Experimental Studies on Flexural Behavior of waste Plastic Fiber Reinforced Concrete Slab

Manjunath Itagi, B.P. Annapurna

Abstract: Plastic disposal is challenging issue across the globe. The use of plastic in concrete will overcome the disposal problem. In this paper, we study the possibility of disposing waste in concrete. The effect of fiber is been studied for varying percentages of fiber 0.5% to 3.0% by weight of cement, with a variation of 0.5 % interval. The effect of fiber is been studied for two types of dispersion of fiber 1.Dispersed both in tension and compression zone 2.Dispersed only in tension zone. The flexural strength of slab with fiber reinforced concrete for nine point loading is been studied, the grade of concrete considered is M20. The results are compared with conventional concrete. It is been found that with the addition of fiber the strength of concrete considerably increases. Addition of plastic fiber of 1.5%shows the maximum increase in strength of concrete. The addition of plastic fiber increases the strength maximum at first crack level compared to ultimate load level. The number of cracks developed in fiber reinforced concrete is very less compared to conventional concrete.

Keywords: Plastic fiber, Fiber reinforced concrete,Flexural strength,Compression and Tension zone, Tension zone.

I .INTRODUCTION

Now days due to growth of urbanization and industrialization for particular country will lead waste disposal problems. In the present era, the useof plastic growing day by day and it takes many years to degrade. It does not decay or nor degenerates in soil or water and it also produces toxic gases when it burns in environment. Therefore the way to reuse and recycle plastic to be formulated. Otherwiseit will harm the environment. Due to overcome these problems, waste plastics can be used in concrete construction industry.Our life depends directly or indirectly on concrete. Concrete is most used material on the earth. It consists of coarse aggregates, fine aggregates and cement. These materials fill the voids in concrete and it bonds together properly in construction of buildings etc. normal concrete is low in tensile strength and little resistance to cracking. Due to addition of plastic fibers in concrete will act as crack arrestor, improves the dynamic and static properties, control the shrinkage, reduce the permeability and reduce the bleeding of water this type of concrete is called fiber reinforced concrete.**Need For The Present Work:** In the present matrix of concrete, addition of fibers control the cracks in concrete and also it improves the crack resistance and also controls the widening of cracks.

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Objective: To determine the flexural strength ofplastic fiber reinforced concrete slab. Description of concrete specimens are shown in Table1

II .EXPERIMENTAL INVESTIGATION MATERIALS

Cement
The character of concrete depends the quality and quantity of cement. In this paper, Birla super cement 53 grade was used for the present research. Tests are determined as per IS-12269:1987. The properties of cement are as shown in Table 2.

Fine aggregate
The character of concrete depends the quality and quantity of M-sand. In this paper, locally available M- sand was used for the present research. Tests are determined as per IS. The properties of M-sand are as shown in Table 3.

Coarse aggregate
The character of concrete depends the quality and quantity of coarse aggregate. In this paper, locally available coarse aggregate was used for the present research. Tests are determined as per IS 23861963. The properties of coarse aggregates are as shown in Table 4.

Water
For mixing and curing of concrete clean potable water was used in this research

Plastic fiber
The waste plastic fiber is obtained from LM Wind Power Blades (India) Pvt. Ltd Bangalore- 562111, Thefiber properties are tabulated in Table 5.

III . EXPERIMENTAL METHODLOGY

All the slabs were tested for a Nine-point load system. The slab was simply supported on all four sides by a supporting frame. Over this support the slabs were placed and were checked for any eccentricity and level difference. Nine points are marked at the central one third of the slab at 100mm c/c and steel balls of 50mm dia is placed on these nine points (Fig 3) and steel plate of 25mm thick is placed over these balls. The loading jack then placed over the plate to apply the load.
After the arrangement of loading system LVDT is placed at the centre of the slab just below the load as shown in Fig 4. Before loading , that is at zero loads LVDT reading is set to zero. Using hand operated hydraulic jack the load is continuously applied and the corresponding deflections were recorded. The application of loads is continued up to the failure of slab and the corresponding deflection is recorded

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Table 1 Description of concrete specimen

Description of concrete	Designation	% of fiber	No. of specimen	
			FRCP (CT)	FRCP (T)
Conventional Concrete	CC	0	2	
1) Fiber Reinfrced Concrete with plastic fiber Dispersed both in Compression and Tension Zone 2) Fiber Reinfrced Concrete with plastic fiber Dispersed only in Tension Zone for varying % of fiber (0.5% to 3.0%)	1) FRCP(CT) 2) FRCP (T)	0.5	1	1
		1	1	1
		1.5	1	1
		2	1	1
		2.5	1	1
		3	1	1

Table 2 Cement properties

Sl. No.	Test	Results	Requirements as per IS 12269 : 1987
1	Specific Gravity	3.10	3.15
2	Fineness of cement	6.15%	Less than 10%
3	Standard Consistency	29%	Not Specified

Table 3 Fine Aggregate Properties

Sl. No.	Physical properties	Results
1	Specific Gravity	2.65
2	Fineness Modulus	2.73
3	Bulk density (kg/m^3)	1445

Table 4 Coarse Aggregates Properties (12.5mm down size)

Sl.No	Particulars	Results
1	Fineness Modulus	4.2
2	Specific Gravity	2.67

Table 5 Fiber Properties

Properties	Plastic fiber
Length(mm)	25
Diameter(mm)	0.234
Tensile Strength(N/mm^2)	226

Fig 1: Plastic fiber

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Fig 2: Concrete with plastic fiber (FRCP)

Fig 3&4: Experimental set up for flexural behavior of slab

Mix Design

M-20 grade concrete was designed as per IS-10262-2009.The concrete mix ratio obtained is 1:2.12:2.15

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IV .RESULTSANDDISCUSSIONS

First Crack Load

With addition of Plastic fiber in concrete (FRCP (CT)) by 0.5%, 1.0%, 1.5%, 2.0%, 2.5% the increases first crack load compared to conventional concrete by 4.9%, 19.4%, 30.5% , 25.2% and 8.7% respectively. However further increase in the addition of 3% of fiber decrease strength by 1.9%.

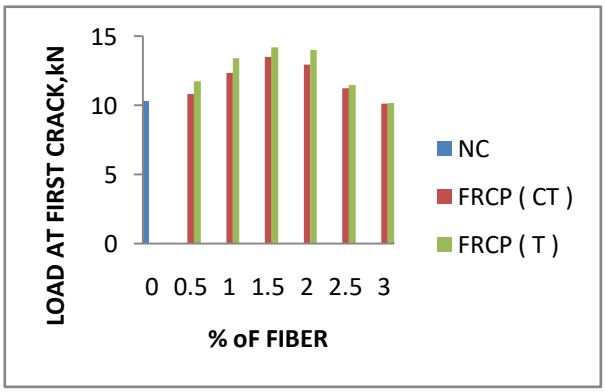

Fig 5: Comparison of First Crack Load of Concrete with Different % of Fiber

Deflection at First Crack Load

The corresponding deflection at first crack load of concrete with plastic fiber (FRCP (CT)) compared to conventional concrete(CC) for fiber content of 0.5%, 1.0%, 1.5% ,2.0 and,2.5% increases by 14.8%, 33.3%, 59.2% ,51%, and 37% respectively, for addition of 3% of fiber decrease the defection by 2.3% .

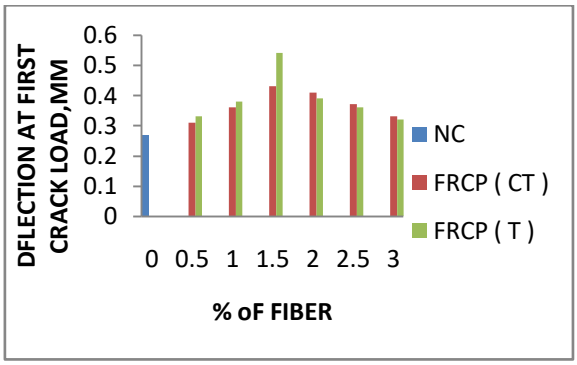

Fig 6 Comparison of Deflection at First Crack load of Concrete with Different % of Fiber

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Ultimate Load

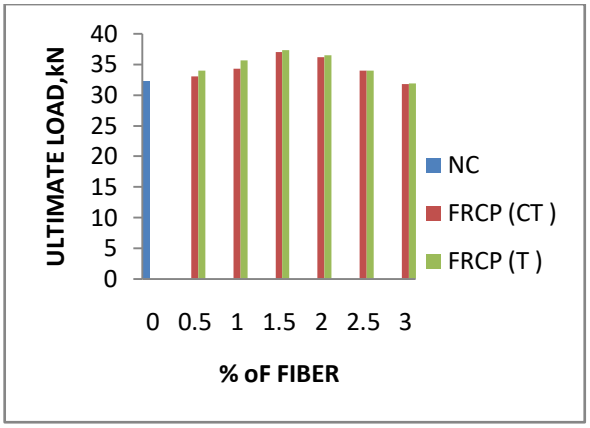

Fig 7 Comparison of Ultimate Load of Concrete with Different % of Fiber

For concrete with addition of Plastic fiber (FRCP (CT)) of 0.5%, 1.0%, 1.5%, 2.0% and 2.5% the increase in ultimate load compare to conventional concrete is observed to be 2.4%,6.5%, 14.7.5% , 12% and 1.35.3% respectively, for addition of 3% of fiber strength decrease by 1.3% .

Deflection at Ultimate Load

Corresponding deflection of slab with and without fiber at ultimate load variation of values similar to the ultimate load with addition of fiber**.**

For concrete (FRCP (CT)) compared to conventional concrete(CC) the increase in deflection at ultimate load for fiber 0.5%, 1.0%, 1.5% ,2.0 ,2.5% and 3% is observed to be 1.1%, 4.1%, 61% ,56 %, 26% and 2.3% respectively.

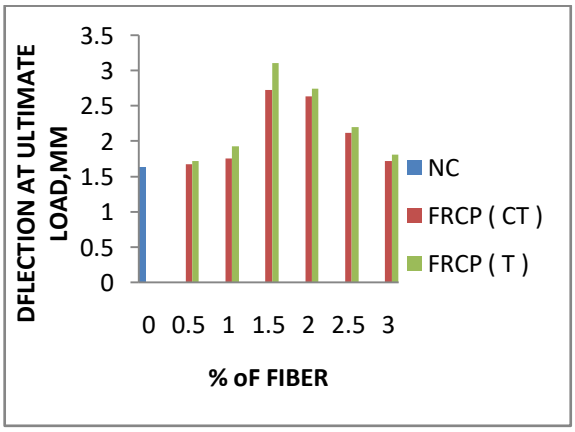

Fig 8 Comparison of Deflection at Ultimate Load of Concrete with Different % of Fiber

The dispersion of Plastic fiber intension zone (FRCP(T)) has more influence on First crack load ,Ultimate load and its corresponding Deflection.For an optimum Percentage of 1.5% of fiber the First crack load ,Ultimate load and its corresponding Deflection compare to conventional concreteincreased by 37.3%, 15.9% and 100%,84.5% respectively.

Cracks in Slabs

Fig.(9,10 and 11) shows the cracks produced in the slabs CCand FRCP for 1.5% fiber content, it is seen that number of cracks are less in concrete with plastic fiber slabs compared to CC slabs.

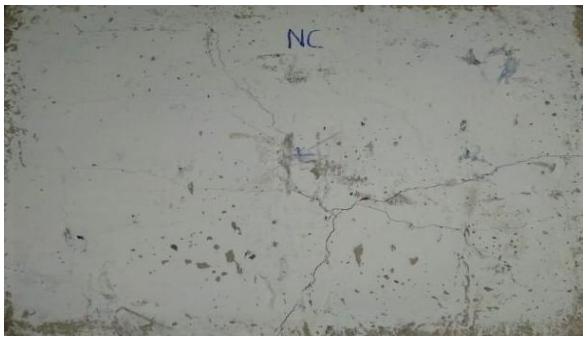

Fig 9: Crack Pattern of Conventional Concrete Slab

Fig 10: Crack Pattern of FRCP (CT) 1.5% Fiber Content Slab

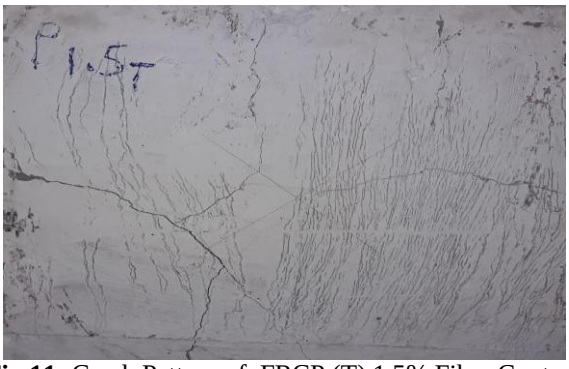

Fig 11: Crack Pattern of FRCP (T) 1.5% Fiber Content Slab

V .CONCLUSIONS

- The FRC slabs with fiber dispersed on the compression tension zone and only tension zone side shows increase in its strength compare to conventional concrete.
- The FRC slabs with fiber dispersed on the tension side shows maximum increase in its strength , first crack load , ultimate load and their corresponding deflections compare to conventional concrete.

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- The addition of Plasticfiber to the concrete shows maximum increase in the First crack load and its corresponding deflection compared to ultimate load.
- The first crack load and its corresponding deflection of FRC slabs of FRCP(T) with 1.5% fiber compared to conventional concrete is found to be increased by 36.9% and 77.7% respectively.
- The ultimate load and its corresponding deflection of FRC slabs of FRCP(T) with 1.5% fiber compared to conventional concrete is found to be increased by 14.7% and 42.9% respectively.
- The slab with Fiber dispersed on Tension side FRCP(T), shows more resistant to crack propagation. Number of cracks produced are considerably less compared to CC and FRCP (CT).
- The inherent properties of industrial waste can be effectively utilized in increasing the strength of concrete efficiently, instead of destroying its useful inherent properties. Also in turn reducing the problem of disposal.

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