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An Experimental Investigation on Partial Replacement of Cement by Gypsum and Fine Aggregate by Glass Particles

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ABSTRACT

GYPSUM Which has pozzolanic property and FLY ASH is a industrial byproduct and Waste Glass creates serious environmental problem, mainly due to the in consistency of waste glass stream. GLASS PARTICLES can be used as filler material which is partially mixed and Comparative study is studied in this project. In this project Gypsum, Fly ash, Glass particles, Fine aggregate, Coarse Aggregate and Water are used in the proportion to the cement concrete mixture. The percentage of gypsum in partial replacement cube is 43%, 53%, 63% and Fly ash is about 2% and glass particle is about 10%, 15%, and 20% is well on the strength of M25 concrete. The compressive test of the cube is carried out and the result will be submitted after the test.

I. INTRODUCTION

The entire construction industry is in search of suitable and effective waste product that would considerably minimize the cost and the use of cement. Gypsum plays a very important role in controlling the hardening of the cement. Gypsum which has the pozzolanic properties and in this study the comparative study of gypsum when partially mixed with Fly ash is studied. Fly Ash is a industrial by - product and it refines pore structure and produces concrete of improved mechanical strength. In this project, gypsum and Fly Ash will be used in proportions as concrete mixture with cement, fine and coarse aggregate.

The conventional concrete along with gypsum and small quantity of Fly Ashas the partial replacement of cement in concrete.Afterthe casting process the cubes and beams were produced in a tank for 28 days. By this study, the high strength is achieved in gypsum and Fly Ash as partial replacement of cement in concrete mixture with the percentage 83%, 73% and 63% of gypsum and 2% of Fly Ash. The overall percentages of gypsum and Fly Ash in cube and beam is 65%, 75% and 85%.

The use of river sand as fine aggregate leads to exploitation of natural resources, lowering of water table, sinking of bride piers and erosion of river bed. If fine aggregate is replaced by waste glass by specific percentage and in specific size range, it will decrease fine aggregate content and thereby reducing the ill effects of river dredging and thus making concrete manufacturing industry sustainable.

Ground waste glass was used as fine aggregate in concrete and no reaction was detected with fine particle size, thus indicting the feasibility of the waste glass reuse as fine aggregate in concrete. Larger the particle size of waste glass, more is the chance of ASR occurrence. Shayan and Xu reported fine glass powder for incorporation into concrete up to 30% as apozzolanic material the ASR . Hence, the size of waste glass used was in range 75 micron to 4.75 mm.

DevelopmentofConcreteMix

- However, at the hardened state, there is notmuchdifferenceintermsofmechanicalpropertiesanddurabilitybetweenothertypeofconcretemixesviz.highperformanceconcrete(HPC),normal strengthconcrete(NSC),etc.(SubratoChowdhuryetal. 2008).

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- ConcretemixforthisstudywasdesignedusingEFNARC[4,5]normsaswellasBIS10262.mixcanbedesignedtoprovidetherequiredhardenedconcretepropertiesforanapplication,similartoconventionalconcrete.
- Partial mix is designed to have higherpastecontentorfinescomparedtoconventionalconcrete.

1.1 OBJECTIVE

- To study the durability effects when mineral admixtures of higher fineness is used as cement replacement in concrete.
- To study the effectiveness of gypsum waste as a mineral admixtures as it is one of the industrial waste and its usage can reduce the environmental pollution.
- . To study the workability, Compressive strength and durability of a concrete mix containing waste glass as a
- replacement for fine aggregate.
- 2. To determine the optimal use of finely crushed waste glass in concrete.
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- To determine the optimal use of finely crushed waste glass in concrete.
- To minimize the pollution causing by cement.
- To minimize the waste of glass materials and it can be used as filler material for concrete.

1.2 SCOPE

- Thescopeofthelearnaboutisconstrainedtothefollowingaspects.The workability, compressive strength,split tensile strength of gypsum in ofdifferentcombineproportionswithconstantw/cratiohavebeeninvestigated.
- Usage of gypsum helps in quick setting of cement in concrete.
- Gypsum and Fly Ash acts as an effective replacement of cement because of its pozzolanic and mechanical strength.
- Control hardening of cement.
- To achieve the better replacement of cement.
- To investigate the galss particles can be used as a better replacement of fine aggregate

1.3 METHODOLOGY

- LiteratureCollectionandStudy
- MaterialCollectionand Study
- TestOnMaterialStudy&Properties
- MixDesignM-25 Grade ofConcrete
- TestingofFreshConcrete
- CastingofSpecimens
- CuringofSpecimens
- Testing The Mechanical Properties oftheConcrete
- ResultandDiscussions
- Conclusion

II. MATERIAL PROPERTIES

2.1 MATERIALUESD

a) Cement(OPC53)
b) FineAggregate
c) CoarseAggregate
d) Gypsum
e) Fly ash
f) Glass Particles

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g) Mixingofwater

OPC53 Grade conformingIS12269:1987,Minimumcementcontent:320kg/m3(IS456:2000),SpecificgravityofCement:3.02

2.1.1 Cement

S. No	TestforCement	Apparatus	ValueObtained
1.	Standard consistence test	Vicatapparatus	26.5%
2.	Initialsetting time	Vicat apparatus	30 minutes
3.	Final settingtime	Vicatapparatus	230 minutes
4.	Specificgravitytest	Conicalflask	3.02

Fig,.1.CEMENT

2.1.2 Fine Aggregate

Natural sand is used for this investigation which is conforming to IS:383 – 1970 and specific gravity of Fine Aggregate is 2.65.

Fig.,2.Fine aggregate

2.1.3 Coarse Aggregate

AsperIS383:1970the20mmused.Theshapeofcoarseaggregateisangular,waterabsorption is 1.0%. Specific gravityofnominal sizeof aggregateis 2.56.

Fig.,3.Coarse aggregate

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2.1.4 Gypsum

Gypsum is Calcium SulphateDihydrate (CaSO4.2H2O). Gypsum powder is a industrial waste used as a by – product of cement. It is useful in the hardening of the cement and quick setting of cement. The white color gypsum is used for the investigation of the project.

Fig.,4.Gypsum

2.1.5 Fly Ash

Fly ash is a fine gray powder consisting mostly of spherical, glassy particles that are produced as a byproduct in coal-fired power stations. Fly ash has pozzolanic properties, meaning that it reacts with lime to form cementitious compounds. It is commonly known as a supplementary cementitious material.

Fig.,5.Fly Ash

2.1.6 Glass Particles

Glass is one of the oldest man-made materials. It is produced in many forms, including packaging or container glass, flat glass, bulb glass, and cathode ray tube glass, all of which have a limited life in form in which they are produced and need to be reused or recycled in order to avoid environmental problems.

Fig.,6.Glass Particles

2.1.7 Water

According to IS 3025, water to beused for mixing and curing should be freefrominjuriousordeleteriousmaterials.PortableWaterisgenerallyconsideredsatisfactory. In the present investigation,available water within the campus is usedforboth mixing and curingpurposes.

III. MIX DESIGN

3.1Materialsandmixdesign

Following materials were used inthepreparationconcrete(i)Ordinaryportlandcement (ii)Riversand(iii)Coarse aggregates(iv)Superplasticizer(v)Tapwater (V) Ordinaryportlandcementof53Grade (VII) Gypsum (VIII) Fly Ash (IX) Glass particles satisfyingtherequirementsofIS12269:1987. Thespecificgravityofcement is3.12 . Natural sand is usedasfineaggregates(F.A).Propertiesoffine aggregates was 2.43. the fineaggregatesbelongtozoneIIofIS383:1970

3.2Concretemixproportion

ThemixesweredesignatedinaccordancewithIS10262-2009mixdesignmethod.Basedontheresults,themixproportions M25 was designed. Concrete mixwithw/cratioof0.45wasprepared.Thedetails Of mix proportion for 1m^3 of concrete are given n below table.

Grade	Cement	FA	CA	Water
Mix25	425.72	838.44	828.34	191.61
	1	1.96	1.95	0.45

IV. COMPRESSIVE STRENGTH

Compressive Strength can be defined as the measure maximum resistance of a concrete toaxialloading.Thespecimensusedinthecompressive test are: 150 mm x 150 mm x 150mm. There are three specimen were used in thecompressiontestingforeachmixes.Thecompressiontestingmachineusedfortestingthe cube specimens is of standard make. Thecapacity of testing machine is 2000 KN. Themachinehasafacilitytocontroltherateofloadingwithacontrolvalve.Theplatesarecleaned before the testing of cubes. After therequired period of curing, the cube specimensare removed from curing tank

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and cleaned towipeoffthesurfacewater.Itisplacedonmachines such that the load is placed centrally.The smooth surface of specimen is placedonthebearingsurfaces.

4.1 SplitTensileStrength

Thesplittensilestrengthofconcreteisdetermi nedbycastingcylindersofsize150bmm x 150 mm x 150 mm. The cylinders weretested by placing them uniformly. Specimenswere taken out from curing tank at the age of 7,14, and 28 days of moist curing and tested aftersurfacewaterdippeddownfromspecimens.This test was performed on Universal TestingMachine (UTM) as shown in fig. Split Tensilestrength of concrete is tested on cylinders atdifferentpercentageofcementreplacementscontenti n concrete.

Thestrengthofconcretehasbeentestedoncylinder at 7, 14, and 28 days. 7 days test has beenconducted to check the gain in initial strength ofconcrete. 28 days test gives the data of final strengthof concrete at 28 days curing. Compression testingmachine is used for testing the Split Tensile strengthtest on concrete along with two wooden boards. Atthe time of testing the cylinder taken out of wateranddried and thentested.

4.2 FlexuralStrength

Flexurespecimensshallbebeamswhosecross section is a square with a side length not lessthanthreetimesthemaximumcoarseaggregate size and not less than 100 mm. Thebeam length shall be at least 80 cm longer thanthree times the side length of the cross-section.Thestandardcross-sectionalsizeofflexurespecimensis100by100mmor1 50mmby150 mm. Self compacting concrete shall not beshiftedwithasievetoreducethesizeofspecimensasp racticedfornormalconcrete.

CASTING OFSPECIMENS

a) Cubes(150x150x150mm)
b) Cylinders(150mm diameter,300mmheight)
c) Prism(500×100×100mm)

TESTINGOFSPECIMENS

a) Compressivestrength test
b) Splittensilestrengthtest
c) Flexuralstrengthtest

V. RESULTS FOR REPLACING GYPSUM

5.1 SPILTTENSILESTRENGTHTEST

%OF GYPSUM	SPILTTENSILESTRENGTH TESTN/mm^2	
	7DAYS	28DAYS
65%	36.6	45.2
75%	39.2	48.7
85%	37.5	46.3

5.2 COMPRESSIONSTRENTHTEST

%OF GYPSUM	COMPRESSIONSTRENGTH TEST N/mm^2	
	7 DAYS	28DAYS
65%	38.2	47.5
75%	40.4	50.5
85%	39	48.1

5.3 FLEXURALSTRENGTHTEST

%OF GYPSUM	FLEXURALSTRENGTH TEST N/mm^2	
	7 DAYS	28DAYS
65%	2.45	3.75
75%	3.5	4.45
85%	3.25	3.39

VI. RESULTS FOR REPLACING GLASS PARTICLES

6.1 SPILTTENSILESTRENGTHTEST

%OF GLASS PARTICLES	SPILTTENSILESTRENGTHTESTN/mm^2	
	7DAYS	28DAYS
0%	25.67	35.7

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50%	22.26	31.31
75%	25.02	28.45

6.2 COMPRESSIONSTRENGTHTEST

%OF GLASS PARTICLES	COMPRESSIONSTRENGTH TEST N/mm^2	
	7 DAYS	28DAYS
0%	31.5	44
50%	32	42
75%	31.7	45.9

6.3 FLEXURALSTRENGTHTEST

%OF GLASS PARTICLES	FLEXURALSTRENGTH TEST N/mm^2	
	7 DAYS	28DAYS
0%	4.5	6.2
50%	3.32	4.34
75%	3.13	3.23

VII. CONCLUSION

- From the above experimental investigation ofthefollowing conclusionsare,
- Cement replacement 0%, 25%, 50%, 75%, with Gypsum leads to increase in mechanical properties for M25 grade of concrete in 28 days of curing.
- Fine aggregate replacement 0%, 25%, 50%,75%, withglass particles leads to increase inmechanicalpropertiesforM25gradeofconcrete .
- From50%thereisdecreasein mechanicalstrength for7 and 28 days of curingperiod.
- The completely replacement of CementbyGypsum is given aminimumresults.
- Optimumcontentofglass particlesforachievinghigherstrength is50%.
- Thestrengthisincreasedby50%anddecreasedby75%and100%,whencompared to 50% of replaced. to achieve thehighstrengthofself compacting concrete.
- Gypsum may be costlier than Cement but it is eco-friendly and pollution free to the nature.
- Glass Particles mayqualifies50%economicthanthenaturalsand.
- Theresultsshowedmoderateflowabilityandpassing ability properties with replacement ofcement by Gypsum and replacement of fine aggregate by glass particles.

REFERENCES

[1]. "An Experimental study of gypsum as partial replacement of cement in concrete". By N.Vyshali And M.Jeganraj–March – 2019.

[2]. "Effect Of Gypsum Powder As Partial Replacement Of East Cement On Fresh And Hardened Properties Of Self-Compacting Concrete" By ChernetGetanehTebabal Advisor: BelachewAsteray (Ph.D.),October 2019.

[3]. "Effect of Gypsum Amount in Cement on Fresh and Hardened Properties of Self-Compacting Concret" by ChernetGetanehTebabal,May 2020.

[4]. "Experimental data on flexural strength of reinforced concrete elements with waste glass particles as partial replacement for fine aggregate" by OlumoyewaDotunAtoyebia,nObanishola M. Sadiq b, March 2018.

[5]. "Study of Strength and Workability of Different Grades of Concrete by Partial Replacement of Fine Aggregate by Crushed Brick and Recycled Glass Powder" by Tiwari Darshita , Patel Anoop, June 2014.

[6]. "Recycling of waste glass as a partial replacement for fine aggregate in concrete" by Zainab Z. Ismail *, Enas A. AL-Hashmi, October 2008.

[7]. "Effect Of Cement Replacement By Fly Ash And Fgd Gypsum On Strength Of Subbase" by PisutRodvinij AndChotikanRatchakrom, May 2020.

[8]. "Recycled glass as a partial replacement for fine aggregate in structural concrete – Effects on compressive strength" by M. Adaway& Y. Wang.

[9]. "Partial Replacement of Fine Aggregate by Glass Powder in Concrete" by Suraj P Mishra ,Kalpana D Thakur, Vicky N GuptaFebruary 2020.