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Experimental Investigation Of Waste Glass Powder As Partial Replacement Of Cement In Concrete

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Abstract :

Cement manufacturing assiduity is one of the carbon dioxides emitting sources besides deforestation and burning of fossil energies. The global warming is caused by the emigration of hothouse feasts, similar as CO2, to the atmosphere. Among the hothouse feasts, C02 contributes about 65 of global warming. The global cement assiduity contributes about 7 of hothouse gas emigration to the earth's atmosphere. In order to address environmental goods associated with cement manufacturing, there's a need to develop indispensable binders to make concrete. Accordingly, expansive exploration is ongoing into the use of cement reserves, using numerous waste accoutrements and artificial by products. Sweats have been made in the concrete assiduity to use waste glass as partial relief of course or fine summations and cement. In this study, finely pulverized waste glass is used as a partial relief of cement in concrete and compared it with conventional concrete. This work examines the possibility of using Glass greasepaint as a partial relief of cement for new concrete. Glass greasepaint was incompletely replaced as 10, 15, 20 and 25 and tested for its compressive, water immersion and flexural strength of 7 days and 28 days of age and were compared with those of conventional concrete; from the results attained, it's plant that glass greasepaint can be used as cement relief material up to flyspeck size lower than 355μm to help alkali silica reaction. It is found that waste glass powder posses' pozzolanic property but depends upon the fineness and 20% replacement of cement is found to be efficient to increase the compressive and flexural strength. Water absorption of concrete is reduced by replacement of cement at any amount. Operation of scrap tyre waste dust should minimize environmental impact and maximize conservation of natural resources. One possible result for this problem is to incorporate rubber patches into cement- predicated paraphernalia. Scrap tyres can be Shredded into raw paraphernalia for use in hundreds of scruple rubber products. The other part of the problem is that aggregate product for construction purpose is continuously leading to the reduction of natural resources. Also, some countries are depending on imported total and it's surely truly precious. For illustration, the Netherlands doesn't retain its own aggregate and has to import. This concern leads to a largely growing interest for the use of necessary Paraphernalia that can replace the natural aggregates. Therefore, the use of recycled waste tyres as an aggregate can give the result for two major problems the environmental problem created by waste tyres and the reduction of natural resources by aggregate product consequently the deficiency of natural aggregates in some countries. According to the Automotive Tyre Manufacturers Association (ATMA), in India, farther than92.2 million tyres of Various orders were manufactured. Predicated on an estimate, 60 of the waste tyres are disposed off via unknown routs. The raw paraphernalia in tyres include natural and synthetic rubber, carbon dark, nylon, polyester.

I. INTRODUCTION

Glass is a transparent material produced by melting a admixture of accoutrements similar as silica, pop ash, and CaCO3 at high temperature followed by cooling where solidification occurs without crystallization. Glass is an ideal material for recycling. Recycling of construction waste helps in saving the limited tip space and save waste disposal costs. The energy needed to exercise the recyclable accoutrements is less that of virgin accoutrements. It's an inert material which could be reclaimed and used numerous times without changing its chemical parcels whereas use of recycled accoutrements is the most seductive option in the field of construction moment.

Moment, the interest of the construction community in using waste or recycled accoutrements in concrete is adding because of the sustainable construction, the waste glass from in and around the small shops is packed as a waste and disposed as tip property. Besides using waste glass as cullet in glass manufacturing, waste glass is also crushed into specified sizes or fine greasepaint for use in colorful operation similar as water filtration, fortitude trouncing, beach cover for sport turf and beach relief in concrete.

Also In the recent, colorful attempts and exploration are going on to use ground glass as its relief in the constituents of concrete product, which may be considered as a part of greenhouse operation. It's also observed that waste glass that's crushed and screened is a strong, safe and provident replacing cement by pozzolanic material like glass greasepaint in concrete, not only increases the strength and introduces frugality but also enhances the continuity.

The effect of global warming has impacted everyone on the earth and is a well- honored conception. High situations of energy are demanded to produce cement, which release large quantities of carbon dioxide(CO_2) and also contributes to the hothouse feasts by substituting a portion of the Portland cement with glass greasepaint hothouse emigrations are dropped. Fly ash and silica cloud negotiate this as well but glass greasepaint could be a cheaper volition, since the demand in the concrete manufacturing is adding day by day, the application of swash beach as fine total can also be minimized by the use of glass greasepaint.

It's observed that glass is unstable in the alkaline terrain of concrete and could beget injurious alkali- silica response problems. This property has been used to avail by grinding it into a fine glass greasepaint for objectification into concrete as a pozzolanic material. In laboratory trials it can suppress the alkali- reactivity of coarser glass patches, as well as that of natural reactive summations. It undergoes salutary pozzolanic responses in the concrete and could replace it up to certain probabilities.

Fig.1.1. Fine glass power

Why waste glass powder as partial replacement?

- Glass comprises several chemical varieties including binary alkalisilicate glass, boron-silicate glass, and ternary soda-lime silicate glass.
- Several research work on the use of finely ground glass as a pozzolanic material also started as early as 1970s.
- Most of the work in this area is relatively recent.
- Waste glass powder is relatively good substitute for cement and has overcome several environmental issues.
- Moreover, waste glass is potentially very useful material.
- Have many appropriate economical applications.

Types of Glass	Composition (by weight)	Uses
Soda-Lime-Silica	73% Silica-14%, Soda - 9% Lime - 3.7% Magnesia - 0.3% Alumina	Glass Widows- Bottles - Jars
Boron-Silicate	81% Silica-12%, Boron Oxide 4% Soda - 3% Alumina	Pyrex Cookware - Laboratory Glassware
Lead (Crystal)	57% Silica – 31% Lead Oxide- 120% Potassium Oxide	Lead Crystal Tableware

II. LITERATURE REVIEW

2.1 Waste Glass

Theoretically, glass is a completely recyclable material; it can be reclaimed without any loss of quality. There are numerous exemplifications of successful recycling of waste glass as a cullet in glass product, as raw material for the product of abrasives, in sandblasting, as a pozzolanic cumulative, in road beds, pavement and parking lots, as raw accoutrements to produce glass bullets or globules used in reflective makeup for roadways, to produce fiberglass, and as fractionators for lighting matches and firing security.

Waste glass can also be produced from empty glass bottles and pots, and come in several distinct colors containing common liquids and other substances. This waste glass is generally crushed into small pieces that act the sizes of gravels and beach. Thus as an volition there's a implicit to incompletely replace the concrete blend cement to reduce the demand of cement and hence the global warming.

In its original form, glass comes as a balanced combination from three main raw natural accoutrements beach, silica, and limestone, in addition to a certain chance of recycled waste glass employed in the manufacturing process. The glass recycling process produces a persecuted glass product called" cullet", which is frequently mixed with virgin glass accoutrements to produce new end products.

Fig.2.1.1 Powder obtained from crushed glass pieces

2.2 Common Forms Of Glass

I. Despite the fact that glass accoutrements can be reclaimed ever and the same glass can be reclaimed so numerous times over to produce colorful products, but, in order to keep producing the stylish end product the recycled accoutrements must be of a high quality. Thus, nonstop residual quantities of waste glass performing from construction downfalls, domestic and medical disposals, and artificial affair junk accoutrements are still cumulating and hence need to be land filled or reused in concrete composites as a partial cover for cement after crushing.

II.Technically, spectacles are generally manufactured in the form of tubes, rods, concave vessels and a variety of special shapes, as well as flat glass and granulate for use substantially in chemistry, laboratory technology. medicinals, optoelectronics, colorful domestic uses, and ménage appliance technology. For the purposes of bracket, the multitude of specialized spectacles can be roughly arranged in four main groups, according to their oxide composition(in weight percent).

III. Borosilicate spectacles is the first main order with the presence of substantial quantities of silica(SiO2) and boric oxide(B203> 8) as glass network formers. The quantum of boric oxide affects the glass parcels in a particular way. Piecemeal from the largely resistant kinds(B203 ≤ 13) there are others that due to the different way in which the boric oxide is incorporated into the structural network- have only low chemical resistance(B203> 15).

IV. Secondly, the Alkaline- earth alumina silicate spectacles are free of alkali oxides and contain 15- 25 A1203, 52- 60 SiO2, and about 15 alkaline worlds. Veritably high metamorphosis temperatures and softening points are typical features. Main fields of operation are glass bulbs for halogen lights, display spectacles, high- temperature thermometers, thermally and electrically largely loadable film resistors and combustion tubes.

V. Alkali-supereminent silicate spectacles are the third main order and similar spectacles generally contain over 10 lead oxide(PbO). Lead spectacles containing 20- 30 PbO, 54- 58 SiO2 and about 14 alkalis are largely separating and thus of great significance in electrical engineering. They're used in beacon stems and lead oxide is also of great significance as anX-ray defensive element(radiation shielding glass and cathode shaft tube factors).

VI. The last order is the oldest glass type and negligibly the Alkali alkaline earth silicate spectacles(pop- lime spectacles). It comprises flat spectacles(window glass) and vessel spectacles, which are produced in large batches. Similar spectacles contain about 15 alkali(generally Na2O), 13 16 alkaline worlds(Ca0 MgO), 0- 2 A1203 and about 71 Si02. Variants of the introductory composition can also contain significant quantities of BaO with reduced alkali and alkaline- earth content.

2.3 Properties of glass

VII. Pozzolanic material

Due to its silica content, powered glass is considered a pozzolanic material and thus displays parcels analogous to that of other pozzolanic accoutrements similar as cover ash, silica cloud and sediment. it was determined from the once exploration that glass greasepaint with lower than 75 µm would act as a pozzolan and up to 30 glass greasepaint could be incorporated as an effective cement relief rather the chance may vary depending upon the size, chemical composition and the type of glass greasepaint available.

VIII. AAR suppressant(alkali aggregate response)

AAR is a response that occurs between largely alkaline cement paste and reactive silica patches plant in summations. The response produces a gel which exerts an extensive pressure on the concrete. Over time, this extensive pressure causes spalling and loss of strength of the concrete and could potentially lead to failure. Pozzolan accoutrements are an effective AAR suppressant if used as an indispensable Cementous material.

IX. Glass greasepaint as a binder

When mulled waste glass greasepaint is used in recycled aggregate concrete as partial relief of cement, it interacts with calcium hydroxide available in the attached mortar/ paste adhering to aggregate face to form calcium silicate hydrate which is the crucial binder among cement hydrates. Due to its finer flyspeck size it act as good binder in the concrete blend.

2.4 Material Description

This section summarizes the parcels of all the factors used in the colorful concrete composites,

- **Concrete Compound Accoutrements**

Concrete is a structural material that contains some simple rudiments but when mixed with water would form a gemstone like material. Concrete blend is comprised of coarse summations generally clay, fine summations generally beach, cement, water, and any necessary complements. Concrete possesses numerous favorable parcels as a structural material, among which are its high compressive strength and its property as a fire- resistant element to a considerable extent.

The inimical parcels include a fairly weak tensile strength as compared to its compressive strength and the capability to form cracks in changeable areas. With sword bars as internal underpinning, the cracks can be controlled to some degree. Unlike other structure accoutrements similar as sword and plastic, concrete isn't a invariant material due to the fact that it contains a rate of clay and beach, therefore failure mode or position of the failure is changeable.

Due the nature of concrete, concrete has an capability to have its form changed or altered to meet situational requirements. Therefore, if a job calls for high strength, featherlight or rainfall resistant concrete, its form is available or a custom bone can be cooked. Concrete has three main factors when it's lately mixed and they're water, cement and summations. Water is demanded to begin the hydration process for the concrete and after four weeks of curing until full implicit strength of the concrete can be achieved.

- **Water**

Water is one of the most important rudiments in concrete product. Water is demanded to begin the hydration process by replying with the cement to produce concrete. There has to be a sufficient quantum of water available so that the response can take its full course but if too important water is added, this will in fact drop the strength of the concrete. The water- cement rate is an important conception because other than the form for the concrete blend, the quantum of water used would also determine its finial strength. In further details, if too little water were added, there would not be enough water available to finish the response, therefore some of the cement would harden and bond with other dry cement shorting the hydration process. On the other hand, if too important water were added also while the cement is witnessing hydration the cement would be in a slurry result, and the probability of cement cling with summations would drop. And as a result, when the hydration process is completed, the cement content would still be in a slurry result and with no strength.

The type of water that can be used to mix concrete must be drinkable which is basically has neither conspicuous taste nor odor. Principally, water containing lower than 2000 ppm of total dissolved solids can be used. Therefore the type of water that was used to mix concrete throughout the testing program was normal valve water with attention paid for not including contaminations. history is converted into a substance, which has tremendous strength. But using too important cement in concrete is precious, and therefore summations would take the place of cement without reducing its strength and reduce the cost. For our design water cement rate of0.47 was used.

- **Summations**

Summations are broken down into two main orders, which are coarse and fine summations. Coarse summations in general are larger than 2 mm in periphery and fine summations are defined to be lower than 2 mm. Summations that are used in concrete have to pass the norms set in implicit problem. When the chemical response has reached the end, the original cement ASTM. The economics part of concrete is to use as little cement as possible and still gain the needed strength. Therefore, when concrete is formed, the coarse summations with its large volume would make up a large portion of the concrete. The fine summations would fill in the voids created form the coarse total and reduce the quantum of cement needed. If only coarse summations are used also there would be voids between the patches and the voids created would be filled with cement paste. Therefore fine summations are used to fill those voids. In substance, the thing is to produce a concrete admixture that has the least quantum of void spaces therefore using lower cement paste to fill the voids between the patches.

When fresh summations are used to mix concrete, the summations themselves also contain some humidity either from water condensing on the patches or the summations was washed in some way with water. Consequently, there are four distinct countries that the summations can be in. Roaster dry summations would absorb water to fill its own internal voids and in doing so would reduce the water cementratio.However, also the hydration process isn't permitted to continue and the strength of the concrete blend would be reduced by a considerable quantum, If this occurs. Air dry summations would absorb some water but not to an extraneous degree like the roaster dry summations. The face would appear dry and therefore some water is absorbed and reduces the water cement rate. Therefore the strength of the concrete is reduced by a small quantum. Impregnated dry face summations have their internal voids fill with water and therefore can not absorb any

more water. These summations would keep the water cement rate constant and the concrete would retain its full strength. Summations have their internal voids and face area impregnated with water. Rather of absorbing water, the summations would add water to the admixture and in doing so; the water cement rate is increased, dwindling the strength of the concrete.

For this exploration the water content for the summations was prepared under the impregnated face dried(SSD) condition in order to avoid any possible over or under estimation of water content due to humidity immersion by the mixed summations, and also to guarantee the true effectiveness of the different watercement rates used for preparing the concrete blend.

2.5 Former studies

1. **Caijun and Keren et al**; reviewed the three possible uses of waste spectacles in product of cement and concrete, where their results can be epitomized as follows Originally, the use of waste spectacles as concrete summations has a slight negative effect on the plasticity, strength and freezing- deliquescing resistance of cement concrete. Still, the main concern is expansion and cracking of the concrete containing glass summations. It needs to control the pH of the system below 12 in order to help implicit erosion of glass summations and expansion of the concrete, which may be achieved by the relief of Portland cement with pozzolanic

accoutrements similar as cover ash, silica cloud and meta- humus. Secondly, waste spectacles barrels be used as raw accoutrements for cement product as siliceous sources. Still, it'll increase the liquid content in the clinker, results in the conformation of some Na composites and increase in the alkali content in the cement. The effect will be dependent on the quantum of waste glassused.However, the goods can be veritably minimum, If the chance of waste glass used in the raw accoutrements is low.

Eventually, ground glass maquillages parade veritably good pozzolanic reactivity and can be used as cement relief. As anticipated, its pozzolanic reactivity increases as its finesses increase. Alkalis in the glass greasepaint can beget alkali- aggregate response and expansion if summations are alkali- reactive.

Results from ASTM C- 1260 testing indicate that the alkali- aggregate response expansion decreases as glass relief increases, and will be under the injurious limit if the glass relief is 50 or further. The combined use of other supplementary bonding accoutrements similar as coal cover ash, ground blast furnace sediment and meta- humus can also drop the expansion from alkali- aggregate response. Lithium swab can be a veritably effective cumulative to help the alkali- aggregate response expansion of concrete containing glass maquillages.

2. DrG. Vijay Kumar et al; while studying on" Glass Powder as partial relief of cement in concrete product" stated that finely pulverized waste spectacles was used as a partial relief of cement in concrete and compared it with conventional concrete. This work examines the possibility of using Glass greasepaint as a partial relief of cement for new concrete. Glass greasepaint was incompletely replaced as 10, 20, 30 and 40 and tested for its compressive, Tensile and flexural strength up to 60 days of age and were compared with those of conventional concrete from the results attained, it's plant that glass greasepaint can be used as cement relief material up to flyspeck size lower than 75um to help the alkali silica response.

Conventional concrete shows at 28 days compressive strength as31.1 N/ mm ², split tensile strength of2.27 N/ mm ² and flexural strength of3.25 N/ mm ². It was plant that 40 relief of cement with glass greasepaint had gained33.7 strength further than the conventional concrete. Split tensile strength was also conducted which gave4.4 increase in strength by 40 relief of cement. Flexural strength of concrete was increased by88.09,99.07 and 100 from the partial relief of cement by 20, 30 and 40 independently.

Eventually he'd concluded that Glass greasepaint concrete increases the compressive, tensile & flexural strength effectively, when compared with conventional concrete. Veritably finely ground has been shown to be excellent padding may have sufficient pozzolanic parcels to serve as partial cement relief, the effect of ASR appear to be reduced with finer spectacles, with relief position.

3.**Kumarappam et al**; carried out trial on" In partial relief of cement in concrete using waste glass" and reviewed performance of concrete containing glass Greasepaint as partial negotiation of cement. Portland Cement(PC) was incompletely replaced with 0-40 glass greasepaint. Testing includes ultrasonic palpitation haste, compressive strength & immersion. Samples where twisted in water at 20 ° C results indicate that the maximum strength of concrete & finalize that there's a methodical increase in depression as the glass greasepaint in blend increases the depression ranged from around 40 mm for the reference(i.e., 0 glass greasepaint) to 160 mm at 40 glass greasepaint. Using ground glass greasepaint can reduce the use of cement and the associated energy demand impact of air pollution and Co2 emigration. The depression of concrete seems to increase in glass greasepaint in the concrete blend. At 10 of glass greasepaint contains the compressive strength of concrete is advanced than that of the control. Above 20 of Glass greasepaint the strength mainly decreases.

4.J.M. Khatib et al; while studying on" Glass Powder Application in Concrete Product" stated that due to global warming the need to cut down energy operations. The main enterprises for the use of crushed consumption have increased. The effect of global spectacles as summations for Portland cement concrete are warming has impacted everyone on the earth and is a the expansion and cracking caused by the glass wellrecognized conception. High situations of energy are summations due to alkali silica response. Due its silica demanded to produce cement, which releases large quantities happy, ground glass is considered a pozzolanic material of carbon dioxide(CO2) and also contributes to the green and as similar can parade parcels analogous to other house feasts. The exploration paper was studied for glass greasepaint as cover to cement in concrete product, and the concrete was prepared by replacing cement by, 30, & 40 and was tested for its depression value, compressive test and ultrasonic palpitation haste and compared to the conventional concrete.

It was concluded that using ground glass greasepaint can reduce the use of cement and the associated energy demand and impact on air pollution and CO emigration. The depression of concrete seems to increase with the increase in glass greasepaint in the concrete blend. At 10 glass greasepaint content the of compressive strength of concrete is advanced than that of the control. Above 20 glass greasepaint the strength mainly decreases.

3 PRESENT WORK

3.1. Objectives

The various objectives of our project are as follows

1. **Determine the effect of powdered waste glass on the strength of concrete**

Silica	72.80%
Alumina	01.06%
Lime	08%
Iron oxide	0.36%
Magnesia	04.18%
Sodium oxide	13.10%
Potassium oxide	0.26%
Sulphur trioxide	0.18%

Table 3.1.1 Below shows the constitutions of glass

This above table shows the chemical properties of glass & from the above we conclude that the presence of silica in cement is the building property for the concrete. The strength of the concrete mainly depends upon the binding property of cement. In the glass silica is rich & when we use the glass in concrete. it increase the binding strength & hence automatically the strength of the concrete is increased.

2. To serve both as partial cement replacement & filler

Glass is unstable in the alkaline environment of concrete & could cause deterious alkali-silica reaction problems. This property has been used is advantage by grinding it into a fine glass powder (GLP) for incorporation into concrete on a pozzolanic material.

3. To use waste glass powder effectively by partially replacement the cement minimizing the environmental effects:

• To check its workability as green house decreases

• To minimize the environmental pollution.

4. To check the performance of concrete containing glass powder and compare it with conventional concrete:

The most important objective of this project is evaluate the recyclability of powered waste glass as a pozzolana as partial replacement of cement in concrete. And study the comparative effects of addition of powder glass, fly ash & silica fumes in concrete as pozzolana is mitigate alkali aggregate reaction.

5. To check the aesthetic appeal of the concrete:

The aesthetic appeal of the glass powder concrete is also checked whether it glass powder has any effects on the aesthetic appeal of the concrete derived.

6. To increase the compressive and flexural strength effectively as compared with conventional concrete:

• To check its durability as an admixture.

• To check its effects on concrete as thermal insulator.

Recent research have shown that concrete made with recycled glass aggregate have shown better. Long term strength better thermal insulation due to its better thermal properties of the glass aggregates.

3.2. Methodology

3.2.1 Mix design

Data Required

Grade of concrete: M20

Size of aggregate: 20 mm Properties of cement:

Specific gravity = 3.25

Compressive strength at 7 days = 224.49 kg/cm³

Properties of fine aggregate:

Specific gravity = 2.68 Water absorption = 0.5

Properties of coarse aggregate:

Size of coarse aggregate = 20 mm

Specific gravity = 2.82

Water absorption = 0.71% Mix Design Procedure:

1. Targeted mean strength :

TMS = fck+ kx S.D

=20+4 x1.65 = 26.60 kN/m²

2. W/C ratio:

a) From graph = 0.47

b) From table no. -0.55 (for M20 grade)

Take least value among them: 0.47

3. Air content:

Size of aggregate (mm)	Air content %
10	3.0
20	2.0
40	1.0

a)Size of total = 10 mm

b) Air content = 3 (from above table)

4. Water content for moderate depression for 20 mm = 186 kg/ m ³(from tableno. 43)

Cement content = (water content)/(w/ c rate)

= 186/0.47

= 395.744 KG/ M ²> 300 KG/ M ³

Henceo.k.(from tableno. 5)

5. Correction

From the tableno. 42 for 10 mm 35(beach as of total aggregate volume) w/ c rate handed = 0.47

= 0.6-0.47

= 0.13

CONDITION	ADJUSTMENT	
	ΔW	ΔP (%)
Sand Zonel,III,IV	0	-1.5% /zone (+for 1)
CF (±) 0.1	3% (±)	0
w/c (±) 0.05	0	±1%
Rounded agg	-15	-7

From table no. 44 (zone correction)
Zone correction = -1.5 (Zone III)
% of sand content = 35 - 1.5-2.6
= 30.9 Zone III

For fine aggregate
% sand content = (water content + (cement constant/specific gravity)

+(fine aggregate/specific gravity) x(1/sand content %))
(1-0.2)% = (186+ (395.744/3.25)+ (F.A/2.68) x (1/0.31)) x (1/1000)
800 = 186+ (395.744/3.25) + (F.A/2.68) x (1/0.31)
F.A. = 408.94kg/m³
For Coarse aggregate
800 = (186+ (395.744/3.25) + (C.A/2.82) x (1/(1-0.31))) x (1/1000)

C.A. = 957.786 kg/m³
Water absorption correction:
Water absorbed by F.A. = 0.5% of 620.17
= (0.5/100) x 408.94

= 2.0447 KG/M³

Actual aggregate required =957.786

=957.786KG/M³

Water absorbed by C.A. = 69% of 1131.28 kg/m³

= (0.71/100) * 957.786

= 6.80 kg/m³

Actual coarse aggregate required = 957.786 - 6.8

=950.986 KG/M³

Revised water content = 186 +2.0447+ 6.8

=194.8447 kg/m³

Ratio:

Cement	Sand	Aggregate	water
395.744	406.895	950.986	194.8447
1	1.95	3.15	0.45

Adopted ratio: 1 : 1.95 : 3.15 : 0.45

3.2.2. Cube casting and beam casting

CONDITION	ADJUSTMENT	
	ΔW	ΔP (%)
Sand Zonel,III,IV	0	-1.5% /zone (+for 1)
CF (±) 0.1	3% (±)	0
w/c (±) 0.05	0	±1%
Rounded agg	-15	-7

From table no. 44 (zone correction)

Zone correction = -1.5 (Zone III)

% of sand content = 35 - 1.5-2.6

= 30.9 Zone III

For fine aggregate

% sand content = (water content + (cement constant/specific gravity)

+(fine aggregate/specific gravity) x(1/sand content %))

(1-0.2)% = (186+ (395.744/3.25)+ (F.A/2.68) x (1/0.31)) x (1/1000)

800 = 186+ (395.744/3.25) + (F.A/2.68) x (1/0.31)

F.A. = 408.94kg/m³

For Coarse aggregate

800 = (186+ (395.744/3.25) + (C.A/2.82) x (1/(1-0.31))) x (1/1000)

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Water absorbed by F.A. = 0.5% of 620.17

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Revised water content = 186 +2.0447+ 6.8

=194.8447 kg/m³

Ratio:

Cement	Sand	Aggregate	water
395.744	406.895	950.986	194.8447
1	1.95	3.15	0.45

Adopted ratio: 1 : 1.95 : 3.15 : 0.45

3.2.2. Cube casting and beam casting

In this study, al of totfive groups of concrete mixes were prepared in laboratory.

- First group was plain cement concrete was used for casting
- Second group was 10% cement replacement by fine glass powder of size 355µm and the name given to the specimens was W10
- Third group was 15% replacement by fine glass powder and the specimens of these group were named W15
- Fourth group was 20% replacement of cement by glass powder and the specimens of this group were named as W20.
- Fifth group was 25% replacement of cement by glass powder and the specimens named W25.

For our project we had used M20 grade of concrete with the mix ratio of **1 : 1.95 : 3.15 : 0.45**

1. Plain cement concrete cubes

- Nine plain cement concrete cubes were casted.
- Size 15 cm x 15 cm x 15 cm.
- Compressive strength of cubes at 7 days and 28 days curing were recorded.
- Three plain cement concrete beams were casted.
- Size 15 cm x 15 cm x 53.34 cm.
- Flexural strength of beam at 28 days curing was recorded.

2. Concrete cubes and beams with 10% replacement of cement

- 10% of cement was replaced by glass powder of size 355µm while preparing the mix.
- Nine concrete cubes were casted.
- Size 15 cm x 15 cm x 15 cm

- Compressive strength of cubes at 7 days and 28 days curing were recorded.
- Three concrete beams were casted.
- Size 15 cm x 15 cm x 53.34 cm.
- Flexural strength of beam at 28 days curing was recorded.

3. Concrete cubes and beams with 15% replacement of cement

- 15% of cement was replaced by glass powder of size 355µm while preparing the mix.
- Nine concrete cubes were casted.
- Size 15 cm x 15 cm x 15 cm.
- Compressive strength of cubes at 7 days and 28 days curing were recorded.
- Three concrete beams were casted.
- Size 15 cm x 15 cm x 53.34 cm.
- Flexural strength of beam at 28 days curing was recorded.

4. Concrete cubes and beams with 20% replacement of cement

- 20% of cement was replaced by glass powder of size 355µm while preparing the mix.
- Nine concrete cubes were casted.
- Size 15 cm x 15 cm x 15 cm.
- Compressive strength of cubes at 7 days and 28 days curing were recorded.
- Three concrete beams were casted.
- Size 15 cm x 15 cm x 53.34 cm.

5. Flexural strength of beam at 28 days curing was recorded Concrete cubes and beams with 25% replacement of cement

- 25% of cement was replaced by glass powder of size 355µm while preparing the mix.
- Nine concrete cubes were casted.
- Size 15 cm x 15 cm x 15 cm.
- Compressive strength of cubes at 7 days and 28 days curing were recorded.
- Three concrete beams were casted.
- Size 15 cm x 15 cm x 53.34 cm.
- Flexural strength of beam at 28 days curing was recorded.

6. **3.2.3. Present Study:**

This section shows various testing carried out on concrete cubes and beams

➢ Flexural Strength

Flexural strength test is done as per IS: 516-19595. Beams are tested for flexure in Universal Testing Machine of capacity 40 tons as shown in Fig. 11. The bearing surfaces of the supporting and loading rollers are wiped clean before loading. The prisms are placed in the machine in such a manner that the load is applied to the uppermost surface along the two lines spaced 13.3 cm apart. The axis of the specimen is aligned with the axis of the loading device. The load is applied at a rate of 400kg/min without shock. The specimen is loaded till it fails and the maximum load (P) applied to the specimen during test is noted. After fracture the distance (a) between the crack and nearest support is measured.

The flexural strength of the specimen is expressed as the modulus of rupture
F_b = (P x a)/(bxd²) when a is greater than 13.3 cm or

F_b = (3 x P x a)/(bxd²) when a is in between 11.0cm and 13.3cm where, a = the distance between the line of fracture and the nearest support
b = measured width in cm of the specimen, d = measured depth in cm of the specimen was supported, and
P = maximum load in kg applied on the specimen.
If a is less than 11.0 cm the test result is discarded.

➢ **Water absorption test**

Three full size blocks shall be completely immersed in clean water at room temperature for 24 hours The blocks shall then be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh, visible surface water being removed with a damp cloth, the saturated and surface dry blocks immediately weighed. After weighing all blocks shall be dried in a ventilated oven an at 100 to 1150 °C for not less than 24 hours and until two successive weighing at intervals of 2 hours show an increment of loss not greater than 0.2 percent of the last previously determined mass of the specimen. The water absorption calculates as given below:

Absorption, percent =(A-B)/B x 100

Where,

A= wet mass of mass of unit in kg.

B = dry mass of unit in kg

Compressive strength of concrete

Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. For cube test two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15cm x 15 cm are commonly used. This concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed, and test specimens are put in water for curing. The top surface of these specimen should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen.

These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

➢ Computations

Size of the cell = 15 cm x15cm x15cm
Area of the instance(calculated from the mean size of the instance) = 225 cm ²
Characteristic compressive strength(f ck) at 7 days =
Anticipated maximum cargo = fck x area xf.s
Range to be named is … … … … … … … … ….
Analogous computation should be done for 28- day compressive strength
Maximum cargo applied = . tones = … … …. N
Compressive strength(Cargo in N/ Area in mm2) = . = … …. N/ mm ²
= … … … … … …. N/ mm2

➢ Coffers

• Glass greasepaint was collected from the shops located at artificial area in Chandrapur where grinding of dinnerware's is carried out.
• BirlaA-1 cement was used.
• 20 mm summations were used from original area.

4 RESULT AND ANALYSIS

4.1. Results of Compressive strength

Cells were tested for their compressive strength gained after 7 days curing and 28 days curing all the reading were recorded

➢ Conventional concrete

Sr. no	Name of specimen	7 days strength N/mm²	28 days strength N/mm²
1	WS1	24.44	30.67
2	WS2	21.33	31.89
3	WS3	22.66	30.45
	Average	22.66	31.00

Table 4.1.1 Compressive strength of plain concrete cubes

III. **Cement:**

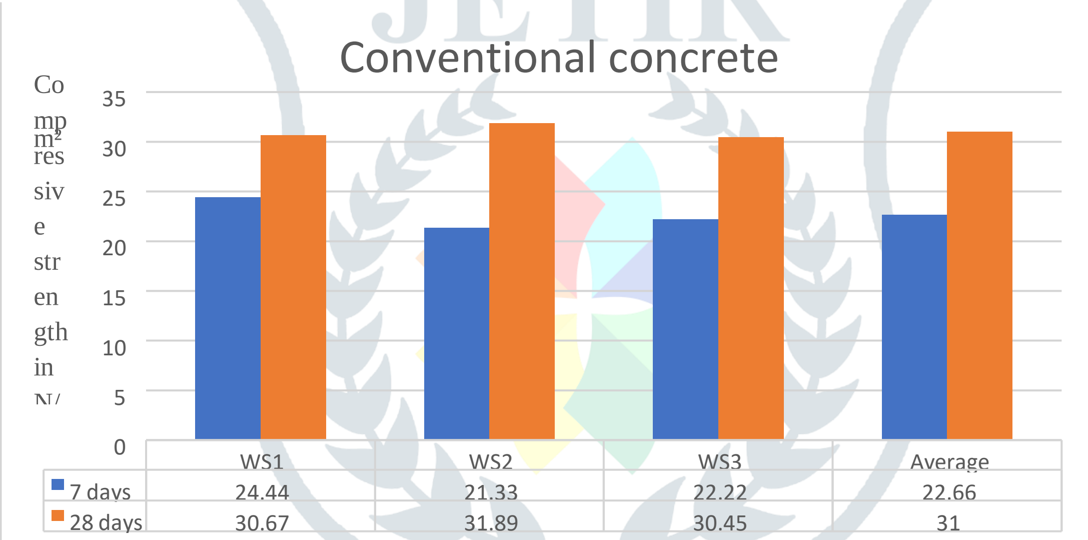


Fig.4.1.1. bar chart showing 7 and 28 days strength of conventional concrete cubes

Trail with 10% replacement of cement

Sr. no	Name of specimen	7 days strength N/mm²	28 days strength N/mm²
1	$W10_1$	28.44	30.66
2	$W10_2$	27.11	28.44
3	$W10_3$	30.67	33.78
	Average	28.74	30.96

Table.4.1.2. Compressive strength of 10% replacement

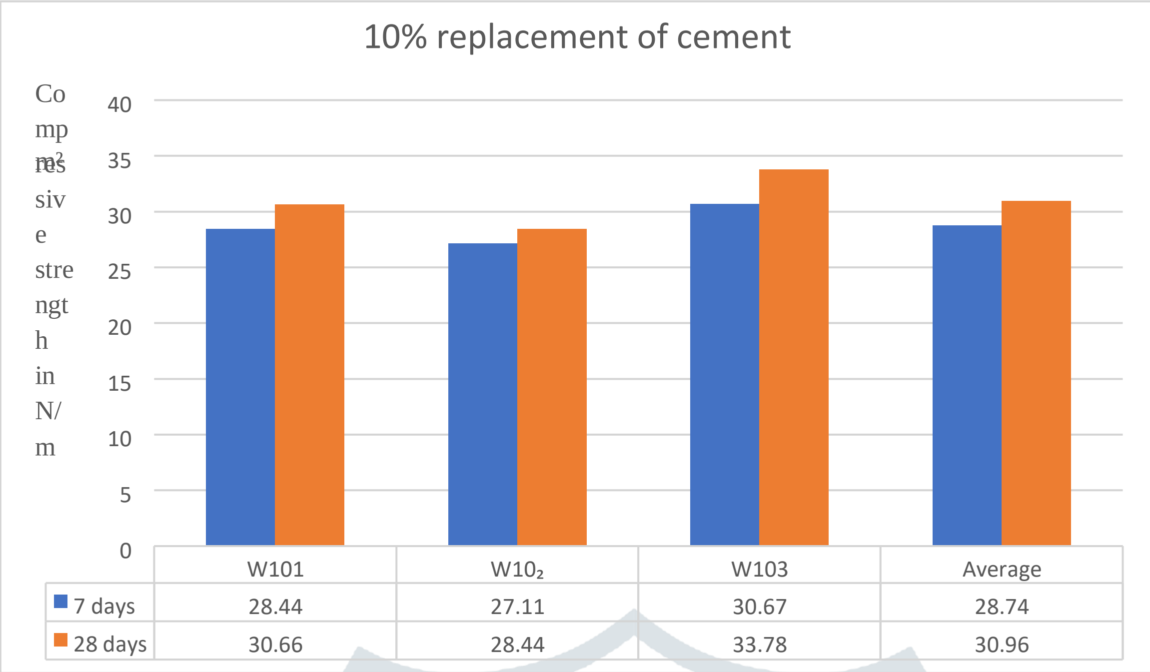


Fig.4.1.2 bar chart showing 7 and 28 days strength of 10% replacement

Trail with 15% replacement of cement

Sr. no	Name of specimen	7 days strength N/mm²	28 days strength N/mm²
1	$W15_1$	24.00	26.67
2	$W15_2$	25.33	29.33
3	$W15_3$	21.78	30.22
	Average	23.70	28.74

Table.4.1.3. Compressive strength of 15% replacement

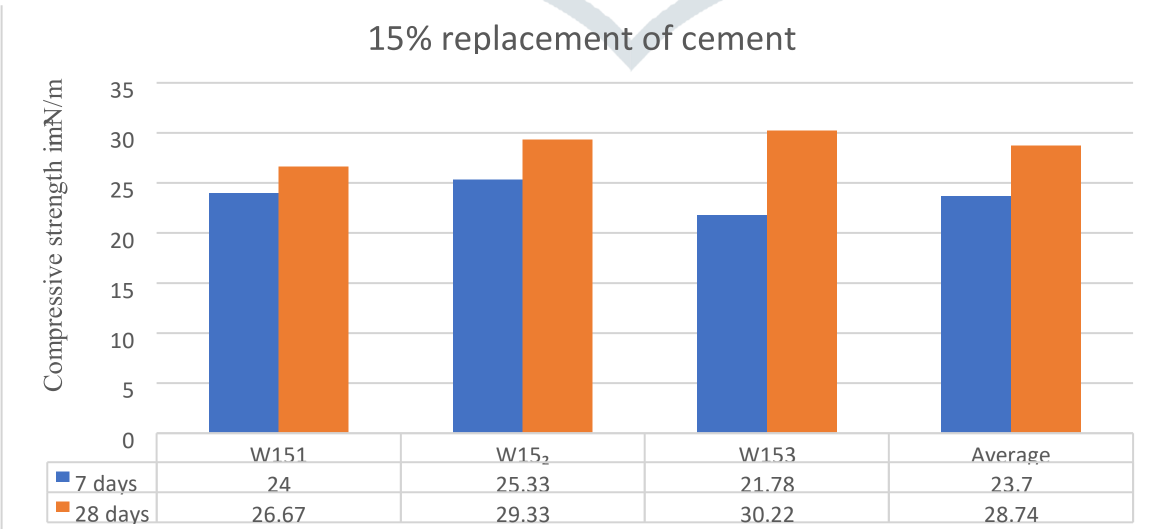
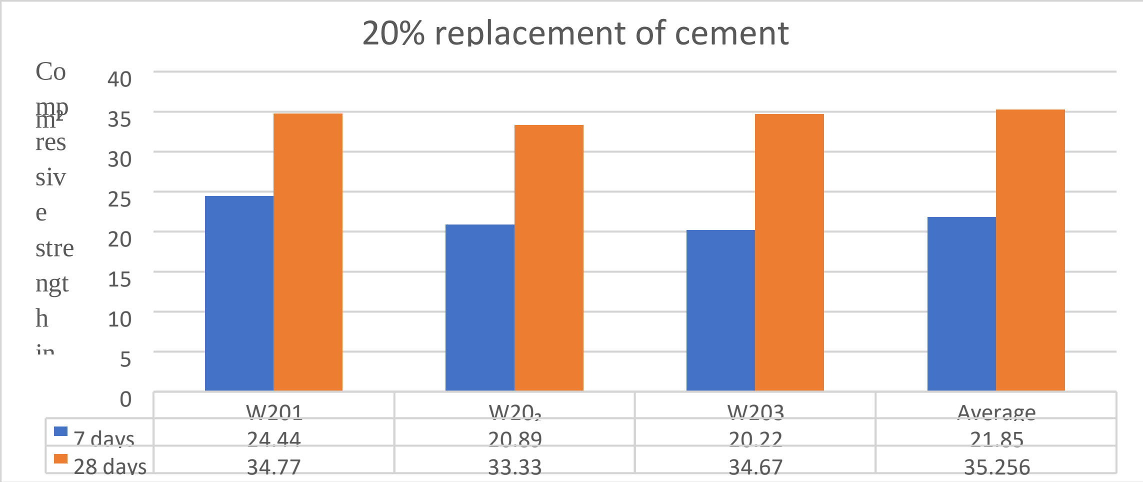


Fig.4.1.3 bar chart showing 7 and 28 days strength of 15% replacement

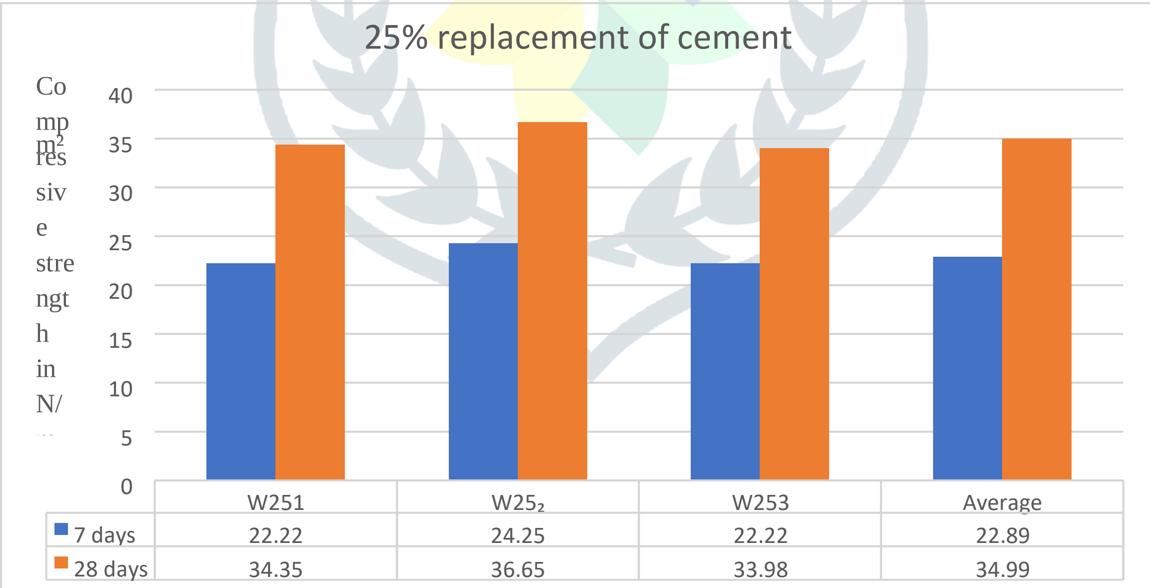


Trail with 20% replacement of cement

Sr. no	Name of specimen	7 days strength N/mm²	28 days strength N/mm²
1	$W20_1$	24.44	34.77
2	$W20_2$	20.89	33.33
3	$W20_3$	20.22	34.67
	Average	21.85	35.256

Table.4.1.4. Compressive strength of 20% replacement

Fig.4.1.4 bar chart showing 7 and 28 days strength of 20% replacement



Trail with 25% replacement of cement

Fig.4.1.5 bar chart showing 7 and 28 days strength of 25% replacement

Sr. no	Name of specimen	7 days strength N/mm²	28 days strength N/mm²
1	$W25_1$	22.22	34.35
2	$W25_2$	24.25	36.65
3	$W25_3$	22.22	33.98
	Average	22.89	34.99

Table.4.1.5. Compressive strength of 25% replacement

4.2. Results of water Absorption test

Water absorption test was conducted on cubes at 28days age of concrete.

➢ Conventional concrete

Sr. no	**Name of specimen**	**% Absorption**
1	WS1	2.24
2	WS2	3.13
3	WS3	3.91
	Average	3.09

Table.4.2.1. percentage of water absorption for Conventional concrete

- Trail with 10% replacement of cement

Sr. no	Name of specimen	% Absorption
1	$W10_1$	1.05
2	$W10_2$	1.08
3	$W10_3$	0.98
	Average	1.04

Table.4.2.2. percentage of water absorption for 10% replacement

- Trail with 15% replacement of cement

Sr. no	Name of specimen	% Absorption
1	$W15_1$	0.967
2	$W15_2$	1.050
3	$W15_3$	1.114
	Average	1.043

Table.4.2.3. percentage of water absorption for 15% replacement

- Trail with 20% replacement of cement

Sr. no	Name of specimen	% Absorption
1	$W20_1$	3.17
2	$W20_2$	3.43
3	$W20_3$	2.077
	Average	2.089

Table.4.2.4. percentage of water absorption for 20% replacement

- Trail with 25% replacement of cement

Sr. no	Name of specimen	% Absorption
1	$W25_1$	1.84
2	$W25_2$	1.65
3	$W25_3$	2.13
	Average	1.87

Table.4.2.5. percentage of water absorption for 25% replacement

4.3 Results of Flexural strength:

Flexural strength was conducted on beams of size 15 x 15 x 53.34 cm at 28 days age of concrete. This test was carried out at universal testing machine.

➢ Flexural strength of 0 % replaced glass powder

Sr. no	Name of specimen	Strength in N/mm²
1	WS1	65.11
2	WS2	65.11
3	WS3	66.977
	Average	65.73

Table.4.3.1. Flexural strength of 0 % replaced glass powder

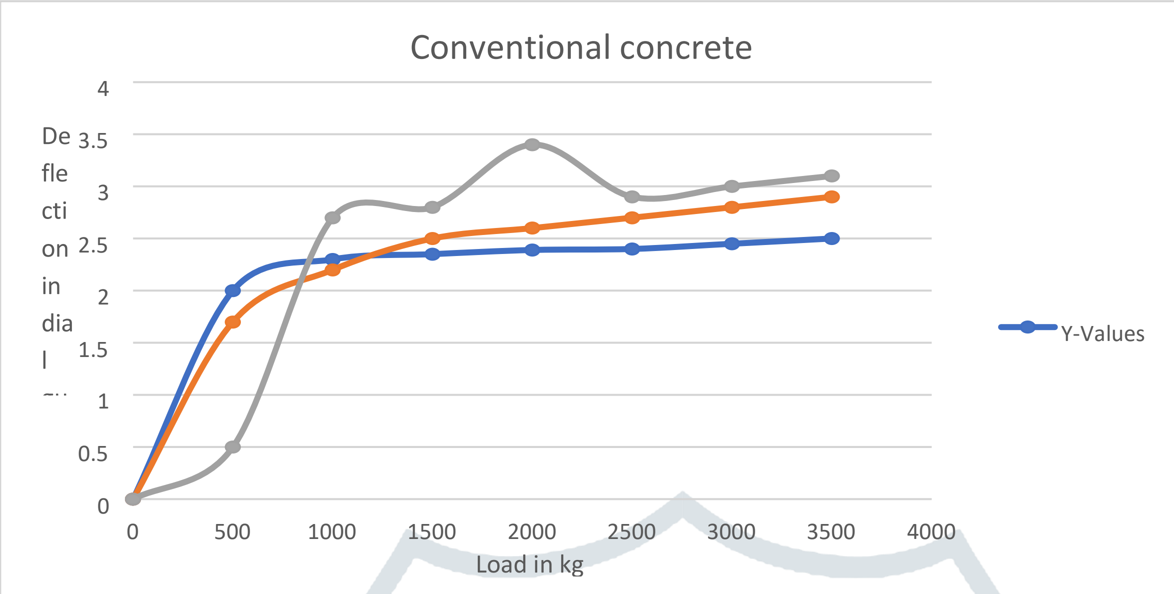


Fig.4.3.1. graph showing flexural strength of 0% replacement

- Flexural strength 10% replaced glass powder

Sr. no	Name of specimen	Strength in N/mm²
1	$W10_1$	39.07
2	$W10_2$	51.16
3	$W10_3$	55.81
	Average	48.68

Table.4.3.2. Flexural strength of 10% replaced glass powder

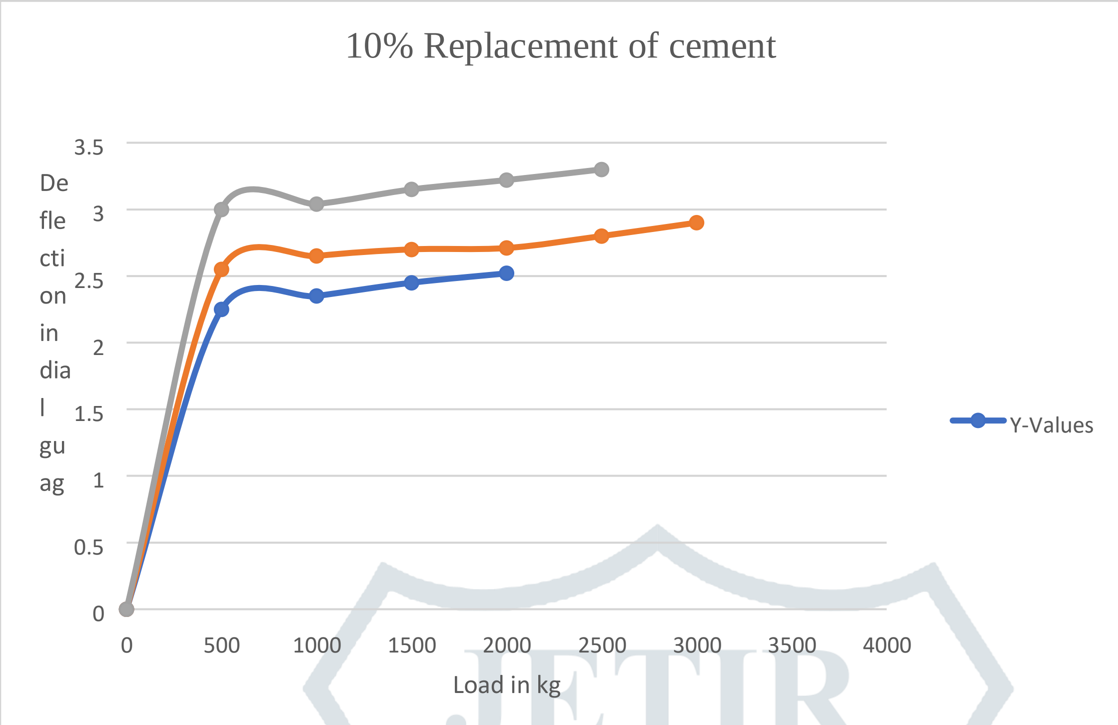


Fig.4.3.2. graph showing flexural strength of 10% replacement

- Flexural strength 15% replaced glass powder

Sr. no	Name of specimen	Strength in N/mm²
1	W15₁	62.32
2	W15₂	68.83
3	W15₃	66.7
	Average	66.04

Table.4.3.3. Flexural strength of 15 % replaced glass powder

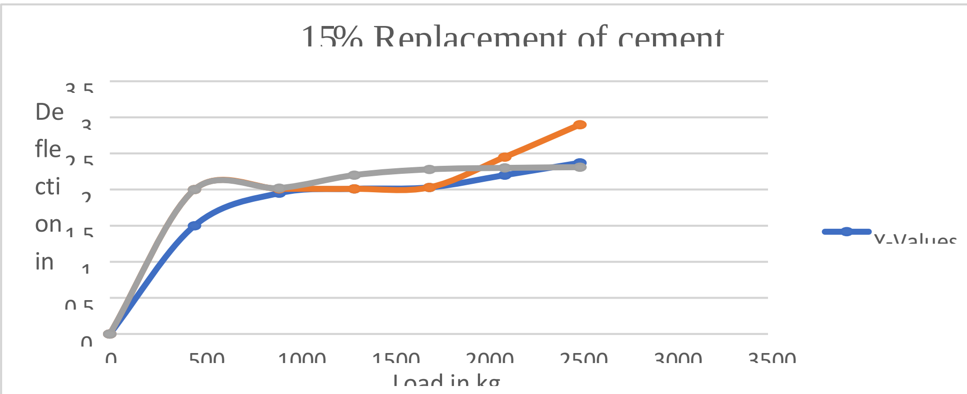


Fig.4.3.3. graph showing flexural strength of 15% replacement

- Flexural strength 20% replaced glass powder

Sr. no	Name of specimen	Strength in N/mm²
1	W20₁	46.51
2	W20₂	46.51
3	W20₃	55.81
	Average	49.61

Table.4.3.4. Flexural strength of 20 % replaced glass powder

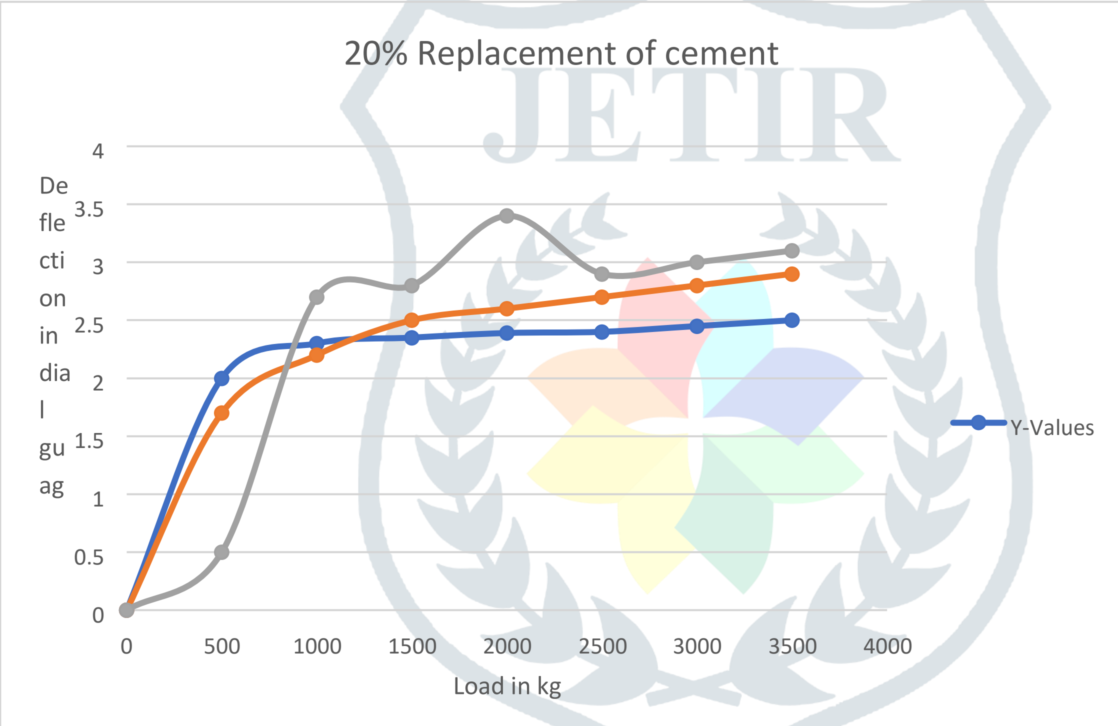


Fig.4.3.4. graph showing flexural strength of 20% replacement

4.4. Analysis

Compressive strength

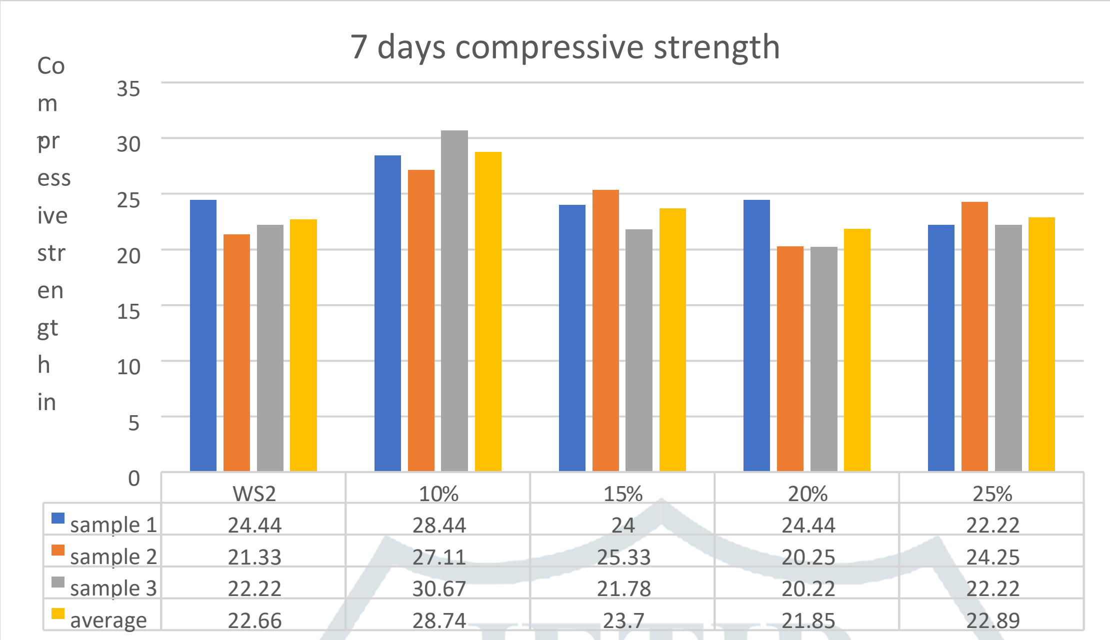


Fig. 4.4.1. bar chart showing comparison of 7 days Compressive strength for all Samples

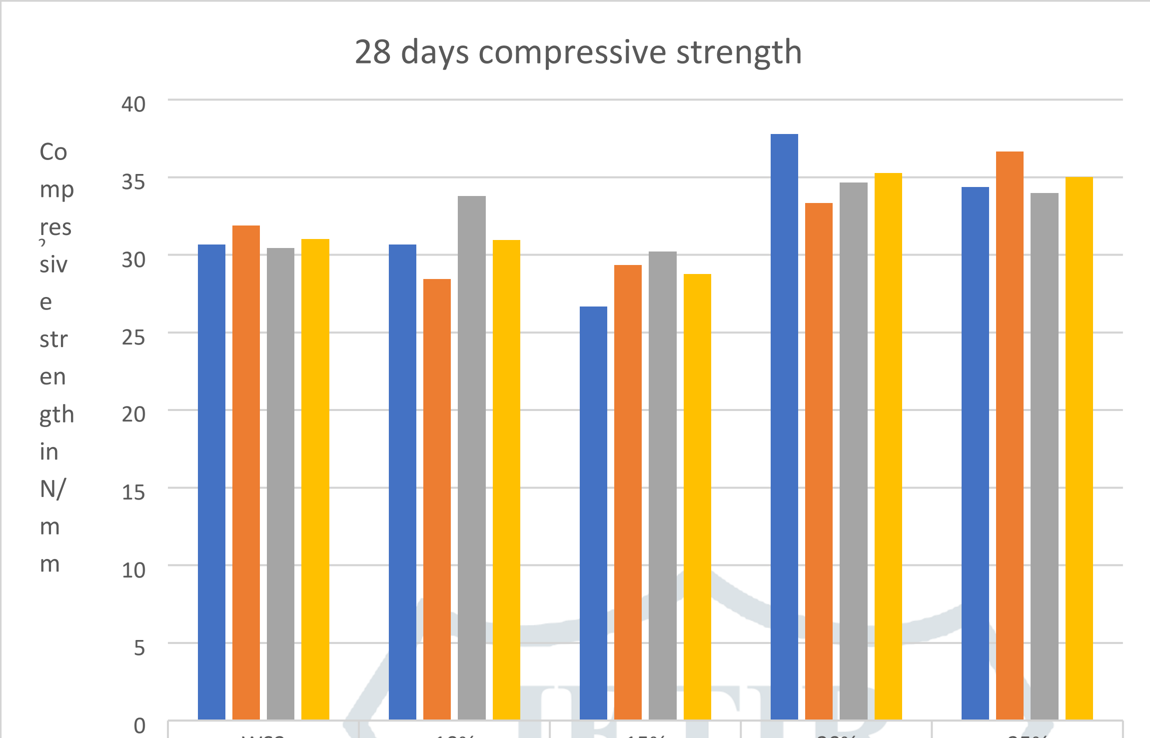
7 days compressive strength

	Sample 1	Sample 2	Sample 3	Average
WS2	24.44	21.33	22.22	22.66
10%	28.44	27.11	30.67	28.74
15%	24.00	25.33	21.78	23.70
20%	24.44	20.25	20.22	21.85
25%	22.22	24.25	22.22	22.89

Table.4.4.1. 7 days Compressive strength for all samples

It is observed that the strength gained by all the samples at 7 days curing is nearly equal to that of conventional concrete. It is also found that replacement of cement by 10% gives maximum strength that is 30.63% more than the conventional concrete. Replacement of cement by 15% and 25% also gave 7.72% and 4.04% strength more than the conventional concrete. 20% Replacement of cement did not show much increase in strength but gave nearly equal strength to conventional concrete.

- 28 days compressive strength

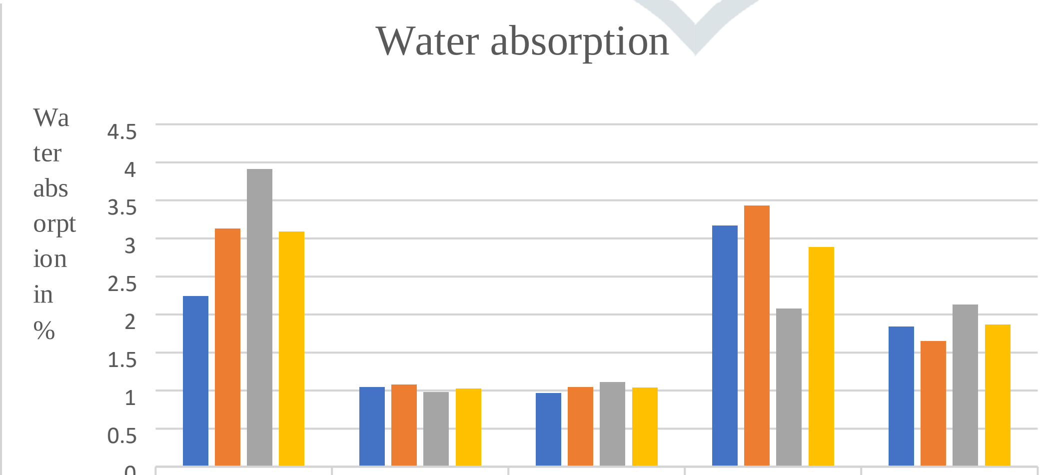


	WS2	10%	15%	20%	25%
sample 1	30.67	30.66	26.67	37.77	34.35
sample 2	31.89	28.44	29.33	33.33	36.65
sample 3	30.45	33.78	30.22	34.67	33.98
average	31	30.96	28.74	35.26	34.99

Table.4.4.2. 28 days Compressive strength for all sample
Fig.4.4.2. bar chart showing comparison of 28days Compressive strength for all Samples

It is found that the strength obtained by conventional concrete at 28 days of curing is 31.00N/mm². It is also found that 20% and 25% replacement of cement by waste glass powder gained strength 13.74% and 12.74% more than the conventional concrete respectively. 10% and 15% replacement of cement by waste glass powder did not gave strength more than the conventional concrete but it is nearly equal to it. So it can be finalized that 20% and 25% replacement of cement by waste glass powder of size 355µ can be used effectively

- Water absorption



	WS2	W10	W15	W20	25%
sample 1	2.24	1.05	0.967	3.17	1.84
sample 2	3.13	1.08	1.05	3.43	1.65
sample 3	3.91	0.98	1.114	2.077	2.13
average	3.09	1.03	1.043	2.89	1.87

	Sample 1	Sample 2	Sample 3	Average
WS2	2.24	3.13	3.91	3.09
W10	1.05	1.08	0.98	1.03
W15	0.967	1.050	1.114	1.043
W20	3.17	3.43	2.077	2.89
W25	1.84	1.65	2.13	1.87

Table.4.4.3. water absorption for all sample

Fig.4.4.3. bar chart showing comparison of water absorption for all Samples

It is observed that water absorption by any amount of waste glass powder reduces the water absorption of concrete. Water absorption is reduced to 34.33%.34.76%,

- Flexural strength

	Sample 1	Sample 2	Sample 3	Average
WS2	65.11	65.11	66.97	65.73
W10	39.07	51.61	55.81	48.68
W15	62.32	68.83	66.7	66.04
W20	46.51	48.51	55.81	49.61
W25	1.84	1.65	2.13	1.87

Table.4.4.4. flexural strength for all sample

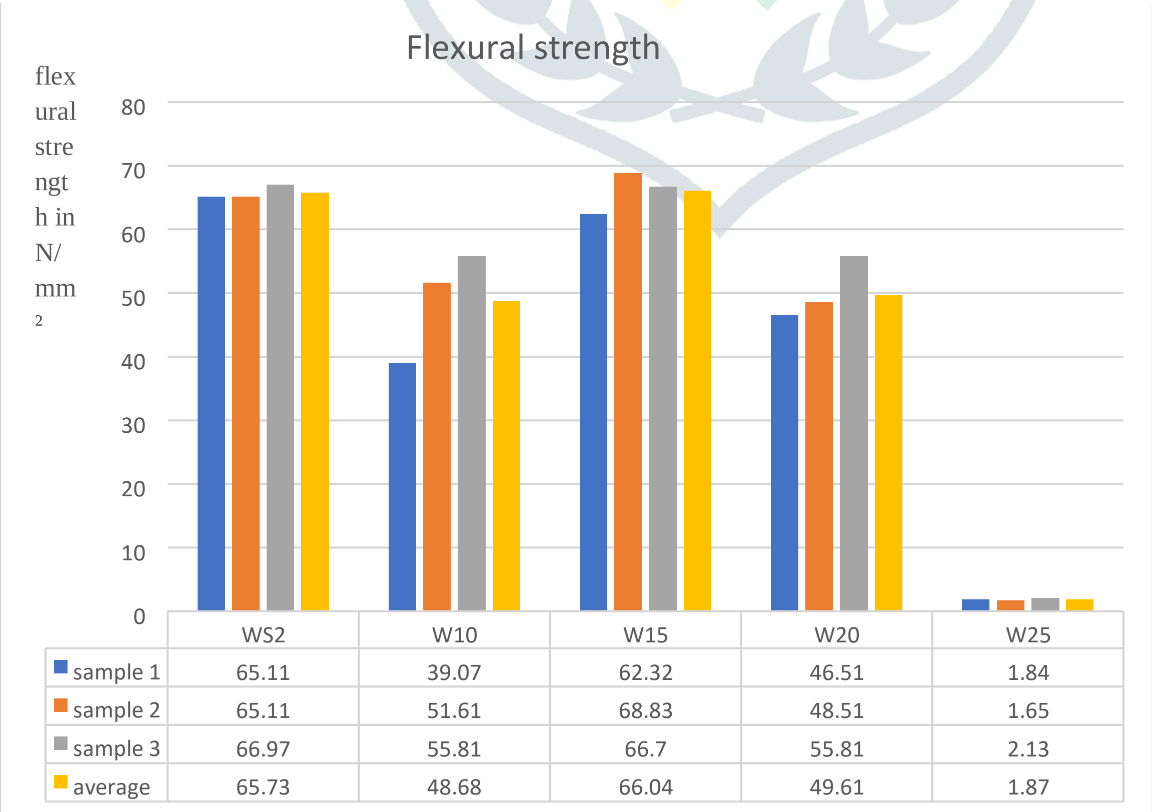


Fig.4.4.4. bar chart showing comparison flexural strength for all Samples

It is found that the flexural strength of concrete is not much increased by replacement of cement. Only 15% replacement of cement with waste glass powder gave strength more than the conventional concrete. 10% and 20% replacement of cement did not show any increment in flexural strength.

CONCLUSION

The following conclusions can be stressed from the affair of this exploration and can be epitomized as follows

➢ Waste glass greasepaint if plant finer shows pozzolanic geste. Glass greasepaint exhibits pozzolanic parcels but is dependent upon fineness of the greasepaint.

➢ On addition of 20 glass greasepaint cosign the rate of gain of strength is low but at 28th day it meets needed design strength.

➢ At the position of 20 relief of cement by glass greasepaint meets maximum strength as compare to that of normal concrete and other chance of relief of cement.

➢ Addition of any quantum of glass greasepaint has shown reduction in water immersion of concrete.

➢ Base on the data from this design, the relief rate of 20 of glass greasepaint of size 355µµm has been recommended as the outside to achieve the profitable and environmental benefits without any inimical effect.

➢ The results attained from the present study shows that there's great eventuality for the application of stylish glass greasepaint in concrete as relief of cement.

➢ Glass greasepaint concrete increases the compressive, tensile and flexural strength effectively, when compared with conventional concrete.

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