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STUDY ON MECHANICAL PROPERTIES OF HFRC USING GFRP WRAPPINGS

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Abstract-*Concrete is a solid hard matrix consisting of binding material (cement),filler material (fine aggregate and coarse aggregate),water and admixture if required in case of harsh mix to make the concrete workable .if fibres such as steel, polypropylene ,WPE,HDPE(High Density Polyethylene) etc are added to the nominal mix it said to be hybrid concrete or hybrid fibre reinforced concrete .for this study we have designed M30 grade concrete for both nominal mix aswell as for hybrid mix with fibre content 1% which includes (0.5%HESF+0.5%HDPE) respectively. HESF (Hooked End Steel Fibre) of dimensions 50mm length, 1mm thickness aspect ratio 50,HDPE(High Density Polyethylene) is used from waste servo oil bottle and it is cutted as required size i,e 50mm length,2mm width and 1mm thickness ,aspect ratio 50.tests are performed such as compressive , split tensilefor hybrid and nominal mix with and without GFRP(glass fibre reinforced polymer) GFRP are used to reduce the cracks ,crack width ,and increase the durability of concrete ,GFRP of 900gsm are used as per the specifications provided by the manufacturer. the overall strength is increased in case of compressive strength by 25% when compared without gfrp wrappings .in case of split tensile the strength is increased gradually by 15% respectively.*

***Key words*:** *Compressive strength, split tensile strength,HDPE, HESF, GFRP.*

1.INTRODUCTION

concrete is a composite material consisting of cement (binding material) sand and coarse aggregate (filler material) and water, some addition of admixture to the concrete. since from the beginning of civil engineering applications materials were used clay,lime& cement, there is a need to change the brittleness of concrete by adding some other special or alternative materials to the concrete. In the ancient times the problems of brittleness of concrete was solved by the adding of differntfibres from the organic origin such as dry grassfibres, limebrick, pozzalona But nowadays Steel fibres, polypropylene, HDPE fibres,Waste plastic fibres etc. were used to enhance the tensile properties of concrete in the concrete. concrete means condensed or hard like stone. concrete has high compressive strength but weak in tensile strength, for this reason reinforced bars such as Steel bars, rods, steel fibres ,hdpe and waste plastic fibresetc which increases the tensile strength of the concrete.by addition of these special fibres in the concrete which reduces the cost as well as the durability of the concrete. Various concrete mix produces different strength usually concrete mechanical properties are found by cube and cylinder specimen at the end of 7 and 28 days curing.

1.1 FIBRE REINFORCED CONCRETE

Fibrereinforcedconcrete is defined as compo site materials made with ordinary cement sand, filler material (coarseaggregate) and incorpratingdiscreete dis-continuous fibres such as long wires (rods ,meshes, woven fabrics not considered as discrete fibres) in the concrete.why we have to use such discrete fibres to the concrete, in order to increase the tensile property and strain capacity of the FRC which otherwise in the plain concrete In plain concretr they have low tensile strength capacity and low strain capacity. by the addition of these discrete discontinuous fibre which also increases the crack resistance ductility etc will be increased to the frc. these discrete fibres are used from the recycled tyres, used carpet waste,servo oil bottles,waste plastic fibres, which reduces the cost. addition of discrete fibre to the concrete act as a crack arrester and sustaining dynamic and static parameters.fibres. usually various types of fibres used in the concrete but not all fibres are effective and economical and every single fibre has different properties and limitations.

1.2 HYBRID FIBRE REINFORCED CONCRETE

HFRC is defined as the addition of two or more materials such as Natural fibres and synthetic fibres to the concrete.cement and fine aggregate coarse aggregate water few admixtures with addition of natural or synthetic fibres. by the combination of this natural and synthetic fibres to the concrete reduces the crack after casting and increases the ultimate strength and toughness of the concrete. various types of fibres are used natural and synthetic fibres such as Steel, polypropylene, carbon, jute, banana, HDPE fibres.the strength of HFRC depends on the hybrid materials, aspect ratio,orientation contents ,geometry etc uses of hfrc in buildings such as column beams extra in road work Bridge Foundation dams etc.

1.3GFRP (Glass Fibre Reinforced Concrete Polymer)

GFRP consisting of finely divideg glass fibres which can be used in production of textiles and also used as reinforcing material in plastic products,thus resulting a composite material called GFRP (Glass fibre Reinforced polymer).

BENEFITS OF GFRP

- Light weight material can be applied easily with hand techniques
- Fast curing and early installation on site
- Resistant against heat,cold ,frost and corrosion
- Increases resistance to fatique
- Reduces crack propagaton and incresses impact resistance
- Its cost is low

GFRP WRAPPING PROCEDURE

- Surface of the specimen is cleaned to avoid the improper application gfpr,surface should be free from dust ,oil,dirt and moisture content etc
- Primer is applied on concrete surface were gfrp is applied, mixing has been adopted as per the manufacturers specification
- Mixing saturant (MB4500A part A) and primer (MB3500 part B) are mixed in ratio 2:1 then mixed thoroughly for 2 minutes
- Primer is applied to the specimen by brush of size 4inch and it is kept for 24hrs curing

2.PROJECT OBJECTIVES

- To determine the strength property of compressive of M30 grade hybrid concrete with and without GFRP wrappings and also comparing with nominal mix.
- To know the split tensile strength parameters of M30 grade hybrid concrete with and without GFRP wrappings

3.MATERIALSUSED

3.1 Cement

OPC (Ordinary Portland Cement) of 53 grade conforming to IS 12269-1987 are used. BIRLA A1 OPC cement is produced which is tested in lab.Cement is the main binding material in concrete.

3.2 Fine Aggregate

Zone II Aggregates are used locally available(jewargi sand) sand is used conforming as per IS 383-1978. It act as filler material

3.3 Coarse Aggregate

Locally available crusher Crushed rock of size 20mm and 12.5mm downsize conforming as per IS383-1978. Various tests like Specificgravity ,Bulk Density were carried out in the lab.

3.4 Super Plasticizer

Addition of fibres makes the concrete less workability so super plasticizer are used to increase the workability and act as water recucing agent upto 30%. Optimum dosage was adopted is1.5% of cement weight.

3.5 Hooked End Steel Fiber (Hesf):

Hooked end Steel fibres are used having length 50mm ,width 2mm and thickness 1mm Aspect ratio 50.

3.6 High Density Polyethylene Fibres

High density polyethylenefibres (HDPE) are used from the waste servo oil bolttle collected from garriages which is then cutted with required length 50mm ,width 2mm and thickness 1mm Aspect ratio 50.HDPE has greater proportion of crystalline regions than LDPE hence have more tensile strength and crack resistance. HDPE density varies from 940-955kg/m3 as per ASTM D1505.

4.EXPERIMENTAL WORKS AND DISCUSSION

4.1MIX DESIGN BY IS METHOD

Concrete mix is designed asper IS 10262-2009 for M30 grade of concrete to get the high strength by adding Hybrid fibresi,eHeSF (Hooked end Steel Fibre) and HDPE (High Density Polyethylene) with 1% of volumeoffibre to concrete i,e(0.5% hdpe + 0.5% hesf) .

MixDesign			
Water	Cement	F.A.	C.A.
0.35	1	1.52	2.44

4.2Addition of fibres

Hooked end Steel Fibers From literature paper i have taken density of HeSF (Hooked end Steel Fibers) as 7850 kg/m^3. Added 0.5% volume HesfFibres to concrete,For one cube calculation weight of fibres are 132gms and for cylinder calculation weight of fibres 208gms

HDPE(High density polyethylene fibres)

From journal paper HDPE Density is taken as 900 kg/m^3. With an amount 0.5% Hdpe volume to concrete,For one cube calculation weight of fibres is 15gms and for cylinder calculation weight of fibres 23.85gms

5.0 TEST RESULTS

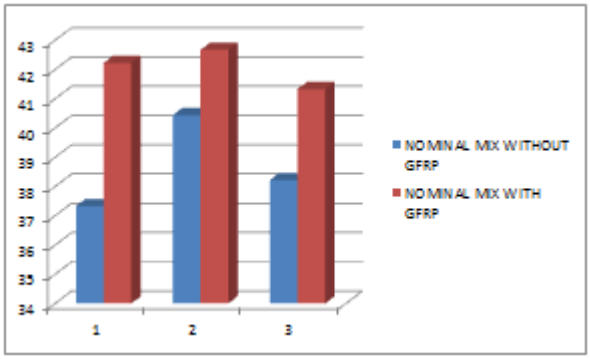
5.1COMPRESSIVE TEST: Compressive test cubes of 150 *150 *150 mm size were casted in accordance to Is 456 2000 and tested under compression testing machine at the end of 28 days curing failure load is noted down and surface cracks are observed before keeping the specimen in the machine the specimen surface is cleaned and kept in the room temperature.

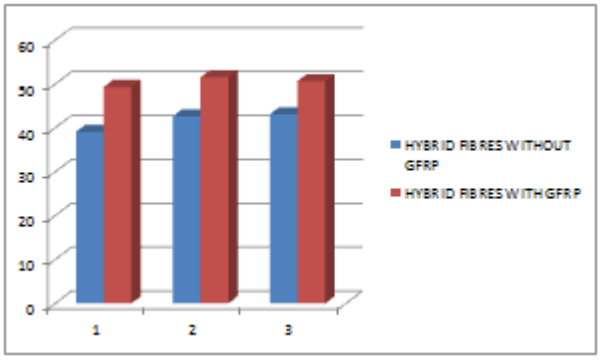
Nominal mix With GFRP			
Sl.No.	Load KN	Strength MPA	AVG. StrengthMPA
1.	950	42.22	42.07
2.	960	42.67	
3.	930	41.33	

Nominal mix Without GFRP			
Sl.No.	Load in KN	Strength in MPA	Avg Strength in MPA
1.	840	37.33	38.66
2.	910	40.44	
3.	860	38.22	

HYBRID FIBRES with GFRP			
Sl.No.	Load in KN	Strength in MPA	Avg Strength inMPA
1.	1110	49.33	50.51
2.	1160	51.55	
3.	1140	50.66	

HYBRID FIBRES Without GFRP			
Sl.No.	Load(KN)	Strength (MPA)	Avg Strength inMPA
1.	880	39.11	41.62
2.	960	42.66	
3.	970	43.11	





From the above graph the normal cube result increased for GFRP wrapping by 8.10%. and for hybrid concrete by 8.9Mpa when compared to without gfrp

5.2 SPLIT TENSILE STRENGTH TESTS RESULT:Split tensile test as per Astm c 496 cylinder of 150 mm dia and length 300 mm size were casted in standard manner and tested in the CTM Machine at the end of 28 days curing

SplitTensile strength =(2*P)/(π*l*d)=__N/mm²

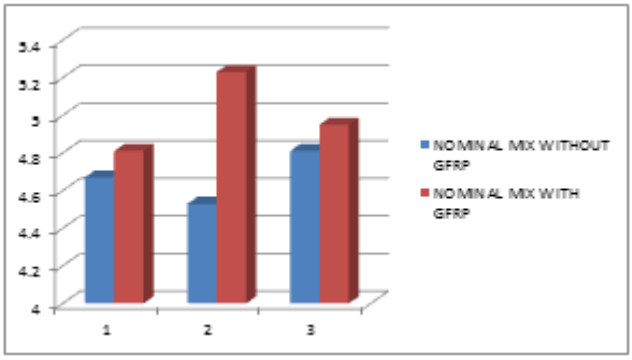
P=load., d=dia, and l=length.

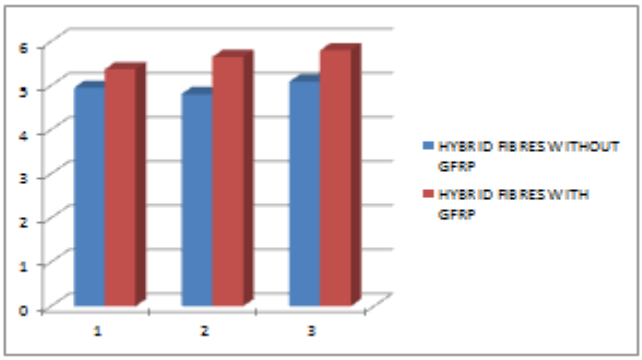
Nominal mix With GFRp			
Sl.No	Load in KN	Strength in MPA	Avg Strength in MPA
1.	340	4.81	4.99
2.	370	5.23	
3.	350	4.95	

Nominal mix Without GFRP			
Sl.No.	Load(KN)	Strength (MPA)	Avg Strength(MPA)
1.	330	4.67	4.67
2.	320	4.53	
3.	340	4.81	

HYBRID With GFRP			
Sl.No.	Load(KN)	Strength(MPA)	Avg Strength in MPA
1.	380	5.37	5.60
2.	400	5.65	
3.	410	5.80	

HYBRID FIBRES Without GFRP			
Sl.No.	Load(KN)	Strength (MPA)	Avg Strength(MPA)
1.	350	4.95	4.95
2.	340	4.81	
3.	360	5.09	





From the above graph the normal mix with gfrp have increased by 4.61% and for fibre added concrete by 12% when compared to without gfrp

CONCLUSIONS

- HDPE fibres are easily and freely available which reduces the cost and make the structure economical, HDPE fibres are added to concrete which reduces the corrosion effects
- GFRP applied specimens increases the strength parameters and also the durability of hybrid concrete and also reduces the surface cracks, crack width and enlargement of cracks in concrete.
- For compressive strength test the normal cube result increased for GFRP wrapping by 8.10%. and for hybrid concrete by 8.9Mpa when compared to without gfrp
- For split tensile strength test the normal mix with gfrp have increased by 4.61% and for fibre added concrete by 12% when compared to without gfrp.

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