is strength regression and expansion in concrete mix if waste glass aggregate replaced with coarse aggregate. This was due alkali reactions. And strength loss was also found in fine aggregate substitution.

The present study on waste glass powder as a replacement of cement to assess the pozzolanic activity of fine glass powder in concrete. A number of test were conducted on specimens to study the effect of 10% ,20% and 30% replacement of cement by waste glass powder. The compressive strength, split tensile strength and the flexural strength test were conducted for the mixes at the curing age of 7 days and 28 days. All the results of experiments were compared with the normal concrete mix's results. Waste glass powder in partial replacement of cement in concrete can be prove beneficial to disposal problem of glass waste and the need of economic raw material to the concrete industry.

Keywords — Disposal Solution, Economical raw material, Waste glass, Behaviour of concrete, Compressive Strength, Flexural Strength.

I. INTRODUCTION

Concrete is a blend of cement, sand, coarse aggregate and water. The key factor that adds value to concrete is that it can be designed to withstand harshest environments significant role. Today global warming and environmental devastation have become manifest harms in recent years, concern about environmental issues, and a changeover from the mass-waste, mass-consumption, mass -production society of the past to a zero-emanation society is now viewed as significant. Normally glass does not harm the environment in any way because it does not give off pollutants, but it can harm humans as well as animals, if not dealt carefully and it is less friendly to environment because it is non-biodegradable. Thus, the development of new technologies has been required. The term glass contains several chemical diversities including soda-lime silicate glass, alkali-silicate glass and boro-silicate glass. The introduction of waste glass in cement will increase the alkali content in the cement. It also help in bricks and ceramic manufacture and it preserves raw materials, decreases energy consumption and volume of waste sent to landfill. As useful recycled materials, glasses and glass powder are mainly used in fields related to civil engineering, for example, in cement, as pozzolana (supplementary cementitious materials), and coarse aggregate. Their recycling ratio is close to 100%, and it is al so used in concrete without adverse effects in concrete durability. Therefore, it is considered ideal for recycling.

Recently, Glasses and its powder has been used as a construction material to decrease environmental problems. The coarse and fine glass aggregates could cause ASR(alkali-silica reaction) in concrete , but the glass powder could suppress their ASR tendency, an effect similar to supplementary cementations materials (SCMs). Therefore, glass is used as a replacement of supplementary cementitious materials.

To lower the amount of glass being discarded as well as to find use to the non-recycled glass in new applications the professional community is being pressurized by the environmental organizations as much of the glass produced in the world is discarded, land filled or stockpiled. Glass is a widely used product throughout the world; it is versatile, durable and reliable. The uses of glass ranges drastically, it is used by the electronic industry in the making of computer and television screens; by the construction industry in the shape of windows and mirrors; by the medical industry in the making of medical equipment and most importantly by the food and beverage industry to make millions of packaging bottles. As a result, industry has made of glass a marketable good, as glass production keeps increasing throughout the United States and the world.

Glass is an environmentally friendly material, as it can be recycled many times and used in many applications. It is not uncommon throughout the world to have glass products that are made up of nearly 49% recycled material due to the fact that it is one of the few materials that can be recycled many times without altering its chemical properties or composition. Glass containers are often reused in bottling and depending on its color (green, amber and clear) can also be crushed and reused in the making of new glass products.

II. METHODOLOGY

A. Glass Powder Based Concrete Composition

The technology of WGP concrete was based on adding or partially replacing Portland cement with amounts of fine material such as glass powder without modifying the water content compared to common concrete. The materials procured for obtaining this composition were OPC, aggregates (fine and coarse), waste glass powder, and the water. After procurement, testing of materials was done to achieve the desired properties of all the materials in order to obtain the desired strength at the end. Once testing of materials was done, mix trials were practiced in order to choose a optimal w/c ratio. After selection of w/c ratio, mix design was prepared and all the materials are proportioned in accordance to the mix design. However, hardened concrete becomes a strong, durable, and practically impermeable building material that requires no maintenance after completion of proper proportioning, mixing, placing, curing, and consolidation. A nominal mix of concrete of proportion 1:1.5:3 (M-20) was adopted for the present study. The first mix Mx-0 was control mix having only cement as binder. The Mx-1, Mx-2, Mx-3 mix represent the replacement of cement by waste glass powder by 10%, 20%, 30% respectively. Materials once proportioned and mixed together to obtain a concrete paste, specimens were casted and cured for performing various tests to analyze the properties of the concrete containing waste glass powder. Tests performed were as follows:-

Fresh concrete tests:

1) *Slump Cone test*
2) *Compaction Factor Test*

Hardened Concrete Tests:

1) *Compressive Strength Test*
2) *Flexural Strength Test*

B. Casting of Specimens

The test moulds required for casting the specimens were kept ready before the mix was prepared. Tighten the bolts of the moulds carefully because if bolts of the moulds are not kept tight the concrete slurry coming out of the mould when vibration takes place. Then moulds were cleaned and oiled on all contact surfaces of the moulds and place the moulds on vibrating table. The concrete was filled into moulds in layers and then vibrated. The top surface of concrete was struck off level with a trowel. The number and date of casting were put on the top surface of the specimens casted. To cast concrete samples, 150mm×150mm×150mm standard dimension cube moulds were casted for carrying out compressive strength test and total no. of samples casted are 24 for all the mixes, 3 samples each for testing at the age of 7and28 days respectively. Similarly for flexural strength test, beams specimens of dimensions 500mm×100mm×100mm moulds were casted in 24 no. While moulds were filled with paste of concrete in three layers, they are tamped 30 to 32 times using a small rod after filling each layer and finally compacted using a mechanical vibrating table for attaining good concrete strength.

TABLE-I: DETAILS OF SPECIMENS

S.No.	Mix Designation	Slump(mm)	Compaction Factor
1	Mx-0	50	.86
2	Mx-1	65	.878
3	Mx-2	85	.899
4	Mx-3	115	.925

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III. SIMULATION AND RESULT ANALYSIS

A. *Slump Flow Test And Compaction Factor*

There was a systematic increase in slump as the glass powder in the mix increases. The slump ranged around 50mm for the reference mix (i.e. 0% glass powder) to 110mm at 30% glass powder. It was clear from results that the value for compaction factor increases with the increase in the glass powder content. So the consistency of mix increases and hence the mix is easily workable.

TABLE-II: SLUMP AND COMPACTION FACTOR

S. No.	Name of test	Specimen	% of Waste Glass Powder Added	No. of specimens at		Total specimens
				7 day s	28 day s	
1.	Compre ssive strength test	Cube 150mm x 150mm x 150mm	0%	3	3	24 cubes
			10%	3	3	
			20%	3	3	
			30%	3	3	
2.	Flexure strength test	Beam 100 mm 100 mm x 500 mm	0%	3	3	24 beams
			10%	3	3	
			20%	3	3	
			30%	3	3	

B. *Compressive Strength Test*

It can be seen that in general, compressive strength of concrete containing 20% waste glass powder shows higher or maximum strength as compared to the conventional concrete. There was an increase of approximately 12% and 17.8% in the compressive strength of concrete containing 10% and 20% waste glass powder when replaced by cement as compared to that of plain concrete at the age of 7 days respectively. Similarly, at the age of 28 days increase in strength was about 9.5% and 20% for 10 and 20% replacement of cement by glass powder respectively. But at 30% replacement, compressive strength was reduced to 11.9% and 29.5% at the age of 7 and 28 days respectively.

TABLE-III: COMPRESSIVE STRENGTH AT 7 DAYS

Mix Description	Sample No.	Compressive Strength (N/mm2)	Average Compressive strength (N/mm2)
Mx-0 (100% Cement)	1 2 3	16.55 16.10 15.95	16.02
Mx-1 (10% WGP + 90% Cement)	1 2 3	18.25 17.65 18.10	18.00
Mx-2 (20% WGP + 80% Cement)	1 2 3	19.95 18.80 17.85	18.86
Mx-3 (30% WGP +70% Cement)	1 2 3	14.64 14.10 13.56	14.10

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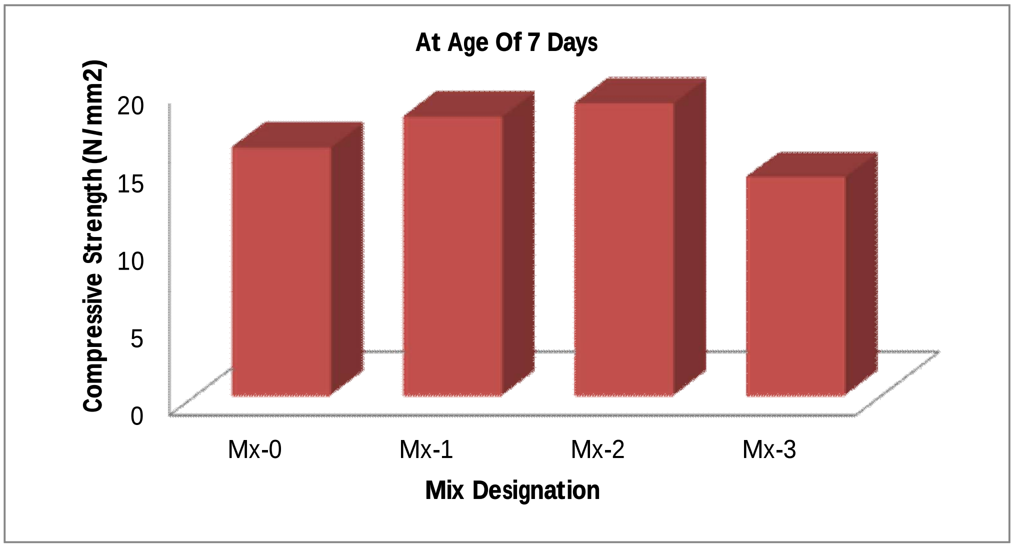
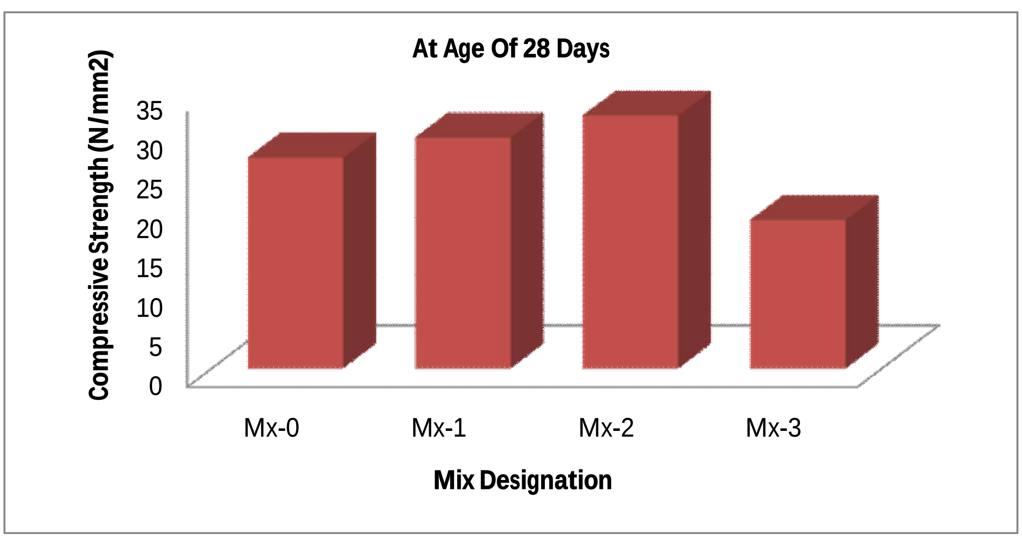


TABLE-IV
COMPRESSIVE STRENGTH AT 28 DAYS

Mix Description	Sample No.	Compressive Strength (N/mm2)	Average Compressive Strength (N/mm2)
Mx-0 (100% Cement)	1 2 3	27.19 26.56 26.75	26.84
Mx-1 (10% WGP + 90% Cement)	1 2 3	29.98 29.44 28.75	29.39
Mx-2 (20% WGP + 80% Cement)	1 2 3	32.65 32.15 31.78	32.19
Mx-3 (30% WGP +70% Cement)	1 2 3	19.65 18.85 18.20	18.9



C. Flexural strength test

It can be seen that the flexural strength of concrete containing 10% and 20% waste glass powder is more than that of the reference concrete. The optimal dosage of replacement is said to be at 20% as the maximum strength was achieved at this % of replacement, beyond which it decreases. At 10% and 20% replacement, the percentage increase is about 8.9% and 10% at the age of 7 days and 11.1% and 14% at the age of 28 days respectively. At 30% replacement, the decrease in the strength is measured to be 9.6% and 15.2% respectively at the age of 7 and 28 days.

TABLE-V
FLEXURAL STRENGTH AT 7 DAYS

Mix Description	Sample No.	Flexural Strength (N/mm2)	Average Flexural Strength (N/mm2)
Mx-0 (100% Cement)	1	2.825	2.74
	2	2.845	
	3	2.54	
Mx-1 (10% WGP + 90% Cement)	1	3.11	2.985
	2	3.02	
	3	2.825	
Mx-2 (20% WGP + 80% Cement)	1	3.17	3.02
	2	3.05	
	3	2.845	
Mx-3 (30% WGP +70% Cement)	1	2.825	2.477
	2	2.355	
	3	2.25	

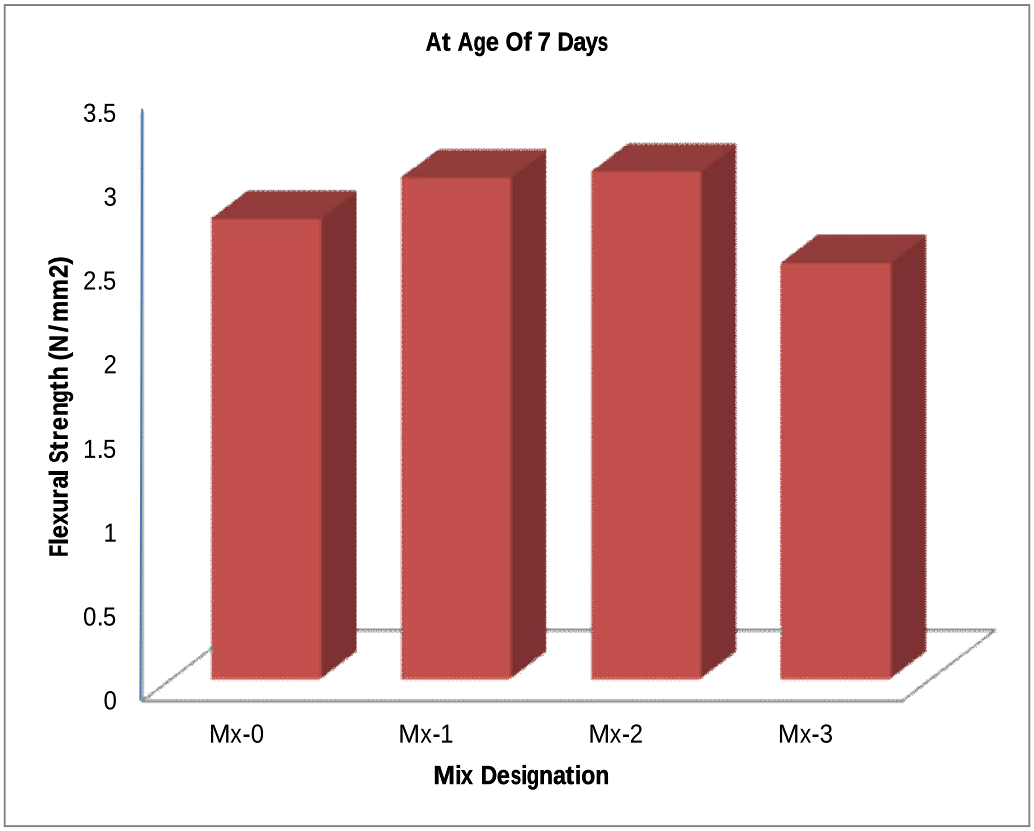


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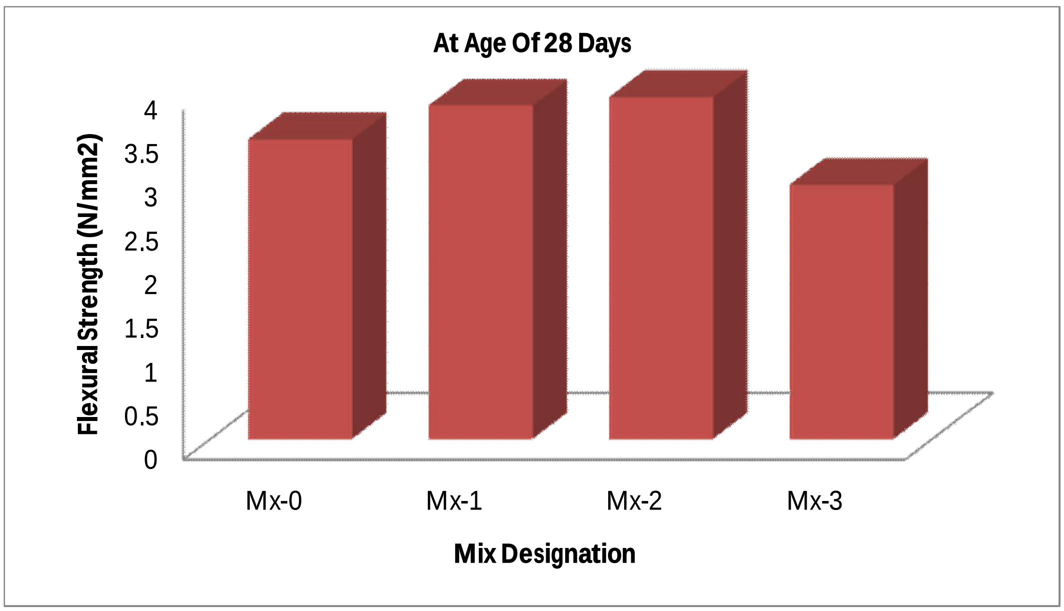
TABLE-VI

FLEXURAL STRENGTH AT 28 DAYS

Mix Description	Sample No.	Flexural Strength (N/mm2)	Average Flexural Strength (N/mm2)
Mx-0 (100% Cement)	1 2 3	3.79 3.455 3.10	3.448
Mx-1 (10% WGP + 90% Cement)	1 2 3	4.085 3.940 3.475	3.834
Mx-2 (20% WGP + 80% Cement)	1 2 3	4.098 3.948 3.75	3.932
Mx-3 (30% WGP +70% Cement)	1 2 3	3.1 2.845 2.830	2.925



IV. CONCLUSION

Use of waste glass in concrete can prove to be economical as it was non useful waste and free of cost. Use of waste glass in concrete will eradicate the disposal problem of waste glass and prove to be environment friendly thus paving way for greener concrete. Use of waste glass in concrete will preserve natural resources particularly river sand and thus make concrete construction industry sustainable. The performance test results conducted in this research confirm that the properties of those special mixed concretes are satisfactory. The properties tested include workability, air content, density, compressive strength, tensile strength, and water absorption. Moreover, it is found that water absorption is strongly related to the strength of the concrete. It has been concluded that 30% Glass Powder could be incorporated as cement replacement in concrete without any long term detrimental defects. Ultimately, glass is found to be an ideal material as a decorative aggregate in architectural concrete with its satisfactory performances and aesthetic property improvement.

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REFERENCES

[1] Vijayakumar G., Vishaliny H. and Govindarajulu D. (2013) "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production" International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2008 Certified Journal), Volume 3, Issue 2, February.

[2] Vasudevan Gunalaan and Pillay Seri Ganis Kanapathy "Performance of Using Waste Glass Powder in Concrete As Replacement Of Cement" American Journal of Engineering Research (AJER) ISSN: 2320-0936 Volume-02, Issue-12.

[3] Vandhiyan R., Ramkumar K. and Ramya R.(2013) "Experimental Study On Replacement Of Cement By Glass Powder" International Journal of Engineering Research and Technology (IJERT) ISSN: 2278-0181, Volume 2 Issue 5, May.

[4] Jangid Jitendra B. and Saoji A.C. (2014) "Experimental investigation of waste glass powder as the partial replacement of cement in concrete production" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2320-334 [International Conference on Advances in Engineering and Technology –(ICAET-2014)]

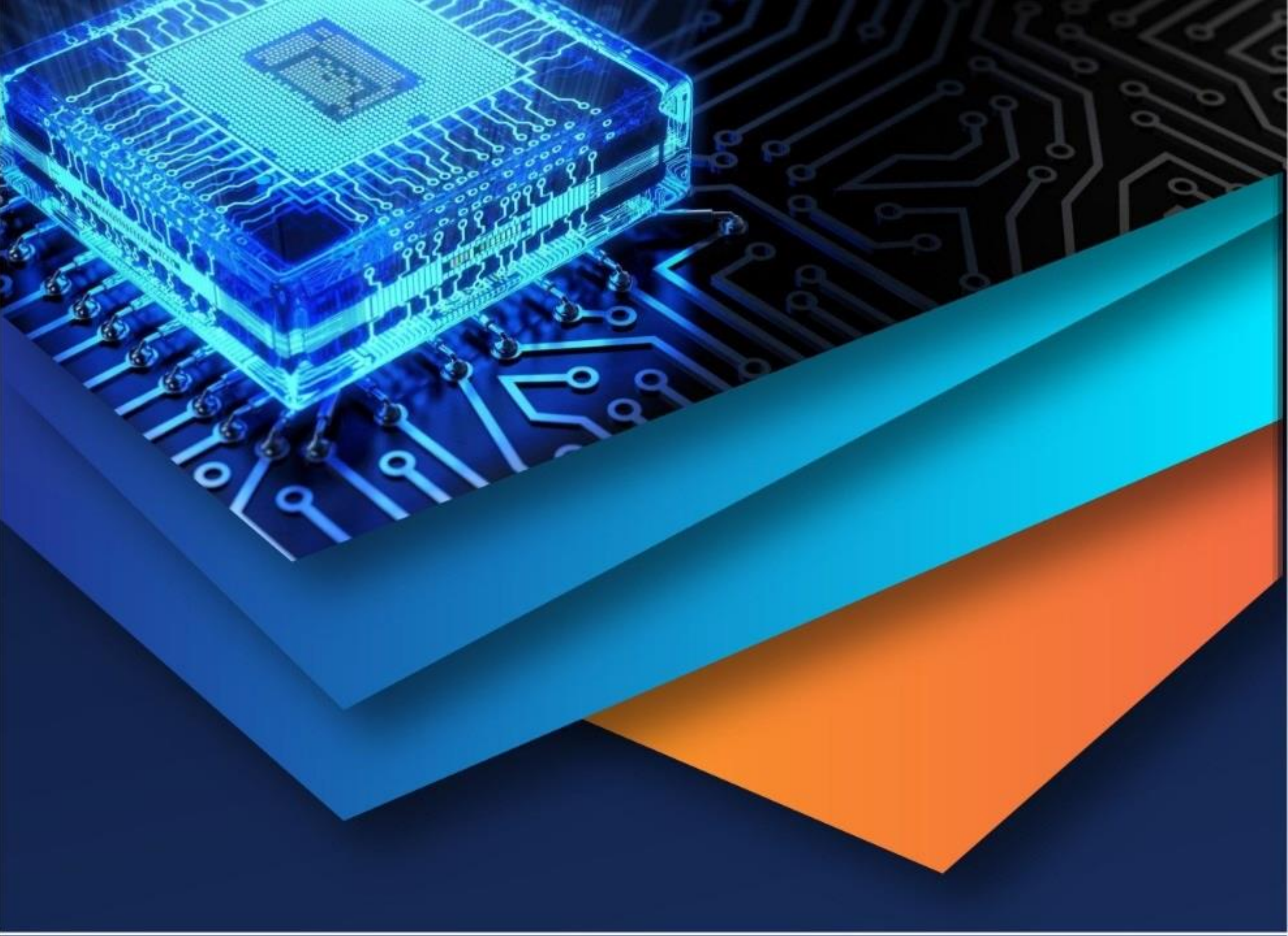
[5] Mindess, S., J. F. Young, and D. Darwin (2003) "Concrete", Second Edition, Prentice Hall.

[6] Nwaubani Sunny O. and Poutos Konstantinos I. (2013) "The Influence of Waste Glass Powder Fineness on the Properties of Cement Mortars" International Journal of Application or Innovation in Engineering and Management (IJAIEM) ISSN 2319 – 4847 Volume 2, Issue 2.

[7] Osmani M. and Pappu A. (2012) "Utilisation of Glass Reinforced Plastic Waste in Concrete and Cement Composites" Proceedings of Second International Conference on Sustainable Construction Materials and Technologies, Ancona Italy.

[8] Patel Dhirendra, Yadav R.K. and Chandak R.(2012) "Strength Characteristics of Cement Mortar Paste Containing Coarse and Fine Waste Glass Powder" International Journal of Engineering Sciences Research-IJESR ISSN: 2230-8504 Volume 03, Issue 02.

[9] Patil Dhanraj Mohan and Dr.Sangle Keshav K (2013) "Experimental Investigation of Waste Glass Powder as Partial Replacement of Cement in Concrete". International Journal of Advanced Technology in Civil Engineering, ISSN: 2231 –5721, Volume-2, Issue-1, 2013



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