International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 401-410 www.ijaem.net ISSN: 2395-5252

Effect of Chopped Glass Fibers on Concrete Tiles Strength

Sahu C[1] Kumar V[2]
[1]M.Tech Scholar, Dept. of Civil Engineering, PKGCET, Haryana,
[2] Assistant Professor, Dept. of Civil Engineering, PKGCET, Haryana

Submitted: 01-06-2022 Revised: 05-06-2022 Accepted: 08-06-2022

ABSTRACT:
The effect of glass fibre on flexural strength, split-tensile strength and compressive strengthwas studied for different fibre content on M-20 grade concrete designed as per IS 10262.Themaximum size of aggregates used was 20mm. To study the effect on compressive strength,flexuralstrength,split-tensilestrength6cubes,6prismsand6cylinderswerecastedandtested .After that a practical application of GFRC in the form of cement concrete tiles was taken intoconsiderationandnospecialtechniquewasusedtoproducethistiles.Thethicknessofthetileswas 20mm and maximum size of aggregates used was 8mm.The water cement ratio was keptconsistent and the admixture content was varied from .8 to 1.5 percent to maintain slump inbetween 50mm to 100mm.The mix proportion used was 1:1.78:2.66. The size of short fibresusedwere30mmandtheglassfibreswerealkaliresistant.Theeffectofthisshortfibresonwettransverse strength, compressive strength and water absorption was carried out. Six full sizedtiles400mm*400mm*20mmweretestedandtheresultsrecorded.Pulsevelocitytestswasalsoconducted.

I. INTRODUCTION

General

Oneofthemost important buildingmaterial isconcreteanditsusehasbeeneverincreasinginthe entire world. The reasons being that it is relatively cheap and its constituents are easilyavailable, and has usability in wide range of civil infrastructure works. However concrete hascertaindisadvantageslikebrittlenessandpoorresistancetocrackopeningandspread.Concrete is brittle by nature and possess very low tensile strength and therefore fibres are used in oneform or another to increase its tensile strength and decrease the brittle behaviour. With time alot of experiments have been done to enhance the properties of concrete both in fresh state aswell as hardened state. The basic materials remain the same but superplasticizers, admixtures,micro fillers are also being used to get the desired properties like workability, Increase ordecreasein settingtime and highercompressive strength. Fibreswhichareappliedforstructuralconcretesareclassifiedaccordingtotheirmaterial

AsSteelfibres,AlkaliresistantGlassfibres(AR),Syntheticfibres,Carbon,pitchandpolyacrylonitrile(PAN) fibres.

GlassFibreReinforcedConcrete

Glassfibrereinforcedconcrete(GFRC)isacementitouscompositeproductreinforcedwithdiscreteglassfibresofvaryinglengthandsize.Theglassfibreused isalkalineresistant as glass fibre are susceptible to alkali which decreases the durability of GFRC. Glassstrandsareutilizedforthemostpartforoutsidecladdings,veneerplatesanddifferentcomponents where their reinforcing impacts are required during construction. GFRC is stiff infresh state has lower slump and hence less workable, therefore water reducing admixtures areused.FurtherthepropertiesofGFRCdependsonvariousparameterslikemethodofproduc

theproduct.Itcanbedonebyvariousmethodslikespraying,casting,extrusiontechniquesetc.Cement type is also found to have considerable effect on the GFRC. The length of the fibre,sand/filler type, cement ratio methods and duration of curing also effect the properties of

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 401-410 www.ijaem.net ISSN: 2395-5252

II. MATERIALS AND METHODS

Materials

Concrete

Concrete is the most widely used construction material. The basic materials of concrete arePortland cement, water,fine aggregates i.e. sand and coarse aggregates.The cementandwater form a paste that hardens and bonds the aggregates together. Concrete in fresh state isplastic and can be easily moulded to any shape, as time passes it hardens and gains strength.Theinitial gaininstrengthisduetoachemical reactionbetweenwaterand C2sandlattergaininstrengthisduetoreactionbetween C3sandwater.Concreteisproducedbyeitherfollowing nominal mix proportions in which the mix proportions are fixed as per grade of concreterequiredor mixdesign proportions,latterproducesmoreeconomical concrete.

Inourwork Portlandslagcement(PSC)-43gradeKonarkcementwasused.Standardconsistency, initial setting time, final setting time, 28-day compressive strength tests werecarriedoutaspertheIndianstandardspecifications.Cleanriversandpassingthrough4.75mmsieve was used as fine aggregates. The specific gravity of sand was 2.68 and grading zone ofsandwaszone3asperIS.Angularstoneswereusedascoarseaggregatesmaximumsize20mmandspecificgravity2.72.Concrete was mixedand cured byordinarywaterortap water.

For casting cubes, cylinders and prisms maximum size of aggregate used was 20mm whereasin case of tiles the maximum size of aggregates used was 8mm.The water cement ratio usedforconcrete tileswas0.45 andadmixturewasused to attain the desireworkability.

Cement

Cement is an extremely ground material having adhesive and cohesive properties whichprovide a binding medium for the discrete ingredients. The processes used for manufacture ofcement can be classified as dry and wet.. The cement commonly used is Portland cement, it isalsodefinedashydrauliccement,i.e.acementwhichhardenswhenitcomeswithwaterduetochemicalreactionbuttherebyformingawaterresistantproduct.Portland cementisobtainedwhen argillaceous and calcareous materials are grounded to fine powder and mixed in definiteproportion and fused at high temperature. When blast furnace slag is also used as one of theingredients than the cement obtained is called Portland slag cement (PSC). Portland slagcement(PSC)– 43grade (Konark Cement) wasused forthe experimentalprogramme.

FineAggregates

Aggregates are generally obtained from natural deposits of sand and gravel, or from quarriesby cutting rocks. The least expensive among them are the regular sand and rock which havebeen lessened to present size by characteristic specialists, for example, water, wind and snowandsoon.Thestreamstoresarethemostwell-knownandareofgoodquality.Thesecondmostregularly used source of aggregates is the quarried rock which is reduced to size by crushing.Thesizeofaggregatesusedinconcrete rangefromfewcentimetres or more,downtoacoupleof microns. Fine aggregates is the aggregate most of which passes through a 4.75mm IS sieveand contains just that much coarser material as allowed by the IS details. The fine aggregateusedfortheexperimentalprogrammewasobtainedfromriverbedofKoel.Thefineaggregatepassed through 4.75 mm sieve and had a specific gravity of 2.68. The sand belonged to zoneIIIas perIS standards.

CoarseAggregates

Theaggregatesthevastmajorityofwhichareheldon4.75mmISsieveandcontainsjustthata lot of fine material as is allowed by the code specifications are termed as coarse aggregates.The coarse aggregates may be crushed gravel or stone obtained by the crushing of gravel orhardstone;uncrushedgravelorstoneresultingfromnaturaldisintegrationofrockandpartiallycrushedgravelorstoneobtainedasaproductoftheblendingofthenaturallydisintegrated andcrushed aggregates. In our case crushed stone was used with a nominal maximum size of 20mmand specificgravityof 2.78.

Water

Water is the one most essential element of cement. Water assumes the vital part of hydrationofconcretewhichframesthecouplinglatticeinwhichthedormanttotalsareheldinsuspensionmediumuntilthegridhassolidified,furthermoreitservesasthelubricantbetweenthefineandcoarseaggregates and makes concreteworkable.

Fiber

Fibre is a natural or synthetic string or used as a component of composite materials, or, whenmattedintosheets,usedtomakeproductssuchaspaper,papyrus,orfelt.Concreteisbrittlebynature and is weak in flexure as well as direct tension therefore in order to improve thispropertiesfibres areaddedtoconcrete.Fibresmaybeshort discreteorinformsofrodsormaybeeveninformoftextilefibresorwovenmeshfibres.Varioustypesoffibreshavebeenaddedto concrete some have high modulus of elasticity some have low modulus of elasticity eachcategorycanimprovecertainpropertiesofconcrete.Inourcaseshortdiscreteglassfibreswereused and as glass fibre is susceptible to alkali we used alkali resistant glass fibres. A fiber is amaterialmadeintoalongfilamentwithadiametergenerallyintheorderof10tm.Themain functions of the fibers are to carry the load and provide stiffness, strength, thermal stability,andotherstructural properties in the FRC.

Glassstrandsarefilamentsgenerallyutilizedasapartofthemaritimeandmechanicalfieldstocreatecompositesofmedium-elite.Theirunconventionaltrademarkistheirhighquality.Glassisbasicallymadeofsilicon (SiO2)with atetrahedralstructure(SiO4).Somealuminum oxidesand other metallic particles are then included different extents to either facilitate the workingoperations or change a few properties (e.g., S-glass strands show a higher elasticity than E-glass).

The era development of fiberglass is fundamentally in light of turning a bunch made of sand,alumina, and limestone. The constituents are dry mixed and passed on to melting (around1260°C)inatank.Theliquefiedglassisconveyedstraightforwardlyonplatinumbushingsand,bygravity,goesthroughspeciallyappointedopeningssituatedonthebase.Thefibersarethengathered to shape a strand ordinarily made of 204 fibers. The single fiber has a normalmeasurementof10μmandisregularlysecuredwithameasuring.Theyarnsarethenpackaged,much of the time without curving, in a meandering. Glass filaments are likewise accessible asslim sheets, called mats. A mat may be made of both long persistent and short strands (e.g.,irregular filaments with an ordinary length somewhere around 25 and 50 mm), haphazardlyorganized and kept together by a concoction bond. The width of such tangles is variablebetween 5 cm and 2 m, their thickness being around 0.5 kg/m^2. Glass filaments normally havea Young modulus of versatility lower than carbon or aramid strands and their scraped arearesistanceismoderatelypoor;consequently,alertintheircontrolisneeded.Likewise,theyareinclined to crawl and have low exhaustion quality. To upgrade the bond in the middle of,filamentsandgrid,andtosecurethestrandsitselfagainstsolubleoperatorsanddampness strands experience estimating medicines going about as coupling specialists. Such medicinesarehelpfultoimprovetoughnessandweaknessexecution(staticandelement)ofthecompositematerial.FRP compositestakinginto accountfiberglassarenormallymeantasGFRP.

Admixture

Admixturesarethechemicalcompoundsthatareusedin concreteotherthanhydrauliccement(OPC), water and aggregates, and can also be called as mineral additives that are added to theconcrete mix just before or during blending to adjust one or more of the particular propertiesoftheconcreteinthefreshorhardenedstate.Theutilization ofadmixtureisnecessarytooffera change which is not financially achievable by changing the extents of water, cement andthoughnotinfluencingtheperformanceanddurabilityoftheconcrete.Usuallyusedadmixtures are accelerating admixtures, retarding admixture, air-entraining admixtures andwater-reducingadmixture.Inourcaseawaterreducingadmixturewasusedtoobtainthedesireworkabilityaswith increase in fibrecontent themixturewas becomingstiffer.

The experimental work consists of casting cubes, cylinders and prisms to study the effect ofglass fibres on the compressive, flexural and split tensile strength of concrete. The effect wasstudied by varying the fibre content from 0% to 0.3%, no water reducing admixture was usedfor the experimental programme. To check the effect on concrete for fibre content variation 6specimens each of cube, prisms and cylinders were casted. Test were conducted on thespecimenafter 7daysand28 days.

Furtherinordertogetapracticaluseofglassfibresinconcrete,concretetileswerecasted.Thesizeofthetiles being400mm*400mm*20mm.Themaximumsizeofaggregates used for8mmincaseoftilesandthetestingfortileswasdoneasperIS1237:2012.Thefibrecontentvariedfrom 0% to 0.7% and the main study of interest was compressive strength, wet transversestrengthand waterabsorption.

Mixing Of Concrete

In order to obtain a uniform mix thorough mixing of concrete is necessary. Concrete can beproduced in two ways either by hand mixing or machine mixing. Hand mixing can be done ona plane levelled surface such as a wooden platform or a paved surface having tight joints so asto prevent paste loss To do mixing first the surface is cleaned and then moistened after thatsand is first poured on the surface and then cement is spread on the sand after that thoroughmixingisdone.When thecementand sandgets uniformlymixed coarseaggregates arespreadovertheuniformsandandcementmixandthen againmixedthoroughly.Tomixthematerialseither a hoe or a square-pointed D-handled shovel is used. Dry materials are mixed until thecolour of the mixture is uniform. Having obtained uniform coloured dry mix water is slowlyaddedandthemixisagainturnedatleastthreetimesaftercompletelytheentiremixingprocessfreshconcreteis producedwhich is plasticandcan bemoulded as perourneeds.

Inourinvestigationmachinemixingwasdonetoproducethefreshconcrete.Firstthemachinedrumwascleaned andthenmoistenedsoastopreventanylossofwateraswereaddingonlya calculated amount and no extra water is added. All the dry materials are put in the drum andthendrymixedbyrotatingthedrumwhenathorough mixisobtained glassfibresareaddedasper the calculated which is a percent of total weight of concrete and then the materials aremixedthoroughly.Afterthatwaterisaddedandmixedagainuntilauniformcolouredmixis obtained.Aftercompletingallthisprocesstheconcreteisdroppedonaflatandcleanplatefromwherewetakeit and fill our moulds.

Compaction

Allspecimenswerefirstfilledintheirrespectivemouldsandthenhandcompactedusingarodof30mm diameterinthreelayersbytamping20timesoneachlayer.Toattainfullcompactionthe specimens were than vibrated on a vibrator table. The tiles were prepared by putting theconcrete in the mould and then hand tamping using a plane surfaced wooden block and thenthemouldwasheldtightbyhandsandvibratedon thevibratortable.Thesurfacewaslevelled,finishedand smoothenedbymetaltrowels.

CuringOfConcrete

A significant part of the physical properties of cement rely on upon the degree of hydration ofbond and the resultant microstructure of the hydrated concrete. As a result of hydration arandom three dimensional structure is gradually formed which fills the space occupied bywater.Thehardenedcement pastehasaporousstructureandtheporescanbedividedintotwocategories as gel pores and capillary pores. Hydration of cement takes place only when thecapillary pores remain saturated. Curing is necessary to make the concrete more durable,strong, impermeable and resistant to abrasion and frost. Curing is done by spraying water orpond curing or keeping them packed under moist gunny bags so as to prevent the loss ofmoisturefromthesurfaceandinside.Curingstartsassoonastheconcretereachesitsfinal set.It is generally recommended to do curing for at least 14 days to attain at least 90% of theexpected strength. In our case pond curing method was used for all specimens including thetiles.

III. EXPERIMENTAL SETUP

Various tests conducted on the specimens are described below along with the description andimportance.

There were two ways in which the investigation was carried out one in which only cubes,cylindersandprismswerecastedandthegradeof concretewasM-20.Theproportioningoftheconcretewas.Thenominal maximumsizeofaggregatewas20mmandnoadmixturewasused.

Compressivestrength

The most important property of concrete is its compressive strength and durability. Concreteis mostly used in construction where load transferred is mostly via compressive strength. Inorder to check the effect of fibres on the compressive strength of concrete 150mm cubes werecast and tested .The cubes were tested at the age of 7days and 28 days and the variation wasnoted.

Fibrecontentwasvariedfrom0%to0.3%whenthenominalmaximumsizeofaggregateswas20mmandnoadmixturewasused.Thewater cementratiowas fixedat 0.5.Theworkabilityofthemixwas observedtocome downbut howevernoextrawaterwasused.

SplitTensileStrength

Concrete may be subjected to tension in very rare cases and is never designed to resist directtension. However, the load at which cracking would occur is important and needs to bedetermined. The tensile strength of concrete as compared to its compressive strength is verylow and is found to be only 10-15 % of the compressive strength. There are various factorswhich influence the tensile strength of concrete like aggregates, age, curing, air-entrainmentand methodoftest.

To conduct the split tension test a cylindrical concrete specimen is loaded along its length as aresult of the loading tensile stresses are developed along the central diameter along the lateraldirection. The specimen splits into two when the limiting tensile strength is reached and thisvaluecan becalculatedfrom the load given below

Adiagramis shownto showhow thetest iscarried out:

FlexuralStrength

Flexural strength is also a measure of the tensile strength of concrete. In practical concretemay not be subjected to direct tension but it is subjected to flexure in many cases particularlyinbeamswhichisaflexuralmember.Flexuralstrengthisalsoreferredtoasmodulusofrupture.Inorder to calculatethe flexural strengtha

TestscarriedoutonCementandConcreteTiles

Cementandconcreteflooringtilesaretestedasper IS1237:2012Therearevarioustestsgivenin the code but we have done the water absorption test and wet transverse strength .Other teststhat were conducted on the tiles was the pulse velocity test which is a non-destructive test andpredicts the quality but not the grade of concrete. The IS code does not say anything about thecompressive strength test but however in order to check the compressive strength six 100mmcubeswerecast and tested at 7 days and 28 days.

Waterabsorptiontest

Six tiles were immersed in water for 24hrs, than the tiles were taken out and wiped dry. Eachtile was immediately weighted after saturation. The tiles were then placed in an oven at 65^{0}Cfor24 hrs and then cooled and reweighedat roomtemperature.
Waterabsorptionwascalculatedusingtheformulaasgiven below:

$$\frac{M1-M2}{M2} X100$$

Where
M1= mass of the saturated specimen;M2=massoftheoven-driedspecimen.
WetTransverseStrengthTest

Inordertodeterminethewettransversestrengthoftilessixfullsizedtilesaretestedat28daysas per the guidelines given by IS 1237:2012 .Before performing the test the tiles are soaked inwaterfor24hrsandthenplacedhorizontallyontwoparallelsteelsupports,thewearingsurfaceisupwardsanditssidesparalleltosupports.Theloadisappliedinsuchawaythatthesteelrodis parallel to supports and midway between them.It is required that the length of the supportsand of the loading rod shall be longer than the tile. The diameter of the loading rod shall be12mmandberounded.Theloadisappliedatauniformrateof2000N/min,untilthetilebreaks.Thewettransversestrength iscalculatedusingthe formula giveninIScodeasgivenbelow:

$$\frac{3PI}{2bt^2} N/mm^2$$

Where,

P=breakingload inN;

I = span between supports, in mm;b=tile width, inmm; and
t=tilethickness,inm

CompressiveStrength

To get the compressive strength variation due to glass fibres 100mm cubes were cast with thesame mix as used for casting concrete tiles with the same amount of admixtures. Six 100mmcubes were cast for each fibre content. Three cubes were tested at 7days and three at 28 days.Thecompressivetestwasdoneonuniversaltestingmachine.Thecubeswerecuredusingpondcuring method and before testing they were allowed to surface dry. The formula used forcalculatingcompressivestrength isgiven below:

$$c=\frac{P}{A} N/mm^2$$

Where,

P=load in Newton (N) at which failure occurs,A=surface areain mm$^{2.}$

PulseVelocityTest

The pulse velocity test is a non-destructive test and is covered in IS 13311 (Part 1) – 1992.Itgivesameasureof thequalityof concrete.Theunderlyingprinciple of thistest is–Themethodconsistsofmeasuringthetimeoftravel ofanultrasonicpulsepassingthroughtheconcretebeing tested.Comparativelyhighervelocityisobtainedwhen concretequalityisgoodintermsofdensity,uniformity, homogeneityetc.Firstcouplantisappliedtothesurfacesofthetransducers and pressed hard onto the surface of the material. The transducers are not movedwhile a reading is being taken, as this can generate noise signals and errors in measurements.Thetransducersarecontinuouslyheldontothesurfaceofthematerialuntilaconsistentreadingappears on the display, which is the time in microsecond for the ultrasonic pulse to travel thedistance‘L’.Themeanvalueofthedisplayreadingsistakenwhentheunit’sdigithunts

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 401-410 www.ijaem.net ISSN: 2395-5252

between two values. The velocities obtained can be interpreted in the form of quality ofconcreteand not in formof thegradeof concrete.

Pulsevelocity=(Pathlength/Traveltime)

Procedure

Experimentsstartedwiththepreliminarytests onmaterialpropertiesaspertheIndianstandards.
Composites being made of cement, fiber and sand as major components tests wereconducted for standardizing properties of these materials. Tests of physical properties of sand,cement and fiber were conducted first and then they were used in the research. NO tests wereconducted on water as ordinary tap water from govt. water supply was used throughout theresearchwork.
Specific gravity test: The test was conducted as per IS 2720-part iii to obtain the specificgravityof cement. Thespecificgravityof cementwas found to be3.10.
ConsistencyTest:AsperIS4031-partiv1988aconsistencytestwasdoneonthecementusingVicat'sapparatus confirmingtoIS 5513.Thestandardconsistencywas foundto be30%.
Finenesstest:Finenessofthe cementwastestedasperIS4031-part1 bythemethodofsieveanalysis. A 10g sample of cement was agitated for 2 mins over a 90 micron sieve . The testresultsprovedthatalmostallthecementpassedthroughthesieveandnegligibleweightofdustwasretained.
Test for the grade of cement (Compressive strength test): AS per the guidelines of IS 4031-part vi 1988 cubes of cement mortar were casted at water content of(P/4 + 3 %) of total drymass taken and were tested for 7 day and 28 day strength. For simplicity ,3 day strength testwasomitted.untilteststhecastedcubeswerekeptin waterforcuring.Theminimum7day compressive strength averaged over three cubes was 24.33 MPa and 28 day strength averagedoverthreecubeswas 41.67MPa.

Testonsand

Specific gravitytest:Thespecificgravityofsandwas measured usingapycnometerbytheprocedureconfirmingtoIS 2386partiii-1963.Thespecificgravitywas found tobe 2.66
Sieve analysis of sand : In order to ascertain the particle sine distribution of sand Dry sieveanalysis was carried out. The sieve sizes were as per IS 2386-part I. The zone of sand waszoneiii.

PreparationofM-20gradeconcrete

M-20 grade concrete was prepared using the mix design guidelines as per IS -10262 withoutusing admixture. A water cement ratio of 0.50 was adopted as fibre reduces the workability ofconcrete to a great extent. Maximum .3% chopped fibres by weight of concrete were added tocheck the effect of fibres on the properties of concrete as even at 0.3 % the concrete turnedvery harsh and a great deal of vibration was needed. Total 4 different batches of M-20 gradeconcretewas prepared with 0, 0.1,0.2 and 0.3percent fibre.
RESULTS

Theresults obtainedareshownbelow intabularform
CompressiveStrengthofConcrete(inN/mm^2)

The 7 days compressive strength was studied and thevalues of 3 samples studied are shownin the tabular form.Table 1 shows the data of 7 days compressive strength obtained. Table 1gives the 7 day compressive strength of concrete with maximum nominal size of aggregates20mm.The 7 days compressive strength was also plotted Fig2 by taking the average of thisthree values overall an increase in the compressive strength was observed with addition offibers.

TABLE-1

Serialnumber	Withoutfibre	0.1%fibre	0.2%	0.3%
1	16.89	17.77	21.33	22.22
2	16.44	17.33	20.88	22.67
3	16.44	17.33	21.33	23.11

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 401-410 www.ijaem.net ISSN: 2395-5252

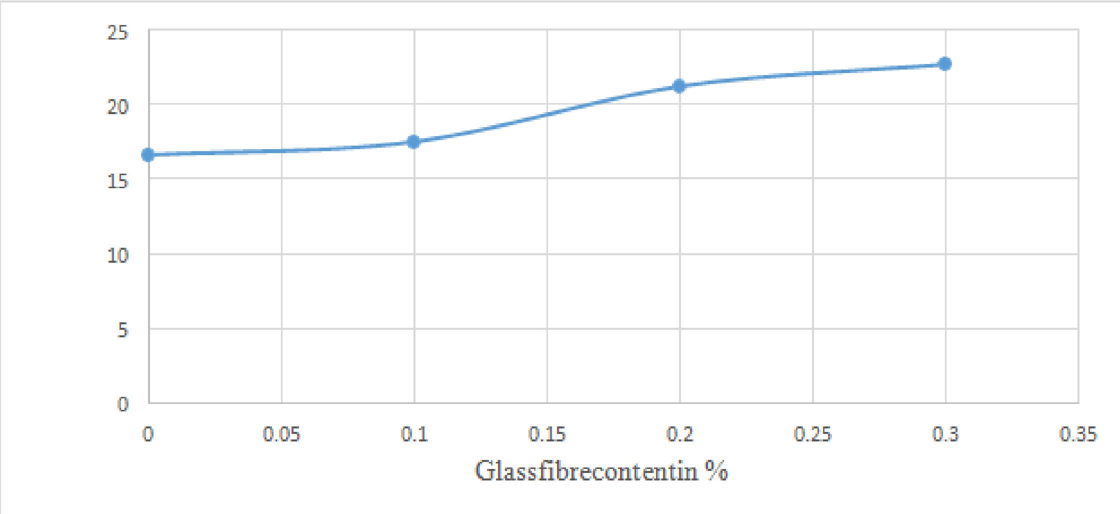


TABLE-2

Serialnumber	Withoutfibre	0.1%	0.2%	0.3%
1	25.33	28	28.88	30.22
2	25.77	31	28.88	28.88
3	25.33	28	31	30.66

SplitTensileStrengthcomparison(inN/mm^2)

The7daysSplitTensilestrengthwasstudiedandthevaluesof3samplesstudiedareshownin the tabular form.Table 3 shows the data of 7 days compressive strength obtained. Table 3gives the 7 days compressive strength of concrete with maximum nominal size of aggregates20mm.The 7 days compressive strength was also plotted Fig4 by taking the average of thisthree values overall an increase in the compressive strength was observed with addition offibers.

TABLE-3

Serialnumber	Withoutfibre	0.1%	0.2%	0.3%
1	1.485	1.84	2.405	2.405
2	1.626	1.70	2.26	2.405
3	1.45	1.84	2.26	2.263

FlexuralTensileStrength(inN/mm^2)

The7daysFlexuralTensilestrengthwasstudiedandthevaluesof3samplesstudiedareshowninthetabularform.Table5showsthedataof7daysflexuraltensileobtained.Table5givesthe7 daycompressive strength of concrete with maximum nominal size of aggregates 20mm.The7 days compressive strength was also plotted Fig6 by taking the average of this three valuesoverall anincreaseinthecompressivestrengthwasobservedwithadditionoffibers

TABLE-4

Serialnumber	Withoutfibre	0.1%	0.2%	0.3%
1	4.6	4.744	4.988	5.744
2	4.7	4.776	4.988	5.424
3	4.8	4.756	4.9	5.704

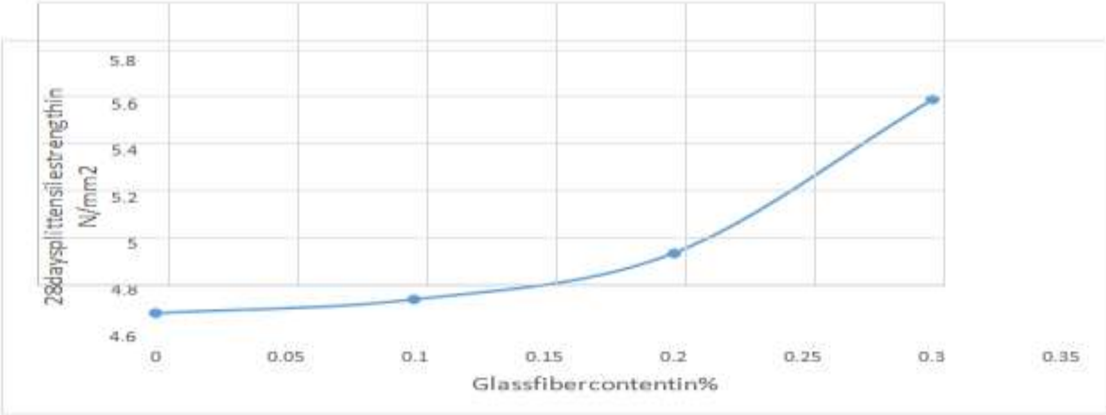
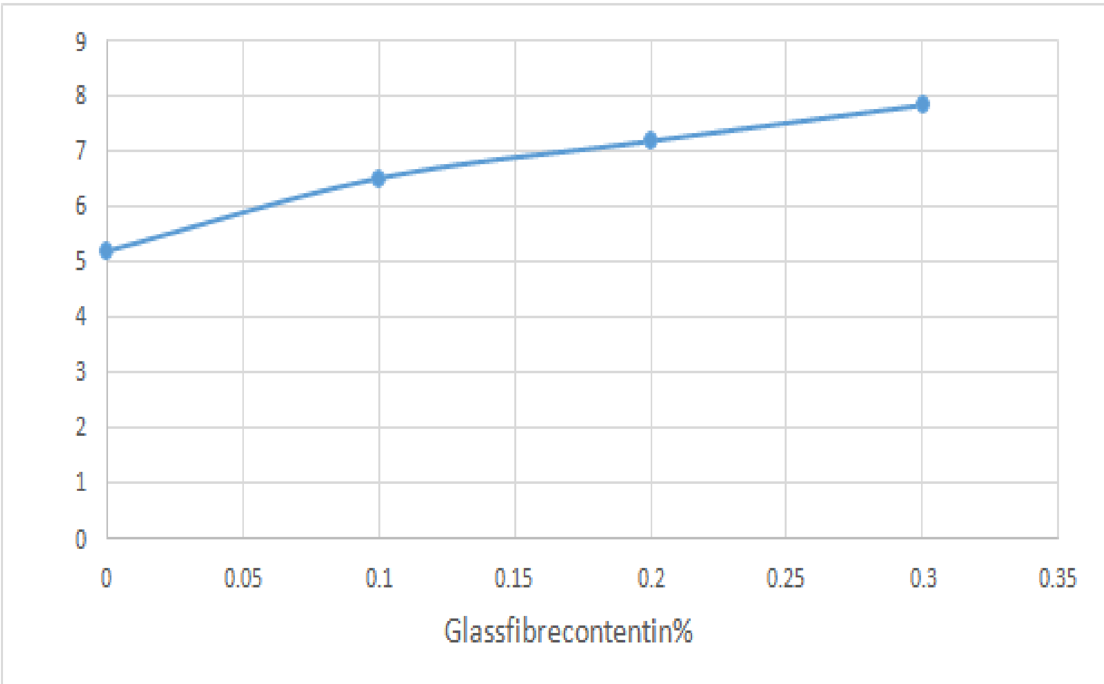


Figure6Effectof Glassfiberson 7daysFlexural strength

The28daysflexuraltensilestrengthwasstudiedandthevaluesof3samplesstudiedareshownin the tabular form.Table 6 shows the data of 28 days compressive strength obtained. Table 6givesthe28daysflexuraltensilestrengthofconcretewithmaximumnominalsizeofaggregates 20mm.The 28 days flexural tensile strength was also plotted Fig7 by taking theaverage of this three values overall an increase in the compressive strength was observed withadditionof fibers.

TABLE-5

Serialnumber	Withoutfibre	0.1%	0.2%	0.3%
1	5.104	6.368	7.544	7.156
2	5.204	6.456	7.104	7.96
3	5.242	6.652	6.844	8.32



REFERENCE

[1]. Cook D.J., Pama R.P., Weerasingle H.L.S.D. "Coir fibre reinforced cement as a low costroofingmaterial".BuildEnviron 1978;13(3):193–8.

[2]. Perez-Pena.MandMobasher.B,"Mechanicalpropertiesoffiberreinforcedlightweight concrete composites ". Cement and Concrete Research, Vol. 24, No. 6, pp.1121-1132,1994

[3]. BrandtAM."Cement-basedcomposites:materials,mechanicalpropertiesandperformance".London:E&FN Spon; 1995. p. 470

[4]. Nakamura H, Mihashi H. "Evaluation of tension softening properties of fiber reinforcedcementitiouscomposites."Fracture MechanicsofConcreteStructures1998; I:499e510.

[5]. MirzaF.A.,SoroushianndP."Effectsofalkali-resistantglassfiberreinforcementoncrackand temperature resistance of lightweight concrete." Cement and Concrete Composites2002;24(2):223–7

[6]. RobertS.P.Coutts."AreviewofAustralianresearchintonaturalfibrecementcomposites"Cement & Concrete Composites27(2005)518–526

[7]. Khosrow Ghavami. "Bamboo as reinforcement in structural concrete elements" .Cement&ConcreteComposites 27 (2005) 637–649

[8]. Huang Gu, ZuoZhonge "Compressive behaviour of concrete cylinders reinforced byglassand polyesterfilaments".Materialsand Design26 (2005) 450–453

[9]. AndrzejBrandt.M"Fibrereinforcedcement-based(FRC)compositesafterover40yearsofdevelopment inbuildingandcivilengineering". CompositeStructures86(2008)3–9

[10]. Luiz C. Roma Jr., Luciane S. Martello, HolmerSavastanoJr ."Evaluation of mechanical,physicalandthermalperformance ofcement-basedtilesreinforcedwithvegetablefibers".Construction andBuildingMaterials22(2008)668–674

[11]. Filho Toledo Dias Romildo, Andrade Silva Flavio de, Fairbairn E.M.R.."Durability ofcompression molded sisal fiber reinforced mortar laminates". Construction and BuildingMaterials23 (2009)2409–2420

[12]. Wu. Y.-F. "The structural behaviour and design methodology for a new building systemconsisting of glass fiber reinforced gypsum panels" Construction and Building Materials23(2009)2905–2913

[13]. Swami B.L.P. , "Studies on glass fiber reinforced concrete composites – strength andbehaviour Challenges", Opportunities and Solutions in Structural Engineering, 2010,pp-1-1

[14]. TonoliG.H.D.,S.F.Santos,A.P.Joaquim,H.SavastanoJr"Effectofacceleratedcarbonationon cementitiousroofingtilesreinforcedwithlignocellulosicfibre"Constructionand BuildingMaterials 24 (2010) 193–201

[15]. Enfedaque .A, D. Cendon, F. Galvez , Sanchez-Galvez .V,"Failure and impact behaviorof facade panels made of glass fiber reinforced cement(GRC)". Engineering FailureAnalysis 18 (2011)1652–1663.

[16]. Mohamed S. Issa, Ibrahim M. Metwally, Sherif M. Elzeiny "Influence of fibers onflexuralbehavioranddductilityofconcretebeamsreinforcedwithGFRPrebars"EngineeringStructures 33 (2011) 1754–1763.

[17]. Sung-SikPark"Unconfinedcompressivestrengthand ductilityoffiber-reinforcedcementedsand."Constructionand BuildingMaterials25(2011)1134–1138

[18]. MajidAli,AnthonyLiu,HouSou,NawawiChouw"Mechanicalanddynamicpropertiesofcoconutfibrereinforcedconcrete"ConstructionandBuildingMaterials30(2012)814–825

[19]. Frank Schladitz , Michael Frenzel , Daniel Ehlig "Bending load capacity of reinforcedconcrete slabs strengthened with textile reinforced concrete" Engineering Structures 40(2012)317–326

[20]. ShashaWang,Min-HongZhang,SerTongQuek"Mechanicalbehavioroffiber-reinforced high-strengthconcrete subjected tohigh strain-rate compressive loading"Constructionand BuildingMaterials 31 (2012) 1–11

[21]. AlbertoMeda,FaustoMinelli,GiovanniA.Plizzari"Flexuralbehaviourof RCbeamsinfibrereinforced concrete" Composites:Part B43(2012)2930–2937

[22]. Funke H. ,Gelbrich .S , Ehrlich .A "Development of a new hybrid material of textilereinforced concrete and glass fibre reinforced plastic" Procedia Materials Science 2 (2013)103– 110

[23]. Xiangming Zhou, SeyedHamidreza Ghaffar, Wei Dong, Olayinka Oladiran, Mizi Fan"Fractureandimpactpropertiesofshortdiscretejutefibre-reinforcedcementitiouscomposites"Materials

and Design 49(2013) 35–47

[24]. Mohammad Sayyar ,ParvizSoroushian "Low-cost glass fiber composites with enhancedalkali resistance tailored towards concrete reinforcement" .Construction and BuildingMaterials44 (2013)458–463

[25]. Gowri .R, Angeline Mary.M., "Effect of glass wool fibres on mechanical properties ofconcrete".InternationalJournalofEngineeringTrendsandTechnology(IJETT)-Volume4Issue7-July2013.

[26]. Foglar Marek, Kovar Martin. "Conclusions from experimental testing of blast resistanceof FRC and RC bridge decks". International Journal of Impact Engineering 59 (2013)18e28

[27]. Bonakdar .A, Babbitt F., Mobasher B. "Physical and mechanical characterization ofFiber-ReinforcedAeratedConcrete(FRAC)".Cement&ConcreteComposites38(2013)82–91

[28]. ChanakaM.Abeysinghe,DavidP.Thambiratnam,NimalJ.Perera"Flexuralperformance of an innovative Hybrid Composite Floor Plate System comprising Glass–fibre Reinforced Cement, Polyurethane and steel laminate" Composite Structures 95(2013)179–190

[29]. TassewS.T.,LubelA.S.,"Mechanicalpropertiesofglassfiberreinforcedceramicconcrete".Construction and BuildingMaterials51(2014)215–224.

[30]. Dey V., Bonakdar A., Mobasher B. "Low-velocity flexural impact response of fiber-reinforcedaerated Concrete".Cement&ConcreteComposites49(2014)100–110

[31]. Pantelides C.P., Garfield T.T., Richins W.D., Larson T.K., Blakeley J.E. "Reinforcedconcreteandfiberreinforcedconcretepanelssubjectedtoblastdetonationsandpost-blaststatictests". Engineering Structures 76 (2014)24–33.

[32]. AgarwalAtul,NandaBharadwaj,MaityDamodar."Experimentalinvestigationonchemically treated bamboo reinforced concrete beams and columns". Construction andBuildingMaterials 71 (2014) 610–617

[33]. Raphael Contamine, Angel Junes , Amir Si Larbi "Tensile and in-plane shear behaviouroftextilereinforcedconcrete:Analysisofanewmultiscalereinforcement".ConstructionandBuildingMaterials 51 (2014) 405–413

[34]. Wai Hoe Kwan ,Mahyuddin Ramli, Chee Ban Cheah "Flexural strength and impactresistancestudy offibrereinforcedconcreteinsimulatedaggressiveenvironment".ConstructionandBuildingMaterials63 (2014)62–71

[35]. MobasherBarzin,DeyVikram,ZviCohen,AlvaPeled"Correlationofconstitutiveresponse of hybrid textile reinforced concrete from tensile and flexural tests" Cement &ConcreteComposites53 (2014)148–161.

[36]. Ali Shams , Michael Horstmann , Josef Hegger "Experimental investigations on Textile-Reinforced Concrete (TRC) sandwich sections" Composite Structures 118 (2014) 643–65