Studies on stress- strain behaviour of fibre reinforced self-compacting concrete in confined state

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Abstract. In the present study, the stress-stain behaviour of self-compacting concrete (SCC) and fibre reinforced self-compacting concrete (FRSCC) were taken up. The stress-strain behaviour was studied for the SCC and FRSCC mixes in unconfined and confined states. The confinement was given in the form of steel hoops in the cylinders, 3 hoops (0.8%), 4 hoops (1.1%), 5 hoops (1.3%) and 6 hoops (1.6%). The addition of fibres along with confinement of FRSCC with steel hoops enhanced the compressive strength, indicating further confinement effect in the FRSCC. It is observed that the addition of fibres is helpful in lower confinements only. Beyond 1.1% confinement, the addition of any type of fibres doesn't show any effect on compressive strengths. From the stress-strain behaviour of all types of FRSCC, it is concluded that the ultimate load-carrying capacity and strains at peak stresses are more in SFRSCC and HFRSCC for mixes up to 1.1% confinement. The addition of fibres to SCC has increased the ductility in both confined and unconfined states

1 Introduction

Self-Compacting concrete, originally developed in Japan has given answers to many mechanical and durability problems and enhanced the strength and durability characteristics of concrete. Introduction of fibres in SCC has further improved its characteristics like crack, resistance, plasticity, impact resistance, durability etc., The Studies on Stress-Strain behaviour of concrete are essential in determining the parameters like energy absorption, toughness, plasticity index and they are very useful in design of structures using such concretes. Further modelling the stress-strain behaviour helps in predicating their behaviour.

2 Methodology

In this phase of investigations, the stress-stain behaviour of self-compacting concrete (SCC) and fibre reinforced self-compacting concrete (FRSCC) were taken up. The stress-strain behaviour was studied for the SCC and FRSCC mixes in unconfined and confined states. The confinement was given in the form of steel hoops in the cylinders, 3 hoops (0.8%), 4 hoops (1.1%), 5 hoops (1.3%) and 6 hoops (1.6%) as shown in Fig 1. The tests were carried out on the standard cylindrical specimens of diameter 150mm and height 300mm. After casting, the cylinders were capped with cement mortar and cured for a period of 28 days in curing tanks. The specimens were then taken out and made surface dry. The samples were placed in a microprocessor strain controlled universal testing machine of 1000 kN capacity and tested under uni-axial compression as per IS 516:1959. The stress–strain behaviour as obtained was plotted.

Fig.1. Cylinders with different Confinements

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Table 1. Percentage of confinement by volume

		Volume of confinement percentage
C0	Confinement 0 hoops	0.00
C3	Confinement 3 hoops	0.80
C4	Confinement 4 hoops	1.06
C5	Confinement 5 hoops	1.33
C6	Confinement 6 hoops	1.59

Table 2. Stress-strain values of plain self-compacting concrete (PSCC) mixes made with PF=1.12 and s/a=0.53 in confined state

PF=1.12 and s/a=0.53									
M30PSCC-C0		M30PSCC-C3		M30PSCC-C4		M30PSCC-C5		M30PSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0002	3.01	0.0001	2.76	0.0060	0.00	0.0000	0.22	0.0000	0.26
0.0003	6.18	0.0003	5.91	0.0000	45.20	0.0003	5.86	0.0003	5.22
0.0005	9.86	0.0006	10.05	0.0000	0.39	0.0005	10.19	0.0006	10.96
0.0007	13.37	0.0008	13.40	0.0004	7.83	0.0008	14.96	0.0009	15.91
0.0010	17.55	0.0011	16.95	0.0007	12.52	0.0010	18.21	0.0012	20.87
0.0013	22.39	0.0012	20.30	0.0010	16.04	0.0012	23.42	0.0015	25.30
0.0015	25.57	0.0015	23.85	0.0012	20.35	0.0015	26.44	0.0018	29.22
0.0018	29.08	0.0016	26.60	0.0014	25.43	0.0018	30.78	0.0021	32.87
0.0019	32.42	0.0019	29.37	0.0018	28.17	0.0022	34.45	0.0024	36.00
0.0022	34.27	0.0021	32.32	0.0020	31.70	0.0026	37.91	0.0026	39.13
0.0026	38.31	0.0024	34.69	0.0024	35.02	0.0029	39.20	0.0029	42.78
0.0027	34.96	0.0025	36.86	0.0027	37.57	0.0030	40.07	0.0032	45.91
0.0030	33.80	0.0028	37.46	0.0031	40.30	0.0033	41.79	0.0037	49.04
0.0032	30.48	0.003	42.48	0.0033	44.91	0.0037	47.06	0.0040	50.61
0.0035	27.50	0.0031	38.86	0.0035	39.13	0.0038	41.54	0.0044	56.76
0.0037	23.67	0.0034	37.88	0.0037	35.80	0.0041	40.01	0.0045	50.61
0.0039	21.01	0.0037	35.34	0.0039	33.46	0.0043	37.61	0.0048	48.26
0.0042	18.53	0.0039	33.59	0.0041	31.30	0.0045	36.07	0.0050	47.48
0.0044	16.03	0.0042	31.83	0.0043	28.96	0.0047	34.33	0.0051	45.13
0.0046	15.54	0.0044	29.09	0.0046	26.61	0.0050	31.70	0.0052	42.00
		0.0045	26.74					0.0054	39.65
		0.0047	24.98						
		0.0049	23.42						

Table 3. Stress-strain values of plain self-compacting concrete (PSCC) mixes made with PF=1.14 and s/a=0.57 in confined state

PF=1.14 and s/a=0.57									
M30PSCC-C0		M30PSCC-C3		M30PSCC-C4		M30PSCC-C5		M30PSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0000	0.17	0.0002	4.50	0.0000	0.66	0.0000	0.26	0.0005	8.61
0.0000	0.34	0.0005	8.36	0.0002	4.80	0.0003	5.93	0.0007	14.09
0.0002	4.48	0.0008	13.93	0.0004	8.95	0.0005	11.35	0.0010	19.57
0.0005	8.97	0.0012	18.43	0.0008	12.66	0.0007	15.22	0.0012	23.22
0.0008	12.59	0.0014	22.29	0.0011	18.56	0.0009	19.08	0.0016	30.26
0.0011	16.72	0.0017	26.79	0.0015	22.93	0.0011	23.73	0.0019	34.96
0.0013	20.52	0.0020	30.21	0.0017	26.42	0.0014	26.81	0.0022	38.61
0.0017	23.62	0.0022	33.86	0.0020	31.00	0.0017	31.45	0.0026	42.52
0.0020	27.24	0.0025	36.43	0.0023	34.72	0.0021	36.08	0.0030	45.39
0.0023	29.48	0.0027	37.93	0.0026	37.55	0.0024	38.91	0.0033	48.00
0.0027	34.48	0.0029	40.07	0.0029	39.30	0.0027	42.51	0.0035	49.30

0.0029	36.90	0.0030	42.21	0.0033	44.54	0.0031	45.33	0.0037	51.13
0.0033	36.90	0.0033	42.00	0.0036	44.76	0.0033	45.32	0.0041	52.17
0.0035	34.66	0.0036	41.14	0.0039	43.01	0.0035	46.60	0.0043	50.61
0.0037	31.38	0.0039	38.79	0.0041	40.39	0.0036	47.37	0.0044	48.78
0.0040	28.28	0.0041	36.00	0.0043	37.55	0.0040	44.50	0.0047	45.13
0.0042	25.86	0.0042	33.00	0.0045	35.59	0.0044	41.37	0.0049	41.74
0.0043	24.14	0.0044	30.86	0.0046	34.06	0.0047	39.29	0.0052	37.57
0.0045	22.07	0.0045	28.29			0.0051	37.45		
0.0047	20.86								

Table 4. Stress-strain values of glass fibre reinforced self-compacting concrete (GFRSCC) mixes made with PF=1.12 and s/a=0.53 in confined state

PF=1.12 and s/a=0.53									
M30GFRSCC-C0		M30GFRSCC-C3		M30GFRSCC-C4		M30GFRSCC-C5		M30GFRSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0004	6.00	0.0001	2.36	0.0000	0.19	0.0000	0.00	0.0000	0.52
0.0006	10.00	0.0003	5.70	0.0001	2.33	0.0003	4.36	0.0003	6.01
0.0009	14.00	0.0006	10.81	0.0003	5.04	0.0005	10.46	0.0005	9.93
0.0012	17.00	0.0009	14.54	0.0006	8.73	0.0009	14.17	0.0008	16.46
0.0015	22.00	0.0011	17.49	0.0009	12.22	0.0013	20.07	0.0011	21.16
0.0017	24.00	0.0013	20.44	0.0012	16.49	0.0017	24.65	0.0013	26.12
0.0019	27.00	0.0015	24.37	0.0014	19.98	0.0020	28.36	0.0017	31.07
0.0020	28.00	0.0018	27.71	0.0016	22.89	0.0022	32.07	0.0021	35.51
0.0022	32.00	0.0019	31.64	0.0019	27.16	0.0026	35.13	0.0024	37.85
0.0023	34.00	0.0023	34.19	0.0020	29.68	0.0029	38.85	0.0026	41.50
0.0023	36.00	0.0025	35.37	0.0022	34.53	0.0033	41.04	0.0029	45.41
0.0026	35.00	0.0027	37.14	0.0025	36.27	0.0034	43.00	0.0034	47.74
0.0028	33.00	0.0029	40.28	0.0027	37.44	0.0036	44.10	0.0036	48.51
0.0031	30.00	0.0030	40.87	0.0030	39.57	0.0037	44.97	0.0038	49.29
0.0037	15.00	0.0032	40.87	0.0032	41.51	0.0040	44.99	0.0040	51.63
		0.0037	38.91	0.0036	41.70	0.0044	41.75	0.0042	52.93
		0.0040	34.78	0.0042	39.76	0.0047	39.59	0.0045	53.17
		0.0042	30.07	0.0046	36.27	0.0049	36.56	0.0049	49.74
		0.0046	27.51	0.0051	33.36			0.0051	45.27
		0.0048	24.96	0.0055	30.06			0.0053	40.55
				0.0057	26.96				

Table 5. Stress-strain values of glass fibre reinforced self-compacting concrete (GFRSCC) mixes made with

PF=1.14 and s/a=0.57 in confined state

PF=1.14 and s/a=0.57									
M30GFRSCC-C0		M30GFRSCC-C3		M30GFRSCC-C4		M30GFRSCC-C5		M30GFRSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0001	3.52	0.0000	0.43	0.0001	0.21	0.0000	0.52	0.0000	0.00
0.0003	6.46	0.0003	5.16	0.0002	3.93	0.0002	5.98	0.0001	3.13
0.0005	10.37	0.0005	10.10	0.0005	8.51	0.0004	10.66	0.0002	6.77
0.0010	16.83	0.0007	13.54	0.0007	12.21	0.0007	15.60	0.0005	10.68
0.0012	20.74	0.0011	18.26	0.0009	17.02	0.0010	20.54	0.0007	15.88
0.0016	24.85	0.0013	21.69	0.0013	21.36	0.0012	26.00	0.0010	20.84
0.0018	28.37	0.0015	25.99	0.0016	26.15	0.0014	30.16	0.0012	25.52
0.0021	32.48	0.0018	28.99	0.0018	28.76	0.0017	33.53	0.0014	29.44
0.0024	35.41	0.0021	32.63	0.0021	32.89	0.0019	37.68	0.0017	33.61
0.0025	35.80	0.0024	35.85	0.0024	36.37	0.0022	40.53	0.0019	37.00
0.0028	40.11	0.0026	39.07	0.0027	39.41	0.0026	43.90	0.0021	40.38
0.0031	40.11	0.0030	41.85	0.0030	40.70	0.0030	45.96	0.0023	43.26

0.0034	38.93	0.0032	43.34	0.0032	42.87	0.0033	46.98	0.0027	46.65
0.0038	35.41	0.0035	42.25	0.0036	45.68	0.0034	47.75	0.0028	48.22
0.0040	31.89	0.0038	39.21	0.0039	44.77	0.0037	45.90	0.0032	49.80
0.0042	28.76	0.0039	36.40	0.0042	40.57	0.0040	44.31	0.0038	52.43
0.0044	25.83	0.0041	34.24	0.0045	35.50	0.0043	40.90	0.0041	53.49
0.0045	24.07	0.0044	32.07	0.0046	33.08	0.0045	38.80	0.0043	54.28
		0.0045	30.55	0.0047	28.68	0.0046	36.45	0.0044	53.51
				0.0048	25.81			0.0046	52.49
								0.0049	50.94
								0.0050	48.61

Table 6. Stress-strain values of steel fibre reinforced self-compacting concrete (SFRSCC) mixes made with PF=1.12 and s/a=0.53 in confined state

PF=1.12 and s/a=0.53									
M30SFRSCC-C0		M30SFRSCC-C3		M30SFRSCC-C4		M30SFRSCC-C5		M30SFRSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0003	6.43	0.0003	5.05	0.0002	4.77	0.0003	5.41	0.0003	6.75
0.0005	10.91	0.0006	10.11	0.0005	9.54	0.0004	9.74	0.0006	10.91
0.0008	15.19	0.0009	13.21	0.0007	14.53	0.0008	16.45	0.0010	16.62
0.0011	19.09	0.0010	16.12	0.0009	19.09	0.0011	21.00	0.0012	21.04
0.0016	24.35	0.0012	19.23	0.0012	23.42	0.0014	26.41	0.0017	26.49
0.0018	27.66	0.0015	22.92	0.0014	27.97	0.0017	30.74	0.0021	34.81
0.0020	30.00	0.0018	27.19	0.0016	31.44	0.0018	33.55	0.0025	39.48
0.0023	33.51	0.0021	30.49	0.0020	35.55	0.0020	36.15	0.0029	43.38
0.0025	36.62	0.0022	34.58	0.0023	38.58	0.0024	38.96	0.0032	47.27
0.0027	38.96	0.0024	37.88	0.0027	41.17	0.0026	41.99	0.0037	51.95
0.0031	38.57	0.0027	41.56	0.0030	41.58	0.0030	42.86	0.0040	53.51
0.0035	36.43	0.0028	41.75	0.0032	42.66	0.0033	43.51	0.0043	54.55
0.0038	32.73	0.0032	42.32	0.0034	43.74	0.0035	45.67	0.0044	55.84
0.0041	29.42	0.0037	41.33	0.0037	41.77	0.0039	45.24	0.0048	55.32
0.0043	28.64	0.0040	38.78	0.0040	36.54	0.0042	42.21	0.0053	51.17
0.0045	24.94	0.0044	34.86	0.0041	33.27	0.0045	40.48	0.0056	48.31
0.0046	22.60	0.0046	31.55	0.0045	30.64	0.0048	38.74	0.0059	45.19
0.0048	19.68	0.0047	28.42	0.0046	27.37	0.0049	37.01		
		0.0048	26.28						
		0.0048	26.28						

Table 7. Stress-strain values of steel fibre reinforced self-compacting concrete (SFRSCC) mixes made with PF=1.14 and s/a=0.57 in confined state

PF=1.14 and s/a=0.57									
M30SFRSCC-C0		M30SFRSCC-C0		M30SFRSCC-C0		M30SFRSCC-C0		M30SFRSCC-C0	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0000	0.65	0.0003	6.26	0.0000	0.26	0.0000	0.52	0.0001	0.26
0.0002	4.33	0.0005	11.01	0.0002	4.69	0.0001	4.19	0.0002	6.29
0.0004	8.44	0.0007	14.03	0.0003	8.85	0.0003	8.65	0.0005	11.00
0.0006	11.47	0.0009	17.26	0.0007	14.83	0.0005	12.31	0.0007	13.89
0.0007	14.07	0.0012	22.01	0.0009	19.51	0.0008	16.77	0.0010	18.86
0.0010	16.67	0.0016	27.83	0.0012	23.41	0.0009	21.22	0.0012	22.53
0.0012	19.05	0.0019	34.08	0.0015	27.30	0.0012	24.37	0.0016	29.08
0.0013	21.65	0.0022	37.53	0.0017	31.73	0.0014	29.34	0.0021	37.21
0.0016	25.32	0.0026	40.75	0.0019	34.58	0.0017	32.75	0.0024	41.66

0.0019	29.87	0.0030	43.11	0.0022	37.95	0.0018	36.16	0.0028	45.07
0.0022	32.90	0.0033	46.12	0.0025	41.59	0.0022	39.56	0.0032	48.73
0.0024	35.28	0.0036	45.67	0.0028	43.14	0.0023	42.97	0.0035	50.83
0.0027	38.10	0.0038	43.93	0.0030	45.47	0.0027	45.59	0.0040	52.40
0.0030	41.99	0.0041	41.31	0.0032	47.80	0.0030	47.42	0.0042	52.66
0.0031	42.86	0.0042	39.14	0.0035	49.09	0.0033	48.47	0.0046	53.97
0.0034	40.04	0.0045	35.45	0.0041	49.58	0.0035	51.09	0.0049	53.45
0.0036	34.63			0.0045	47.72	0.0037	51.62	0.0054	50.83
0.0040	29.00			0.0048	44.58	0.0039	52.40	0.0059	45.59
0.0043	22.08			0.0050	41.17	0.0043	50.83		
0.0044	16.67					0.0046	47.16		
0.0045	12.55					0.0049	45.07		
						0.0052	42.97		

Table 8. Stress-strain values of hybrid fibre reinforced self-compacting concrete (SFRSCC) mixes made with PF=1.12 and s/a=0.53 in confined state

PF=1.12 and s/a=0.53									
M30HFRSCC-C0		M30HFRSCC-C3		M30HFRSCC-C4		M30HFRSCC-C5		M30HFRSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0000	0.58	0.0000	0.22	0.0001	0.26	0.0001	0.78	0.0001	0.26
0.0002	4.08	0.0002	3.04	0.0003	6.98	0.0002	7.30	0.0003	4.92
0.0003	9.34	0.0004	7.81	0.0005	12.67	0.0005	12.00	0.0006	11.66
0.0004	12.84	0.0005	12.15	0.0007	17.59	0.0008	18.26	0.0010	19.95
0.0007	17.11	0.0006	16.92	0.0011	24.31	0.0011	23.74	0.0014	27.72
0.0010	19.83	0.0008	20.82	0.0014	29.22	0.0014	26.35	0.0017	32.90
0.0012	22.93	0.0010	26.03	0.0018	33.62	0.0016	30.26	0.0020	37.56
0.0013	25.07	0.0012	29.50	0.0022	37.76	0.0019	34.96	0.0025	42.73
0.0015	27.20	0.0015	32.76	0.0025	41.38	0.0023	39.13	0.0028	47.13
0.0017	29.73	0.0017	35.58	0.0027	44.48	0.0025	41.48	0.0031	50.75
0.0019	31.86	0.0020	37.98	0.0030	45.52	0.0028	43.83	0.0034	52.81
0.0021	33.80	0.0022	41.45	0.0033	47.07	0.0031	45.91	0.0039	54.61
0.0024	35.54	0.0025	42.33	0.0034	48.88	0.0033	48.00	0.0040	54.60
0.0027	39.03	0.0027	43.43	0.0037	47.59	0.0038	48.78	0.0043	54.84
0.0030	41.16	0.0030	44.31	0.0040	43.45	0.0042	46.43	0.0045	56.39
0.0033	39.01	0.0032	45.83	0.0045	40.86	0.0045	44.61	0.0049	56.37
0.0035	35.30	0.0035	46.93	0.0048	39.31	0.0047	43.30	0.0053	52.71
0.0036	32.17	0.0039	45.65	0.0051	37.50	0.0049	41.74	0.0056	49.32
0.0038	30.02	0.0041	44.14					0.0059	47.49
0.0039	26.12	0.0043	41.13						
0.0041	22.22	0.0046	37.03						
		0.0048	34.22						

Table 8. Stress-strain values of hybrid fibre reinforced self-compacting concrete (SFRSCC) mixes made with

PF=1.14 and s/a=0.57 in confined state

PF=1.14 and s/a=0.57									
M30HFRSCC-C0		M30HFRSCC-C3		M30HFRSCC-C4		M30HFRSCC-C5		M30HFRSCC-C6	
Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress
0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.0000	0.00
0.0002	3.88	0.0003	4.61	0.0000	0.78	0.0002	4.96	0.0001	0.26
0.0005	9.28	0.0005	9.21	0.0002	4.66	0.0005	11.48	0.0002	5.23
0.0007	13.59	0.0007	15.35	0.0004	10.89	0.0007	17.22	0.0004	9.94
0.0009	18.13	0.0009	19.96	0.0006	16.59	0.0009	22.70	0.0007	14.64
0.0011	22.01	0.0012	23.68	0.0009	21.50	0.0012	28.17	0.0010	19.08

0.0014	25.02	0.0014	28.07	0.0012	26.16	0.0014	33.13	0.0012	22.99
0.0016	28.48	0.0017	32.46	0.0015	30.56	0.0017	36.52	0.0015	27.69
0.0019	32.57	0.0020	35.75	0.0017	35.22	0.0019	39.91	0.0017	32.40
0.0021	35.59	0.0023	37.72	0.0019	38.84	0.0021	42.52	0.0019	35.79
0.0024	37.95	0.0025	39.91	0.0023	41.42	0.0024	45.13	0.0023	39.18
0.0027	40.96	0.0027	42.54	0.0027	44.51	0.0027	48.00	0.0024	41.79
0.0030	43.54	0.0030	44.96	0.0030	47.61	0.0030	50.09	0.0026	46.24
0.0030	44.19	0.0032	46.27	0.0032	48.38	0.0032	50.87	0.0029	48.06
0.0033	43.74	0.0034	46.93	0.0036	50.43	0.0035	52.43	0.0033	50.40
0.0036	42.43	0.0038	45.83	0.0038	49.64	0.0037	54.00	0.0036	52.48
0.0039	39.16	0.0042	42.32	0.0040	48.85	0.0041	54.26	0.0039	54.82
0.0042	35.03	0.0044	38.82	0.0042	47.28	0.0043	52.70	0.0042	55.85
0.0043	32.42	0.0045	36.84	0.0046	43.88	0.0045	49.83	0.0045	55.31
0.0045	30.68			0.0047	41.79	0.0047	48.26	0.0048	56.60
				0.0049	39.70	0.0049	46.17	0.0053	54.75
						0.0050	44.09	0.0055	53.42
								0.0057	51.06
								0.0059	48.68

Table 9. Peak stress and strain at peak stress values of fibre reinforced self-compacting concrete mixes made with PF=1.12 and s/a=0.53 in unconfined and confined state

Type	Name	Peak stress (MPa)	Strain at peak stress
PF=1.12 and s/a=0.53	M30PSCC-C0	38.31	0.0026
	M30PSCC-C3	42.48	0.0030
	M30PSCC-C4	44.91	0.0033
	M30PSCC-C5	47.06	0.0037
	M30PSCC-C6	56.76	0.0044
PF=1.12 and s/a=0.53	M30GFRSCC-C0	38.87	0.0024
	M30GFRSCC-C3	44.48	0.0032
	M30GFRSCC-C4	45.76	0.0034
	M30GFRSCC-C5	48.88	0.0039
	M30GFRSCC-C6	58.26	0.0046
PF=1.12 and s/a=0.53	M30SFRSCC-C0	43.40	0.0028
	M30SFRSCC-C3	46.46	0.0030
	M30SFRSCC-C4	47.80	0.0036
	M30SFRSCC-C5	50.05	0.0038
	M30SFRSCC-C6	60.63	0.0047
PF=1.12 and s/a=0.53	M30HFRSCC-C0	45.35	0.0032
	M30HFRSCC-C3	50.18	0.0034
	M30HFRSCC-C4	52.68	0.0036
	M30HFRSCC-C5	52.86	0.0040
	M30HFRSCC-C6	62.33	0.0050

Table 9. Peak stress and strain at peak stress values of fibre reinforced self-compacting concrete mixes made with PF=1.14 and s/a=0.57 in unconfined and confined state

Type	Name	Peak stress (MPa)	Strain at peak stress
PF=1.14 and s/a=0.57	M30PSCC-C0	40.93	0.0031
	M30PSCC-C3	45.84	0.0032
	M30PSCC-C4	48.42	0.0035
	M30PSCC-C5	52.61	0.0039
	M30PSCC-C6	56.65	0.0042
PF=1.14 and s/a=0.57	M30GFRSCC-C0	44.13	0.0030
	M30GFRSCC-C3	47.52	0.0033
	M30GFRSCC-C4	49.98	0.0038
	M30GFRSCC-C5	52.38	0.0036
	M30GFRSCC-C6	59.13	0.0044
PF=1.14 and s/a=0.57	M30SFRSCC-C0	46.57	0.0033
	M30SFRSCC-C3	50.29	0.0035
	M30SFRSCC-C4	53.77	0.0037
	M30SFRSCC-C5	56.94	0.0041
	M30SFRSCC-C6	59.33	0.0048
PF=1.14 and s/a=0.57	M30HFRSCC-C0	48.20	0.0033
	M30HFRSCC-C3	50.37	0.0034
	M30HFRSCC-C4	55.24	0.0038
	M30HFRSCC-C5	58.45	0.0039
	M30HFRSCC-C6	61.56	0.0050

3 Conclusions

1. The addition of fibres along with confinement of FRSCC with steel hoops enhanced the compressive strength, indicating further confinement effect in the FRSCC.
2. It is observed that the addition of fibres is helpful in lower confinements only. Beyond 1.1% confinement, the addition of any type of fibres doesn't show any effect on compressive strengths.
3. From the stress-strain behaviour of all types of FRSCC, it is concluded that the ultimate load-carrying capacity and strains at peak stresses are more in SFRSCC and HFRSCC for mixes up to 1.1% confinement.
4. The addition of fibres to SCC has increased the ductility in both confined and unconfined states.

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