5. DEFLECTION CHARACTERISTIC OF BEAMS

According to Different size of Moderate deep beam concrete was prepared and filled in cubes and cylinders and in beams. To find the compressive strength the cubes and cylinders were tested after 28 days and results were mention in tables. All beams are tested under three-point load and four-point loading in UTM machine. Dial gauge is used to measure the deflection at centre and left and right side.

PRESENTATION AND COMPARISON OF TEST RESULTS

5.1 CONTROL SPECIMEN FOR PLAIN SERIES

Table 5-1 Control Specimen for Plain Series

Beam		Concrete Mix	W/C Ratio	Average Cube Compressive Strength fck N/mm^2	Average Split Cylinder Strength f_t N/mm^2
P150 S300	1P	1:1.56:2.89	0.5	43.11	3.84
P225 S450					
P375 S750	2P	1:1.56:2.89	0.5	36	2.86
P525 S1050					
P300 S600	1P	1:1.56:2.89	0.5	35.85	2.56
P450 S900					
P600 S1200	2P	1:1.56:2.89	0.5	33.77	2.9

5.2 CONTROL SPECIMEN FOR RCC SERIES

Table 5-2 Control Specimen for RCC Series

Beam		Concrete Mix	W/C Ratio	Average Cube Compressive Strength fck N/mm^2	Average Split Cylinder Strength ft N/mm^2
P150 S300	1P	1:1.56:2.89	0.5	36	3.55
P225 S450					
P375 S750	2P	1:1.56:2.89	0.5	36	3.7
P525 S1050					
P300 S600	1P	1:1.56:2.89	0.5	36	3.55
P450 S900					
P600 S1200	2P	1:1.56:2.89	0.5	33.77	2.9

5.3 CONTROL SPECIMEN FOR RCC + FIBRE SERIES

Table 5-3 Control Specimen For RCC + Fiber Series

Beam		Concrete Mix	W/C Ratio	Average Cube Compressive Strength fck N/mm^2	Average Split Cylinder Strength f_t N/mm^2
P150 S300	1P	1:1.56:2.89	0.5	36	4.7
P225 S450					
P375 S750	2P	1:1.56:2.89	0.5	36	3.7
P525 S1050					
P300 S600	1P	1:1.56:2.89	0.5	36.74	4.7
P450 S900					
P600 S1200	2P	1:1.56:2.89	0.5	33.77	2.9

Table 5-4 Control Specimen For RCC ,PFRC and SFRC

Type	Beam	Conc.Mix	Fiber	W/C Ratio	Average Cube Compressive Strength (N/mm^2)	Average Split Cylinder Strength(N/ mm^2)
RCC	A2, B, C, D, E	1:2.47:3.25	--	0.45	31.11	3.304
PFRC	A2, B, C, D, E	1:2.47:3.25	0.7 % polypropylene fiber	0.45	31.78	3.18
SFRC	A2, B, C, D, E	1:2.47:3.25	0.7 % steel hook end fiber	0.45	34.25	3.59

5.4 LOAD DEFLECTION CHARACTERISTICS FOR BEAMS

Deflections were measured in all the beams at central position and left and right side. Deflection and Load deflection curves are shown here for all beams. Generally during elastic stage, the central deflection was slightly more than the left and right deflections under central point load. In some of the beams in which major cracks appeared in shear zones all of a sudden. The corresponding side of the deflection increased slightly more than the central deflection.

Load deflection curves saw two distinct stages. First stage is elastic stage up to the yield load and second stage is inelastic stage up to the Ultimate

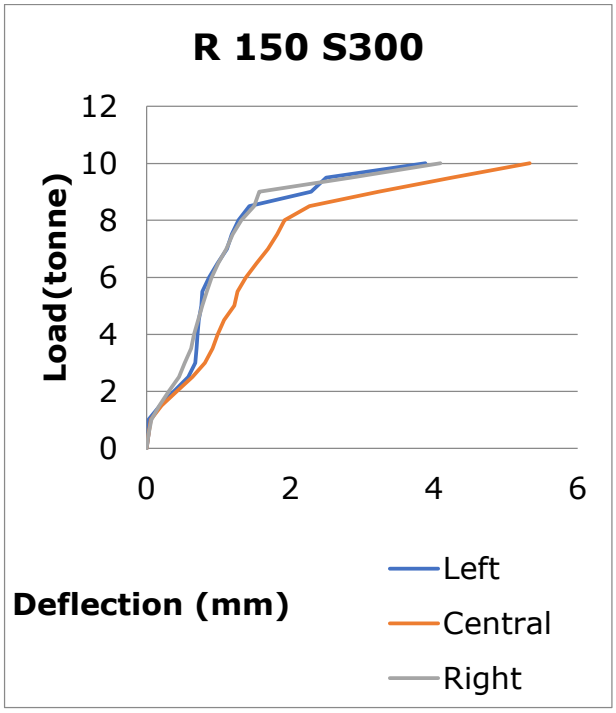
load. During the elastic stage the curve is almost linear and can be approximated by a straight line. After yielding of beam the curve change its slope and it becomes flatter. It was observed that a considerable deviation in load deflection curve after the yielding of beam.

5.4.1 Load Deflection Readings of R150 S300 and Load Vs. Deflection Graphical Representation

Table 5-5 Load Deflection Readings of R150 S300

Load (tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
0.5	0.03	0.03	0.03
1	0.03	0.06	0.07
1.5	0.19	0.21	0.18
2	0.38	0.42	0.31
2.5	0.58	0.64	0.45
3	0.68	0.81	0.53
3.5	0.7	0.92	0.62
4	0.71	0.99	0.66
4.5	0.73	1.08	0.72
5	0.76	1.22	0.78
5.5	0.78	1.27	0.84
6	0.87	1.38	0.91
6.5	0.99	1.53	1
7	1.12	1.69	1.11
7.5	1.19	1.82	1.2
8	1.28	1.92	1.32
8.5	1.43	2.27	1.5
9	2.29	3.23	1.57
9.5	2.5	4.25	2.84
10	3.88	5.33	4.09

Graph 5-1 Load Vs. Deflection Graph R150 S300

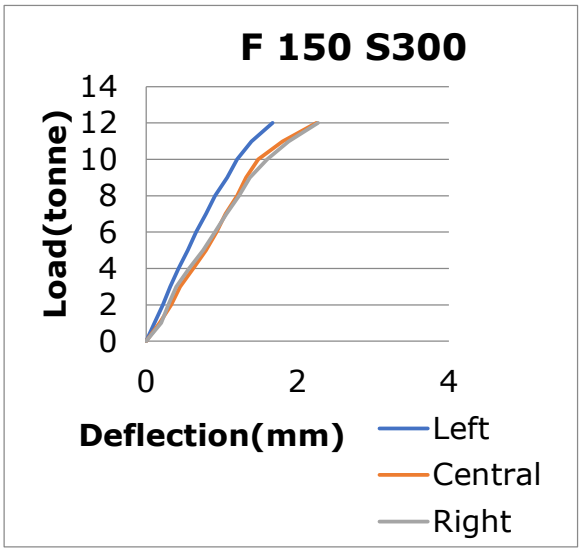


5.4.2 Load Deflection Readings of F150 S300 and Load Vs. Deflection Graphical Representation

Table 5-6 Load Deflection Readings of F150 S300

Load (tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1	0.11	0.18	0.2
2	0.22	0.33	0.29
3	0.32	0.45	0.4
4	0.43	0.62	0.57
5	0.55	0.79	0.75
6	0.66	0.93	0.91
7	0.79	1.05	1.06
8	0.91	1.2	1.23
9	1.07	1.32	1.37
10	1.2	1.48	1.6
11	1.39	1.8	1.88
12	1.67	2.25	2.27

Graph 5-2 Load Vs. Deflection Graph F150 S300

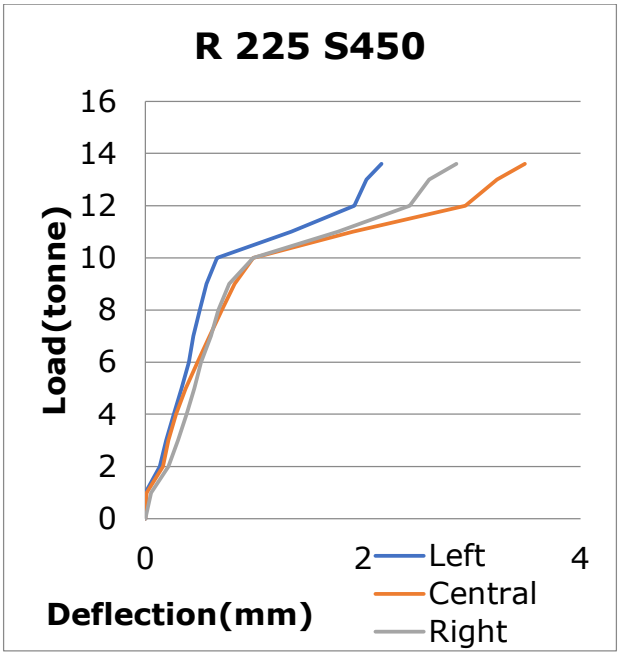


5.4.3 Load Deflection Readings of R225 S450 and Load Vs. Deflection Graphical Representation

Table 5-7 Load Deflection Readings of R225 S450

Load (tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1	0	0.01	0.05
2	0.13	0.16	0.21
3	0.19	0.21	0.3
4	0.26	0.28	0.38
5	0.33	0.37	0.45
6	0.4	0.48	0.51
7	0.44	0.59	0.6
8	0.5	0.7	0.67
9	0.56	0.82	0.77
10	0.66	0.99	0.99
11	1.34	1.91	1.77
12	1.92	2.94	2.43
13	2.03	3.23	2.61
13.6	2.17	3.49	2.86

Graph 5-3 Load Vs. Deflection Graph R225 S450

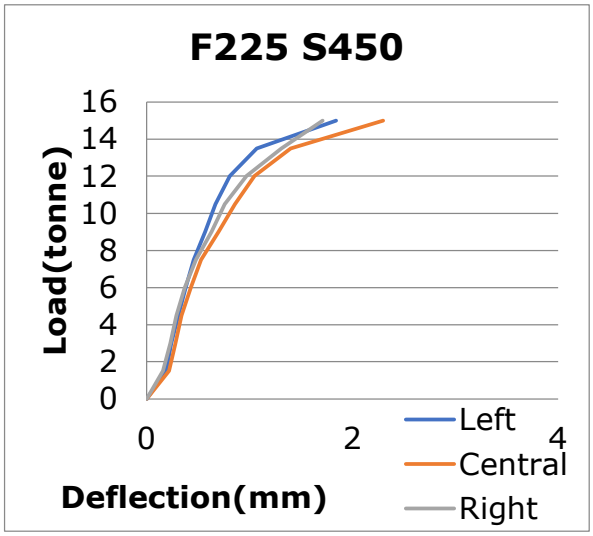


5.4.4 Load Deflection Readings of F225 S450 and Load Vs. Deflection Graphical Representation

Table 5-8 Load Deflection Readings of F225 S450

Load (tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1.5	0.19	0.22	0.16
3	0.24	0.28	0.23
4.5	0.31	0.34	0.29
6	0.38	0.43	0.37
7.5	0.46	0.53	0.48
9	0.57	0.7	0.63
10.5	0.67	0.86	0.76
12	0.81	1.05	0.97
13.5	1.07	1.4	1.31
15	1.84	2.3	1.71

Graph 5-4 Load Vs. Deflection Graph F225 S450

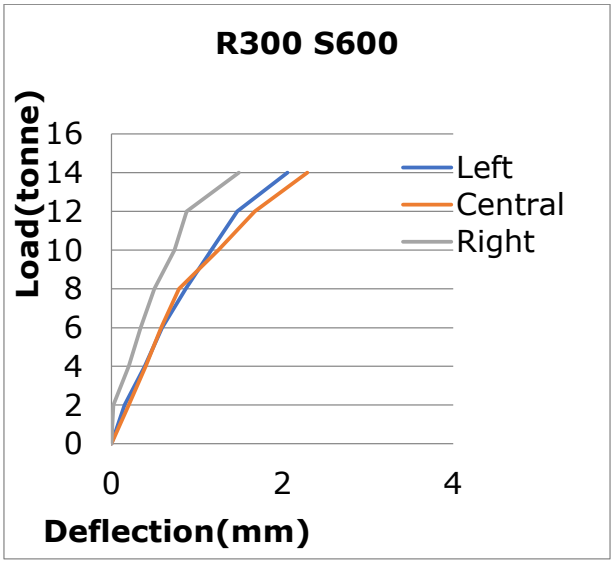


5.4.5 Load Deflection Readings of R300 S600and Load Vs. Deflection Graphical Representation

Table 5-9 Load Deflection Readings of R300 S600

Load (tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.15	0.2	0.02
4	0.39	0.4	0.2
6	0.59	0.58	0.34
8	0.87	0.79	0.5
10	1.17	1.25	0.74
12	1.47	1.68	0.88
14	2.06	2.29	1.49

Graph 5-5 Load Vs. Deflection Graph R300 S600

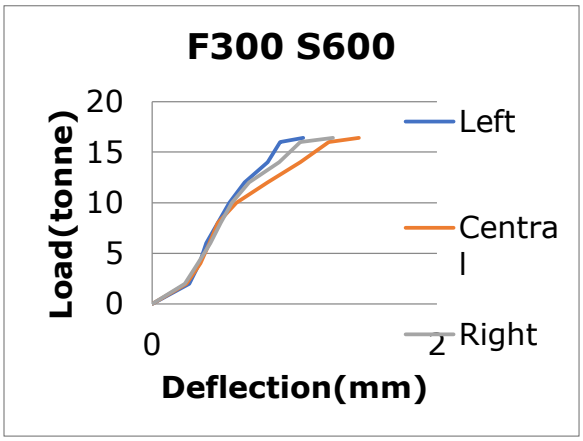


5.4.6 Load Deflection Readings of F300 S600and Load Vs. Deflection Graphical Representation

Table 5-10 Load Deflection Readings of F300 S600

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.26	0.24	0.23
4	0.33	0.34	0.32
6	0.38	0.4	0.41
8	0.46	0.46	0.48
10	0.54	0.59	0.56
12	0.65	0.81	0.68
14	0.81	1.04	0.89
16	0.9	1.24	1.04
16.4	1.06	1.45	1.27

Graph 5-6 Load Vs. Deflection Graph F300 S600

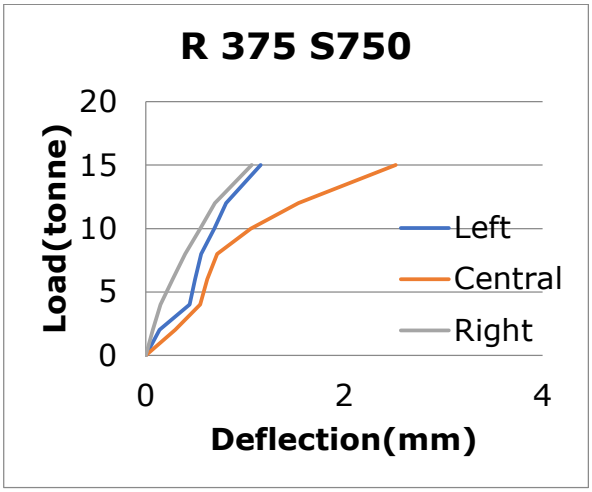


5.4.7 Load Deflection Readings of R375 S750 and Load Vs. Deflection Graphical Representation

Table 5-11 Load Deflection Readings of R375 S750

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.14	0.3	0.07
4	0.44	0.55	0.15
6	0.5	0.62	0.27
8	0.56	0.72	0.4
10	0.69	1.06	0.55
12	0.81	1.54	0.7
15	1.16	2.52	1.07

Graph 5-7 Load Vs. Deflection Graph R375 S750

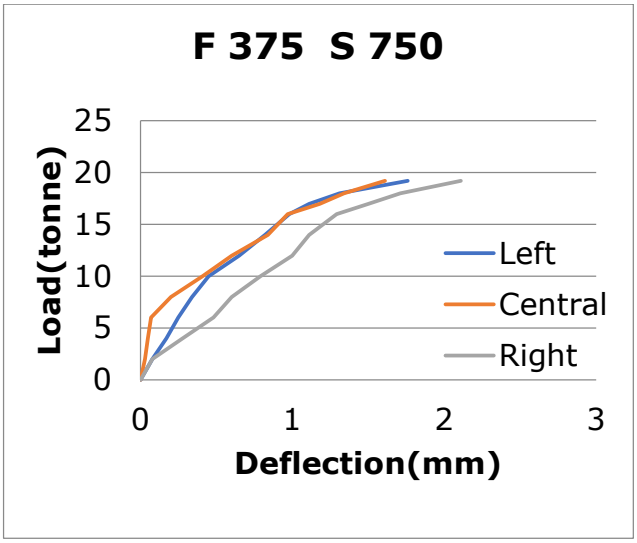


5.4.8 Load Deflection Readings of F375 S750 and Load Vs. Deflection Graphical Representation

Table 5-12 Load Deflection Readings of F375 S750

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.08	0.03	0.08
4	0.17	0.05	0.28
6	0.25	0.07	0.48
8	0.34	0.2	0.6
10	0.45	0.41	0.79
12	0.65	0.6	1
14	0.82	0.84	1.11
16	0.98	0.97	1.29
17	1.11	1.18	1.5
18	1.31	1.34	1.71
19.2	1.76	1.61	2.11

Graph 5-8 Load Vs. Deflection Graph F375 S750

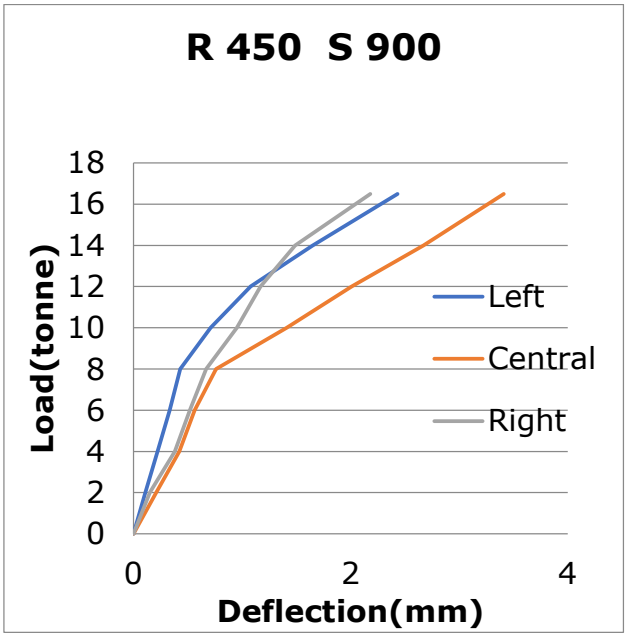


5.4.9 Load Deflection Readings of R450 S900 and Load Vs. Deflection Graphical Representation

Table 5-13 Load Deflection Readings of R450 S900

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.11	0.21	0.15
4	0.22	0.42	0.38
6	0.33	0.56	0.52
8	0.43	0.76	0.67
10	0.71	1.41	0.95
12	1.08	2.01	1.17
14	1.65	2.67	1.49
16.5	2.43	3.41	2.18

Graph 5-9 Load Vs. Deflection Graph R450 S900

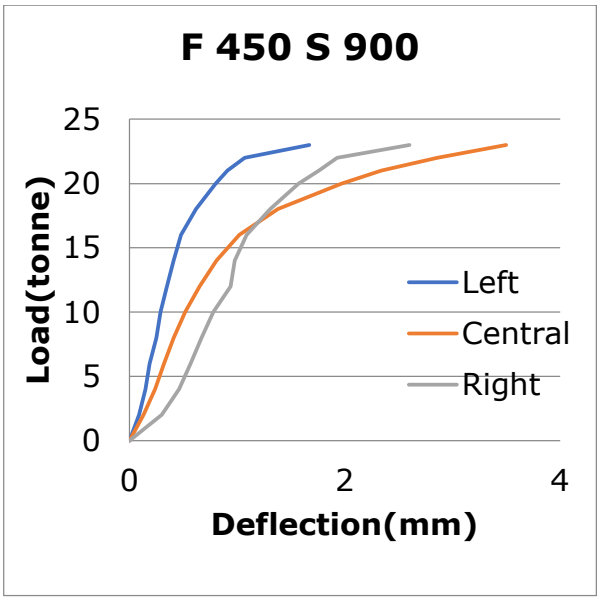


5.4.10 Load Deflection Readings of F450 S 900 and Load Vs. Deflection Graphical Representation

Table 5-14 Load Deflection Readings of F450 S900

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.09	0.13	0.3
4	0.15	0.24	0.46
6	0.19	0.32	0.57
8	0.25	0.41	0.67
10	0.29	0.52	0.78
12	0.35	0.65	0.94
14	0.41	0.81	0.98
16	0.48	1.02	1.09
18	0.62	1.38	1.31
20	0.8	1.97	1.57
21	0.91	2.34	1.76
22	1.07	2.86	1.93
23	1.67	3.5	2.6

Graph 5-10 Load Vs. Deflection Graph F450 S900

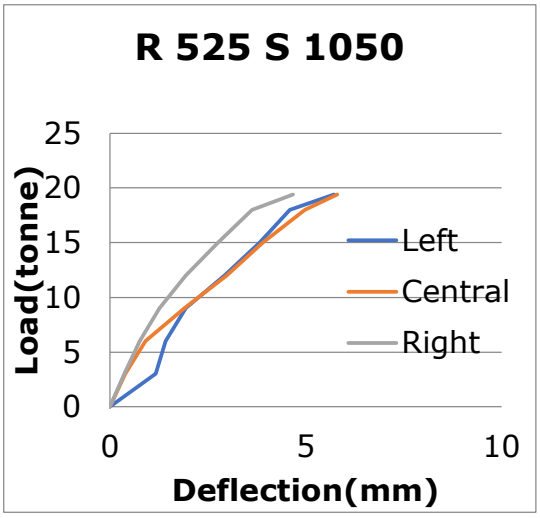


5.4.11 Load Deflection Readings of R525 S1050and Load Vs. Deflection Graphical Representation

Table 5-15 Load Deflection Readings of R525 S1050

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	1.17	0.39	0.36
6	1.42	0.91	0.76
9	1.94	1.9	1.27
12	2.92	2.98	1.94
15	3.83	3.9	2.76
18	4.59	4.98	3.63
19.4	5.72	5.8	4.67

Graph 5-11 Load Vs. Deflection Graph R525 S1050

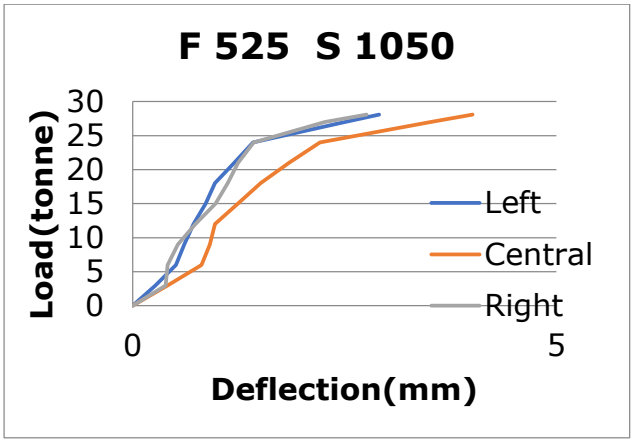


5.4.12 Load Deflection Readings of F525 S1050and Load Vs. Deflection Graphical Representation

Table 5-16 Load Deflection Readings of F525 S1050

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.27	0.41	0.39
6	0.51	0.81	0.41
9	0.61	0.91	0.53
12	0.72	0.97	0.74
15	0.86	1.24	0.98
18	0.97	1.51	1.12
21	1.2	1.84	1.24
24	1.42	2.21	1.43
27	2.51	3.52	2.27
28.1	2.91	4.01	2.76

Graph 5-12 Load Vs. Deflection Graph F525 S1050

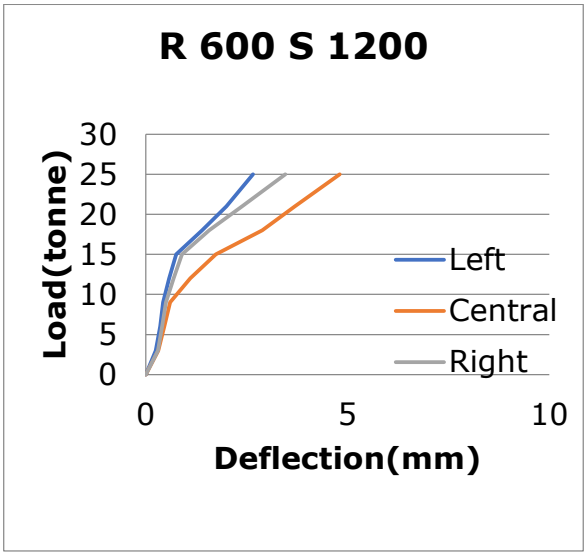


5.4.13 Load Deflection Readings of R600 S1200 and Load Vs. Deflection Graphical Representation

Table 5-17 Load Deflection Readings of R600 S1200

Load (Tonne)	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.25	0.31	0.3
6	0.36	0.46	0.41
9	0.43	0.61	0.5
12	0.58	1.11	0.69
15	0.76	1.74	0.9
18	1.4	2.89	1.57
21	2	3.7	2.39
25	2.66	4.81	3.46

Graph 5-13 Load Vs. Deflection Graph R600 S1200

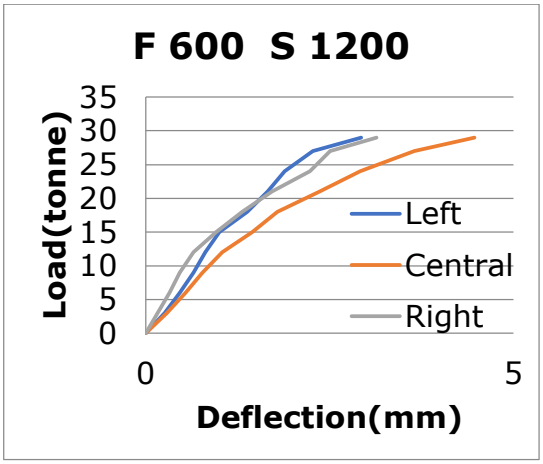


5.4.14 Load Deflection Readings of F600 S1200 and Load Vs. Deflection Graphical Representation

Table 5-18 Load Deflection Readings of F600 S1200

Load tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.26	0.29	0.16
6	0.46	0.54	0.32
9	0.65	0.77	0.46
12	0.81	1.04	0.65
15	1	1.45	0.96
18	1.38	1.79	1.31
21	1.66	2.37	1.72
24	1.89	2.92	2.23
27	2.27	3.65	2.51
29	2.93	4.47	3.14

Graph 5-14 Load Vs. Deflection Graph F600 S1200

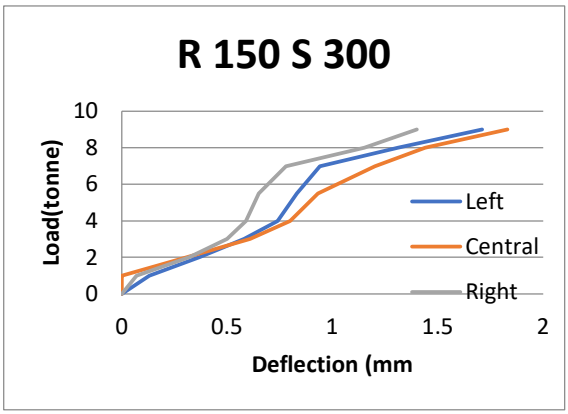


5.4.15 Load Deflection Readings of R150 S300 and Load Vs. Deflection Graphical Representation

Table 5-19 Load Deflection Readings of R150 S300

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1	0.13	0	0.07
2	0.37	0.31	0.32
3	0.58	0.61	0.5
4	0.74	0.8	0.59
5.5	0.83	0.93	0.65
7	0.94	1.2	0.78
8	1.31	1.44	1.15
9	1.71	1.83	1.4

Graph 5-15 Load Vs. Deflection Graph R150 S300

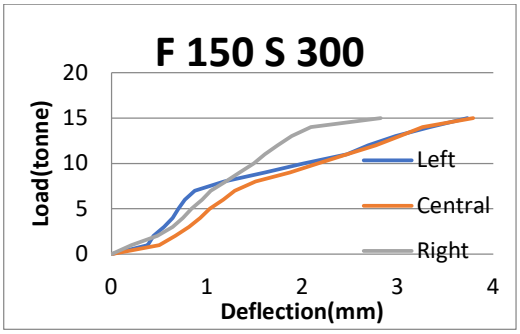


5.4.16 Load Deflection Readings of F150 S300 and Load vs. Deflection Graphical Representation

Table 5-20 Load Deflection Readings of F150 S300

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1	0.38	0.5	0.21
2	0.44	0.67	0.48
3	0.55	0.81	0.64
4	0.64	0.93	0.75
5	0.7	1.03	0.84
6	0.77	1.17	0.95
7	0.87	1.29	1.04
8	1.18	1.51	1.2
9	1.61	1.87	1.34
10	2.01	2.16	1.49
11	2.47	2.47	1.61
12	2.69	2.77	1.74
13	2.98	3.02	1.89
14	3.34	3.26	2.09
15	3.73	3.79	2.82

Graph 5-16 Load Vs. Deflection Graph F150 S300

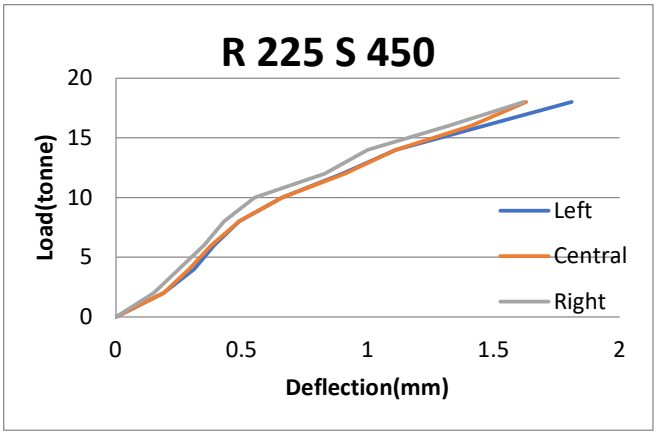


5.4.17 Load Deflection Readings of R225 S450 and Load vs. Deflection Graphical Representation

Table 5-21 Load Deflection Readings of R225 S450

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.19	0.19	0.15
4	0.31	0.29	0.25
6	0.39	0.38	0.35
8	0.49	0.49	0.43
10	0.66	0.66	0.55
12	0.9	0.91	0.83
14	1.11	1.11	1
16	1.46	1.41	1.32
18	1.81	1.63	1.62

Graph 5-17 Load Vs. Deflection Graph R225 S450

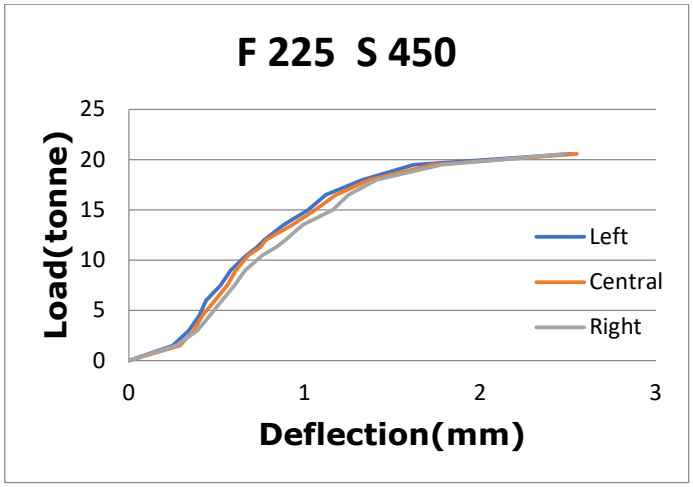


5.4.18 Load Deflection Readings of F225 S450 and Load vs. Deflection Graphical Representation

Table 5-22 Load Deflection Readings of F225 S450

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
1.5	0.25	0.29	0.27
3	0.34	0.37	0.39
4.5	0.4	0.42	0.46
6	0.44	0.49	0.53
7.5	0.52	0.56	0.6
9	0.58	0.61	0.66
10.5	0.67	0.68	0.76
11.3	0.73	0.75	0.84
12	0.77	0.78	0.89
13.5	0.88	0.93	0.99
15	1.02	1.06	1.16
16.5	1.12	1.18	1.25
18	1.33	1.37	1.41
19.5	1.62	1.73	1.78
20.6	2.52	2.55	2.48

Graph 5-18 Load Vs. Deflection Graph F225 S450

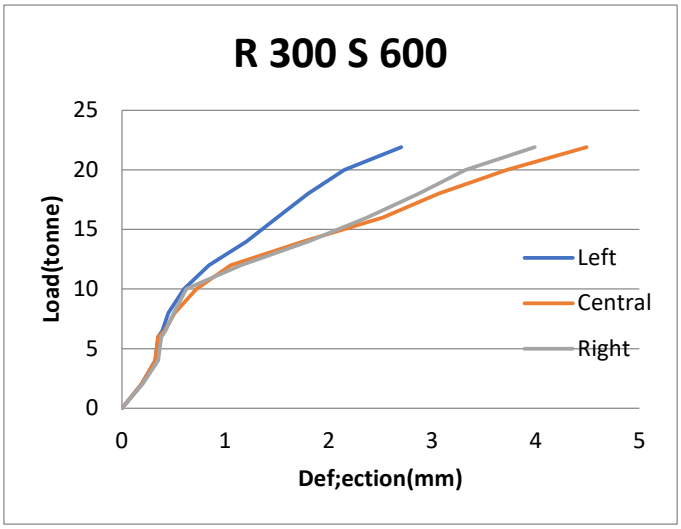


5.4.19 Load Deflection Readings of R300 S600and Load vs. Deflection Graphical Representation

Table 5-23 Load Deflection Readings of R300 S600

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.19	0.19	0.2
4	0.32	0.32	0.35
6	0.35	0.35	0.38
6.5	0.39	0.41	0.42
8	0.45	0.51	0.5
10	0.6	0.72	0.62
12	0.84	1.05	1.15
14	1.2	1.75	1.8
16	1.5	2.52	2.37
18	1.8	3.06	2.87
20	2.15	3.72	3.32
21.9	2.7	4.49	3.99

Graph 5-19 Load Vs. Deflection Graph R300 S600

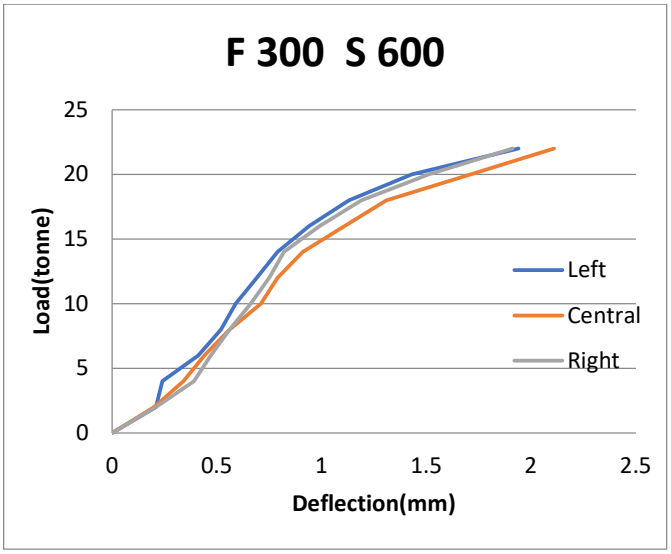


5.4.20 Load Deflection Readings of F300 S600and Load vs. Deflection Graphical Representation

Table 5-24 Load Deflection Readings of F300 S600

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.21	0.2	0.21
4	0.24	0.34	0.39
6	0.41	0.44	0.47
8	0.52	0.56	0.56
10	0.59	0.71	0.66
12	0.69	0.79	0.75
14	0.79	0.91	0.82
16	0.94	1.11	0.99
18	1.13	1.31	1.19
20	1.43	1.71	1.51
22	1.94	2.11	1.91

Graph 5-20 Load Vs. Deflection Graph F300 S600

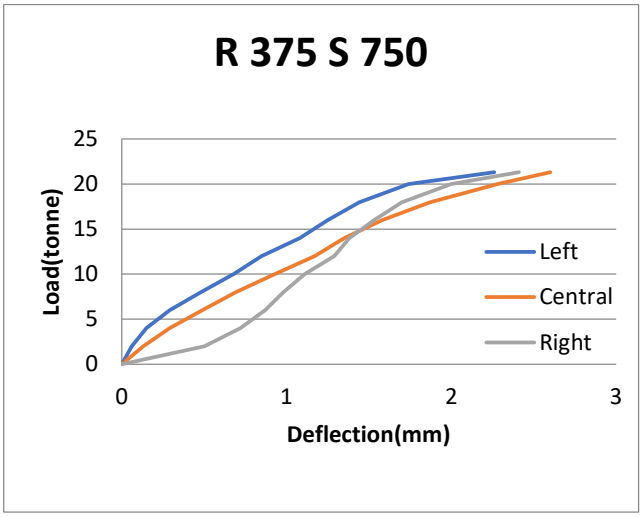


5.4.21 Load Deflection Readings of R375 S750 and Load vs. Deflection Graphical Representation

Table 5-25 Load Deflection Readings of R375 S750

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.06	0.13	0.5
4	0.15	0.29	0.72
6	0.29	0.49	0.87
8	0.48	0.69	0.98
10	0.68	0.93	1.11
12	0.85	1.17	1.29
14	1.08	1.35	1.38
16	1.25	1.58	1.53
18	1.44	1.87	1.7
20	1.74	2.28	2
21.3	2.26	2.6	2.41

Graph 5-21 Load Vs. Deflection Graph R375 S750

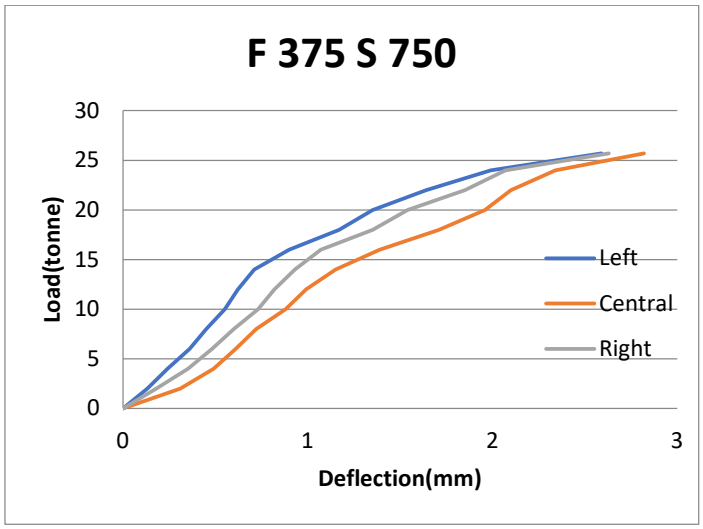


5.4.22 Load Deflection Readings of F375 S750 and Load vs. Deflection Graphical Representation

Table 5-26 Load Deflection Readings of F375 S750

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.13	0.31	0.18
4	0.24	0.49	0.35
6	0.36	0.61	0.48
8	0.45	0.72	0.6
10	0.55	0.88	0.73
12	0.62	0.99	0.82
14	0.71	1.15	0.93
16	0.9	1.39	1.07
18	1.17	1.71	1.35
20	1.35	1.96	1.54
22	1.64	2.1	1.85
24	1.99	2.34	2.07
25.7	2.59	2.82	2.63

Graph 5-22 Load Vs. Deflection Graph F375 S750

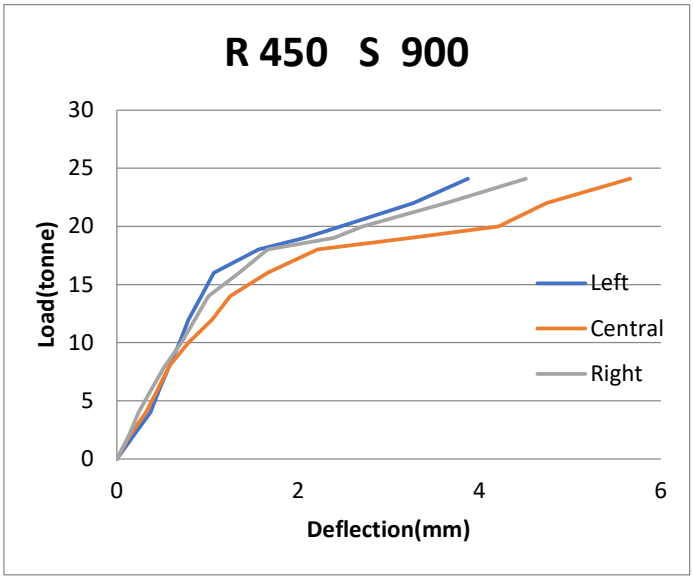


5.4.23 Load Deflection Readings of R450 S900 and Load vs. Deflection Graphical Representation

Table 5-27 Load Deflection Readings of R450 S900

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.18	0.14	0.13
4	0.37	0.32	0.24
6	0.47	0.45	0.38
8	0.58	0.58	0.53
10	0.69	0.79	0.71
12	0.79	1.05	0.86
14	0.93	1.25	1.01
16	1.07	1.66	1.35
18	1.56	2.21	1.66
19	2.07	3.24	2.39
20	2.47	4.21	2.71
22	3.27	4.74	3.63
24.1	3.87	5.66	4.51

Graph 5-23 Load Vs. Deflection Graph R450 S900

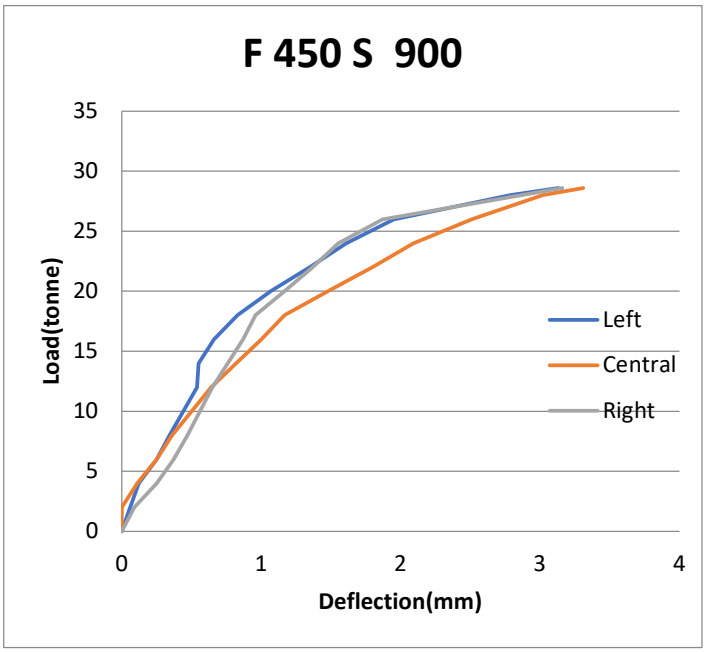


5.4.24 Load Deflection Readings of F450 S900 and Load vs. Deflection Graphical Representation

Table 5-28 Load Deflection Readings of F450 S900

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
2	0.06	0	0.09
4	0.12	0.11	0.25
6	0.25	0.25	0.37
8	0.34	0.36	0.47
10	0.44	0.5	0.56
12	0.54	0.64	0.65
14	0.55	0.82	0.76
16	0.66	1	0.87
18	0.83	1.17	0.96
20	1.07	1.48	1.17
22	1.35	1.8	1.37
24	1.61	2.09	1.55
26	1.95	2.51	1.87
28	2.79	3.02	2.87
28.6	3.13	3.31	3.16

Graph 5-24 Load Vs. Deflection Graph F450 S900

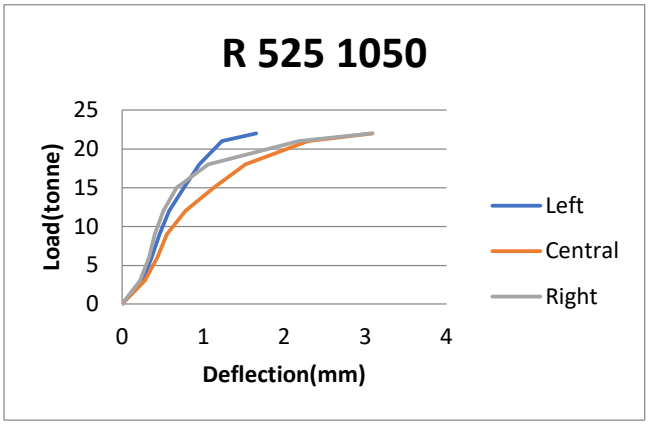


5.4.25 Load Deflection Readings of R525 S1050and Load vs. Deflection Graphical Representation

Table 5-29 Load Deflection Readings of R525 S1050

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.25	0.28	0.22
6	0.36	0.43	0.33
9	0.46	0.55	0.4
12	0.58	0.78	0.51
15	0.76	1.13	0.67
18	0.95	1.52	1.06
21	1.23	2.29	2.18
22	1.65	3.09	3.08

Graph 5-25 Load Vs. Deflection Graph R525 S1050

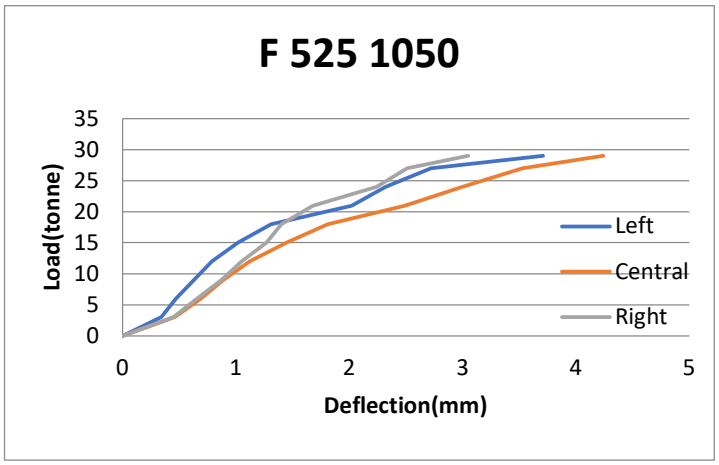


5.4.26 Load Deflection Readings of F525 S1050and Load vs. Deflection Graphical Representation

Table 5-30 Load Deflection Readings of F525 S1050

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.34	0.46	0.45
6	0.47	0.69	0.66
9	0.63	0.89	0.87
12	0.79	1.12	1.05
15	1.02	1.45	1.27
18	1.31	1.81	1.4
21	2.02	2.49	1.68
24	2.32	3	2.24
27	2.72	3.53	2.51
29	3.71	4.24	3.05

Graph 5-26 Load Vs. Deflection Graph F525 S1050

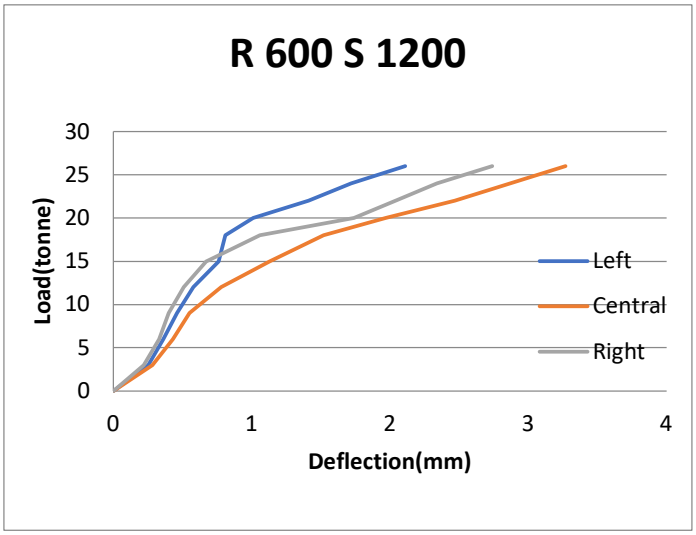


5.4.27 Load Deflection Readings of R600 S1200 and Load vs. Deflection Graphical Representation

Table 5-31 Load Deflection Readings of R600 S1200

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.25	0.28	0.22
6	0.36	0.43	0.33
9	0.46	0.55	0.4
12	0.58	0.78	0.51
15	0.76	1.13	0.67
18	0.81	1.52	1.06
20	1.01	1.97	1.74
22	1.41	2.47	2.04
24	1.72	2.87	2.34
26	2.11	3.27	2.74

Graph 5-27 Load Vs. Deflection Graph R600 S1200

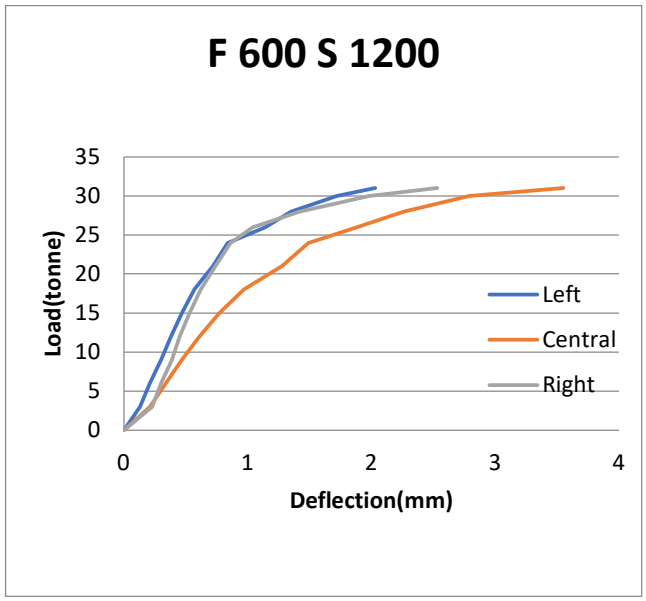


5.4.28 Load Deflection Readings of F600 S1200 and Load vs. Deflection Graphical Representation

Table 5-32 Load Deflection Readings of F600 S1200

Load Tonne	Deflection (mm)		
	Left	Central	Right
0	0	0	0
3	0.13	0.21	0.23
6	0.21	0.34	0.3
9	0.3	0.47	0.39
12	0.38	0.61	0.45
15	0.47	0.77	0.53
18	0.57	0.97	0.62
21	0.72	1.28	0.74
24	0.84	1.49	0.86
26	1.14	1.88	1.04
28	1.35	2.26	1.42
30	1.72	2.79	1.98
31	2.03	3.55	2.53

Graph 5-28 Load Vs. Deflection Graph F600 S1200

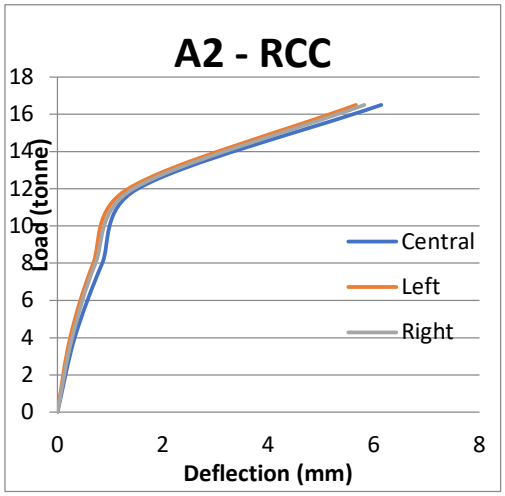


5.4.29 Load vs. deflection observation and graphical representation for A2 - RCC beam:

Table 5-33 load deflection observation for A2-RCC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
A2 /RCC	0	0	0	0
	4	0.24	0.33	0.28
	8	0.67	0.85	0.71
	12	1.35	1.52	1.44
	16.5	5.67	6.14	5.81

Graph 5-29 Load vs deflection of A2-RCC

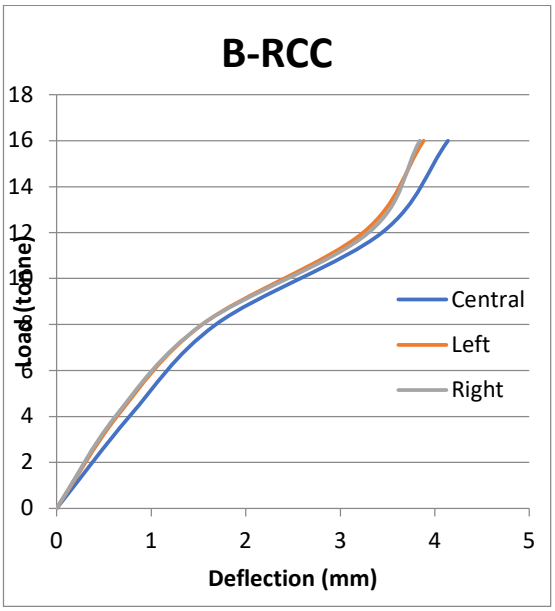


5.4.30 Load vs. deflection observation and graphical representation for B - RCC beam:

Table 5-34 load deflection observation for B-RCC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
B /RCC	0	0	0	0
	4	0.635	0.772	0.628
	8	1.537	1.684	1.542
	12	3.24	3.44	3.31
	16	3.87	4.138	3.83

Graph 5-30 Load vs deflection of B-RCC

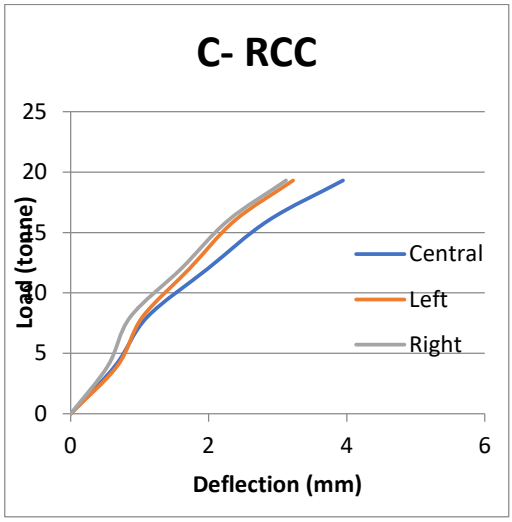


5.4.31 Load vs. deflection observation and graphical representation for C - RCC beam:

Table 5-35 load deflection observation for C-RCC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
C/ RCC	0	0	0	0
	4	0.68	0.648	0.54
	8	1.04	1.106	0.86
	12	1.72	1.984	1.6
	16	2.38	2.865	2.28
	19.3	3.22	3.945	3.12

Graph 5-31 Load vs deflection of C-RCC

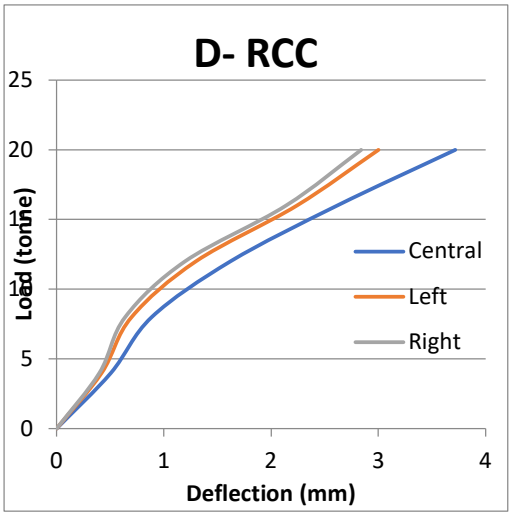


5.4.32 Load vs. deflection observation and graphical representation for D- RCC beam

Table 5-36 load deflection observation for D-RCC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
D /RCC	0	0	0	0
	4	0.42	0.506	0.4
	8	0.7	0.889	0.64
	12	1.3	1.624	1.2
	16	2.24	2.616	2.14
	20	3	3.716	2.84

Graph 5-32 Load vs deflection of D-RCC

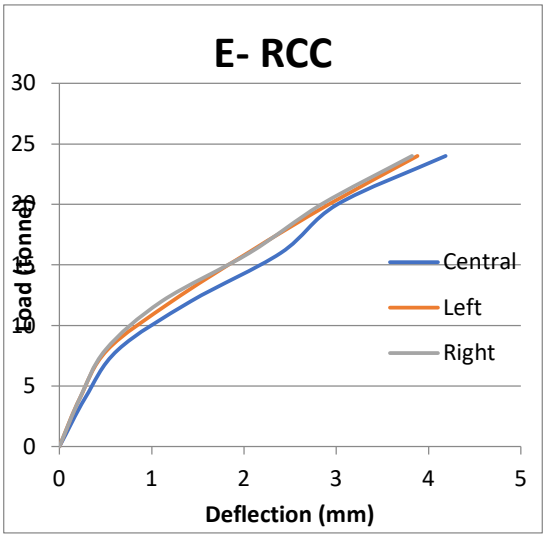


5.4.33 Load vs. deflection observation and graphical representation for E- RCC beam

Table 5-37 load deflection observation for E-RCC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
E/RCC	0	0	0	0
	4	0.22	0.278	0.22
	8	0.52	0.634	0.5
	12	1.22	1.424	1.11
	16	2.04	2.4	2.06
	20	2.92	3.012	2.84
	24	3.88	4.183	3.82

Graph 5-33 Load vs deflection of E-RCC

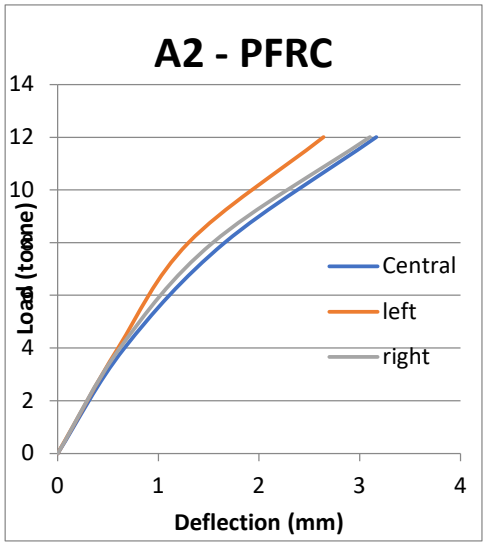


5.4.34 Load vs. deflection observation and graphical representation for A2 - PFRC beam

Table 5-38 load deflection observation for A2-PFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
A2 /PFRC	0	0	0	0
	4	0.6	0.664	0.62
	8	1.3	1.66	1.54
	12	2.64	3.166	3.1

Graph 5-34 Load vs deflection of A2-PFRC

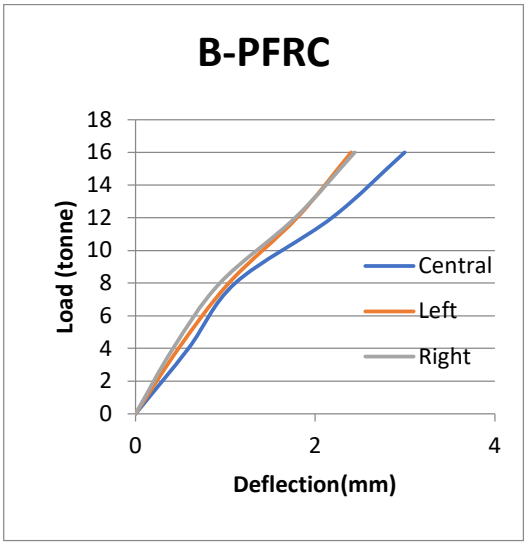


5.4.35 Load vs. deflection observation and graphical representation for B - PFRC beam

Table 5-39 load deflection observation for B-PFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
B /PFRC	0	0	0	0
	4	0.48	0.588	0.42
	8	1.04	1.112	0.94
	12	1.8	2.188	1.78
	16	2.4	2.996	2.44

Graph 5-35 Load vs deflection of B-PFRC

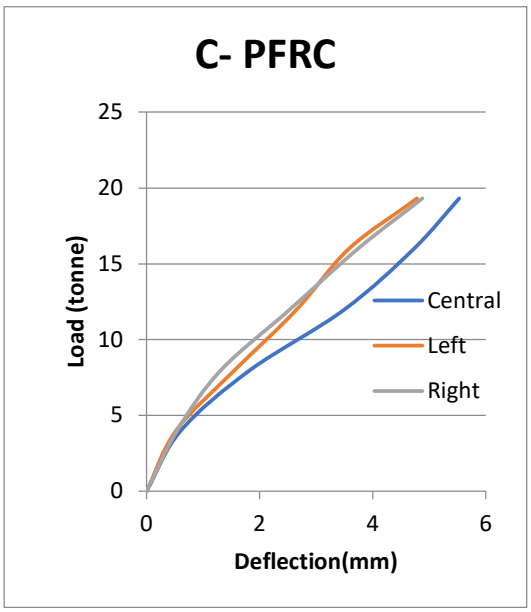


5.4.36 Load vs. deflection observation and graphical representation for PFRC – C beam

Table 5-40 load deflection observation for C-PFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
C /PFRC	0	0	0	0
	4	0.52	0.606	0.54
	8	1.56	1.836	1.32
	12	2.66	3.51	2.54
	16	3.58	4.73	3.74
	19.3	4.78	5.53	4.88

Graph 5-36 Load vs deflection of C-PFRC

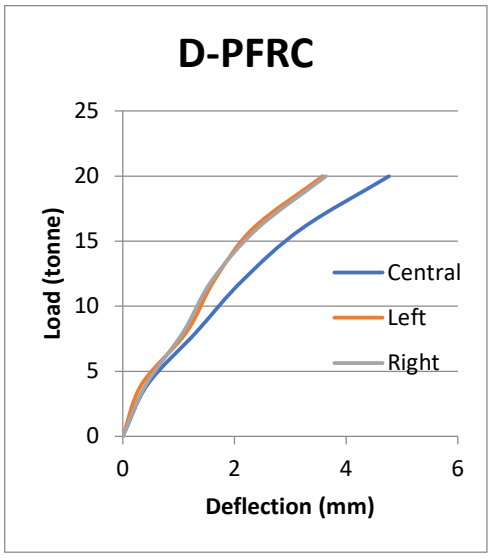


5.4.37 Load vs. deflection observation and graphical representation for D - PFRC beam

Table 5-41 load deflection observation for D-PFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
D /PFRC	0	0	0	0
	4	0.34	0.446	0.42
	8	1.14	1.316	1.08
	12	1.64	2.146	1.6
	16	2.34	3.218	2.42
	20	3.58	4.769	3.64

Graph 5-37 Load vs deflection of D-PFRC

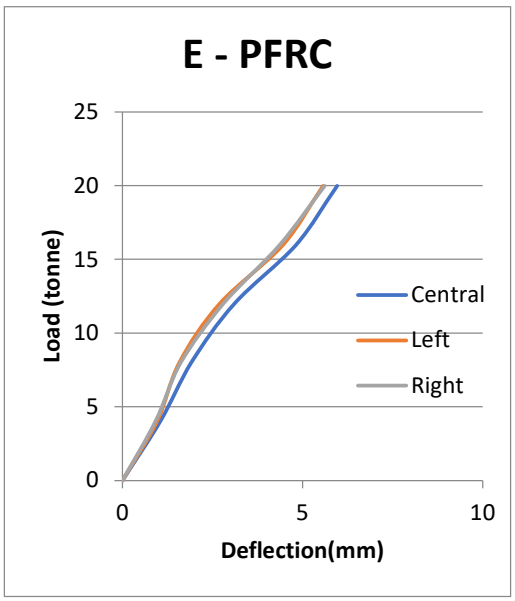


5.4.38 Load vs. deflection observation and graphical representation for E - PFRC beam

Table 5-42 load deflection observation for E-PFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
E/PFRC	0	0	0	0
	4	0.96	1.05	0.92
	8	1.58	1.912	1.62
	12	2.7	3.106	2.8
	16	4.46	4.82	4.37
	20	5.57	5.96	5.61

Graph 5-38 Load vs deflection of E-PFRC

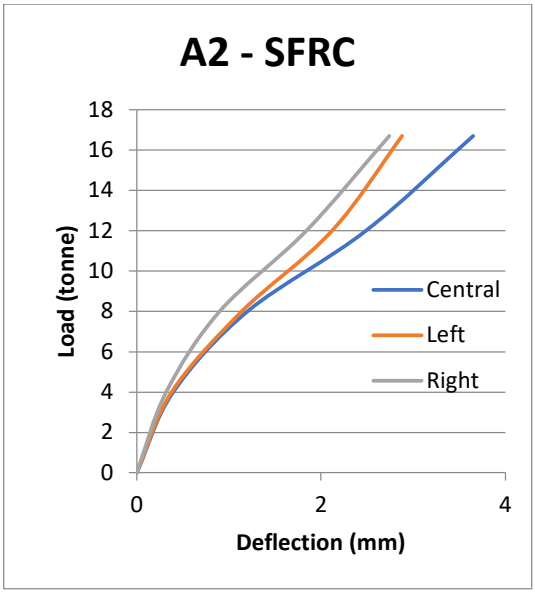


5.4.39 Load vs. deflection observation and graphical representation for A2 - SFRC beam

Table 5-43 load deflection observation for A2-SFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
A2 /SFRC	0	0	0	0
	4	0.38	0.396	0.32
	8	1.14	1.204	0.9
	12	2.12	2.488	1.84
	16.7	2.88	3.65	2.74

Graph 5-39 Load vs deflection of A2-SFRC

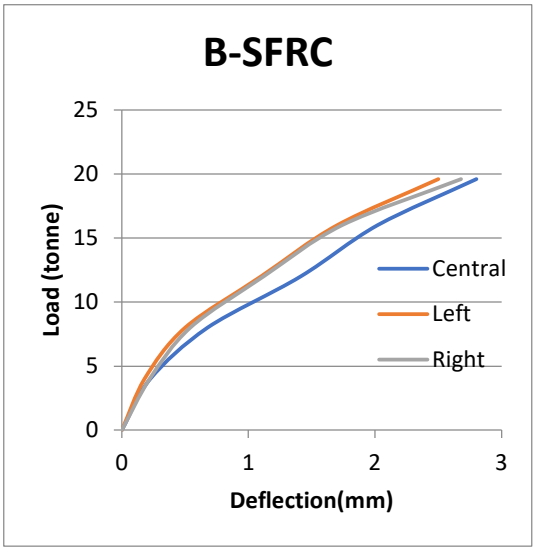


5.4.40 Load vs. deflection observation and graphical representation for B - SFRC beam

Table 5-44 load deflection observation for B-SFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
B/ SFRC	0	0	0	0
	4	0.18	0.224	0.22
	8	0.5	0.678	0.54
	12	1.1	1.412	1.12
	16	1.7	2.02	1.74
	19.6	2.5	2.802	2.68

Graph 5-40 Load vs deflection of B-SFRC

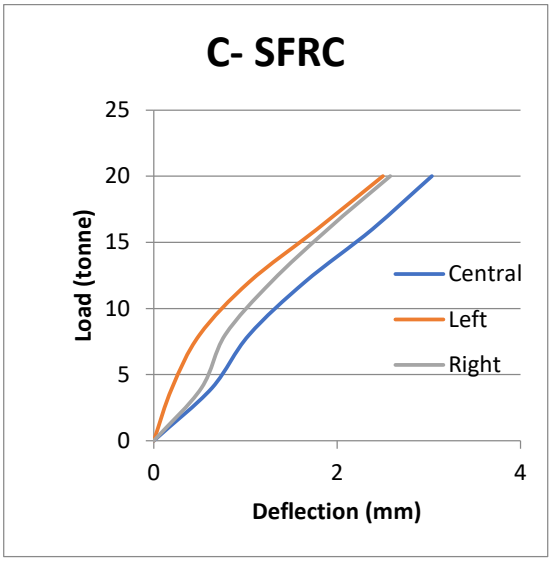


5.4.41 Load vs. deflection observation and graphical representation for C - SFRC beam

Table 5-45 load deflection observation for C-SFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
C/ SFRC	0	0	0	0
	4	0.2	0.634	0.52
	8	0.5	1.04	0.78
	12	1.04	1.648	1.28
	16	1.78	2.384	1.9
	20	2.5	3.032	2.58

Graph 5-41 Load vs deflection of C-SFRC

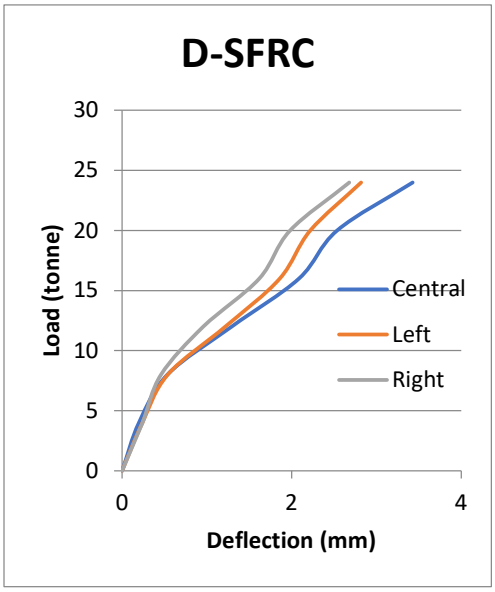


5.4.42 Load vs. deflection observation and graphical representation for D- SFRC beam

Table 5-46 load deflection observation for D-SFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
D/SFRC	0	0	0	0
	4	0.24	0.2	0.24
	8	0.54	0.536	0.46
	12	1.22	1.294	0.96
	16	1.86	2.086	1.62
	20	2.22	2.536	1.98
	24	2.82	3.426	2.68

Graph 5-42 Load vs deflection of D-SFRC

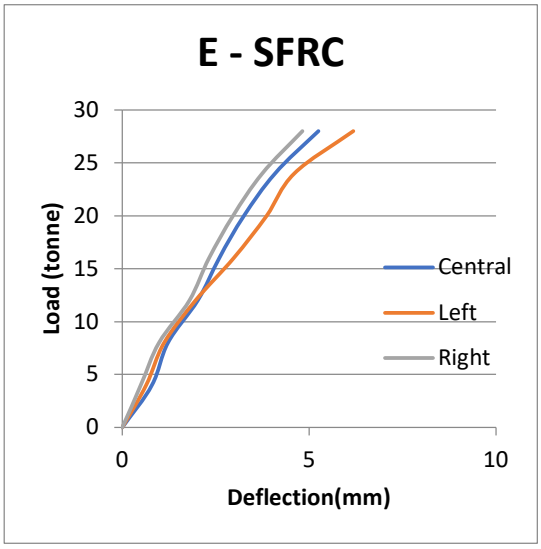


5.4.43 Load vs. deflection observation and graphical representation for E - SFRC beam

Table 5-47 load deflection observation for E-SFRC

Beam name	Load	Deflection (mm)		
		Left	Central	Right
E/ SFRC	0	0	0	0
	4	0.64	0.8	0.5
	8	1.12	1.22	0.98
	12	1.96	2.02	1.8
	16	2.98	2.59	2.32
	20	3.86	3.252	2.96
	24	4.6	4.08	3.74
	28	6.18	5.246	4.82

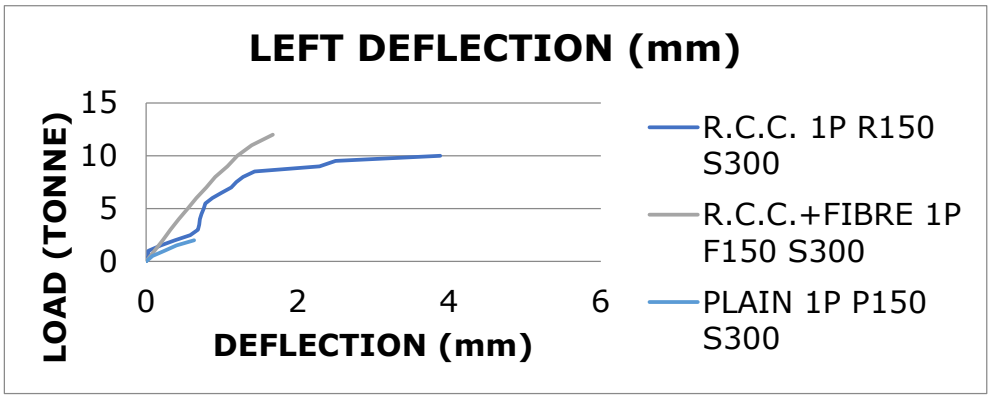
Graph 5-43Load vs deflection of E-SFRC



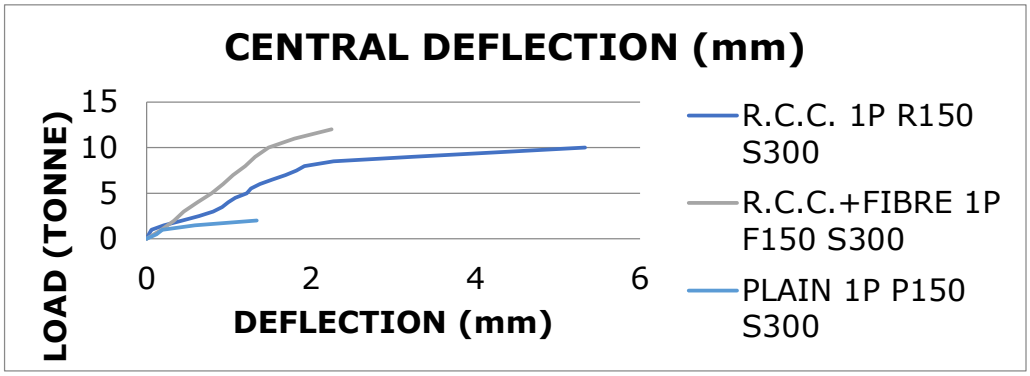
5.5 COMPARISON OF LOAD DEFLECTION CHARACTERISTICS OF PLAIN, RCC AND FIBROUS BEAMS (1P)

Plain Concrete beam possesses very low tensile strength and brittle in nature so it has very much low deflection compared to RCC and Fibrous beams. While Fibrous beam have high tensile strength and generally used as crack arrested concrete so it has low deflection compared to RCC Beams.

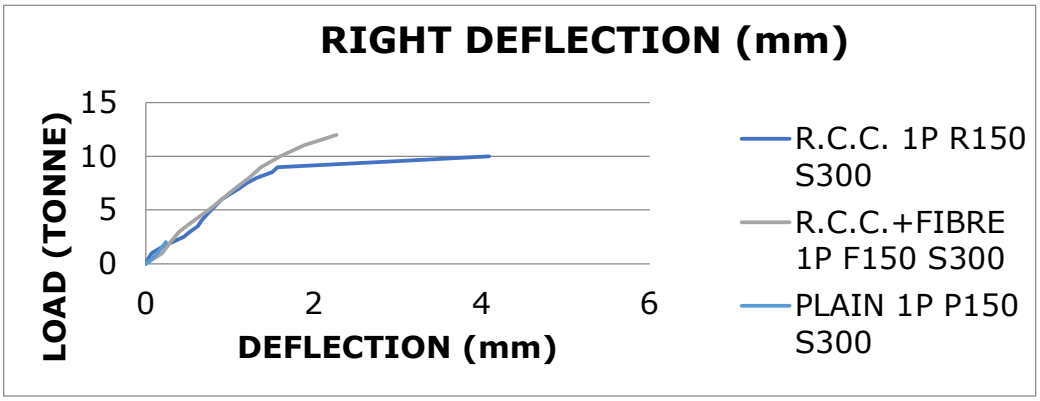
5.5.1 Comparison for Left Central and Right Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series (1 P)



Graph 5-44 Comparison for Left Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

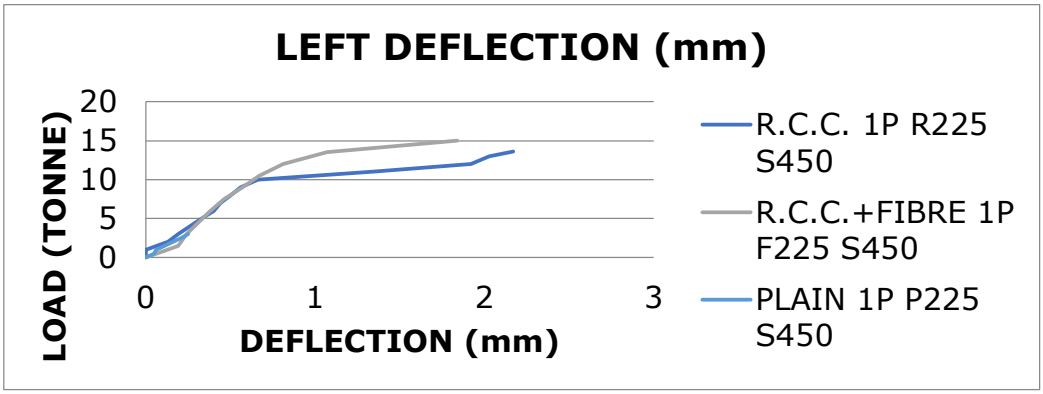


Graph 5-45 Comparison for Central Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

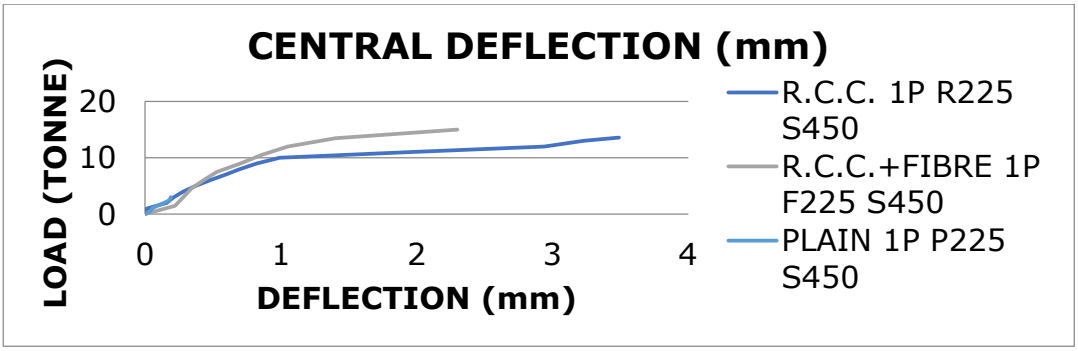


Graph 5-46 Comparison for Right Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

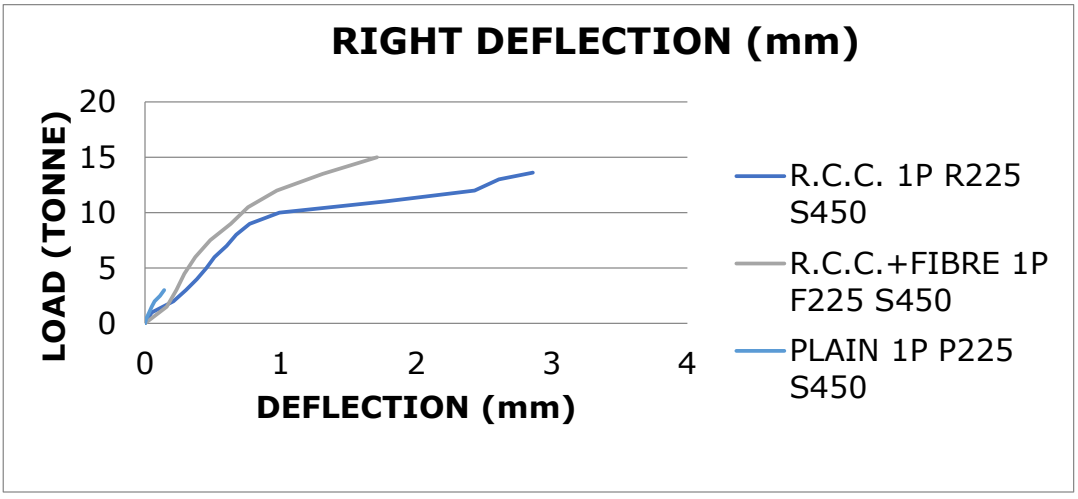
5.5.2 Comparison for Left Central and Right Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series (1 P)



Graph 5-47 Comparison for Left Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

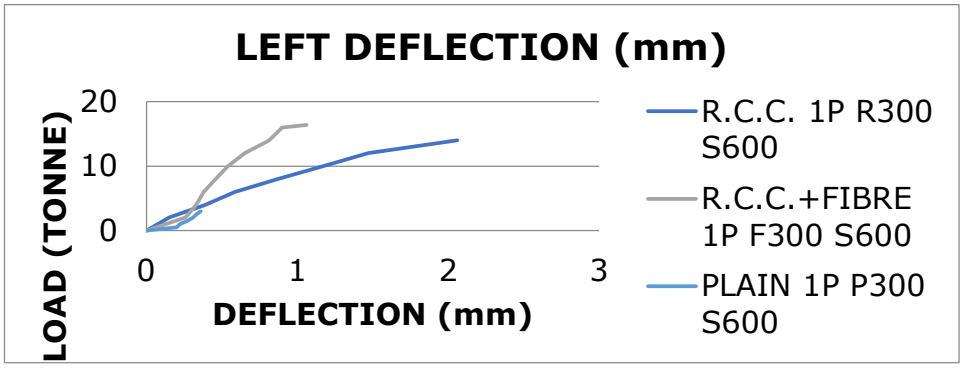


Graph 5-48 Comparison for central Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

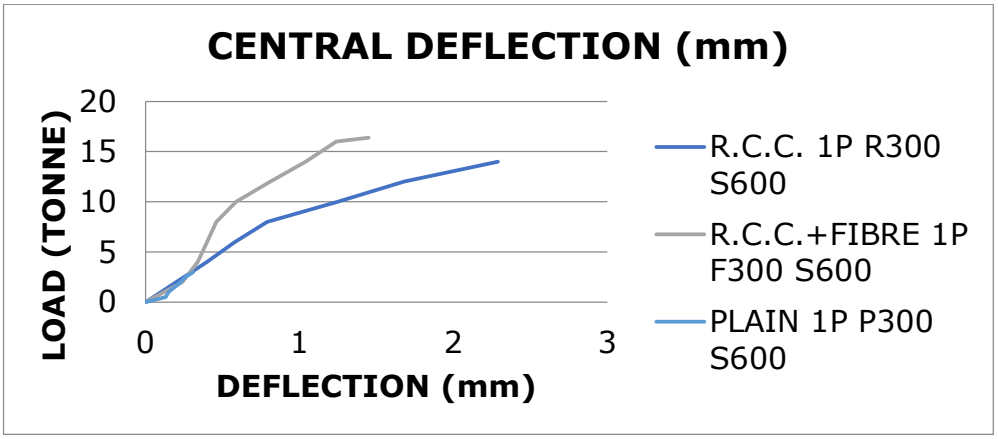


Graph 5-49 Comparison for Right Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

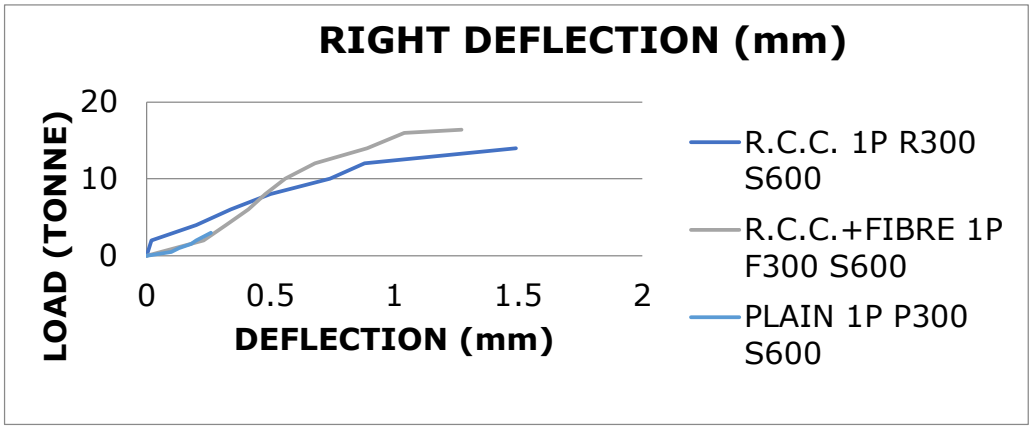
5.5.3 Comparison for Left Central and Right Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series (1 P)



Graph 5-50 Comparison for Left Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

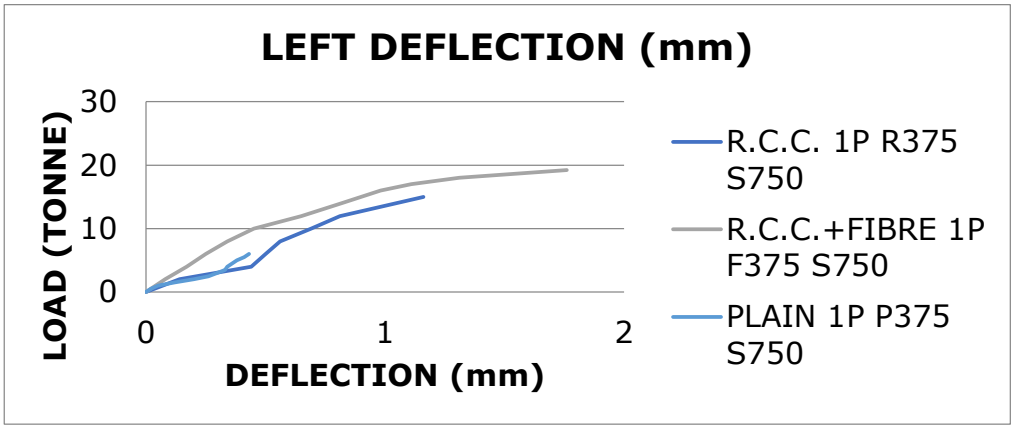


Graph 5-51 Comparison for Central Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

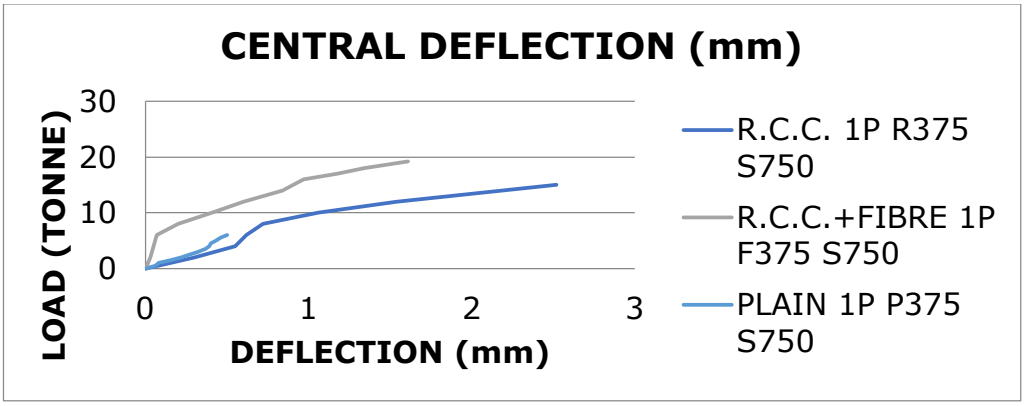


Graph 5-52 Comparison for Right Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

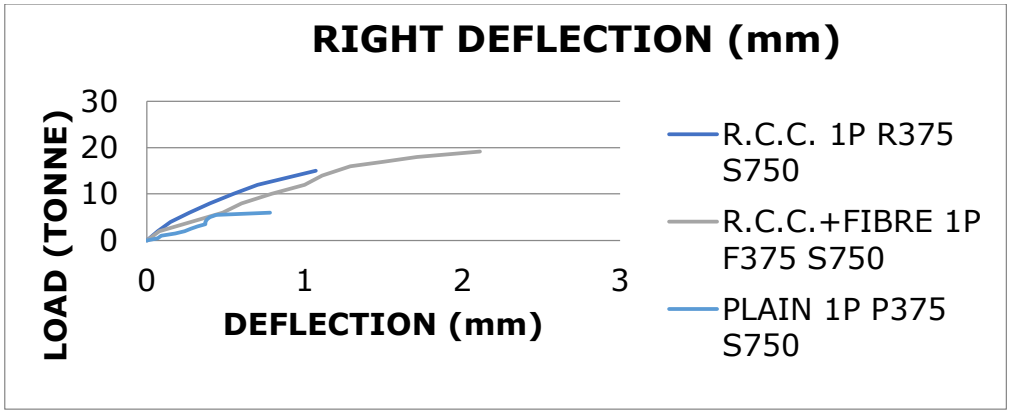
5.5.4 Comparison for Left Central and Right Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series (1P)_



Graph 5-53 Comparison for Left Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

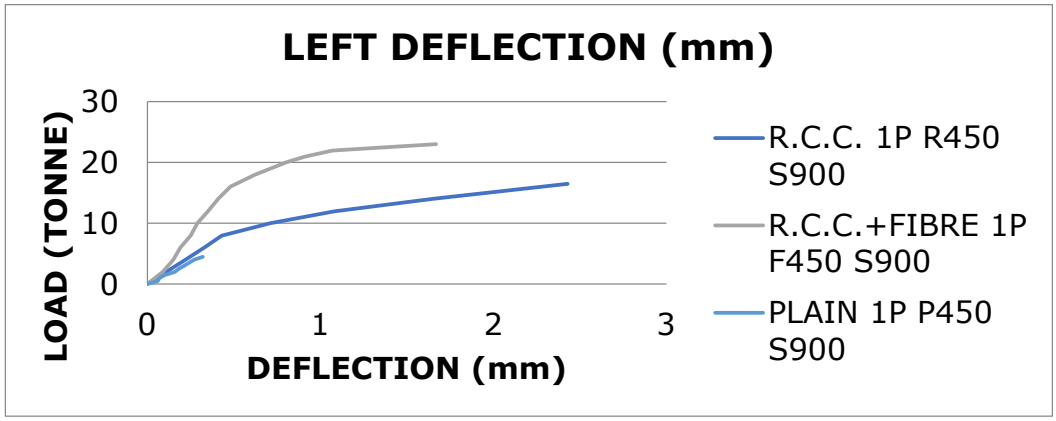


Graph 5-54 Comparison for Central Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

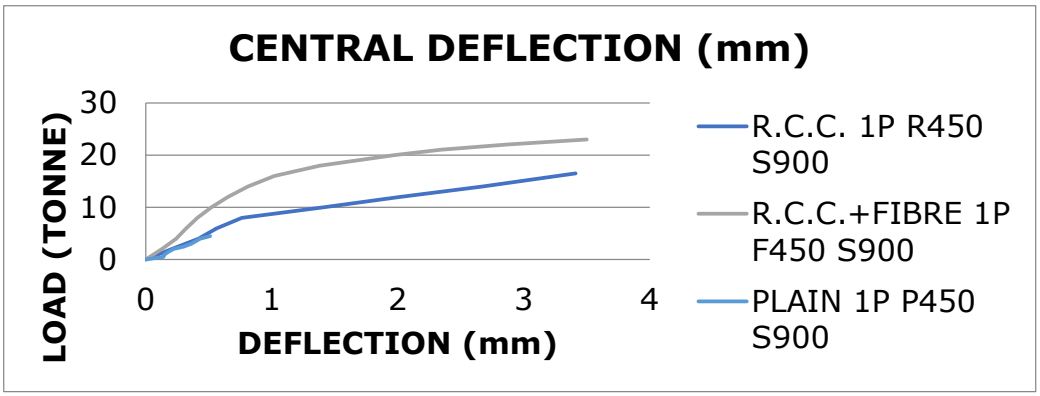


Graph 5-55 Comparison for Right Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

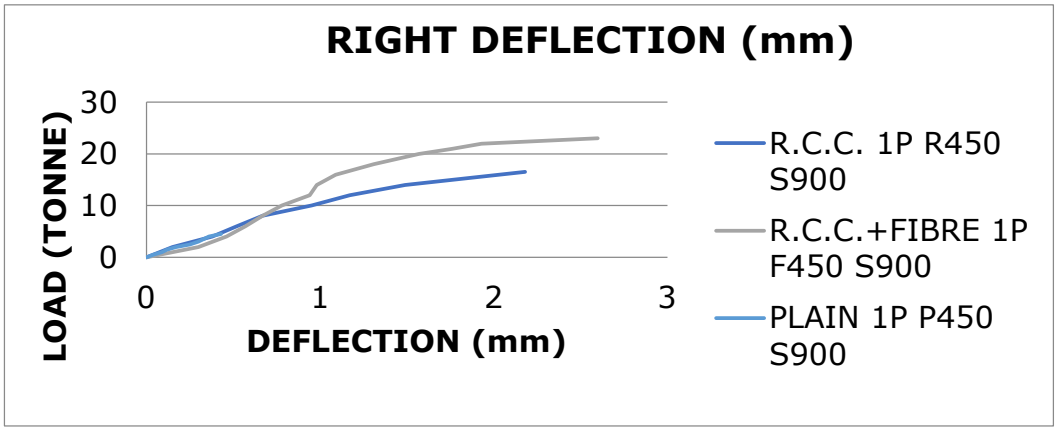
5.5.5 Comparison for Left Central and Right Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series(1 P)



Graph 5-56 Comparison for Left Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

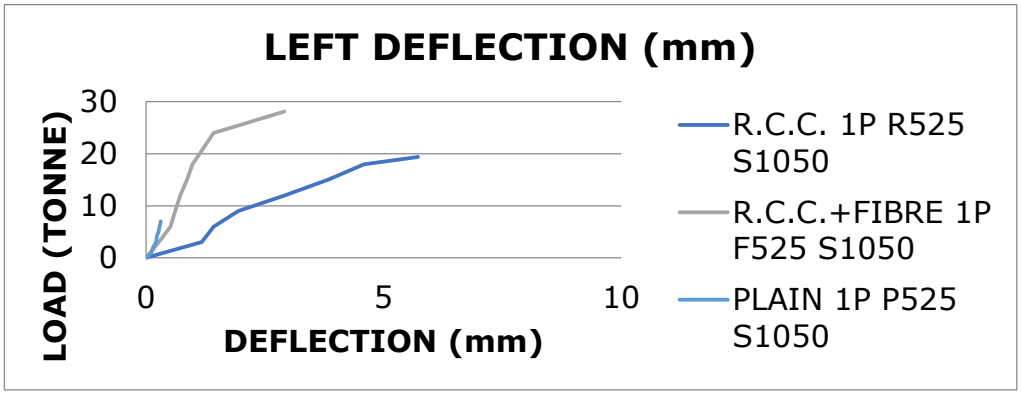


Graph 5-57 Comparison for Central Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

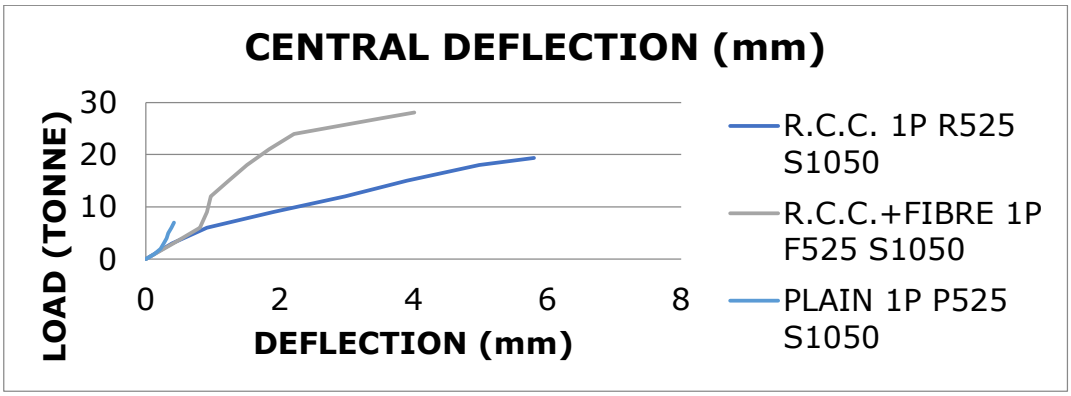


Graph 5-58 Comparison for Right Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

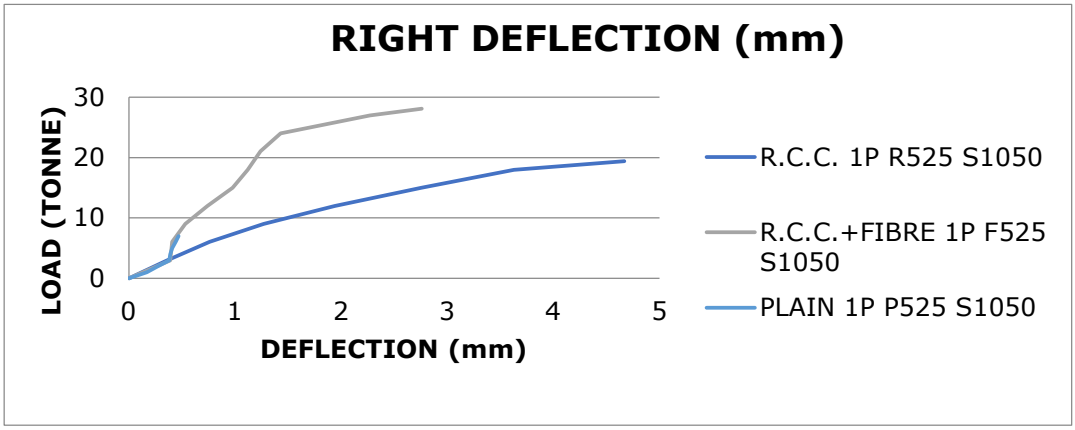
5.5.6 Comparison for Left Central and Right Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series (1 P)



Graph 5-59 Comparison for Left Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

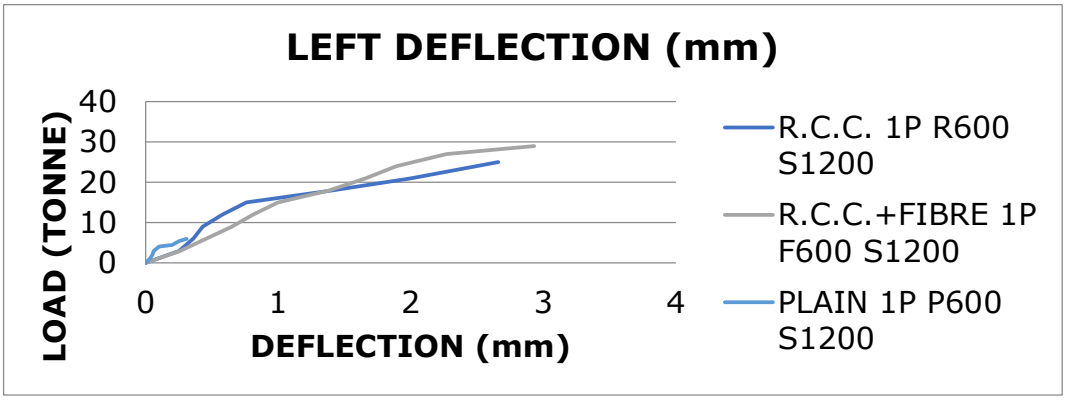


Graph 5-60 Comparison for Central Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

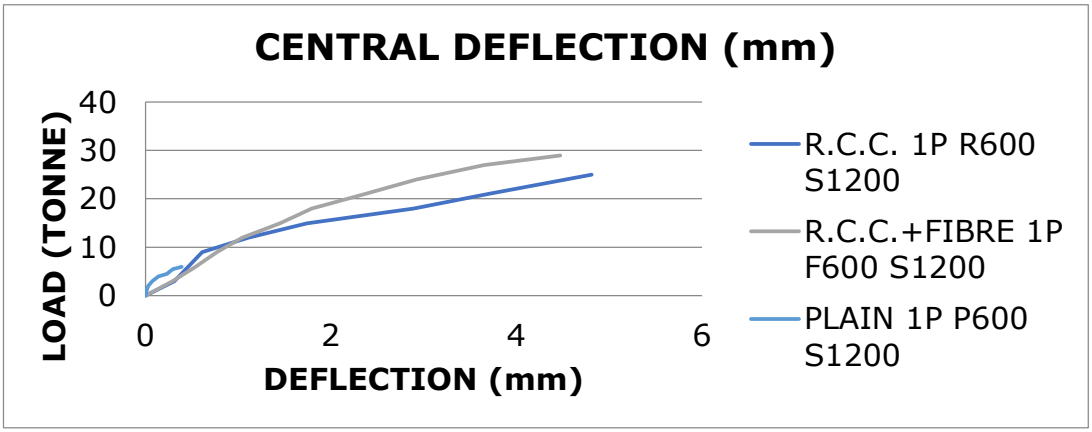


Graph 5-61 Comparison for Right Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

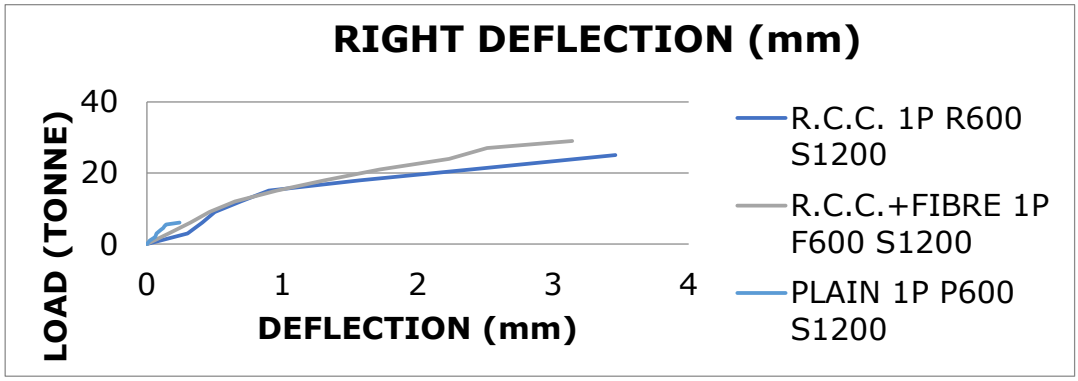
5.5.7 Comparison for Left Central and Right Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series(1 P)



Graph 5-62 Comparison for Left Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series



Graph 5-63 Comparison for Central Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series

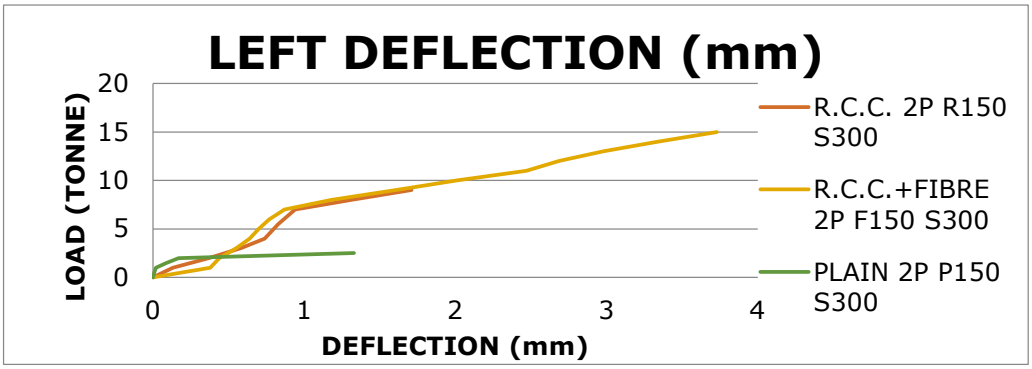


Graph 5-64 Comparison for Right Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series

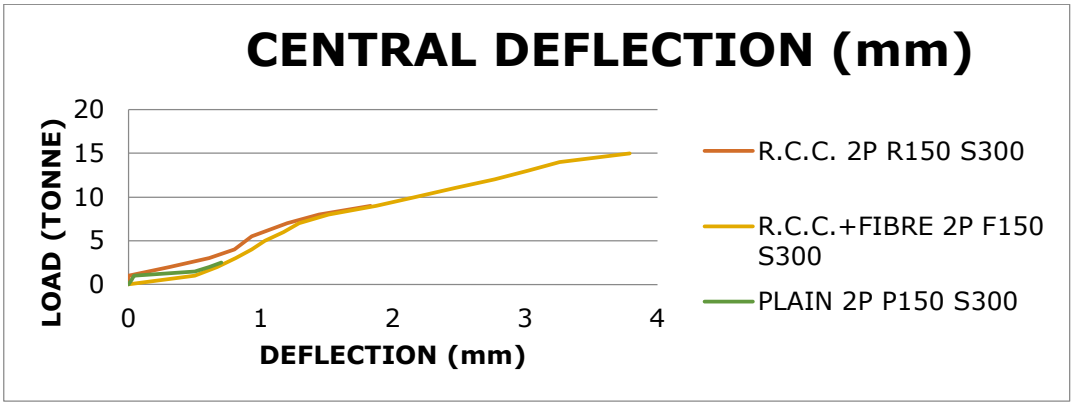
5.6 COMPARISON OF LOAD DEFLECTION CHARACTERISTICS OF PLAIN, RCC AND FIBROUS BEAMS(2P)

Plain Concrete beam possesses very low tensile strength and brittle in nature so it has very much low deflection compared to RCC and Fibrous beams. While Fibrous beam have high tensile strength and generally used as crack arrested concrete so it has low deflection compared to RCC Beams.

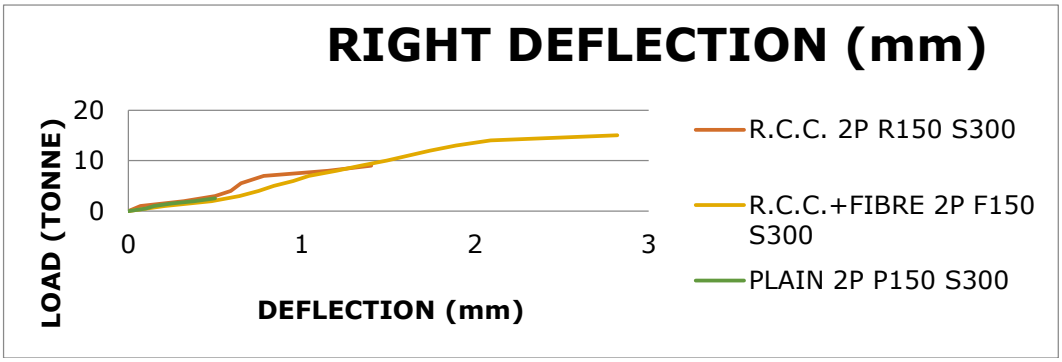
5.6.1 Comparison for Left Central and Right Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-65 Comparison for Left Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

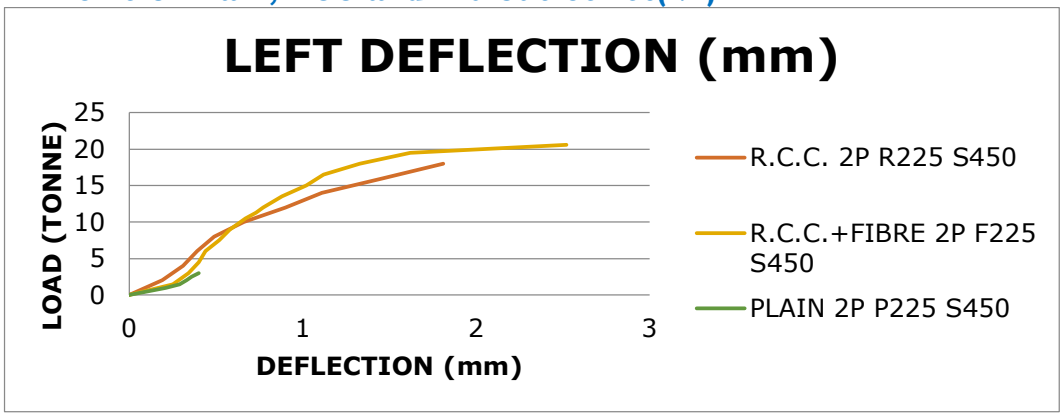


Graph 5-66 Comparison for Central Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

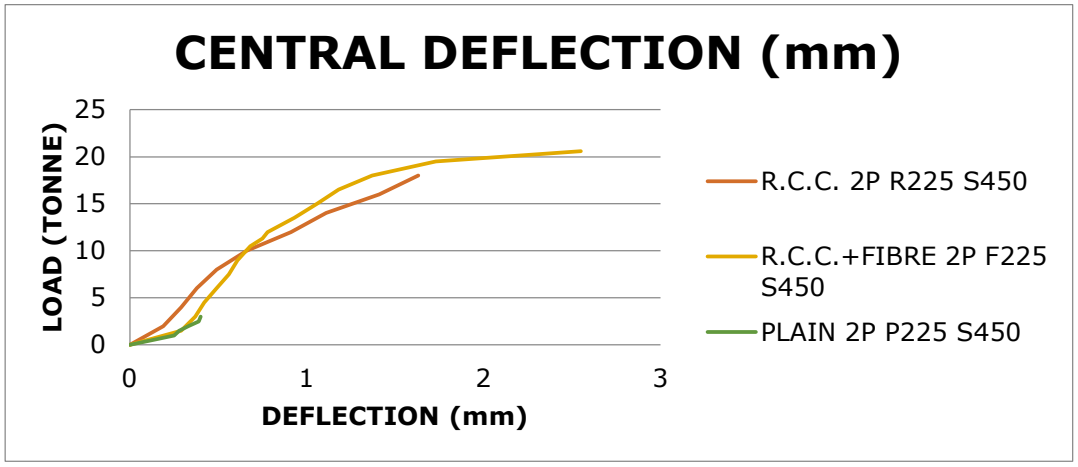


Graph 5-67 Comparison for Right Deflection of 150 x 300 Size of Plain, RCC and Fibrous Series

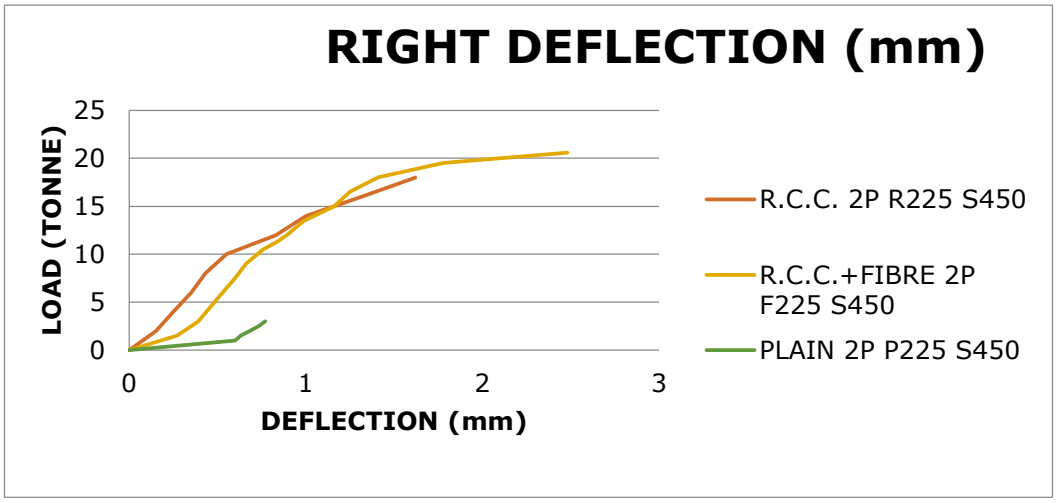
5.6.2 Comparison for Left Central and Right Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-68 Comparison for Left Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

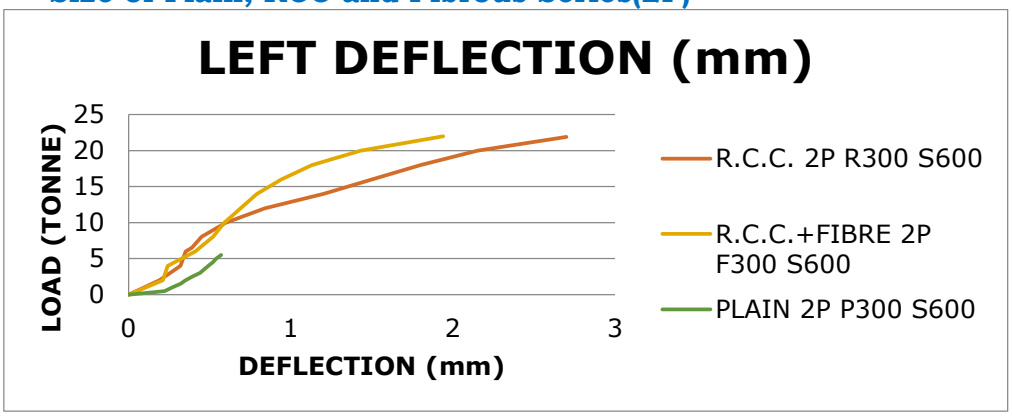


Graph 5-69 Comparison for central Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

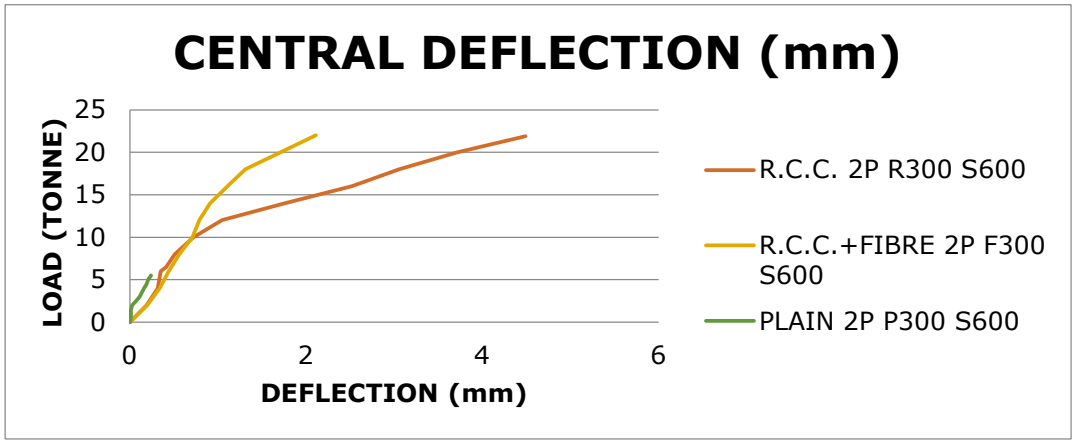


Graph 5-70 Comparison for Right Deflection of 225 x 450 Size of Plain, RCC and Fibrous Series

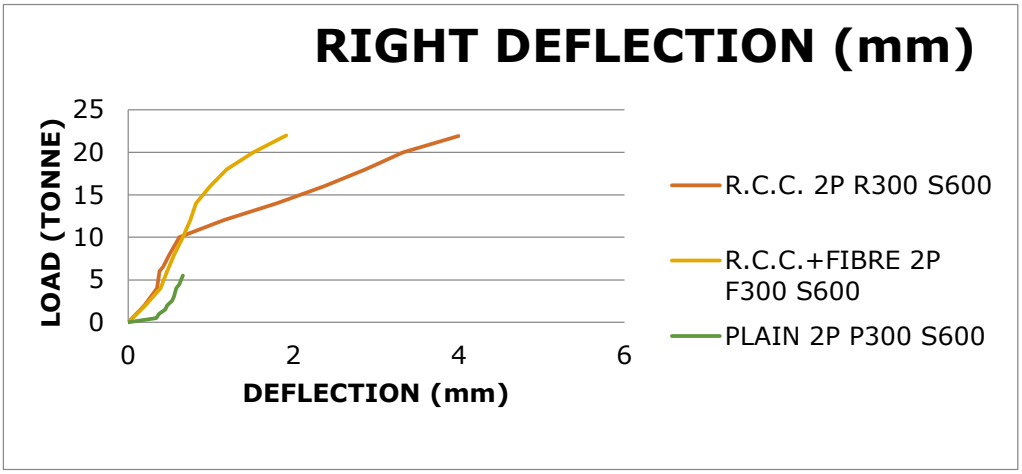
5.6.3 Comparison for Left Central and Right Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-71 Comparison for Left Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

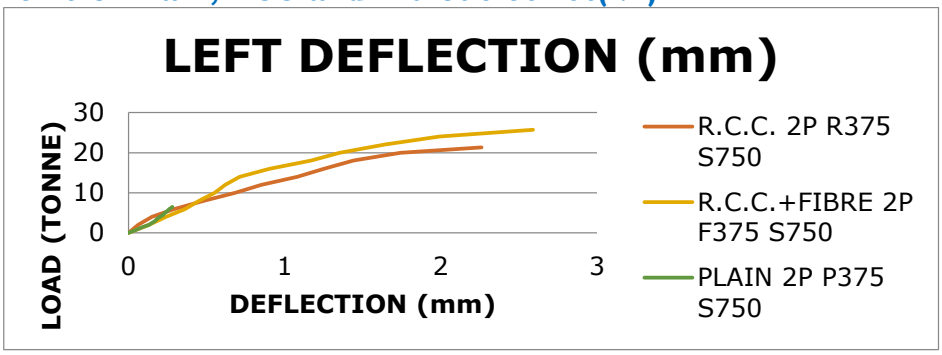


Graph 5-72 Comparison for Central Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

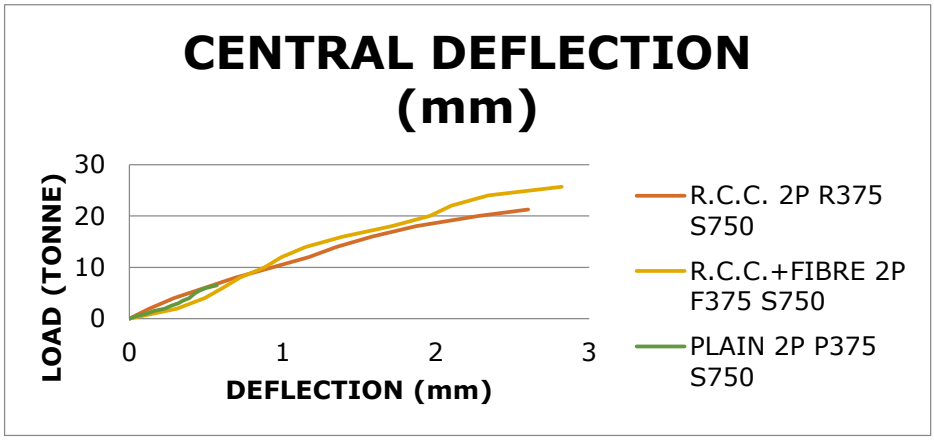


Graph 5-73 Comparison for Right Deflection of 300 x 600 Size of Plain, RCC and Fibrous Series

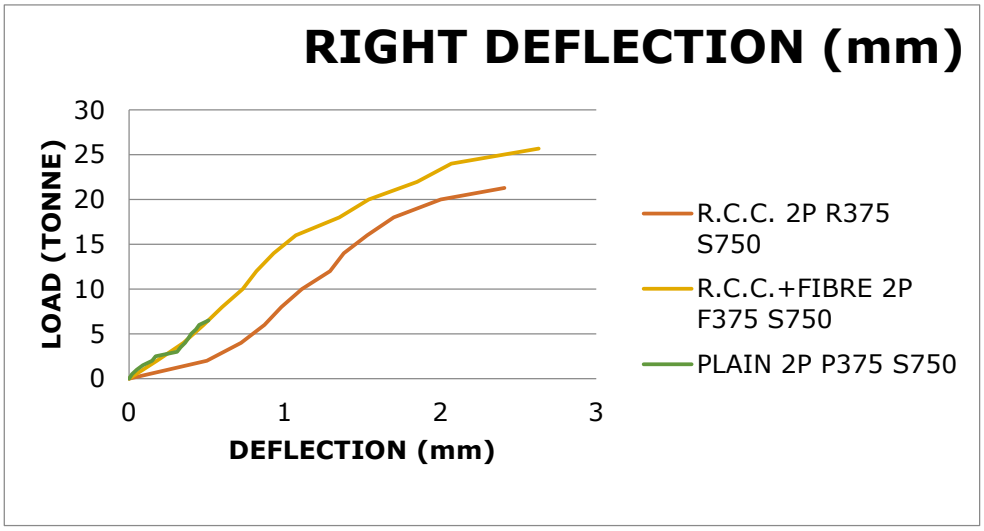
5.6.4 Comparison for Left Central and Right Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-74 Comparison for Left Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

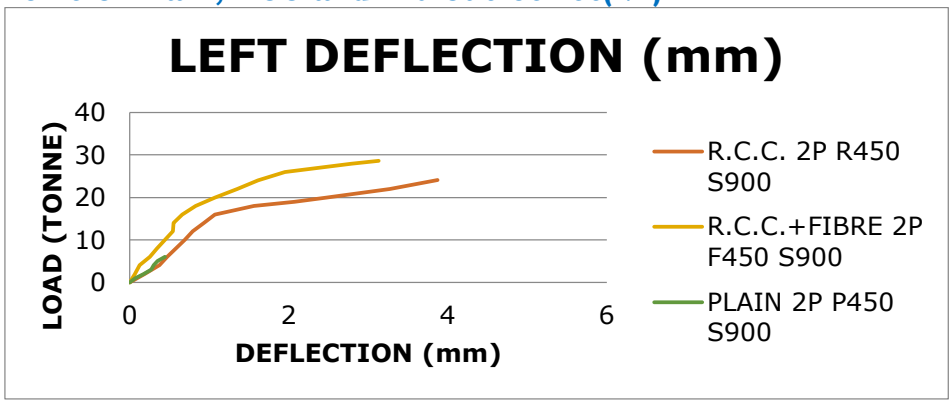


Graph 5-75 Comparison for Central Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

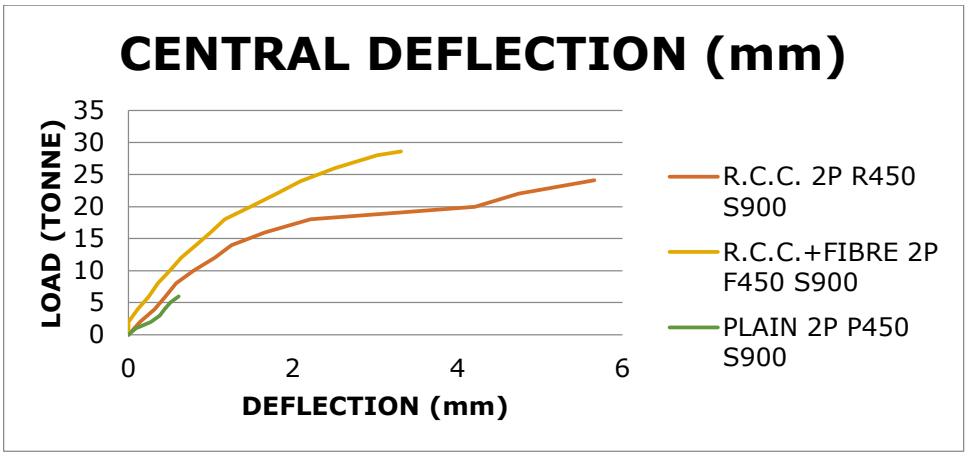


Graph 5-76 Comparison for Right Deflection of 375 x 750 Size of Plain, RCC and Fibrous Series

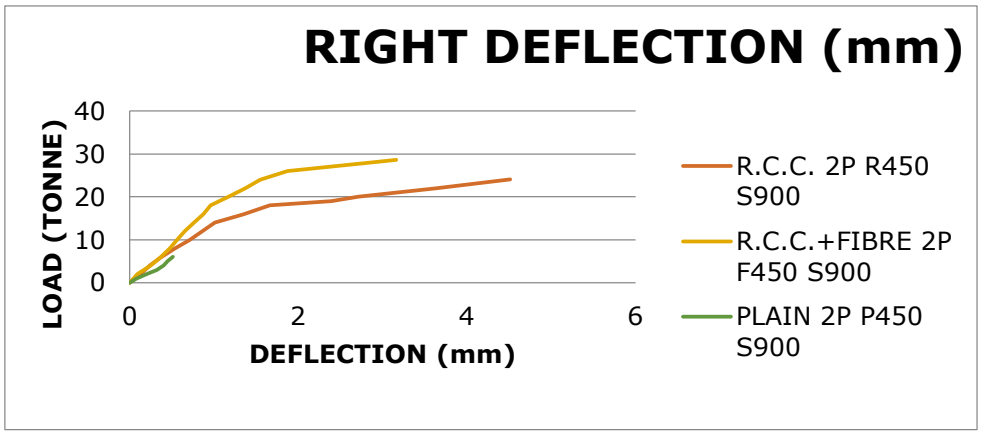
5.6.5 Comparison for Left Central and Right Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-77 Comparison for Left Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

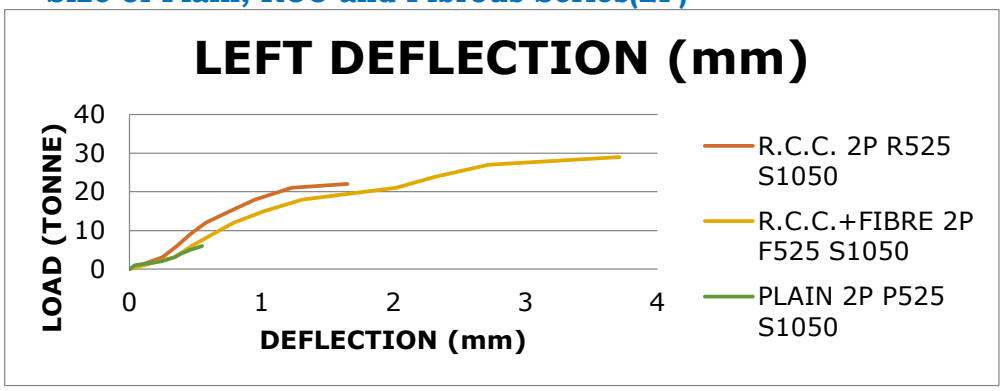


Graph 5-78 Comparison for Central Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

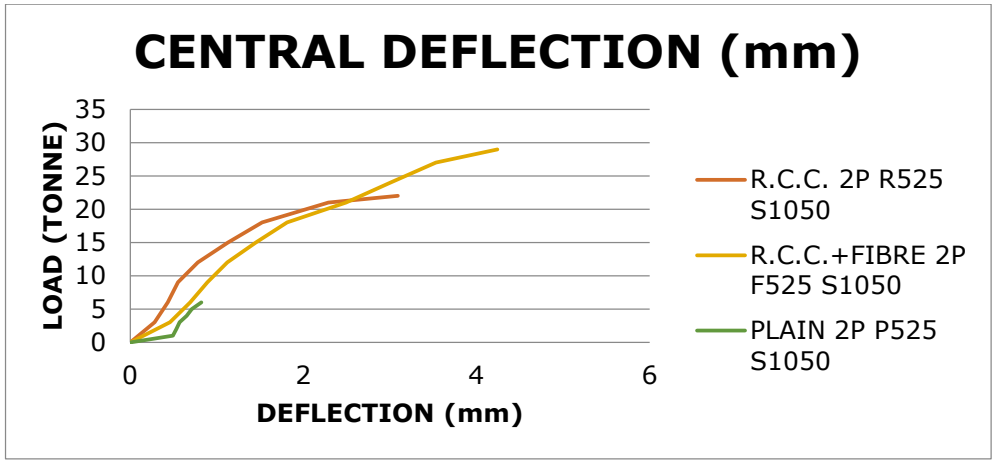


Graph 5-79 Comparison for Right Deflection of 450 x 900 Size of Plain, RCC and Fibrous Series

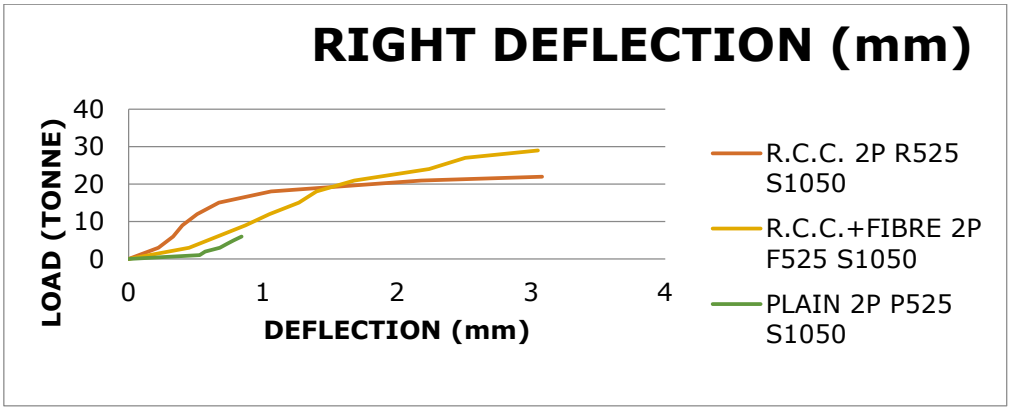
5.6.6 Comparison for Left Central and Right Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-80 Comparison for Left Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

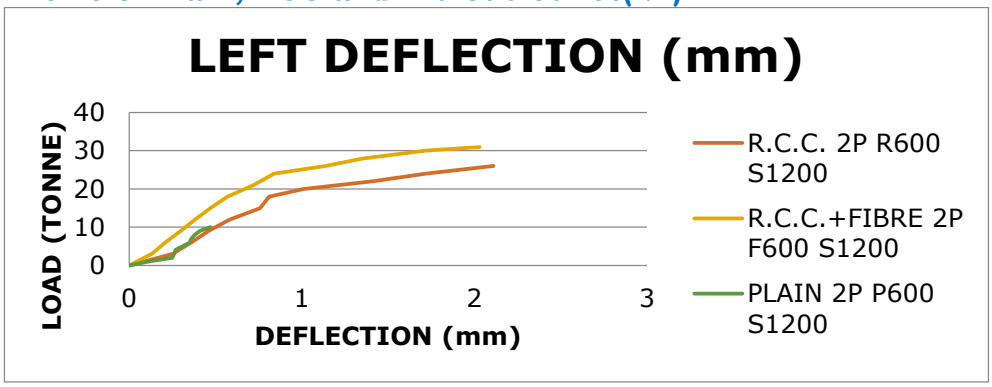


Graph 5-81 Comparison for Central Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

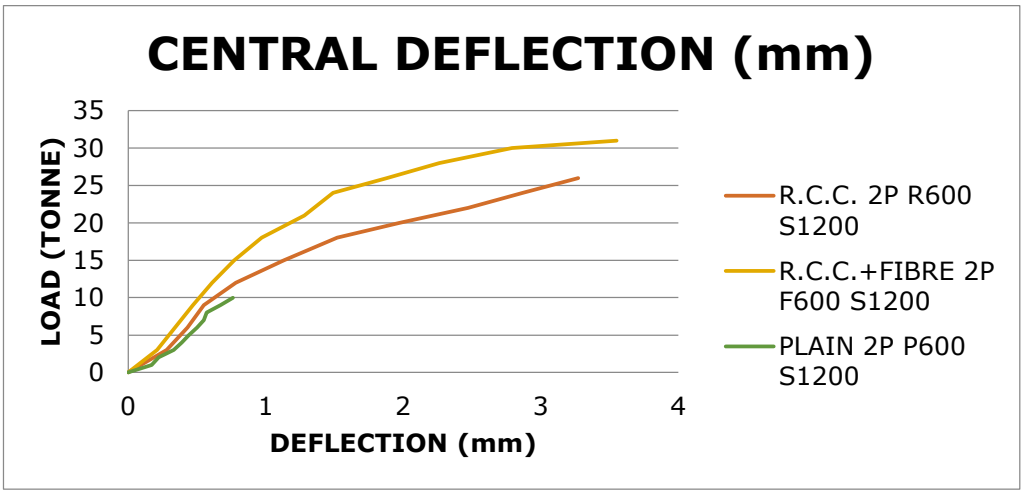


Graph 5-82Comparison for Right Deflection of 525 x 1050 Size of Plain, RCC and Fibrous Series

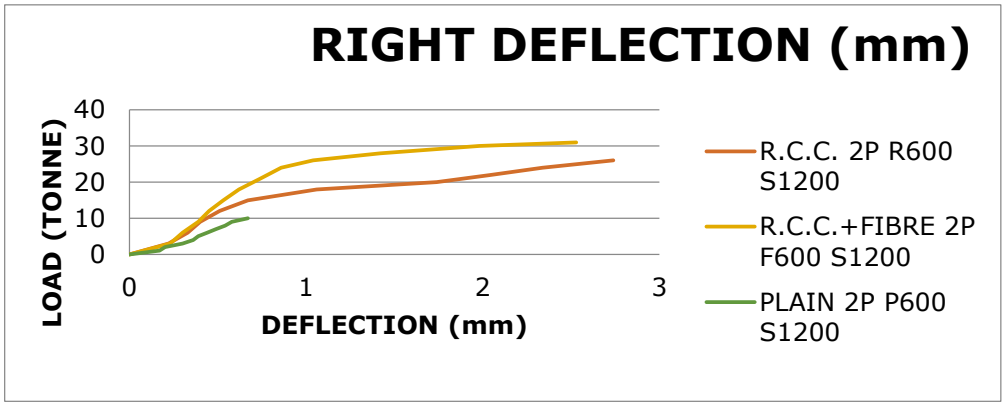
5.6.7 Comparison for Left Central and Right Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series(2P)



Graph 5-83 Comparison for Left Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series



Graph 5-84 Comparison for Central Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series



Graph 5-85 Comparison for Right Deflection of 600 x 1200 Size of Plain, RCC and Fibrous Series

5.7 RESERVED STRENGTH

Looking to the failure of the plain beam were failing in brittle manner while RCC and Fibrous beams were failing in ductile manner. So, there would be some reserve strength in RCC and Fibrous beams after first cracking load, which can be termed as Reserved Strength of the beam.

It can be defined as the ratio of the Ultimate load and first crack load expressed in terms of percentage as

Reserved Strength = {(Wu – Wc) / Wc} x 100

Where, Wu = Ultimate Load ,Wc = First Crack Load

5.8 DUCTILITY FACTOR

It can be defined as the ratio of deflection at Ultimate load to the Deflection at first crack. Ductility Factor = Δ_2 / Δ_1

5.9 RCC 1P RESERVED STRENGTH AND DUCTILITY FACTOR

Table 5-48 RCC 1P Reserved Strength and Ductility Factor

Width (b) mm	Depth (D) mm	Effective length (le) mm	First crack load (tonne) Wc	Deflection at first crack load (mm) Δ1	Ultimate load (tonne) Wu	Deflection at ultimate load (mm) Δ2	Reserved strength ((Wu-Wc)/Wc) x 100	Ductility factor = Δ2/Δ1	Mode of failure
75	150	300	3	0.81	10	5.33	233.33	6.58	Flexure shear
75	225	450	4.8	0.36	13.6	3.49	183.33	9.69	Flexure shear
75	300	600	6.5	0.4	14	2.29	115.38	5.73	Flexure
75	375	750	8	0.72	15	2.52	87.50	3.50	Flexure
75	450	900	8.5	1.02	16.5	3.41	94.12	3.34	Flexure shear
75	525	1050	12	2.98	19.4	5.8	61.67	1.95	Shear
75	600	1200	10	0.78	25	4.81	150.00	6.17	Flexure shear

5.10 FIBER 1P RESERVED STRENGTH AND DUCTILITY FACTOR

Table 5-49 RCC + Fiber 1P Reserved Strength and Ductility Factor

Width (b) mm	Depth (D) mm	Effective length (le) mm	First crack load (tonne) Wc	Deflection at first crack load (mm) Δ1	Ultimate load (tonne) Wu	Deflection at ultimate load (mm) Δ2	Reserved strength((Wu-Wc)/Wc)x 100	Ductility factor = Δ2/Δ1	Mode of failure
75	150	300	4	0.62	12	2.25	200.00	3.63	Flexure shear
75	225	450	11.3	0.75	20.6	2.55	82.30	3.40	Shear
75	300	600	8.5	0.5	16.4	1.45	92.94	2.90	Flexure
75	375	750	10	0.41	19.2	1.49	92.00	3.63	Flexure
75	450	900	15.3	0.9	23	3.5	50.33	3.89	Flexure
75	525	1050	12.6	1.01	28.1	4.01	123.02	3.97	Flexure
75	600	1200	11.2	0.98	29	4.47	158.93	4.56	Shear

5.11 RCC 2P RESERVED STRENGTH AND DUCTILITY FACTOR

Table 5-50 RCC 2P Reserved Strength and Ductility Factor

Width (b) mm	Depth (D) mm	Effective length (le) mm	First crack load (tonne) Wc	Deflection at first crack load (mm) Δ1	Ultimate load (tonne) Wu	Deflection at ultimate load (mm) Δ2	Reserved strength ((Wu-Wc)/Wc) x 100	Ductility factor = Δ2/Δ1	Mode of failure
75	150	300	3	0.61	9	1.83	200.00	3.00	Flexure
75	225	450	7	0.43	18	1.61	157.14	3.74	Shear
75	300	600	6.5	0.41	21.9	4.49	236.92	10.95	Shear
75	375	750	8	0.69	21.3	2.6	166.25	3.77	Shear
75	450	900	8.7	0.65	24.1	5.66	177.01	8.71	Shear
75	525	1050	12	0.78	22	3.09	83.33	3.96	Shear
75	600	1200	13	0.78	26	3.27	100.00	4.19	Shear

5.12 FIBER 2P RESERVED STRENGTH AND DUCTILITY FACTOR

Table 5-51 RCC + Fiber 2P Reserved Strength and Ductility Factor

Width (b) mm	Depth (D) mm	Effective length (le) mm	First crack load (tonne) Wc	Deflection at first crack load (mm) Δ1	Ultimate load (tonne) Wu	Deflection at ultimate load (mm) Δ2	Reserved strength ((Wu-Wc)/Wc) x 100	Ductility factor = Δ2/Δ1	Mode of failure
75	150	300	4.8	1	15	3.79	212.5	3.79	Flexure shear
75	225	450	11.3	0.75	20.6	2.55	82.3009	3.4	Shear
75	300	600	9.7	0.69	22	2.11	126.80	3.06	Shear
75	375	750	15	1.24	25.7	2.82	71.33	2.27	Shear
75	450	900	11.5	0.6	28.6	3.31	148.70	5.52	Shear
75	525	1050	15	1.45	29	4.24	93.33	2.92	Shear
75	600	1200	15.7	0.81	31	3.55	97.45	4.38	Shear

Table 5-52 Reserved Strength and Ductility Factor for Various Series

Sr.no.	Type	B (mm)	D (mm)	L (mm)	Beam no.	Le/d ratio	A/d ratio	First crack load	Ultimate load	Deflection at first crack load Δ1(mm)	Deflection at ultimate load Δ2(mm)	Ductility Δ2/Δ1	Reserved strength	Mode of failure
								W_c	**W_u**				**(Wu-Wc)/Wc**	
1	**RCC**	75	225	900	A2	3.6	1	4.8	13.5	0.45	6.14	13.64	181.25	Flexure-shear
		75	275	1000	B	3.3	1	5.1	17.8	1.23	5.64	4.59	249.02	Flexure
		75	325	1100	C	3.1	1	5.2	19.3	2.44	5.39	2.21	271.15	Flexure-shear
		75	375	1200	D	2.9	1	5.5	21.9	2.20	4.58	2.08	298.18	Flexure-shear
		75	425	1300	E	2.8	1	8.5	25.8	2.59	5.16	1.99	203.53	Flexure
2	**PFRC**	75	225	900	A2	3.6	1	5.2	14.0	1.27	3.55	2.80	169.23	Flexure-shear
		75	275	1000	B	3.3	1	5	18.1	1.11	3.73	3.35	262.00	Flexure-shear
		75	325	1100	C	3.1	1	5.2	19.3	1.25	3.78	3.03	271.15	Flexure-shear
		75	375	1200	D	2.9	1	5.8	21.8	1.72	3.29	1.92	275.86	Flexure-shear
		75	425	1300	E	2.8	1	9.1	26.4	2.59	5.46	2.11	190.11	Flexure-shear
3	**SFRC**	75	225	900	A2	3.6	1	5.2	16.7	2.84	5.99	2.11	221.15	Flexure-shear
		75	275	1000	B	3.3	1	5	19.6	1.17	4.21	3.60	292.00	Flexure-shear
		75	325	1100	C	3.1	1	6.7	21.7	1.15	3.59	3.12	223.88	Flexure-shear
		75	375	1200	D	2.9	1	9.2	24.8	1.97	4.67	2.37	169.57	Flexure
		75	425	1300	E	2.8	1	10	29.9	2.18	5.77	2.65	199.00	Flexure-shear

From the graphs (5-1 to 5-85) of Load vs. Deflection it is observed that during the first elastic stage the curve is almost linear and can be approximated by a straight line. After yielding of beam the curve changed its slope and it becomes flatter. There was a considerable deviation in load deflection curve after the yielding of beam, which can be attributed to the first cracking and yielding of beam which caused a sudden increase in deflection. Generally during elastic stage, the central deflection was slightly more than the left and right deflections. In some of the beams in which major cracks appeared in Shear zones suddenly, the corresponding side of the deflection increases slightly more than the central deflection.

Graph 5-44 to 5-85 reveals that Left and right supports dial gauge readings were almost same due to load is transferred equally on both the side but in some cases one side of dial gauge pointer moved faster it indicates slip of load in that direction. The remedial for sleep of load were proper leveling and provide rough surface between loading frame and supporting arrangement.