Increasing the Strength of Concrete Using Glass Fibre

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Abstract:

Concrete without reinforcement is brittle which is intensified in high strength concrete. Fibres have beenutilized to improve the tensile and bending performance of concrete. Fibres primarily control the propagation of cracksand limit the crack width. Glass fibre reinforced concretes are reliable structural materials with superior performancecharacteristicscomparedtoconventionalconcrete.ThemainadvantageofusingGlassFibreisitshealsthecracksformedin concrete and provides good tensile strength. The addition of Glass fibre in concrete has been found to improve severalproperties, primarily cracking resistance, ductility and fatigue life. In the present study durability properties of highstrengthconcrete(M25)reinforcedwithdifferent percentageofGlassfibre arestudied.The percentageoffibretakenare0.0%, 10%,20%, 30%.

Keywords: Glassfibre, Glass Fibre Reinforced Concrete, durability properties and volume fraction.

Introduction

Concreteisconsideredabrittlematerial,primarilybecauseofitslowtensilestraincapacityandpoor fracturetoughness.Reinforcementofconcretewithshortrandomly distributed fibres can address someof the concerns related to concrete brittlenessand poor resistance to crack growth. Concretecan be modified to perform in a more ductileformby the addition of Glass fibres in the concrete. Glassfibre (or glass fibre) is a material consisting ofnumerousextremelyfinefibresofglass.Glass makersthroughouthistoryhaveexperimentedwithglassfibres,butmassmanufactureofglassfibre wasonlymadepossiblewiththeinventionoffiner machine tooling. In 1893, Edward Drummond Libbeyexhibited a dress at the World's ColumbianExposition incorporating glass fibres with thediameterandtextureofsilkfibres.Glassfibres canalso occurnaturally, asPele's hair. Glasswool,whichisoneproductcalled"fibreglass"today,wasinventedsometimebetween 1932 to 1933 by Games Slayter ofOwens-Illinois,asa materialtobe usedasthermal building insulation.[1] It is marketedunderthetradenameFibreglas,whichhasbecome a genericized trademark. Glass fibrewhen used as a thermal insulating material isspecially manufactured with a bonding agentto trap many small air cells, resulting in thecharacteristically air-filled low-density "glasswool"family of products. Glass fibre has roughly comparable mechanical properties to other fibres such as polymers and glass fibre. Although not as rigid as glass fibre, it is much cheaper and significantly less brittle when used incomposites.Glass fibre reinforced composites are used in marine industry and piping in dustries because of good environmental resistance, better damage tolerenceforimpactloading,highspecificstrengthandstiffness.Glassfibrecement-matrixcompositesarestructural materials that are gaining inimportance quite rapidly due to the decrease inglassfibrecostand the increasingdemand ofsuperiorstructuralandfunctionalproperties.These composites contain chopped glass fibres,typically 6 mm or 12mm in length, as the shortthi choppedglassfibrescanbe usedasanreinforcement in concrete (whereas continuousfibrescannotbesimplyaddedtotheconcretemix)andshortchoppedfibresarelessexpensivethancontinuousfibres.Moreover,the cost increases with fibre content. Therefore,aratherlowvolumefractionoffibresisdesirable.Afibrecontentas low as20%or30%volumeiseffective.Itiswellknownthatoneoftheproblemsofacement-basedmaterialisthe intrinsically brittle type of failure owing tolow tensile strength and poor fracturetoughnessthatimposeconstraintsinstr ucturaldesignandlong-termdurabilityofstructures.Inordertosatisfythe performanceofcement-basedmatrices,inadditionoffibresandadmixture isgettinggrowinginteresttoincreasethetoughness,impactresistance,fatigueendurance,energyabsorptioncapacityaswellastensilepropertiesofthebasicmatrix.Asaresultoftheaboveadvantages,fibrereinforced cement based composites

aresteadilyusedinhydraulicstructures,tunnellinings,highwayandairfieldpavementsandtensile skininouter surface ofconcrete beamsand slabs. In the early stage of fibredevelopment,steelandglassfibreswith geometrystraightandsmoothwereused,asthesefibresimproveinductility,flexuralstrengthandfracturetoughnessofconcretematrix.Variousfibres areavailableinmarket.Theprimaryfactorsthatcontrolledforthiscompositionwerefibrevolumefractionandlength/diameterratio.However,theproblemsfaced were difficulty in mixing

andworkability.Fibresthatarelongandathighervolumefractionswerefoundtoballupduring themixingprocess.Theprocesscalled'balling'occurs, causes the concrete to become stiff andareductioninworkabilitywithincreasedvolumedosageoffibres.Thishasatendencytoinfluencethequalityofconcreteandstrength.Theintroductionoffibreswasbroughtinasasolutiontodevelop concrete inviewofenhancingitsflexuralandtensile strength, which are a new form of binder thatcouldcombinePortlandcementinthebondingwithcementmatrices.Fibresaremostgenerally discontinuous, randomly distributedthroughout the cements matrices. The term of'Fibre reinforced concrete' (FRC) is made upwithcement,varioussizesofaggregates,which incorporatewithdiscrete,discontinuousfibres.

Methodology

Thisexperimentalworkconcernedtoinvestigates the mechanical properties of M25hardened concrete after addition of choppedglassfibre.Cubes150x150x150mmwerecastedtocheckoutthecompressivestrength&durabilityofconcreteWhile testingfor thevarious mechanical properties, chopped Glassfibre were added in the % volume of concretei.e.0.0%, 10%, 20%, 30%.

MaterialUsed

1. Cement
2. Sand
3. Aggregates
4. Water
5. Admixture
6. Glassfibre

ConcreteMixDesign(IS-10262)

1) StipulationForProportioning:

a) Gradedesignation : M25
b) Typeof cement: PPC53 grade
c) Maximumnominalsizeofaggregate:20mm
d) Maximumwatertocement ratio: 0.5
e) Maximumcementcontent: 492.5kg/m3
f) Workability: 100 mm(slump)
g) Exposurecondition: severe

2) TestDataForMaterial:

a) Cementused :Ultratech PPC53 Grade
b) Specificgravity ofcement :3.15
c) Specificgravityof fineaggregate :2.675
d) Specificgravityofcoarseaggregate:2.73
e) Waterabsorption offineaggregate: 0.418 %
f) Waterabsorptionofcoarseaggregate:

0.98 %

g) Moisturein coarseaggregates: Nil
h) Moisturein fineaggregates : Nil

TestsonCement:

a) FinenessTestonCement
b) ConsistencyTestonCement
c) SettingTimeTestonCement
d) SoundnessTest onCement

TestsonSand:

a)MoistureContent Test.

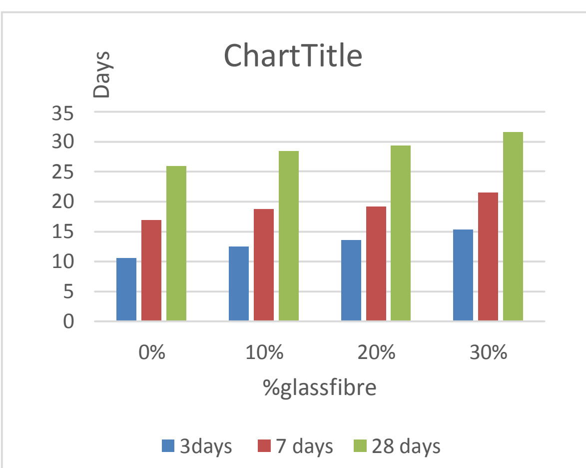
TestsonAggregate

a) CrushingTest

b) AbrasionTest
c) ImpactTest
d) SpecificGravityandWaterabsorbation

Fig.1Compressiontest

Fig.2Castingofcubes



CompressionTest

Compressivestrengthismeasuredbybreaking cylindrical concrete specimens in acompression-testingmachine.Compressivestrengthiscalculatedfromthefailureloaddividedbythecross-sectionalarearesistingtheload and reported in units of pound-force persquareinch(psi)ormegapascals(MPa).Compressive strength can be defined as thecapacity ofconcretetowithstandloadsbeforefailure. Ofthe manytestsappliedtotheconcrete,thecompressive strengthtestisthemostimportant,as it gives an idea about the characteristics ofthe concrete. Compression testing is able todetermine the material's behavior or responseundercrushingloadsandtomeasurethep lasticflowbehaviorand ductile fracturelimitsofamaterial

CompressiveStrengthTest

Sr. no	% GlassFibre	3 daysN/ mm^2	7 daysN/ mm^2	28 daysN/ mm^2
1	0	10.56	16.89	25.56
2	10	12.44	18.72	28.42
3	20	13.56	19.21	29.36
4	30	15.33	21.47	31.56

Objectivesofthestudy

a) To check out the durability of concreteundersulphate attack.
b) To improve strength of a concrete byusingoptimum quantityofglassfibre.
c) Tofindeffectsofsodiumsulphatesolutionan dmagnesiumsulphatesolution
d) onstrengthof aconcrete.
e) The external attack of sulphate salts isconsideredas oneof themajor
f) Problemsaffectingconcretedurability.sow ecan tryto reducethat.
g) Optimumquantityofglassfibreincreasethel ifeofconcreteandincreasethe Characteristicsstrengthofaconcrete.

ConcludingRemark

From the review of the various literatures, ithasbeenseenthattheexperimentalworkrelated to glass fibre reinforced concrete arelessinthefieldofconcrete.Incaseofchoppedglas s fibre, most of the works have been donewiththeuseof6/12mmchoppedlengthfibres.T his means that, work on concrete with 6 mmchopped glass fibre has a scope and interest infuture.
The scope is available to work on the concretewithglassfibreasthepreviousresearchesha vegonethroughonlycompressive,flexure and split tensile strength. In addition of this, thereis a scope for experimental investigation onglassfibrereinforcedconcretedurability,shearstr ength, young's modulus and poisons ratiotest.

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