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Effect on Torsional and Flexural Behavior RC Concrete Beam made with Plastic Waste Bags (PWB) Granules

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Abstract: ***Concrete is one of the most common materials used in the construction industry. In the past few years, many and modification has been done to produce concrete which has the desired characteristics. There is always a search for concrete with higher strength and durability. Plain concrete has good compressive strength but has low tensile strength, low ductility and low fire resistance. To circumvent these shortcomings, extensive research by concrete technologist has led them to find a very promising concrete material called as fiber reinforced concrete. This study aim to characteristics and comparison of the mechanical properties of PWB,Plastic waste Bags granular concrete with conventional concrete. In order to achieve and verify that 00%,10% , 20% 30% fiber percentage by the volume of sand are used in this study with three different concrete mixes test such as Compression test ,Split tensile, Bending test and Torsional Test on different specimens for 28days compressive strength, spilt tensile strength, flexural strength, tests have been performed in the hardened state. The total tested specimens are 48. Performance of conventional concrete is enhance by the addition of PWB in concrete. The brittleness in concrete is reduced and adequate ductility of concrete in ensure by addition of PWB in concrete. In this project the behavior of cube, cylinder & beam structures strengthen by using PWB is experimentally tested. The PWB used are fibers in various volume fraction the main reason for adding this to concrete matrix is to improve the post cracking response of the concrete i.e. to improve its energy absorption capacity and apparent ductility and to provide a crack resistance and crack control and addition of strength for bridging the micro-cracks are suggested as the reason for the enhancement in flexural fiber. The torsional test is an attempt made in this study to implement it for further seismic study. In Concrete Natural sand can be replaced with plastic waste by 10 to 30% to achieve green concrete. Sand can also be replaced up to 30% in the members of building which do not carry high load. Using plastic waste such as polyvinylchloride (PVC), Polypropylene (PP), Polyethylene in concrete reduces the environmental issues and minimizes the difficulties of dumping the major plastic waste. This will help to tackle the increasing pollution all over the world, especially in countries that face the complications regarding waste. In addition to the environmental benefits, it was noted that using plastic scrap can be used to fight against the obstacle of scarcity of natural sand in India.***

Keywords: Plastic waste bags, plastic Fiber, Shear- span ratio, Fiber volume ratio, fiber aspect ratio, longitudinal steel ratio, Flexural test on beam, Torsion test on beam

1. Introduction

The aim of this study is to explore the possibility of re-cycling a waste material that is now produced in large quantities the hazards, while so achieving an improvement of the mechanical properties and durability of the mortar and concrete. This study examines the mechanical properties and the durability parameters of mortars and concrete incorporating plastics bag wastes (PBW) as fine aggregate by substitution of a variable percentage of sand (10, 20, 30 and 40 %). The influence of the PBW on the, compressive and flexural strength, drying shrinkage, fire resistance, sulfuric acid attack, has been investigated and analyzed in comparison to the control mortar. The results showed that the use of PBW enabled to reduce by18–23 % the compressive strength of mortars containing 10 and 20 % of waste respectively, which remains always close to the reference mortar (made without waste). The replacement of sand by PBW in mortar and concrete slows down the penetration of chloride ions, improves the behavior of mortars in acidic medium and improves the sensitivity to cracking. The results of this investigation consolidate the idea of the use of PBW in the field of construction. Sector to the extent that the products to be obtained are not subjected to rigorous quality standards too. The valorization of waste affects two major impacts, environmental impact is solved by disposing of such waste and the economic impact is the use of that in industry or in the field of construction, this waste has the advantage of being available large quantity and low value. The cementing materials, by their performance in terms of mechanical strength and durability dominate the market of construction materials. The addition of polymeric waste to concrete corresponds to a new perspective in research activities, integrating the areas of concrete technology and Environmental technology. Industrial and domestic waste has a significant percentage of polymeric materials in its constitution, which occupies a considerable volume on landfills. Therefore its recycling is The present study focused on the use of plastic aggregates resulting from the crushing of plastic bags waste rejected into nature and to find new ways of valorization in the field of construction. We will present, therefore, compressive and flexural strength of mortars. Their durability towards the chemical attacks such as the acids and the diffusion of chlorides ions. After that, shrinkage tests prevented with the ring and the follow-up of induced cracking will bring relevant.

2. Experimental Programme

A. Test Material

Ordinary Portland cement of 53 grade “ultratech” was used having fineness modulus of 7.3 and crushed aggregate of

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maximum size 12.5mm were used. The grade of concrete is M20 with mix proportion of 1:1.5:3 by weight with water cement ratio of 0.50 was kept constant for all beams [7]. Plastic waste such as polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene (PE) can be used as a replacement of fine aggregate in concrete. Tests were carried out for replacing sand by 10%, 20%, 30% in concrete.

B. Specimen Details

1) Cube moulds of 150 x 150 x 150 mm are used for casting the specimens for compressive strength.
2) Cylindrical moulds of 150 mm diameter and 300 mm long are used for casting the specimens for split tensile strength test.
3) Rectangular beams of 1500x200x300 mm are used for casting the specimens for flexure test.

C. Test Procedure

Testing of Cube Specimens for Compressive Strength:

For the compression test, the cubes are placed in machine in such a manner that the load is applied on the Faces perpendicular to the direction of cast. In Compression testing machine, the top surface of machine is fixed and load is applied on the bottom surface of specimen. The rate of loading is gradual and failure (crushing) load is noted. Also the failure pattern is observed precisely.

Testing of Cylinder Specimens for Split Tensile Strength:
For determining split tensile strength, cylinder specimens are placed between the two plates of Compression Testing Machine. Plywood strips of 3 mm thick, 25 mm wide and 300 mm long, are placed between the plates and surface of the concrete specimens. The load is applied at a uniform rate till the specimen failed by a fracture along vertical diameter.
The split tensile strength is calculated from the formula, $t = 2P/\pi DL$
Where, P is the load at failure and D and L are the diameter and length of specimen, respectively.
Testing of Beam Specimens for Flexure:

In flexure test, the beam specimen is placed in the machine in such a manner that the load is applied to the upper most surface as cast in the mould. All beams are tested under two-point loading in Universal Testing Machine of 100-tonne capacity. The load is increased until the specimen failed and the failure load is recorded

The flexural strength is calculated from the formula
$f_b = PL / bd2$
Where, P = the applied load at failure and,
d = depth of specimen,
b = breadth of specimen and
L = Length of specimen respectively.

Testing of Beam Specimens for Torsion:
In this torsion test the beam is placed with the proper marking and locating the centre of beam and the two lever arms are placed on the opposite end of the beam. The Load is gradually applied on the lever arm this lever arm is created by the action of load applied .The action of Twist or the angle of twist is measured by the the dial gauges attached two the corner of the MS frame. The dial gauge reading is measured or converted into radian by converting the is by its least count.

For example-
2kN load gives 8units of reading
Then 8 x 0.01(L.C.)=0.08mm this is Dial gauge reading.
This Dial Gauge reading is Converted into Angle of Twist
(8 x 0.01/150)=0.000533rad

For Torque
2 kN is divided into two half section 2/2=1kN force at each section of lever arm.
To form a Lever Arm it should be multiplied by 0.55m this is the fabricated lever arm
1 x 0.55 =0.55kN-m

In short
Load-2kN
Angle of Twist=0.000533 rad
Torque =0.55kN-m

Figure 1: Cocnrete cube 150x150x150 testing

Figure 2: Split Tensile Test for PWB

Figure 3: Torsion Test on Various Beam

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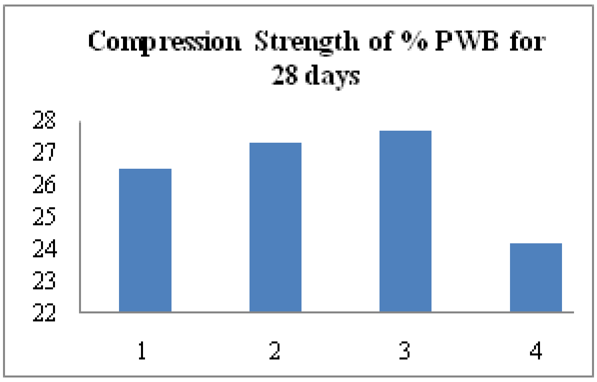
Figure 4: Bending Test on Various Beam

D. Test Result and Discussion

Table 1: Compression test results at the end of 28 days.

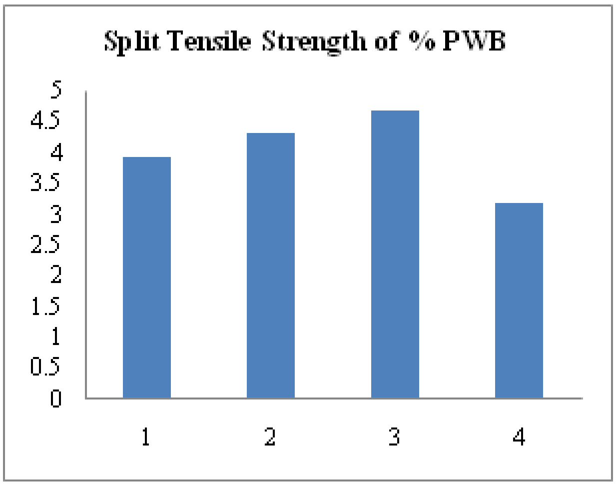
Grade of Concrete	w/c Ratio	% of PWB	Compression Strength in N/mm^2	Average Compression Strength in N/mm^2
M20	0.45	00%	26.70	26.50
			26.30	
			26.50	
		10%	27.50	27.30
			27.40	
			27.00	
		20%	27.80	27.70
			27.60	
			27.70	
		30%	25.20	24.20
			24.20	
			23.20	



Graph 1: compression test results 28days

Table 2: Split tensile test results

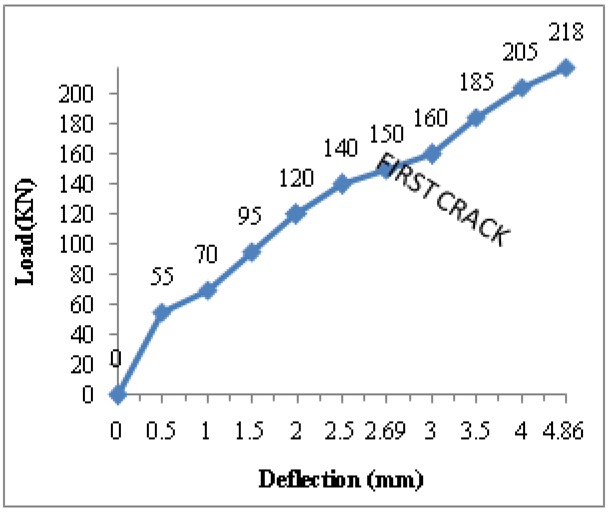
Grade of Concrete	*w/c Ratio*	*% of PWB*	*Split tensile Strength in N/mm^2*	*Average Split tensile Strength in N/mm^2*
M20	0.45	00%	3.48	3.93
			4.35	
			3.98	
		10%	4.36	4.32
			4.23	
			4.55	
		20%	4.98	4.68
			4.56	
			4.58	
		30%	3.22	3.18
			3.54	
			3.12	



Graph 2: Split tensile test results

Discussion

The above graph indicates load vs deflection for M-20 with steel fibre beam.Here the first crack occurs at load-108KN,deflection of 2.32 mm and the ultimate load is 140 KN with deflection of 4.44 mm.



Graph 3: M20 Deep beam- 2(1.0% addition of steel fibre)(load Vs ddeflection)(100MM)

Discussion

The above graph indicates load vs deflection for M-20 beam with 1.0% steel fibre. Here the first crack occurs at load-150KN, deflection of 2.69 mm and the ultimate load is 218 KN with deflection of 4.86mm.

It is evident from Graph 1 that ultimate strength is less when there are no Steel Fibres in the deep beam i.e. for Plain beam of M20 grade.

It is clear form graph 2 and 3 that the addition of steel fibers in concrete mix significantly influenced the cracking behavior, first crack strength and ultimate strength of deep beams. For example beams which contained no fibers and without web reinforcement, exhibited a sudden formation of a long inclined crack. On the other hand, inclined cracks went through a slow process of widening and extension in beams with 0.5 %, 1.0% of fiber content and without web reinforcement.

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In beams with steel fibers first diagonal crack formed at about 60 – 66 % of ultimate load almost in the middle of the shear span. As the load was increased inclined crack propagated towards the support and loading points. Further increase in the load resulted in the propagation and widening of the existing cracks leading to shear failure.

Addition of steel fibers in concrete mix significantly influenced the cracking behavior and ultimate strength of deep beam. This lower rate of crack propagation in fiber reinforced beams may attributed to the restraint provided by the steel fibers that bridge the cracks, this contributing to port cracking strength.

3. Conclusion

Following conclusions are draw based on the results discussed in the previous topic

1) The inclusion of short steel fibers in concrete mix provides effective shear reinforcement in deep beams and provides better crack control in beams.
2) Both the first crack strength and ultimate strength in shear increase for fiber reinforced beams because of their increased resistance to propagation of cracks.
3) Shear strength increases with fiber content and decreasing a/d ratio.
4) Maximum increase of 40 % in first cracking load for beam containing 0.5 % of fiber was observed when compared with beam containing no web reinforcement.
5) When all the beams were tested in this program, maximum shear strength was observed in beams reinforced with 0.5 % and 1.0 % steel fibers followed by beams containing web reinforcement
6) These results supports use of 1.0% steel fibers as an alternative to conventional web reinforcement in deep beams.

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