

REPORT

**STUDY ON EFFECTIVENESS OF
FIBRILLATED POLYPROPYLENE FIBRES
CONDUCTED FOR
TASHI INDIA LIMITED**



GEOTECH SERVICES

SOIL & MATERIAL TESTING LABORATORY

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1 INTRODUCTION

Study on effectiveness of polypropylene fibrillated fibers for improving properties of concrete is conducted for Tashi India Limited. Improvement in flexural, direct tension & abrasion is examined after addition of fibers in concrete of grade M45 against controlled concrete.

2 METHODOLOGY

The methodology adopted for the study is as under -

- a. Controlled concrete mix of grade M45 is designed, using the coarse aggregates of maximum 20 mm size. After finalising the concrete mix, thirty cubes were casted each for, control mix, with 20 mm. fibres and with 24 mm. fibres. Similarly thirty sets of beams of size, 15cm x 15cm x 70cm, were also casted for flexural strength. Dosage of fibres was maintained as single dose (@900 gms/cu.m) . All specimens were tested for 28 days strength.
- b. Specimens were also casted for Direct Tension & Abrasion.
- c. 12 specimens each, for Compressive & Flexural strength were also prepared for 90 days strength for all above combinations, to verify increase in strength.
- d. Physical properties of coarse & fine aggregates were controlled by selecting material from single lot, these are also verified by testing on representative samples.
- e. Cement used was also purchased from single batch.
- f. All test equipments & machines were verified for their calibrations before study.

- 3.1 **Aggregates** - Coarse aggregates used were Crushed Basalt from cone crushing plant. Maximum particle size was 20 mm and were non flaky / elongated in shape. Fine aggregates used were natural sand from River Wainganga.

3.1.1 Sieve Analysis of Coarse & Fine Aggregates.

Sieve Size mm.	Percent Passing		
	20 mm.	10 mm.	Sand(Dry Analysis)
40	100	100	100
20	91.2	100	100
10.0	1.1	97.3	100
4.75	0	16.5	97.3
2.36		0.5	94.3
1.18	--		83.1
0.6		--	57.1
0.3		--	18.7
0.15		--	1.4
		Fineness Modulus of Sand	2.48
		Sand Conforming to Zone	Zone II

3.1.2 Other Properties

Sr.	Properties	Sand	Coarse Aggregate
a.	Specific Gravity	2.62	2.84
b.	Water absorption	1.3 %	1.1 %
c.	Surface moisture	NIL	NIL
d.	Flakiness Index 20 mm.	--	11.6 %
e.	Flakiness Index 10 mm.	--	16.8 %

3.2 Cement – Ultrtech 53 Grade

a.	Consistency	27.5 %
b.	Specific Gravity	3.137
c.	Initial Setting time	200 min
d.	Final Setting time	280 min
e.	Soundness by Le'Chattelier Expansion	0.50 mm
f.	Specific Surface by Blain's Air	297 sq.m / Kg
g.	3 Days Compressive Strength	29.5 Mpa
h.	7 Days Compressive Strength	35.0 Mpa
i.	28 Days Compressive Strength	54.5 Mpa

3.3 Fibrillated Polypropylene Engineered Fibres

Commercial Name : Bajaj Plast Fibres.

Technical Specification (supplied by M/s Tashi India Ltd.)

S.No.	Property	Value
1	Specific Gravity	0.91
2	Tensile Strength	0.67 kN/Sq.mm.
3	Yong's Modulus	4.0 kN/Sq.mm.
4	Melting Point	1650 C
5	Ignition	6000 C
6	Absorption	Nil
7	Bulk Density	910 Kg/m ³
8	Form	Fibrillated
9	Dosage (Normal)	0.25 to 0.40 % by weight of cement

4. MIX DESIGN

4.1 Design Stipulations

Following design stipulations are considered based on proposed use for pavement , site conditions and requirements of IS:456-2000.

Properties	M45 PQC
Type of concrete	Pavement Quality Concrete
Degree of exposure	Moderate
Degree of quality control	Good
Degree of Workability	0.75 Compaction factor
Maximum size of aggregate	20 mm
Maximum Water Cement Ratio	0.50
Minimum cement content	340 Kg / cu.m

4.2 Target Mean Strength (ft)

The target mean strength is given as

$$f_t = f_{ck} + K.S$$

f_{ck} = Characteristic strength required

K = A statistical value based on accepted proportion of

Lower test results and number of test

1.65 for 5 % tests results below f_{ck} .

S = Standard of deviation based grade of concrete

Hence $f_t = 53.3$ Mpa for M45

4.3 Control Mix

Based on the trials taken, the mix finalised as a control mix is as under –

Properties	M45 WITH 20 MSA.
Mix Proportion	1 : 1.51 : 2.81
Water Cement Ratio	0.33
Cementitious Content	450 kg/cu.m.
Cement Content	338 kg/cu.m.
Fly Ash Content	112 kg/cu.m.
Percent Cement Replaced	25 %
Sand Content	680 kg/cu.m.
Coarse Aggregates 20 mm. @ 70 %	885 kg/cu.m.
Coarse Aggregates 10 mm. @ 30 %	379 kg/cu.m.
Admixture SP-500 of FOSROC	5.4 kg/cu.m.
Water Content (W.rt. WC Ratio)	148.5 kg/cu.m.
Water Absorption of CA @ 1.1 %	13.9 kg/cu.m.
Water Absorption of FA @ 1.3 %	8.8 kg/cu.m.
Total Water Content	181.2 kg/cu.m.

5. TRIALS USING FIBRES

Using Fibrillate – 20 mm. and 24 mm. specimens were casted in following manner. These are tested for the properties indicated Average strength and standard deviation are reported in results. -

Properties	Control Mix	20 mm. Fibre	24 mm. Fibre
Compressive Strength	30 cubes	30 cubes	30 cubes
Flexural Strength Beams 10 x 10 x 50 cm.	30 beams	30 beams	30 beams
Direct Tension	10 Specimen	10 Specimen	10 Specimen
Abrasion	6 Specimen	6 Specimen	6 Specimen

Number of specimen mentioned in the table are casted dosage @ 900 gms/cu.m. During preparation of specimen, fibres are added to ingredients during moist mixing and then remaining water is added. The mix proportion and water cement ratio were maintained alike.

6. RESULTS

The results obtained are given below –

COMPRESSIVE AND FLEXURAL STRENGTHS

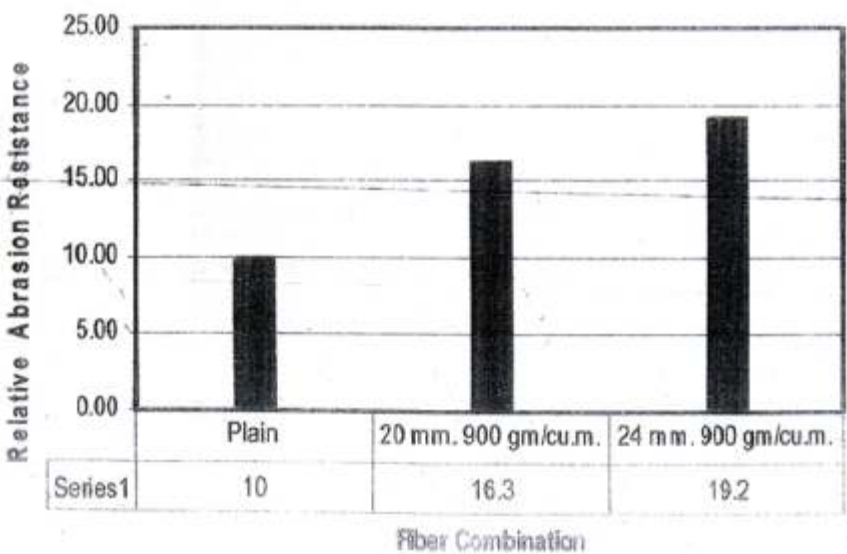
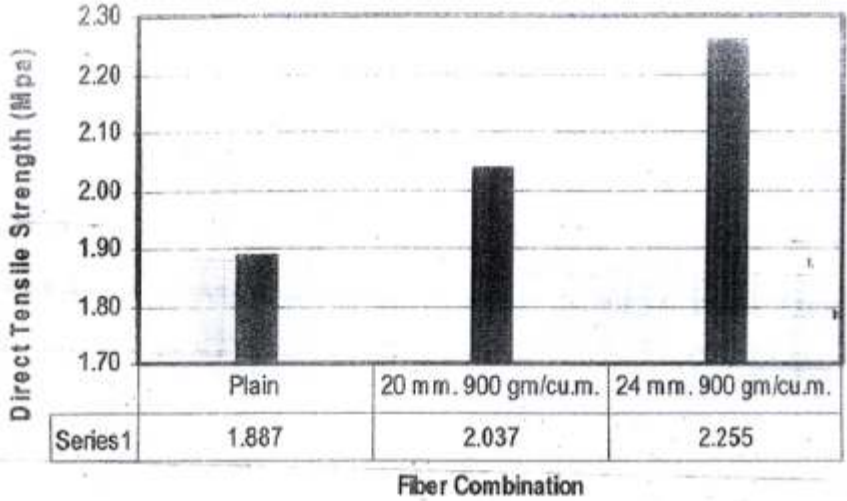
Fibres	28 Days		90 Days	
	Flexural Mpa	Compressive Mpa	Flexural Mpa	Compressive Mpa
Control Mix	5.1	52.8	5.6	59.5
20 mm fibres	5.4 (5.9 %)	58.4 (10.6%)	5.9 (5.4 %)	65.3 (9.6%)
24 mm fibres	5.9 (15.7 %)	61.2 (15.9 %)	6.2 (10.7 %)	69.8 (17.1%)
Multiplier (m) $f_{cr} = m\sqrt{f_{ck}}$	Control Mix, $m = 0.70$ 20 mm. Fibre, $m = 0.70$ 24 mm. Fibre, $m = 0.75$		Control Mix, $m = 0.73$ 20 mm. Fibre, $m = 0.73$ 24 mm. Fibre, $m = 0.74$	

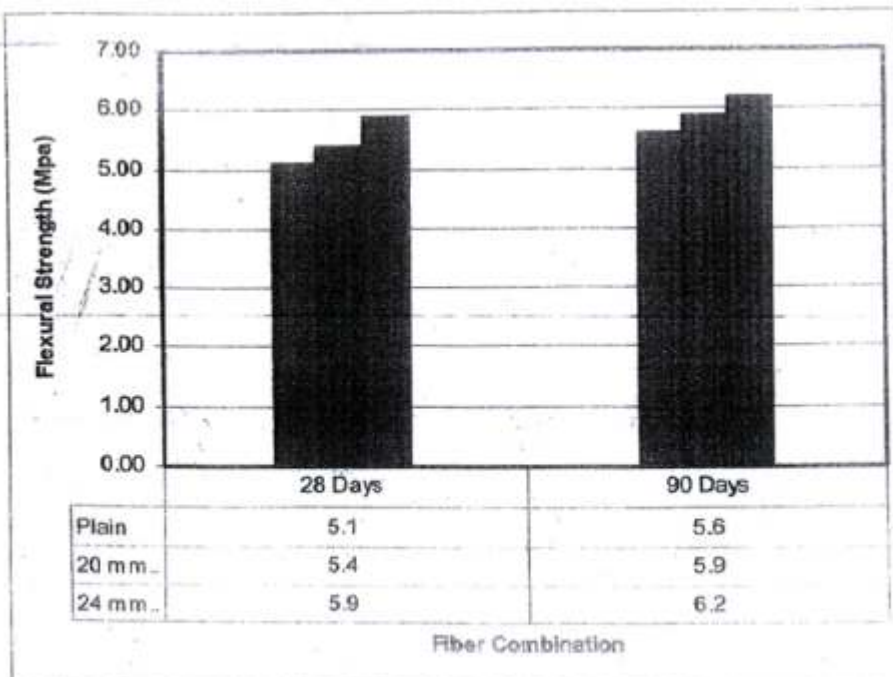
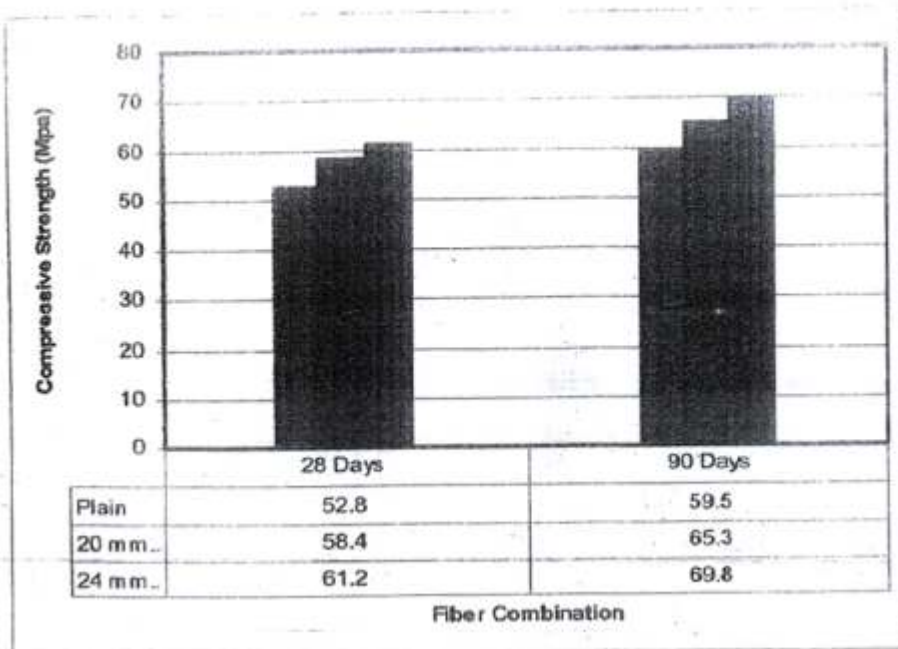
Note : Values in bracket indicate % strength increase w.r.t. control mix.

DIRECT TENSION AND ABRASION RESISTANCE

Sr.	Test	Control Mix	20 mm. Fibers	24 mm. Fibers
1.	28 Days Direct Tensile Mpa	1.89	2.04	2.25
2.	28 Days Abrasion resistance (Wear in mm)	1.02	0.85	0.83

Above results are also represented in following charts.





7 DISCUSSION OF RESULTS

Results indicate that, both Flexural and compressive strengths are improved when fibres are used. Enhancement in compressive strength is observed up to about 16 % at 28 days and 17 % at 90 days for fibres with a higher aspect ratio i.e. 24 mm. Flexural strength is also increased by 5.4 to 15.7 % with different fibre combination and age at testing.

Direct tensile strength improved significantly while using fibres. Moreover with higher aspect ratio and higher dosage of fibres the enhancement of strength is observed even up to 28 %. The increase in strength is due to orientation on fibres. Unlike in flexural strength, where only part of beam below neutral axis resists initial crack propagation, in direct tension, the distribution of fibres perpendicular to crack being more, higher improvement is observed.

Wearing resistance, when tested by method based on ASTM C-779, is improved and mixes with fibres indicated relatively better abrasion resistance.

8. CONCLUSION

Improvement in Flexural & Compressive Strengths, also in direct tension & abrasive resistance is possible; with addition of Fibrillated Polypropylene Fibres of M/s Tashi India Limited, Nagpur.

For GEOTECH SERVICES



A.M. SHINGAREY
Chief Consulting Engineer



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(Deemed University)

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DEPARTMENT OF CIVIL ENGINEERING

CE-1456/CT-1582/ADP/6804
December 24, 2008

30 DEC 2008

To,
M/s. RMC Readymix (India) Pvt. Ltd
C-9 Hingna M.I.D.C. Industrial Area,
Near Tata Motors, Nagpur.

Through:- Mr. Visvas Dabri
Sub:- Testing of concrete cubes Dt. 16/12/08.
Ref:- Your L.No. Rmc/qa-qc/096/08, dated 16/12/2008

TEST REPORT ON CEMENT CONCRETE CUBES
(Nominal Size - 150x150x150mm x mm x mm)

Sr. No.	Identification Mark	Weight of cube in kg.	Size of cube in mm L x B x H	Date of		Crushing load in kN	Compressive strength in N/mm ²
				Casting	Testing		
1	RMC M-35 20/11/08	8.680	150x151x149	20/11/08	18/12/08	1290	56.95
2	"	8.659	150x150x150	"	"	1300	57.70
3	"	8.645	151x150x151	"	"	1180	52.00

Remarks:- 1) The above results relate to the cube samples supplied to this laboratory. Cube received on dated 16/12/2008 vide Job No. 1456.

Bill

Sir,
Please find enclosed a test report and bill for Rs. 169/- as given below which is paid by you through cash at SBI-YRCE Br. Nagpur Vide Chalan No. C7/B/07/6700 dated 22/12/08

Sr.No.	Name of work/test	Rate/Sample	No. of Samples	Amount Rs.
1.	Testing of C.C.Cube	150/-	1	Rs. 150.00
Add:-	Service Tax	12.36%		Rs. 19.00
(Rs. One Hundred and Sixty Nine only)				
TOTAL AMOUNT				Rs 169.00

AE
24/12/08
Dean (R.&D)

Amj
24/12/08
Test

Amj
24/12/08
Head of the Deptt. of Civil Engg.