AN EXPERIMENTAL INVESTIGATION OF VARIOUS STRENGTH PARAMETERS OF SELFCOMPACTING CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY HYPOSLUDGE

Kollati Yedukondalu, Civil Engineering GIET (A) Rajahmundry–533296
Email:k.kalyan612@gmail.com

Dr. D. Venkateswarlu, Professor & HOD Dept.of Civil Engineering, GIET (A) Rajahmundry-533296, Email:dumpa.venkateswarlu@gmail.com

Divya Anusha Naidu, Asst. Professor & Dept.of Civil Engineering, GIET (A) Rajahmundry-533296, Email: anuusha.naidu@gmail.com

ABSTRACT: Self-compacting concrete (SCC) is a special concrete which is highly flow able, non-segregating and by its own weight spread into place, completely fill the formwork even in the presence of dense reinforcement and then encapsulate the rebar without the need of any additional compaction. Similarly with other cement-based materials, SCC also has a brittle characteristic. The mix design for SCC is arrived as per the guidelines of EFNARC. In this investigation, SCC is made by usual ingredients such as cement, fine aggregates, coarse aggregates, water and mineral admixture. The super plasticizer used is Master Gelenium 8777 and the viscosity modifying agent used is Gelenium stream 2.Fresh characteristics are evaluated based on its passing ability, flow ability, viscosity and segregation resistance using J-Ring, slump flow, L-Box test, V-Funnel test and U-Box tests. This research is to study the strength parameters of conventional SCC and fiber reinforced self-compacting concrete with OPC and PPC; the conventional SCC compared with different percentages of fiber reinforced SCC in individual cements of OPC and PPC, and also comparison made between fibers reinforced SCC at different percentages in OPC and PPC. In this work 30 grade of self-compacting concrete mix is designed for both OPC and PPC. For this mix design, hypo sludge is replaced and optimum percentage is found in both cements (4 % for OPC and 2% for PPC). To this optimum percentage of hypo sludge mix, polypropylene fibers (6 mm cut length) of different percentages as 0.2, 0.3, 0.4, and 0.5 per cent are added in both OPC and PPC.Workability and segregation resistance are maintained with increasing percentage of fibers by using super plasticizer and viscosity modifying agent. After 7 and 28 days of curing, the compressive and split tensile strengths are found. Further it can be concluded that polypropylene fiber reduce deformability of SCC in the

fresh state and also with increasing fiber content, mode of failure is changed from brittle to ductile failure, when subjected to compression and splitting. It can be observed from the work, the compressive and split tensile strength results are shown that the addition of 0.2 per cent polypropylene fiber enhanced the mechanical properties in both OPC and PPC.

INTRODUCTION

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete.

Self-compacting concrete (SCC) has been described as "the most revolutionary development in concrete construction for several decades". Originally developed to offset a growing shortage of skilled labor, it has proved beneficial economically because of a number of factors, including:

- Faster construction
- Reduction in site manpower
- Better surface finishes
- Easier placing
- Improved durability
- Greater freedom in design
- Thinner concrete sections
- Reduced noise levels, absence of vibration

Advantages of SCC

At present selfcompacting concrete (SCC) can be classified as an advanced construction material. The SCC as the name suggests, does not require to be vibrated to achieve full compaction. This offers benefits and advantages over conventional concrete.

- Significant reduction in the cost of cast in-situ concrete construction by eliminating compaction needed during the concreting, labour and equipment wear and tear cost related to compaction.
- No vibration of fresh concrete is necessary during placement into forms

- Faster and more efficient placement of fresh concrete is achieved. Total concreting time is reduced.
- Noise level on construction site is reduced. Thus the number of working hours on the construction site can be increased and the night shift in urban zones is enabled.
- Safer and healthier working environment is obtained. Upon self-compacting concrete hardening in structures.
- Good bond between concrete and reinforcement is obtained, even in congested reinforcement.
- High quality of concrete surface finish is obtained with no need for subsequent repair.
- With a better final appearance of concrete surface, smooth wall surfaces and flat floor surfaces that need no further finishing are obtained.
- Improved durability of structures is achieved.

Benefits of hypo sludge

- Hypo sludge improves the properties of fresh and hardened concrete.
- Hypo sludge reduces degradation and bleeding.
- Hypo sludge improves the durability of concrete.
- Hypo sludge improves the setting of concrete due to presence of silica and magnesium.
- Environmental friendly.
- Light weight compare to conventional concrete.
- Hypo sludge is the cheaper substitute to cement.

EXPERIMENTAL INVESTIGATION

This work is to study the strength parameters of conventional and fiber reinforced self-compacting concrete with ordinary Portland cement (OPC) and Portland pozzolana cements (PPC); the conventional SCC compared with different percentages of fiber reinforced SCC in individual cements of OPC and PPC, and also comparison made between fibers reinforced SCC at different percentages in OPC and PPC. In this work, M 30 grade of concrete mix is designed for both OPC and PPC. For this mix design of OPC and PPC, hypo sludge is replaced by weight of cement with different percentages such as 2, 4, 6, 8 and 10% in both cements respectively. The optimum percentage of hypo sludge mix is found in both cements (i.e., 4 % for OPC and 2 % for PPC) and addition of different percentages such as 0.2, 0.3, 0.4, and 0.5 per cent polypropylene fibers of 6mm cut length to the optimum percentage of hypo sludge mix in both cements. After 7 and 28 days of curing, the compressive and split tensile strength results are found for all mixes.

1. *Material used*

The constituents used in selfcompacting concrete are

1. Cement 2. Fine aggregate 3. Coarse aggregate 4. Water 5. Hypo sludge 6. Fiber
7. Superplasticiser 8. Viscosity modifying agent

Table 1.1 Physical properties of cement

Sr. No.	Property	OPC test result	PPC test result	Permissible limits
1	Standard Consistency	33%	35%	25-35%
2	Initial Setting Time	45 min	44 min	30 Min
3	Final Setting Time	450 min	495 min	600 min
4	Specific Gravity	3.10	3.0	3.10

Table 1.2 Sieve analysis of fine aggregate

IS Sieve size	Weight retained (kg)	Percentage weight retained	Percentage passing	Grading limits IS: 383-1970 Zone II (%)
10 mm	0	0	100	100
4.75mm	9	0.9	99.1	90-100
2.36mm	25	3.4	96.6	75-100
1.18mm	163	19.7	80.3	55-90
600µ	408	60.5	39.5	35-59
300µ	210	81.5	18.5	8-30
150 µ	165	98	2	0-10
<150 µ	20	-	-	-
Total	1000	264		

Fineness Modulus = Cumulative Percentage weight retained / 100

= 264/100

= 2.64

Fine aggregate belongs to Zone II

The properties of fine aggregate are found those are specific gravity 2.64, bulk density 1635 $kN/m^3$and fineness modulus 2.64.

Table 1.3 Sieve analysis of coarse aggregate

IS sieve size (mm)	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % weight retained	Cumulative % passing	Grading limits For 12.5 mm graded aggregate IS 383-1970 (%)
20	0	0	0	100	100
12.5	400	400	8	92	90-100
10	2200	2600	52	48	40-85
4.75	2100	4700	94	6	0-10
2.36	300	5000	100	-	-
Total	5000	-	-	-	-

Table 1.4 Physical Properties of coarse aggregate

Sr. No.	Property	Test Result
1	Specific Gravity	2.67
2	Bulk Density(kN/m^3)	1465

Table 1.5 Chemical properties of hypo sludge

Sr. No.	Constituents	%
1.	Lime	49
2.	Silica	5.5
3.	Alumina	2

4.	Magnesium	1.6
5	Sodium oxide	1.6
6.	Potassium oxide	1.6

Polypropylene fiber characteristics

1) Strong, 2) Resistant to stretching and shrinking, 3) Resistant to most chemicals, 4) Quick drying, 5) Crisp and resilient when wet or dry, 6) Wrinkle resistant, 7) Abrasion resistant

Physical and chemical composition of polypropylene fiber

Table 1.6 Physical and chemical composition of polypropylene fibers

Product type	CTP-2017, Polypropylene
Cross-section	Triangular
Cut Length	6 mm
Diameter	30-35μ
Tensile Strength	4500-6000 psi
Melting Point	327°C
Dispersion	Excellent
Acid Resistance	Excellent
Specific gravity	0.98-1.24
Moisture regain	1-2 %
Elasticity	Good
Elongation at break	2.2-50 %

Table 1.7 Properties of superplasticiser

Sr. No.	**Properties**	**Result**
1	Aspect	light brown liquid
2	Relative density	1.10±0.01at 25^{0}C
3	pH	≥6
4	Chloride ion content	<0.2%

Table 1.8 Properties of Viscosity modifying agent

Sr. No.	Properties	Result
1	Aspect	colourless free flowing liquid
2	Relative density	1.01±0.01at 25^0C
3	pH	≥6
4	Chloride ion content	<0.2%

2. *Mix details*

In the present investigation mix proportioning is done using IS 10262:2009 method for M 30 grade concrete. The resulting mixes are modified after conducting trials at laboratory by duly following the EFNARC guidelines to achieve the selfcompacting concrete mix proportion. Mix design followed with the guidelines specified in European Federation dedicated to specialist construction chemicals and concrete systems (EFNARC 2005). The design SCC mix 30MPa was obtained by number of trails with varying quantities of constituent material. The aforementioned mixes are attained after number of trials. Such mixes can be made possible only by using the appropriate ingredients in proper proportions. The final mix proportions are shown in Table 3.9

Table 2.1 Final mix proportions of SCC

Cement (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	W/C Ratio	S.P %		VMA %	
				OPC	PPC	OPC	PPC
460	945	730	0.3	0.7	0.45	0.5	0.3

3. *Workability test results of self-compacting concrete*

The fresh characteristics of self-compacting concrete need to be measured to evaluate its workability performance criteria (i.e., passing ability, flow ability and segregation resistance). Slump flow, V- funnel test, L- Box test and J-ring tests are conducted to characterize the fresh State properties of SCC. The test procedures are given below.

Table 3.1 Workability test results of self-compacting concrete

Test Method	Property	Unit	Value	Recommended values as per EFNARC Guidelines
Slump flow by Abram's cone	Filling ability	mm	700	650-800 mm
T_{50} Slump flow	Filling ability	sec	4.5	2-5 sec
J-Ring	Passing ability	mm	7	0-10 mm
V-Funnel	Filling ability	sec	11.5	8-12 sec
L-Box	Passing ability	h_2/h_1	0.9	0.8-1.0
L-Box T_{20}	Passing ability	sec	3	-
L-Box T_{40}	Passing ability	sec	4.5	-

4. *Testing of specimens*

4.1 *Compressive strength testing machine*

A standard test cube of concrete specimen (150 × 150 × 150 mm) square side is placed horizontally between the loading surfaces of compressive testing machine (Fig 3.13). The capacity of the testing machine is 2000kN the machine has a facility to control the rate of loading with a control valve. Apply the continuously without shock at rate of approximately 140 $kg/cm^2/min$. the compressive strength of concrete is determined by testing of failure at 28 days curing. It is the standard test, to determine tensile strength of concrete in an indirect way. This test would be performed in accordance with IS 516:1959. The plates are cleaned, and kept ready in all aspects of testing. After the required period of curing, the specimens are removed from the curing tank and cleaned to wipe off the surface water. Concrete specimens were allowed to dry for some time at room temperature. Compressive strength of the cube specimens are found by the following method. The cube specimens are placed on the machine such that the load is applied gradually. The smooth surfaces of the specimen are placed on the bearing surfaces. The top plate is brought in contact with the specimens by rotating the handle.

Fig 4.1 Compressive strength testing machine

4.2 *Split tensile strength testing machine*

A standard test cylinder of concrete specimen (300 × 150 mm) diameter is placed horizontally between the loading surfaces of compressive testing machine (Fig 3.14). It is the standard test, to determine tensile strength of concrete in an indirect way. This test would be performed in accordance with IS 5816:1970. The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder along the vertical diameter. Apply the load continuously without shock at a rate of approximately 14-21 kg/cm^2/min. As per IS 456 the split tensile strength of concrete $0.7\sqrt{fck}$. It is estimated that the compressive stress is acting for about 1/6 th depth and the remaining 5/6 th depth is subjected to tension due to poisons effect.

Fig 4.2 Split Tensile strength testing machine

4.3 *Flexural strength testing machine*

A variety of specimen shapes can be used for this test, but the most commonly used specimen size for ASTM is 3.2mm x 12.7mm x 125mm (0.125" x 0.5" x 5.0") and for ISO is 10mm x 4mm x 80mm. Most commonly the specimen lies on a support span and the load is applied to the center by the loading nose producing three point bending at a specified rate. The parameters for this test are the support span, the speed of the loading, and the maximum deflection for the test. These parameters are based on the test specimen thickness and are defined differently by ASTM and ISO. For ASTM D790, the test is stopped when the specimen reaches 5% deflection or the specimen breaks before 5%. For ISO 178, the test is stopped when the specimen breaks. If the specimen does not break, the test is continued as far a possible and the stress at 3.5% (conventional deflection) is reported.

Fig 4.3 Flexural strength testing machine

RESULTS AND DISCUSSIONS

This chapter deals with the results of experimental investigations carried out in different phases. The results of workability and strength characteristics of self-compacting concrete of different mixes are studied in this chapter. The hardened concrete properties namely compressive and split tensile strengths of conventional fiber reinforced self-compacting concrete are studied at 7 and 28 days. Then for mixes OPSCC2, OPSCC4, OPSCC6, OPSCC8 and OPSCC10 (2, 4, 6, 8 and 10% replacement of hypo sludge in OPC) similarly for mixes PPSCC2, PPSCC4, PPSCC6, PPSCC8 and PPSCC10 (2, 4, 6, 8 and 10 % replacement of hypo sludge in PPC), compressive strength values are found at an age of 7 and 28 days. The optimum percentage of hypo sludge mix is found in OPC is 4% and PPC is 2%. For the optimum percentage of hypo sludge mix, recron 3S polypropylene fibers of 6 mm cut length are added with different percentages namely 0.2, 0.3, 0.4 and 0.5% (PPFRSCC1, PPFRSCC2, PPFRSCC3 and PPFRSCC4 respectively). For these polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) mixes, compressive and split tensile strength characteristics are discussed at 7 and 28 days. OPSCC stands for ordinary Portland selfcompacting concrete and the numerical value represents percentage of hypo sludge replaced in cement. Example OPSCC2 is the 2 per cent of hypo sludge is replaced by weight of cement in ordinary Portland selfcompacting concrete. Similarly PPSCC2 is the 2 per cent of hypo sludge is replaced by weight of cement in Portland pozzolana selfcompacting concrete.

4.4 *Flow table values for self-compaction concrete and PPFRSCC*

The flow table results for ordinary Portland cement (OPC) with polypropylene fibers of 6 mm cut length are discussed. The flow table value of conventional selfcompacting concrete (SCC) mix (i.e., M0) is obtained 650 mm. The flow table value of 2 per cent hypo sludge replaced in ordinary Portland selfcompacting concrete (i.e., OPSCC2) is obtained 635 mm. Similarly the flow table values of OPSCC4, OPSCC6, OPSCC8 and OPSCC10 are obtained 640, 650, 628 and 648 mm respectively. The flow table value of 0.2 per cent polypropylene fibre reinforced self-compacting concrete with optimum percentage of hypo sludge (PPFRSCC1) is obtained 640 mm. Similarly the flow table values of PPFRSCC2, PPFRSCC3, and PPFRSCC4 are obtained 630, 620 and 650 mm respectively. The flow table values of all mixes are satisfied with EFNARC guidelines recommended value 550 to 800 mm. Flow table results are given

Table 4.4.1Flow table results for OPC (Polypropylene fibres, 6 mm)

Sr. No.	Mix details	Percentage of hypo sludge (%)	Percentage of fibre (%)	Flow table value (mm)
1	M0	0	-	650
2	OPSCC2	2	-	635
3	OPSCC4	4	-	640
4	OPSCC6	6	-	650
5	OPSCC8	8	-	628
6	OPSCC10	10	-	648
7	PPFRSCC1	4	0.2	640
8	PPFRSCC2	4	0.3	630
9	PPFRSCC3	4	0.4	620
10	PPFRSCC4	4	0.5	650

The flow table results for Portland pozzolana cement (PPC) with polypropylene fibers of 6 mm cut length are discussed. The flow table value of conventional self compacting concrete (SCC) mix (i.e., M0) is obtained 650 mm. The flow table value of 2 per cent hypo sludge replaced in Portland pozzolana self compacting concrete (i.e., PPSCC2) is obtained 640 mm. Similarly the flow table values of PPSCC4, PPSCC6, PPSCC8 and PPSCC10 are obtained 644, 630, 620 and 630 mm respectively. The flow table value of 0.2 per cent polypropylene fibre reinforced self-compacting concrete with optimum percentage of hypo sludge (PPFRSCC1) is obtained 620mm. Similarly the flow table values of PPFRSCC2, PPFRSCC3, and PPFRSCC4 are obtained 615, 620 and 610 mm respectively. The flow table values of all mixes are satisfied with EFNARC guidelines recommended value 550 to 800 mm. Flow table results are given

Table 4.4.2Flow table results for PPC (Polypropylene fibers, 6 mm)

Sr. No.	Mix details	Percentage of hypo sludge (%)	Percentage of fibre (%)	Flow table value (mm)
1	M0	0	-	650
2	PPSCC2	2	-	640
3	PPSCC4	4	-	644
4	PSSCC6	6	-	630
5	PPSCC8	8	-	620
6	PPSCC10	10	-	630
7	PPFRSCC1	2	0.2	620
8	PPFRSCC2	2	0.3	615
9	PPFRSCC3	2	0.4	620
10	PPFRSCC4	2	0.5	610

The addition of hyposludge into selfcompacting concrete (SCC) mixes tends to decreases the flow values. As the percentage of fibres increases, the flow values in SCC mixes are decreases. The workability and segregation resistance are maintained with increasing percentage of fibres by using super plasticizers and viscosity modifying agent (VMA).

4.5 *RESULTS OF STRENGTH PARAMETERS*

4.5.1 Optimum percentage of hyposludge values of OPC at 4%

OPC 4% Optimum	7 Days	28 Days
Compressive strength (MPa)	**35.65**	**45.20**
Split tensile strength (MPa)	**3.21**	**4.32**

Flexibility strength (MPa)	**2.95**	**4.25**

4.5.2Optimum percentage of hyposludge values of PPC at 2%

PPC 2% Optimum	**7 Days**	**28 Days**
Compressive strength (MPa)	**32.20**	**42.21**
Split tensile strength (MPa)	**2.90**	**4.30**
Flexibility strength (MPa)	**2.85**	**4.1**

4.5.3*CompressiveStrength, split tensile strength and Flexural Strength of conventional self-compacting concrete (SCC) and polypropylene fiber reinforced self-compacting concrete (PPFRSCC) with ordinary Portland cement at an age of 7 and 28 days.*

The compressive strengths of conventional self-compacting concrete (SCC) with ordinary Portland cement (OPC) are obtained 25.2 and 38.65 MPa at 7 and 28 days curing respectively. The compressive strengths of polypropylene fiber reinforced self-compacting concrete (PPFRSCC) for ordinary Portland cement (OPC) are obtained 35.60, 32.60, 31.2 and 28.65 MPa for 7 days and similarly 43.65, 42.25, 39.26 and 37.25 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5 per cent of polypropylene fibers respectively. In ordinary Portland cement, the split tensile strengths of conventional self-compacting concrete (SCC) with ordinary Portland cement (OPC) are obtained 2.45and 3.45 MPa at 7 and 28 days curing respectively. The split tensile strengths of polypropylene fiber reinforced self-compacting concrete (PPFRSCC) for ordinary Portland cement (OPC) are obtained 3.46, 3.25, 2.90 and 2.81 MPa for 7 days and similarly 4.54, 3.50, 3.10 and 3.00 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5per cent of polypropylene fibers respectively. In ordinary Portland cement, the Flexibility strengths of conventional selfcompacting concrete (SCC) with ordinary Portland cement (OPC) are obtained 2.8 and 4.0 MPa at 7 and 28 days curing respectively. The Flexibility strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) for ordinary Portland cement (OPC) are obtained 3.8,3.65,3.2 and 2.7 MPa for 7 days and similarly 4.3,3.85,3.6 and 2.95 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5per cent of polypropylene fibers respectively. Here the compressive strengths, split tensile strengths of conventional SCC and different percentages of PPFRSCC with ordinary Portland cement at an age of 7 and 28 days.

Table 4.5.3CompressiveStrength, split tensile strengths and Flexural Strength of conventional SCC and PPFRSCC with OPC at 7 and 28 days of curing.

Concrete designation	Percentage of fibres (%)	Compressive Strength (MPa)		Split tensile strength (MPa)		Flexural strength (MPa)	
		7 days	28 days	7 days	28 days	7 days	28 days
Conventional OPC	0	25.2	38.65	2.45	3.45	2.8	4
PPFRSCC1	0.2	35.60	43.65	3.46	4.54	3.8	4.3
PPFRSCC2	0.3	32.60	42.25	3.25	3.5	3.65	3.85
PPFRSCC3	0.4	31.2	39.26	2.90	3.1	3.2	3.6
PPFRSCC4	0.5	28.65	37.25	2.81	3	2.7	2.95

4.5.4*Compressive strength and split tensile strengths and Flexural Strength of conventional self-compacting concrete (SCC) and polypropylene fiber reinforced self-compacting concrete (PPFRSCC) with Portland pozzolana cement at an age of 7 and 28 days*

The compressive strengths of conventional self-compacting concrete (SCC) with Portland pozzolana cement (PPC) are obtained 27.5 and 39.20MPa at 7 and 28 days curing respectively. The compressive strengths of polypropylene fiber reinforced self-compacting concrete (PPFRSCC) for Portland pozzolana cement (PPC) are obtained 34,29,27.5, and 26.78 MPa for 7days and similarly 42.5,41,40.2 and 38.5 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5 per cent of polypropylene fibers respectively. In Portland pozzolana cement, the split tensile strength of conventional self-compaction concrete (SCC) are obtained 3.4 and 4.35 MPa at 7 and 28 days curing respectively. The split tensile strengths of polypropylene fiber reinforced self-compacting concrete (PPFRSCC) for Portland pozzolana cement (PPC) are obtained 3.15, 2.9, 2.54 and 2.3MPa for 7days and similarly 4.12, 3.8, 3.54 and 2.9 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5 per cent of polypropylene fibers respectively. The Flexibility strength of conventional self-compaction concrete (SCC) are obtained 2.7 and 4.2 MPa at 7 and 28 days curing respectively. The split tensile strengths of polypropylene fiber reinforced self-compacting concrete (PPFRSCC) for Portland pozzolana cement (PPC) are obtained 3.25, 3.1, 2.9 and 2.75 MPa for 7days and similarly 4.5, 4.35, 4.22and 3.9 MPa for 28 days curing at 0.2, 0.3, 0.4 and 0.5 per cent of polypropylene fibers respectively. Here the compressive, split tensile strength and

FlexibilityStrengthof conventional selfcompacting concrete (SCC) and different percentages of PPFRSCC with Portland pozzolana cement (PPC) at an age of 7 and 28 days.

Concrete designation	Percentage of fibers (%)	Compressive Strength (MPa)		Split tensile strength (MPa)		Flexural strength (MPa)	
		7 days	28 days	7 days	28 days	7 days	28 days
Conventional PPC	0	27.50	39.20	3.4	4.35	2.7	4.2
PPFRSCC1	0.2	34	42.5	3.15	4.12	3.25	4.5
PPFRSCC2	0.3	29	41.0	2.9	3.8	3.1	4.35
PPFRSCC3	0.4	27.5	40.2	2.54	3.54	2.9	4.22
PPFRSCC4	0.5	26.78	38.5	2.3	2.9	2.75	3.9

Table 4.5.4Compressive and tensile strengths of conventional SCC and PPFRSCC with PPC at 7 and 28 days of curing.

4.5.5*Comparison between compressive and split tensile strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) of ordinary Portland cement (OPC) and Portland pozzolana cement (PPC) at an age of 7 and 28 days.*

The compressive strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 35.60, 32.60, 31.2, 28.65 MPa and 36, 32, 27.5, 26.78 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 7 days curing respectively. The compressive strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 42.65, 41.25, 39.26, 37.25MPa and 42.5, 41, 40.2, 38.5 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 28 days curing respectively. The split tensile strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 3.46, 3.25, 2.9, 2.81MPa and 3.15, 2.9, 2.54, 2.3 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 7 days curing respectively. The split tensile strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 4.54, 3.5, 3.1, 2.8 MPa and 4.12, 3.8, 3.54, 2.9 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 28 days curing respectively. The Flexibility strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 3.8,3.65,3.2,3.85 MPa and 3.8,3.65,3.2,2.85 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 7 days curing respectively The Flexibility strengths of polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) are obtained 4.3,3.85,3.6,2.95 MPa and 4.5,4.35,4.22,3.9 MPa at 0.2, 0.3, 0.4, 0.5 per cent fibers respectively in both OPC and PPC at 28 days curing respectively. Here the compressive, split tensile strength and Flexibility Strength of different percentages of PPFRSCC with Portland pozzolana cement and ordinary Portland cement at an age of 7 and 28 days.

Table 4.5.5 Comparison between compressive and split tensile strengths and flexural strength of polypropylenefiber reinforced selfcompacting concrete (PPFRSCC) with OPC and PPC at 7 and 28 days of curing.

Concrete designation	**% of fiber**	**Compressive Strength (MPa)**				**Split tensile Strength (MPa)**			
		7 Days		**28 Days**		**7 Days**		**28 Days**	
		OPC	**PPC**	**OPC**	**PPC**	**OPC**	**PPC**	**OPC**	**PPC**
PPFRSCC1	0.2	35.60	34	43.65	42.5	3.46	3.15	4.54	4.12
PPFRSCC2	0.3	32.60	29	42.25	41.0	3.25	2.9	3.50	3.8
PPFRSCC3	0.4	31.2	27.5	39.26	40.2	2.90	2.54	3.10	3.54
PPFRSCC4	0.5	28.65	26.78	37.25	38.5	2.81	2.3	3	2.9

Concrete designation	**% of fiber**	**Flexural Strength (MPa)**			
		7 Days		**28 Days**	
		OPC	**PPC**	**OPC**	**PPC**
PPFRSCC1	0.2	3.8	3.25	4.3	4.5
PPFRSCC2	0.3	3.65	3.1	3.85	4.35
PPFRSCC3	0.4	3.2	2.9	3.6	4.22
PPFRSCC4	0.5	2.7	2.75	2.95	3.9

4.6 *GRAPHS AND DISCUSSIONS*

4.6.1 *Comparison between compressive strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with OPC at an age of 7 days and 28 days curing.*

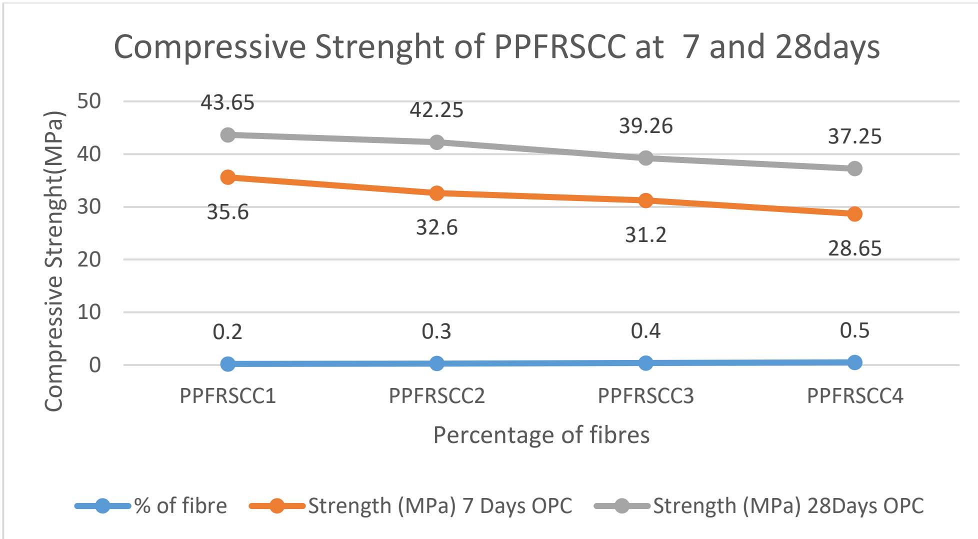

Fig 4.6.1 Comparison between compressive strength of PPFRSCC with OPC at an age of 7 and 28 days

4.6.2 Comparison between split tensile strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with OPC at an age of 7 and 28 days curing.

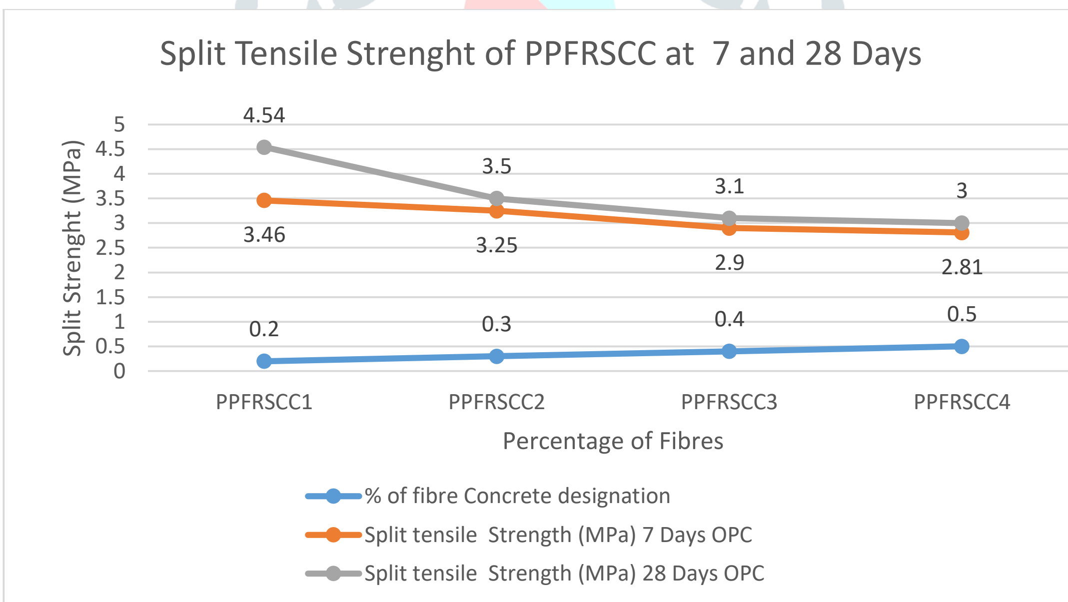

Fig 4.6.2 Comparison between split tensile strength of PPFRSCC with OPC at an age at 7& 28 days

4.6.3 *Comparison between Flexural strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with OPC at an age of 7 and 28 days curing.*

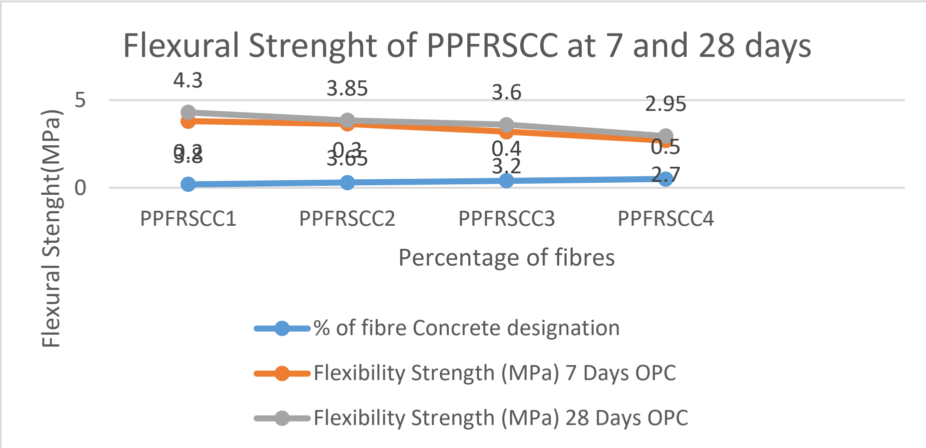

Fig 4.6.3 Comparison between Flexural strength of PPFRSCC with PPC at an age of 7 and 28 days

4.6.4 *Comparison between compressive strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with PPC at an age of 7 and 28 days curing.*

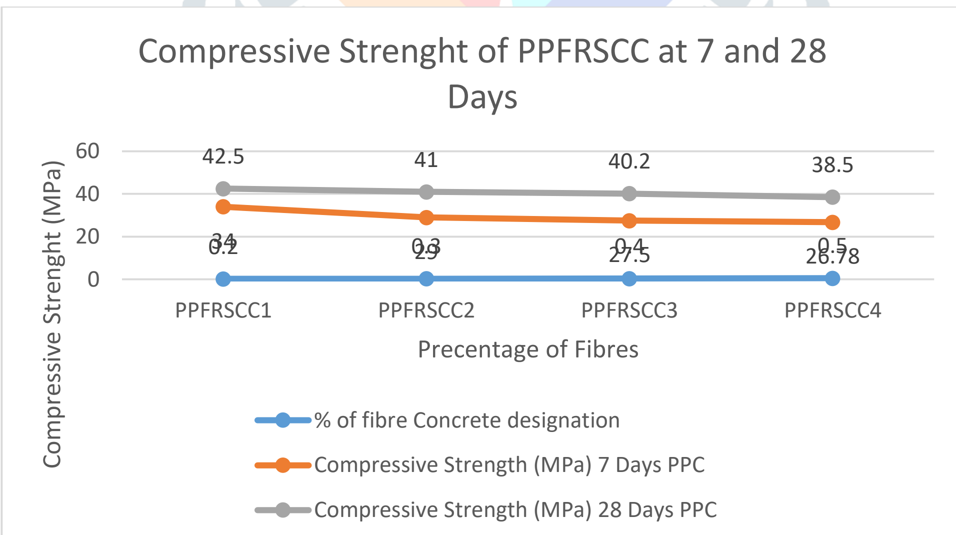

Fig 4.6.4 Comparison between compressive strength of PPFRSCC with PPC at an age of 7 and 28 days

4.6.5 ***Comparison between split tensile strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with PPC at an age of 7 and 28 days curing.***

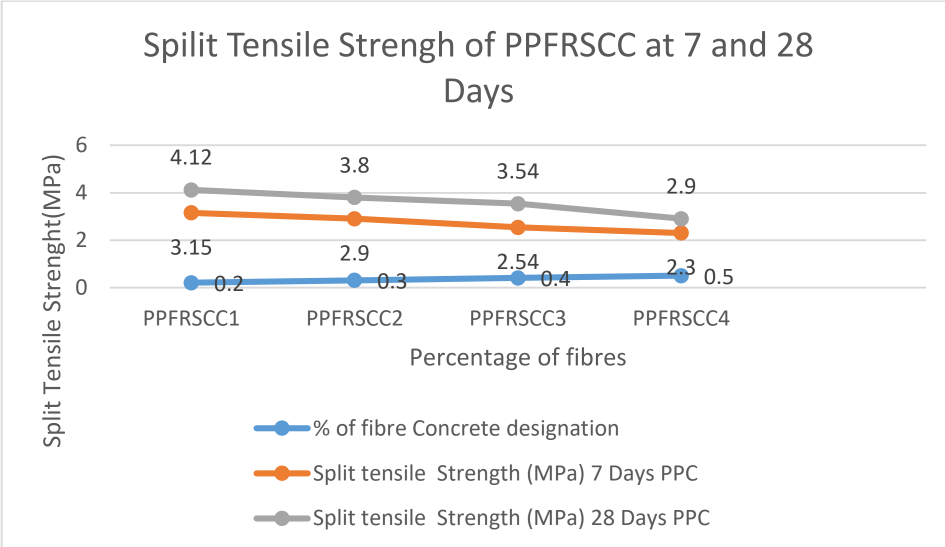

Fig 4.6.5 Comparison between split tensile strength of PPFRSCC with PPC at an age of 7 and 28 days

4.6.6 ***Comparison between Flexural strength of conventional SCC and polypropylene fiber reinforced selfcompacting concrete (PPFRSCC) with PPC at an age of 7 and 28 days curing.***

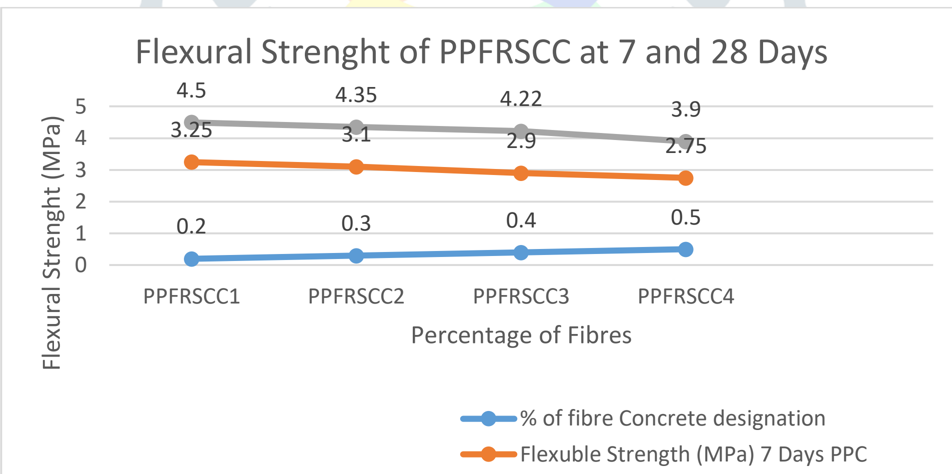

Fig 4.6.6 Comparison between Flexural strength of PPFRSCC with PPC at an age of 7 & 28 days

CONCLUSIONS

The following conclusions are drawn after analyzing results obtained in all cases

1. Optimum percentage of hyposludge replacement in cement was found at 4 per cent for OPC and 2 per cent for PPC.

2. It can be observed from experimental, on addition of different percentages of polypropylene fiber in selfcompacting concrete (SSC), decreases the flowability, passing ability and segregation resistance.
3. The maximum compressive and split tensile strengths of fiber reinforced selfcompacting concrete (PPFRSCC) occurs at 0.2 per cent polypropylene fibers in both OPC and PPC at all ages.
4. It is observed from experiment, addition of polypropylene fibers in conventional SCC with ordinary Portland cement (OPC) the compressive strengths and split tensile strengths increases.
5. It is noticed from experiment, addition of polypropylene fibers in conventional SCC with Portland pozzolana cement (PPC) the compressive and split tensile strengths decreases.
6. From the experiment it is observed as percentage of fibers increases, the compressive and split tensile strengths in SCC are decreases at all ages.

SCOPE OF FUTURE WORK

- To study the strength characteristics of fiber reinforced SCC with addition of different fibers such as polypropylene, steel fibers with different aspect ratio.
- To study the durability properties.
- To study the strength characteristics of different percentages of hyposludge replaced in cement with addition of different fibers.

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