

10. CRACK CHARECTERISTICS

A different beam specimen shows propagation of load and crack width that different points in beam. Crack widths were recorded at different intervals of load. The interval of load is varying for each beam. All the data regarding crack width, propagation load, failure zone, types of material are tabulated and compared with other type of beams based on size effect parameter.

All the Beam data is very important to find the size effect parameter. Measurement of micro cracks were recorded with help of Digital Vernier Gauge. The Vernier gauge having least count of 0.01 mm. All beams were tabulated with the details of crack propagation and crack width. All cracks were marked on the Beam surface with the help of Auto CAD software. Moreover, crack patterns were also highlighted on the photographs using Auto CAD.

10.1. CRACK PATTERNS

Crack pattern and cracking characteristics are important to understand the behavior of beam deformational which predominantly leading towards failure in shear. In RCC members mainly three types of cracks are observed i.e. Flexure cracks, Flexure-shear cracks and Shear cracks. In shallow beams mostly fails in flexure mode so the predominant crack leading towards flexure crack. In Moderate Deep Beams, the predominant crack is flexure-shear crack. In Deep beams, the predominant cracks are shear cracks.

10.2. MODES OF FAILURE

Different types of Mode of failure in Moderate Deep Beam is given as (1) Flexure failure, (2) Flexure-shear failure, (3) Diagonal compression failure, (4) Local compression failure, (5) Anchorage failure at support and (6) Split and diagonal Tension failures.

10.2.1. FLEXURE FAILURE

Flexure failure is due to the yielding of longitudinal main steel bars. Flexure cracks appears first in the region of maximum bending moment and initiated from the soffit of the beam. Flexural crack(s) will propagate upwards quickly. Generally concrete is not crushing in continuous loading, the main steel bars may be in plastic zone or inelastic stage. Flexure failure of normal section manifests a better Ductility. Flexural moment of specimen at Ultimate load is larger than that at yielding of steel by 10-30%. The width(s) of diagonal cracks will be very small.

10.2.2. FLEXURE-SHEAR FAILURE

In this case, As loading reached 20-25% of Ultimate load value, short and small flexure cracks would occur at soffit of beam. As the loading reaches 40-50%, the flexure cracks in shear span extend quickly towards the loading point(s) with width wider in bottom and narrow upwards. In this stage, tensile stresses in longitudinal main reinforcement increases quickly and gradually arch action generate in the whole section of the beam. The flexure crack(s) in the span do not extend upwards until the yielding of main bars. The diagonal crack(s) also extend towards loading point. In this type of failure both flexural and inclined shear cracks had been formed and well developed at the time of failure, but major cause of failure is inclined shear crack in shear zone of specimen.

10.2.3. SHEAR FAILURE

Shear failure is generally classified as Diagonal tension failure and Shear compression failure. Failure in such beams begins with the formation of diagonal tension cracks because of combined bending stress and shear stress. In shear compression failure, parallel inclined cracks were developed. This gives beam a "strut like" appearance between the load point and the support. Here failure occurs by the destruction of the strut. Sometimes, it occurs simultaneously with the formation of second parallel inclined crack. In splitting failure, a diagonal crack suddenly originates from the inner edge of the supporting block and proceeds towards the outer edge of loading plate. After

the formation of the diagonal crack, the beam fails by sudden splitting along the plane of this crack. The appearance of these types of diagonal cracks was often accompanied by a loud noise.

The phenomenon of this failure is similar to that of concrete cylinder under diametrical compressive load i.e. Brazilian split test. In this case, some small flexural cracks at the bottom of beam would occur due to loading. As loading is increased to 40-50% of Ultimate value, a longer diagonal crack occurs in web of the beam in shear span and extends quickly towards support(s) and point(s) of load application respectively with the increase of loading, but the flexural cracks develop slowly remain dormant or inactive. As the loading reaches 85-95% of Ultimate value, Principal diagonal crack appears from support point to loaded point. It follows by a quick enlargement of the crack width and the fast extension of external diagonal crack length. Finally, the concrete is crushing. In this case, generally the longitudinal main bars are not yielding.

10.2.4. LOCAL COMPRESSION FAILURE

At support point and applied concentrated loading point, the value of vertical stress is very large. Hence, if there are no appropriate measures then a local compression failure may occur due to local crushing of concrete at the points of supports and/or application of load.

10.2.5. ANCHORAGE FAILURE

After the stressed state of specimen forms an arch with ties, the tensile stress near support is very large. If their anchorage is not effective, then steel bars are prone to slip from support to create an Anchorage failure.

10.3. OBSERVATION TABLES FOR CRACK WIDTH ANALYSIS

A2/RCC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		12.00tn	13.00tn	13.50tn	
A	0	13.5	SHEAR	0.32	0.98	1.2	
	1	13.5		0.47	0.55	1.09	
	2	13.5		H	0.22	0.49	
B	0	10	SHEAR	0.27	0.38	0.53	
	1	10		0.31	0.36	0.43	
	2	10		0.21	0.45	0.52	
	3	10		0.08	0.2	0.35	
C	0	8	FLEXURE	1.38	2.77	3.08	
	1	8		0.84	1.31	2.44	
	2	9		0.34	1.1	2.12	
	3	9		0.19	0.73	1.13	
	4	12		–	H	0.09	
D	0	10	FLEXURE	H	0.67	0.98	Predominant crack
	1	12		H	1.58	2.29	
	2	12		H	1.34	2.99	
	3	13		–	2.54	3.12	
	4	13		–	H	H	
E	0	11	SHEAR	H	0.78	1.54	
	1	11		H	1.05	1.8	
	2	12		–	0.94	1.97	
	3	13		–	0.27	0.63	
	4	13.5		–	H	0.08	
							A2/RCC/2P
							

A2/PFRC/2P								
CRACKID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		10.00tn	12.50tn	13.00tn	14.00tn	
A	0	5.1	SHEAR	H	H	0.07	0.12	
	1	5.1		H	0.26	0.31	0.34	
	2	8		H	0.11	0.19	0.25	
	3	9.6		–	H	0.04	0.31	
	4	11		–	H	0.13	0.22	
B	0	8	SHEAR	0.08	0.68	1.67	2.45	Predominant crack
	1	9		0.64	2.41	3.02	3.17	
	2	10		–	H	0.07	0.24	
	3	14		–	–	–	H	
C	0	5.8	SHEAR	H	0.09	0.51	0.92	
	1	8		H	0.11	0.21	0.94	
	2	10.2		–	H	0.28	1.11	
D	0	5.1	SHEAR	0.28	0.53	1.24	2.97	
	1	8		0.11	0.98	2.64	3.11	
	2	10.5		–	0.08	0.25	0.27	

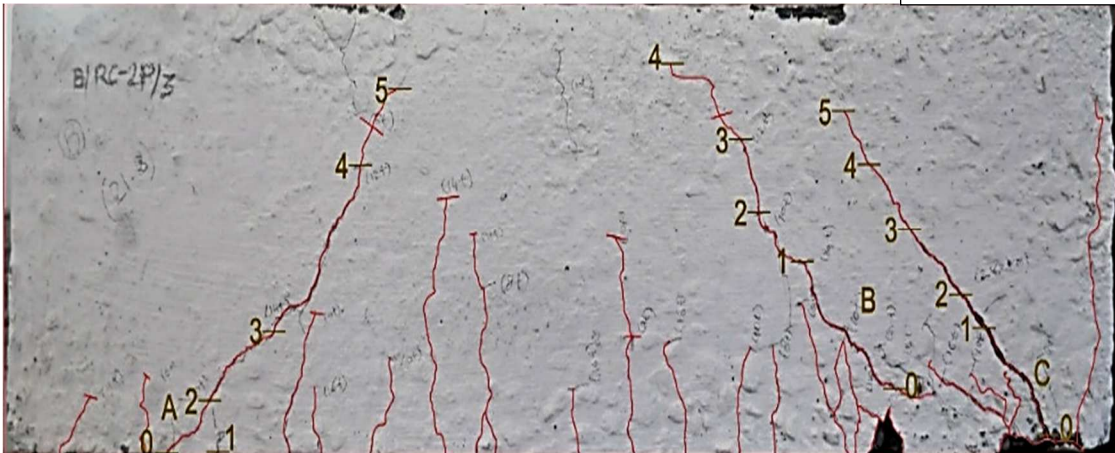
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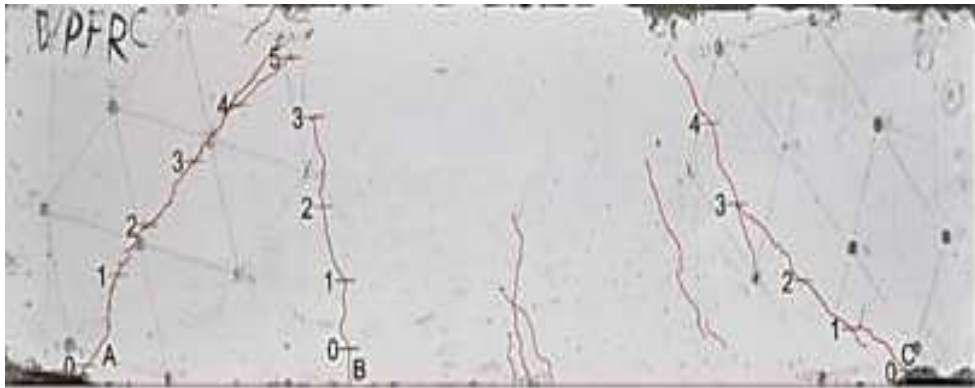
A2/PFRC/2P



A2/SFRC/2P									
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)					REMARKS
		(tn)		8.00tn	10.00tn	14.00tn	16.00tn	16.70tn	
A	0	5.2	FLEXURE	0.23	0.32	1.11	2.74	3.12	Predominant crack
	1	5.2		0.21	1.12	2.94	3.11	3.54	
	2	11		–	–	0.34	1.42	2.1	
	3	14		–	–	H	0.98	1.29	
B	0	5.2	FLEXURE	H	0.78	1.54	2.21	3.24	
	1	5.2		H	0.55	1.22	1.98	3.1	
	2	12		–	–	H	1.02	2.68	
	3	15		–	–	–	0.23	0.67	
C	0	6	SHEAR	H	H	H	0.08	0.58	
	1	6		H	H	0.04	0.12	0.54	
	2	10		–	H	0.18	0.22	0.48	
	3	14		–	–	H	0.14	0.28	
	4	16		–	–	–	H	H	

A2/SFRC/2P

B/RCC/2P									
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS	
		(tn)		16.00tn	16.50tn	17.00tn	17.80tn		
A	0	10	FLEXTURE SHEAR	H	H	H	H		
	1	10		0.3	0.4	2.05	2.28		
	2	10		0.21	0.78	1.05	1.92		
	3	14		0.16	0.87	1.05	1.05		
	4	12		0.34	0.98	1.09	1.55		
	5	8		H	H	0.15	0.54		
B	0	8	FLEXTURE SHEAR	0.24	0.48	0.98	1.13		
	1	10		0.11	0.52	0.89	1.03		
	2	14		0.12	0.78	1.02	1.14		
	3	10		0.08	0.17	0.21	0.54		
	4	12		H	H	H	H		
C	0	11	SHEAR	1.09	1.94	2.21	2.52	Predominant crack	
	1	14		0.21	0.94	1.64	2.41		
	2	12		0.56	1.1	1.53	2.34		
	3	12		0.27	0.55	0.94	1.13		
	4	14		0.09	0.24	0.31	0.61		
							B/RCC/2P		
									

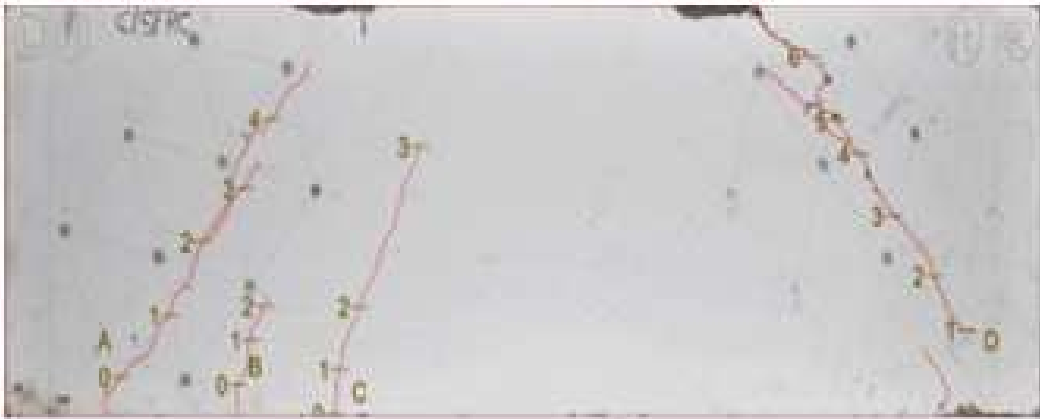
B/PFRC/2P									
CRACK ID	LOAD		FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS		
	(tn)			16.00tn	17.00tn	18.10tn			
A	0	5.2	SHEAR	0.42	0.84	1.1	Predominant crack		
	1	5.2		0.83	1.42	2.12			
	2	7		1.11	2.01	2.49			
	3	12		0.14	1.13	1.94			
	4	12		H	0.32	1.15			
	5	17		–	H	H			
B	0	5.4	FLEXTURE SHEAR	0.27	0.61	0.78			
	1	8		0.08	0.38	0.52			
	2	10		0.1	0.26	0.41			
	3	13		–	H	H			
C	0	6	SHEAR	0.11	0.51	1.25			
	1	6.2		0.14	0.61	1.18			
	2	9		0.05	0.19	0.48			
	3	14		0.14	0.21	0.14			
	4	16.2		–	H	H			
							B/PFRC/2P		
									

B/PFRC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		16.00tn	19.00tn	19.60tn	
A B	0	7	SHEAR SHEAR	0.16	0.88	1.48	Predominant crack
	1	9.5		0.13	1.37	2.50	
	2	10		0.39	0.78	1.27	
	3	12		0.18	0.29	1.77	
	4	15		0.25	0.46	2.4	
	5	15.8		0.36	1.42	1.89	
	6	18		—	0.29	1.3	
	0	5.5		0.18	0.54	1.2	
	1	8		0.35	0.43	0.95	
	2	12		0.29	0.65	2.17	
	3	14.8		0.23	0.24	0.57	
	4	15		0.11	0.27	0.36	
	5	16		H	H	H	
						B/PFRC/2P	



C/RCC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		15.00tn	17.50tn	19.30tn	
A	0	10	SHEAR	0.15	0.39	0.51	
	1	10		0.14	0.14	0.31	
	2	11		0.1	0.15	0.25	
	3	11.7		0.11	0.18	0.62	
	4	13		0.41	0.43	1.01	
	5	14		0.16	0.75	1.83	
	6	14.2		0.42	0.53	1.74	
	7	14.8		0.18	0.22	0.34	
	8	16		–	H	H	
B	0	5.2	FLEXURE	0.44	0.56	0.58	
	1	5.2		0.28	0.34	0.39	
	2	6		0.12	0.26	0.27	
	3	8		0.08	0.14	0.15	
	4	9.5		H	H	H	
C	0	5.2	FLEXURE	0.2	0.34	2.39	Predominant crack
	1	5.2		0.11	0.22	1.39	
	2	7.3		0.31	0.62	2.02	
	3	8.6		0.06	0.14	1.42	
	4	13		0.21	0.47	0.9	
D	0	10	SHEAR	0.34	0.42	0.51	
	1	11.3		0.33	0.44	0.47	
	2	11		0.18	0.21	0.26	
	3	14.8		0.32	0.46	0.52	
	4	14.7		0.24	0.26	0.28	
	5	19		–	–	H	
						C/RCC/2P	
							

C/PFRC/2P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		16.00tn	17.00tn	18.00tn	19.30tn	
A	0	9	SHEAR	0.23	0.19	0.51	0.62	
	1	9		0.2	0.15	0.83	0.94	
	2	11.5		0.12	0.27	0.93	1.08	
	3	13		0.06	0.31	1.21	1.41	
	4	14.7		0.07	0.38	1.31	1.38	
	5	19			–	–	H	
B	0	5.4	FLEXTURE SHEAR	H	H	H	H	
	1	5.4		H	H	H	H	
	2	7		H	H	H	H	
C	0	7	SHEAR	0.67	0.81	1.2	2	Predominant crack
	1	7		0.41	0.94	1.41	1.78	
	2	9		0.32	0.99	1.48	2.37	
	3	9.6		0.13	0.48	1.73	2.01	
	4	10.3		0.23	1.1	1.53	1.94	
	5	10.3		0.1	0.51	0.6	0.61	
C/PFRC/2P								
								

C/SFRC/2P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		16.00tn	19.00tn	21.00tn	21.70tn	
A	0	12	SHEAR	0.23	0.41	0.79	0.85	
	1	12		0.23	0.33	0.64	0.74	
	2	12.7		0.32	0.49	0.75	1.14	
	3	13.2		0.27	0.36	1.12	2.21	
	4	14		0.34	0.32	1	1.97	
B	0	10	SHEAR	H	0.12	0.21	0.22	
	1	10		H	H	0.1	0.13	
	2	10		H	H	H	H	
C	0	6.7	FLEXURE	0.11	0.18	0.21	0.23	
	1	6.7		0.18	0.18	0.22	0.29	
	2	10		H	0.15	0.18	0.27	
	3	12		H	H	0.1	0.12	
D	0	7	SHEAR	0.25	0.51	0.6	0.62	Predominant crack
	1	7.4		0.49	0.62	0.64	0.64	
	2	8		0.34	0.44	0.9	0.94	
	3	8		0.43	0.48	1.14	1.51	
	4	8.9		0.21	0.69	0.97	1.23	
	5	12		0.41	2.17	2.43	2.43	
	6	12		0.17	0.59	0.64	0.78	
C/SFRC/2P								
								

D/RCC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		14.00tn	17.50tn	21.90tn	
A	0	12	SHEAR	0.42	0.51	0.76	Predominant crack
	1	12		0.61	1.32	2.1	
	2	12.8		0.42	1.2	1.97	
	3	14		0.23	1.62	2.05	
	4	14		0.15	0.94	1.49	
B	0	14	SHEAR	0.34	0.42	0.54	
	1	14		0.23	0.38	0.25	
	2	14.9		0.12	0.41	0.45	
	3	15.5		–	H	H	
C	0	5.5	FLEXTURE SHEAR	0.08	0.22	0.41	
	1	11.4		0.15	0.21	0.29	
	2	13		0.2	0.23	0.29	
	3	13		0.21	0.45	0.48	
	4	14.6		–	H	H	
D	0	8	FLEXTURE SHEAR	0.29	0.51	0.74	
	1	9		0.23	0.23	0.25	
	2	13		0.25	0.38	0.42	
	3	14		0.22	0.31	0.35	
	4	14		H	H	0.15	
E	0	5.5	SHEAR	0.58	0.67	1.01	
	1	8		0.32	1.05	2	
	2	12		0.27	0.29	1.94	
	3	14		0.35	0.47	0.84	
	4	14		0.12	0.26	0.54	
D/RCC/2P							
							

D/PFRC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		18.00tn	19.00tn	21.80tn	
A	0	8	SHEAR	0.31	0.41	0.43	Predominant crack
	1	8		0.07	0.34	1.1	
	2	10		0.21	0.62	1.3	
	3	11		0.46	1.13	2.2	
	4	11.7		0.8	1.24	2.28	
	5	13		0.09	0.16	1.45	
	6	13		0.23	0.74	1.11	
	7	13		0.12	0.21	0.64	
	8	19		–	H	0.11	
	9	19		–	H	0.09	
B	0	5.8	FLEXURE	H	H	H	
	1	5.8		H	H	H	
C	0	7	SHEAR	0.21	0.67	1.14	
	1	7.5		0.15	0.94	1.74	
	2	11		0.42	1.74	2.11	
	3	11.5		0.15	1.41	2.14	
	4	13.2		0.1	0.12	0.78	
	5	10		0.11	0.23	0.52	
	6	17		H	0.09	0.16	
D/PFRC/2P							



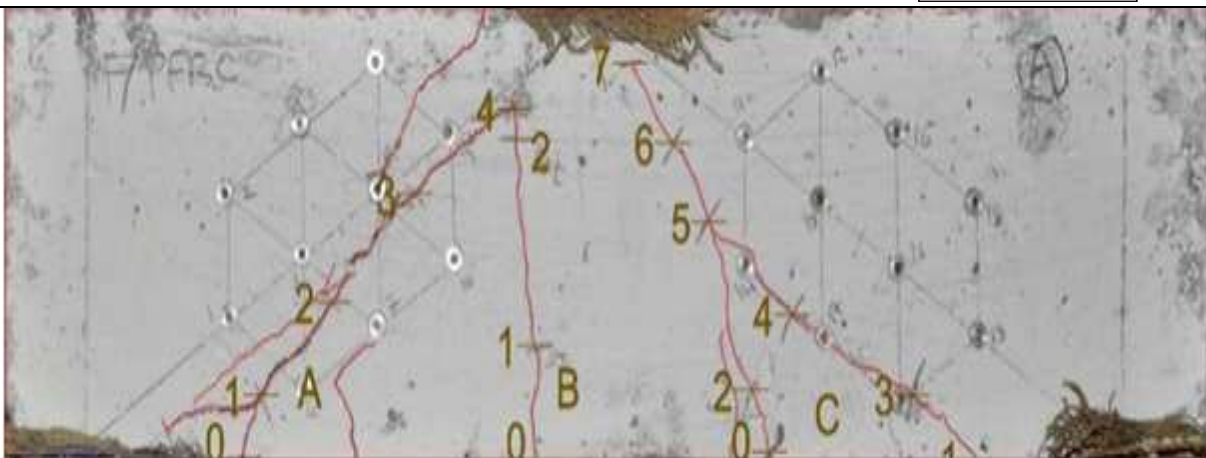
D/SFRC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		18.00tn	22.00tn	24.80tn	
A	0	13	SHEAR	0.25	0.36	0.61	
	1	13		0.2	0.87	1.2	
	2	16		0.18	0.81	1.84	
	3	18		0.16	0.27	0.45	
B	0	9.2	SHEAR	0.06	0.07	0.11	
	1	10		0.29	0.29	0.32	
	2	11.2		0.12	0.14	0.21	
	3	14		H	0.08	0.12	
C	0	9.2	FLEXURE	H	H	0.05	
	1	9.2		H	H	H	
	2	11		H	H	H	
D	0	12.4	SHEAR	0.34	1.94	2.24	Predominant crack
	1	13		0.41	0.67	1.38	
	2	13		0.21	0.26	0.52	
	3	17		0.11	0.24	0.31	
	4	18.2		–	H	H	
E	0	12	SHEAR	0.32	0.35	0.8	
	1	12		0.47	0.51	0.81	
	2	16		0.2	0.35	0.59	
D/SFRC/2P							
							

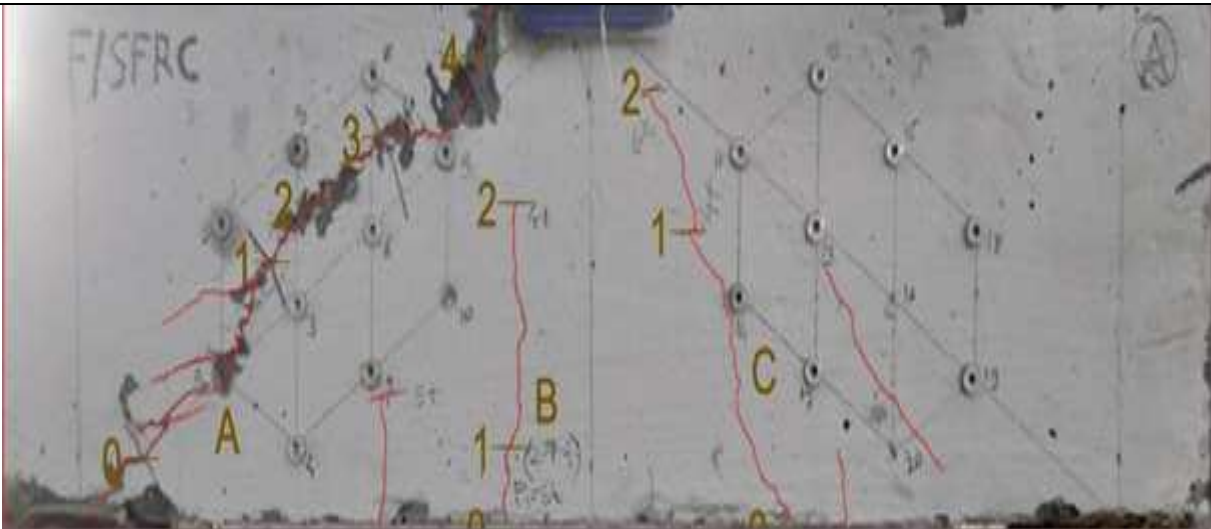
E/RCC/2P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		16.00tn	18.00tn	20.00tn	25.80tn	
A	0	8.5	SHEAR	0	0.37	0.39	0.5	Predominant crack
	1	9		0	0.43	0.45	0.51	
	2	9		0.25	0.49	0.39	0.23	
	3	9.7		0.31	0.5	0.92	1.8	
	4	10		0.37	0.37	0.51	0.54	
	5	10.5		0.32	0.4	0.6	0.22	
	6	14		0	0.48	0.6	0.61	
	7	14		H	H	H	H	
	8	18		H	H	H	H	
B	0	8.5	FLEXURE	H	0.46	0.51	0.52	
	1	9		H	H	0.12	0.23	
	2	9.2		H	0.45	0.5	0.52	
	3	8.5		H	0.46	0.49	0.59	
	4	9		H	H	0.04	0.24	
	5	12		0.06	0.1	0.21	0.23	
	6	17		–	H	H	0.1	
C	0	9	FLEXURE	H	H	H	H	
	1	9		H	H	H	H	
	2	9		H	H	H	H	
D	0	9	FLEXTURE SHEAR	H	H	H	H	
	1	10.8		H	H	H	H	
	2	12		H	H	H	H	
	3	14		0.3	0.4	0.84	1.64	
	4	14		0.37	0.35	0.68	0.68	
	5	16		0.21	0.27	0.28	0.36	
	6	18		H	H	0.14	0.27	
E	0	11	SHEAR	0	0.44	0.47	0.48	
	1	12		0.24	0.53	0.63	0.41	
	3	14		0.34	0.47	0.56	0.61	
	4	16		H	H	0.13	0.33	
							E/RCC/2P	
								

E/PFRC/2P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		23.00tn	24.00tn	25.50tn	26.40tn	
A	0	9.1	SHEAR	0.54	0.79	0.91	1.4	
	1	9.1		0.69	0.84	1.05	1.18	
	2	11		0.11	0.34	0.42	0.56	
B	0	10	SHEAR	H	0.71	0.91	1.32	Predominant crack
	1	11		0.1	0.63	0.87	1.43	
	2	11.7		H	0.39	1.53	1.91	
	3	11.7		H	0.54	1.77	1.91	
	4	12		H	0.28	1.68	1.7	
	5	12		H	0.17	1.11	1.52	
	6	12		H	0.47	0.75	1.43	
	7	14		–	0.21	0.67	0.64	
	8	17		–	–	H	H	
C	0	9.1	FLEXTURE SHEAR	0.14	0.34	0.34	0.51	
	1	10		0.1	0.24	0.81	1.04	
	2	12		H	0.12	0.17	0.41	
	3	17		–	–	0.1	0.39	
D	0	9.1	SHEAR	0.08	0.12	0.28	0.41	
	1	11		0.23	0.46	1.67	1.1	
	2	11		0.21	0.46	1.71	1.23	
	3	12		0.14	0.34	0.43	0.46	
E	0	10	SHEAR	H	0.37	0.9	1.12	
	1	12		H	0.23	0.48	0.68	
	2	11		H	0.42	0.48	0.54	
	3	16		H	H	H	H	
E/PFRC/2P								
								

E/SFRC/2P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		26.00tn	29.00tn	29.90tn	
A	0	10	SHEAR	0.12	0.21	0.24	
	1	14		0.24	0.27	0.87	
	2	21		0.34	0.96	1.7	
B	0	10	SHEAR	0.12	0.64	0.91	
	1	10		0.27	0.81	1.01	
	2	21		0.51	0.62	1.14	
	3	24		0.34	0.81	1.42	
C	0	10	FLEXURE	H	H	H	
	1	20		H	H	H	
D	0	18	FLEXTURE SHEAR	H	H	H	
	1	18		H	H	H	
	2	20		H	H	H	
E	0	16	SHEAR	0.14	0.2	1.19	Predominant crack
	1	16		0.24	0.3	1.33	
	2	16		0.21	0.35	1.89	
	3	18		1.74	1.94	2.14	
	4	29		–	0.19	1.81	
	5	29		–	H	2.07	
	6	29		–	H	1.41	
E/SFRC/2P							
							

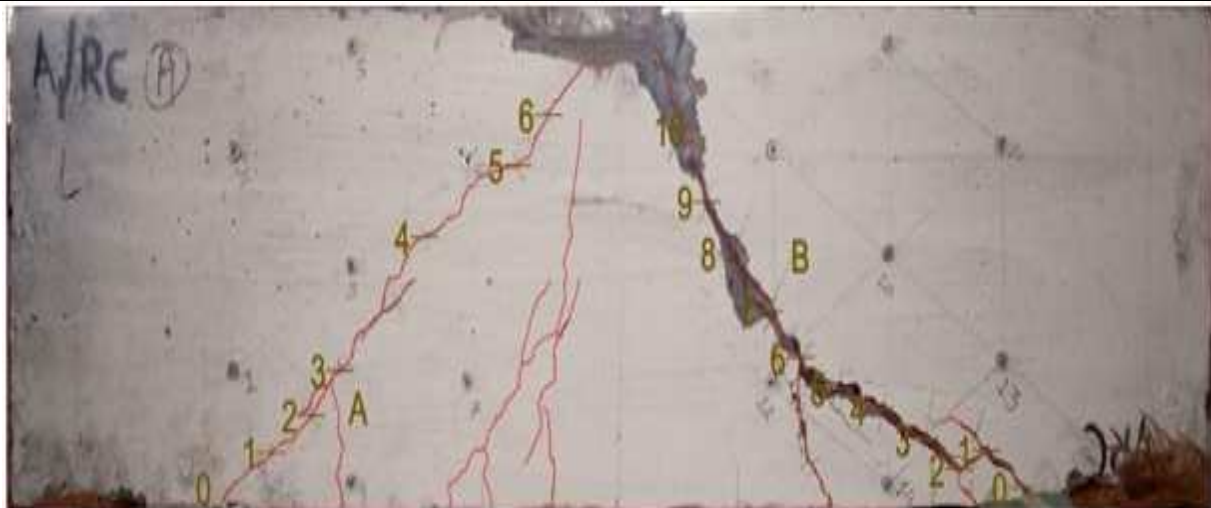
F/RCC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		5.00tn	6.00tn	7.10tn	
A	0	4	SHEAR	H	0.21	0.86	
	1	4		H	0.05	0.12	
B	0	2.7	SHEAR	H	0.23	0.75	Predominant crack
	1	2.7		H	0.24	1.64	
	2	2.7		0.11	0.45	2.07	
	3	4.2		0.84	1.78	3.25	
	4	4.5		0.47	1.04	2.51	
	5	5		0.19	0.43	0.51	
C	0	2.7	SHEAR	0.12	0.21	0.34	
	1	2.7		0.11	0.14	0.23	
	2	3		0.21	1	1.05	
	3	3.2		0.13	1.54	2.64	
	4	4.4		H	0.17	0.52	
	5	6		–	H	H	
							F/RCC/1P
							

F/PFRC/1P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		4.00tn	6.00tn	7.00tn	7.10tn	
A	0	2.9	SHEAR	0.04	0.24	0.54	0.94	Predominant crack
	1	3		H	0.34	0.61	3.27	
	2	3.5		H	0.34	0.72	1.47	
	3	3.8		H	0.36	0.6	2.05	
	4	4		H	H	0.69	0.79	
B	0	2.9	FLEXURE	0.09	0.41	0.77	0.81	
	1	3.4		0.11	0.24	0.62	0.62	
	2	4		H	H	H	H	
C	0	4	SHEAR	H	0.07	0.12	0.44	
	1	4		H	H	0.1	0.42	
	2	4.2		–	0.48	0.57	0.58	
	3	4.5		–	0.28	0.57	0.6	
	4	4.8		–	0.7	1.03	2.45	
	5	5.2		–	0.46	0.52	1.12	
	6	5.2		–	0.18	0.21	0.34	
	7	7		–	–	–	H	
								F/PFRC/1P
								

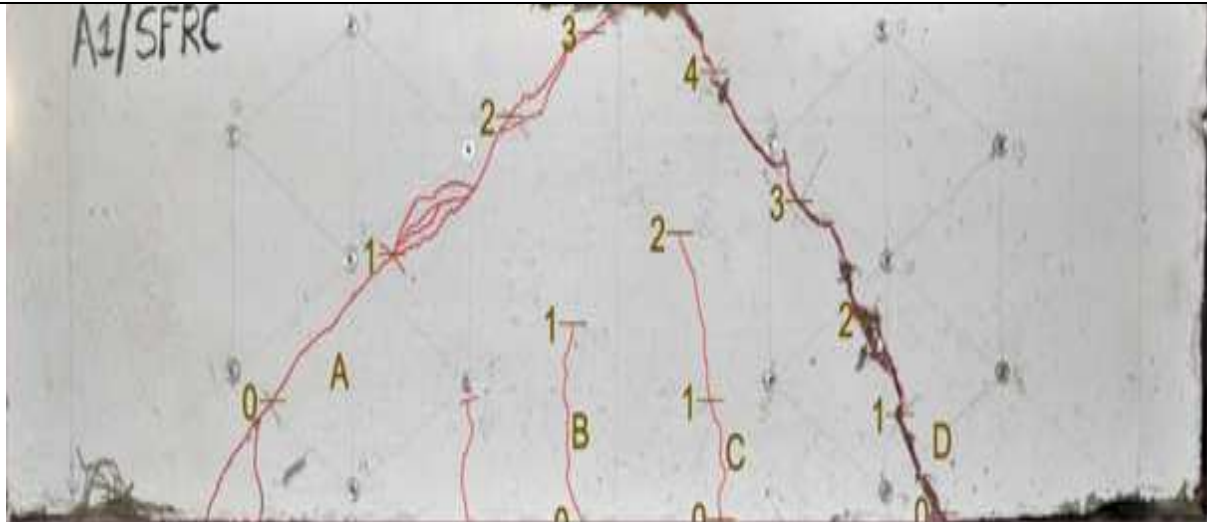
F/SFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		5.00tn	6.00tn	7.30tn	
A	0	3.1	SHEAR	0.23	0.81	3.01	Predominant crack
	1	3.1		0.31	1.91	2.9	
	2	3		0.48	2.11	3.05	
	3	3.5		0.21	1.21	1.91	
	4	4		0.18	1.01	1.68	
B	0	3.1	FLEXURE	H	0.15	0.18	
	1	3.1		H	0.11	0.14	
	2	4		H	H	H	
C	0	3.1	SHEAR	0.61	1.47	2.98	
	1	3		0.51	1.51	2.84	
	2	5		H	0.51	1.72	
F/SFRC/1P							
							

A1/RCC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		6.00tn	7.00tn	7.30tn	
A	0	3.4	SHEAR	H	0.22	0.78	
	1	3.4		H	0.22	0.81	
	2	6		H	0.38	1.05	
	3	5		0.11	0.76	1.21	
	4	5.2		0.14	0.38	0.41	
	5	6		H	0.24	0.28	
	6	6.6		–	H	H	
B	0	3.4	FLEXTURE SHEAR	0.12	0.51	0.94	Predominant crack
	1	5.4		0.07	0.33	0.84	
	2	4		0.61	1.05	1.41	
	3	4.2		0.84	1.56	1.97	
	4	4		0.91	1.99	2.04	
	5	4		1.34	2.14	2.72	
	6	5		1.21	2.12	3.29	
	7	5.2		0.81	1.59	1.61	
	8	5.2		0.74	1.51	1.54	
	9	5.2		0.41	0.96	1.04	
	10	7		–	H	H	

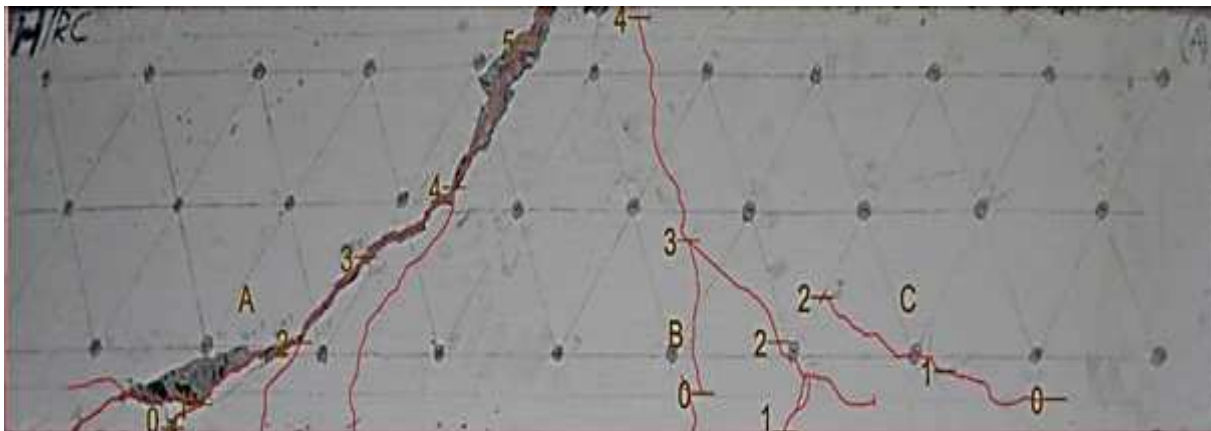
A1/RCC/1P

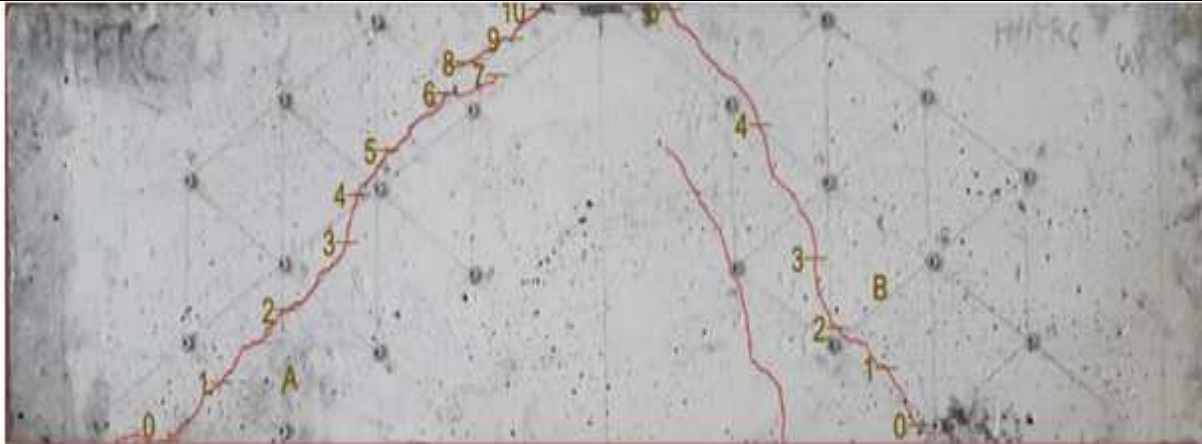


A1/PFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		6.00tn	7.00tn	7.80tn	
A	0	5	SHEAR	H	H	0.24	
	1	5		H	0.5	0.54	
	2	4		H	0.59	0.87	
	3	4		H	0.79	1.02	
	4	4		0.08	0.51	0.57	
	5	6.2		–	0.42	0.48	
	6	6.5		–	H	0.18	
B	0	3.6	FLEXURE	H	0.1	0.12	
	1	6		H	0.04	0.05	
C	0	6	SHEAR	0.08	0.24	0.7	Predominant crack
	1	6		0.12	0.51	1.75	
	2	6		H	1.01	2.78	
	3	5		0.41	3.17	3.29	
	4	4.8		0.52	1.13	2.77	
	5	5.2		0.36	0.85	1.68	
	6	6		H	0.67	NA	
	7	6		0.33	1.26	3.72	
	8	7		H	H	0.07	
A1/PFRC/1P							
							

A1/SFRC/1P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		5.00tn	6.00tn	7.00tn	7.90tn	
A	0	3.7	SHEAR	0.1	0.25	0.43	0.81	
	1	3.7		0.21	0.53	0.91	2.04	
	2	4		H	H	0.1	0.2	
	3	5		H	H	0.12	0.21	
B	0	4	FLEXURE	H	H	H	0.1	
	1	4		H	H	H	0.06	
C	0	4	FLEXURE	H	H	0.07	0.07	
	1	4		H	H	0.07	0.12	
	2	4		H	H	H	0.05	
D	0	3.7	SHEAR	0.94	2.12	3	3.07	Predominant crack
	1	3.7		0.24	1.34	2.33	3.24	
	2	3.7		0.12	0.71	1.35	1.92	
	3	4		H	0.12	0.49	2.06	
	4	6		–	0.14	0.64	1.07	
A1/SFRC/1P 								

H/RCC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		5.00tn	6.00tn	8.20tn	
A	0	4.2	SHEAR	0.13	0.52	2.25	Predominant crack
	1	4.2		0.24	0.61	1.98	
	2	3.7		0.31	0.7	2.1	
	3	3.7		0.84	1.71	2.42	
	4	5		H	0.82	2.22	
	5	5		H	0.25	0.81	
B	0	3.7	FLEXTURE	H	H	H	
	1	3.7		0.23	0.63	1.42	
	2	3.7		0.31	0.74	1.61	
	3	4.8		0.46	0.71	0.84	
	4	5.2		–	H	0.21	
C	0	4	SHEAR	0.11	0.44	0.64	
	1	5		0.18	0.77	0.81	
	2	5.2		H	H	H	
H/RCC/1P							



H/PFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		7.00tn	8.00tn	9.70tn	
A	0	3.7	SHEAR	0.32	0.6	1.42	Predominant crack
	1	3.7		0.12	0.51	1.74	
	2	4.8		0.11	0.21	1.4	
	3	4.8		0.08	0.42	1.49	
	4	5.5		1.7	2.51	2.62	
	5	5.5		0.94	1.07	1.32	
	6	5.5		0.21	0.34	1.41	
	7	4.7		0.31	0.55	0.55	
	8	6		0.24	1.23	2.01	
	9	6		0.51	1.87	2.41	
	10	6.8		0.11	0.53	1.49	
B	0	3.7	SHEAR	0.17	0.41	1.23	
	1	3.7		0.2	0.23	1.27	
	2	5.2		0.14	0.62	1.41	
	3	5.2		0.08	0.84	1.52	
	4	6		H	0.97	1.11	
	5	6		H	H	H	
H/PFRC/1P							
							

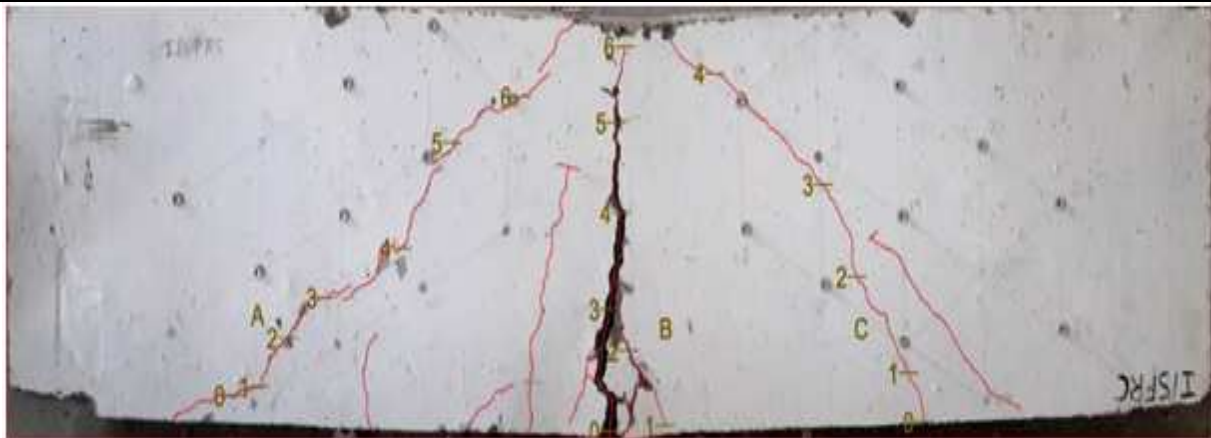
H/SFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		10.00tn	11.60tn	12.20tn	
A	0	3.9	SHEAR	0.13	0.21	0.41	
	1	7		0.18	0.24	0.51	
	2	9		0.19	0.32	0.31	
	3	9		0.05	0.11	0.21	
B	0	5	FLEXTURE	0.84	2.26	3	Predominant crack
	1	8		0.51	2.32	3.19	
	2	8		0.12	0.83	0.98	
	3	8		0.23	0.63	1.77	
	4	9		0.21	0.51	1.78	
	5	9		0.3	1	2.1	
	6	11.6		–	0.12	1.16	
C	0	3.9	FLEXTURE	H	H	H	
	1	6.2		H	H	H	
D	0	5.4	FLEXTURE SHEAR	H	H	0.23	
	1	9		0.08	0.12	0.18	
	2	8		H	0.1	0.13	
							H/SFRC/1P

I/RCC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		8.00tn	8.50tn	9.00tn	
A	0	3.8	SHEAR	0.31	0.78	1.04	
	1	3.8		0.24	0.77	0.98	
	2	4.2		0.21	0.36	1.21	
	3	4.3		0.11	0.24	1.24	
	4	6.4		0.45	1.02	2.05	
	5	8		H	0.23	0.87	
B	0	3.8	SHEAR	0.18	0.21	0.99	Predominant crack
	1	3.8		0.11	0.17	1.1	
	2	4.2		0.21	1.11	2.51	
	3	4.2		0.21	1.46	2.68	
	4	5		0.17	1.11	2.41	
	5	6		0.14	1.14	1.23	
	6	6.6		0.11	1	1.67	
	7	4.5		0.24	0.54	0.67	
	8	8		H	0.33	0.41	

I/RCC/1P



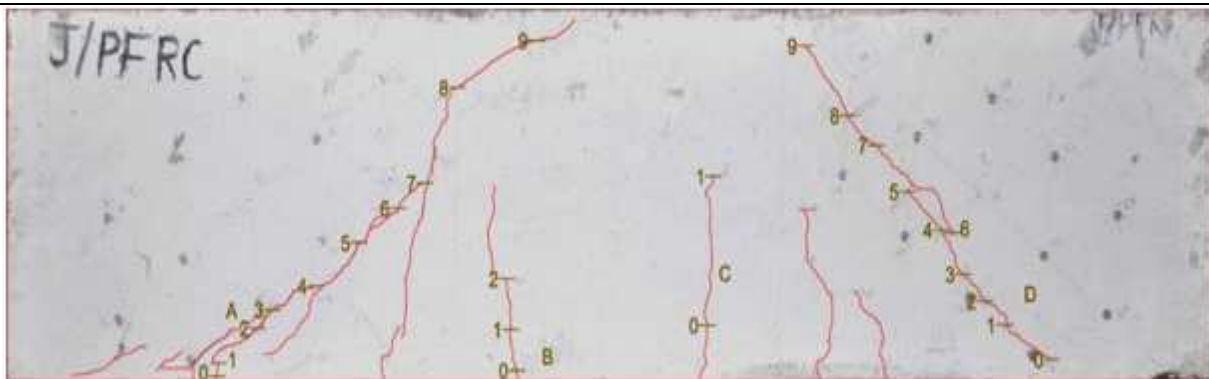
I/PFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		8.00tn	9.00tn	10.10tn	
A	0	5	FLEXTURE SHEAR	0.11	0.23	1.04	Predominant crack
	1	5		0.32	0.54	1.1	
	2	4		0.42	2.01	2.62	
	3	4		0.41	0.62	2.41	
	4	4		0.1	2.63	2.94	
	5	6		0.23	0.62	1.9	
	6	6.8		0.18	0.8	1.6	
	7	7		0.12	1.12	2.62	
	8	8.5		–	H	0.18	
B	0	6	FLEXURE	0.05	0.21	0.3	
	1	6		0.04	0.24	0.33	
	2	6		0.1	0.18	0.21	
	3	8.5		–	H	H	
C	0	4	SHEAR	0.17	0.35	0.43	
	1	4		0.24	0.74	0.38	
	2	5.8		0.12	0.33	0.34	
	3	6.2		0.21	0.26	0.38	
	4	7		H	H	H	
	5	7		H	H	H	
I/PFRC/1P							
							

I/SFRC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		10.00tn	11.00tn	12.50tn	
A	0	7.4	SHEAR	0.11	0.16	0.21	
	1	7.5		0.1	0.18	0.25	
	2	8		0.09	0.12	0.31	
	3	9		0.05	0.11	0.29	
	4	9		0.14	0.21	0.44	
	5	9.2		0.17	0.2	0.22	
	6	10		H	0.11	0.12	
B	0	4.3	FLEXURE	0.12	0.94	1.94	Predominant crack
	1	4.3		0.42	1.25	2.14	
	2	4.3		0.68	2.36	3.32	
	3	5.8		1.05	1.84	3.12	
	4	9		0.14	1.62	2.64	
	5	9		0.08	0.23	0.89	
	6	10		H	0.32	0.82	
C	0	4.3	SHEAR	0.11	0.23	0.68	
	1	4.5		0.11	0.18	0.41	
	2	6		0.14	0.31	1.18	
	3	9		0.09	0.12	0.21	
	4	9.8		H	0.08	0.1	
I/SFRC/1P							
							

J/RCC/1P							
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)			REMARKS
		(tn)		8.00tn	9.00tn	9.40tn	
A	0	4.5	SHEAR	0.67	1.02	1.21	
	1	4.5		0.67	0.98	1.17	
	2	3.9		0.52	0.68	1.12	
	3	3.9		0.21	0.61	1.05	
	4	5		0.36	0.38	0.51	
	5	5		0.32	0.35	0.35	
	6	6		0.28	0.28	0.29	
	7	7		0.22	0.24	0.3	
	8	8		H	H	H	
B	0	3.9	FLEXURE	H	H	H	
	1	3.9		H	0.04	0.08	
	2	3.9		H	H	0.07	
C	0	3.9	SHEAR	0.51	1.41	2.04	Predominant crack
	1	3.9		0.31	1.81	3.02	
	2	4		1.12	1.35	2.1	
	3	4.2		1.22	1.24	1.84	
	4	4.2		1.52	1.84	2.21	
	5	7		0.79	1.02	1.11	
	6	7		0.76	0.78	0.97	
	7	8.2		–	H	H	
						J/RCC/1P	
							

J/PFRC/1P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		8.00tn	9.00tn	10.00tn	11.20tn	
A	0	5	SHEAR	0.17	0.28	0.28	0.34	Predominant crack
	1	5		0.09	0.18	0.22	0.36	
	2	4.2		0.11	0.25	0.75	0.97	
	3	4.2		0.12	0.59	0.74	1.58	
	4	6		H	0.02	0.31	2.11	
	5	5.2		0.18	2.81	2.84	3.24	
	6	6		0.11	1.94	2.23	3.02	
	7	6.2		0.05	0.47	0.51	0.64	
	8	6		H	0.1	0.27	1.11	
	9	6		H	0.14	0.64	1.04	
B	0	4.2	FLEXURE	H	H	0.14	0.21	
	1	4.2		H	0.08	0.11	0.34	
	2	4.2		H	H	H	0.12	
C	0	4.2	FLEXURE	H	H	H	H	
	1	4.2		H	H	H	H	
D	0	4.2	SHEAR	0.09	H	0.49	0.51	
	1	4.2		0.11	H	0.76	0.84	
	2	5		0.17	H	0.51	1.18	
	3	5		0.2	0.21	0.71	2.14	
	4	6		0.24	2.94	3	3.1	
	5	6.5		0.09	0.12	0.37	1.11	
	6	6.5		0.1	0.21	0.52	1.12	
	7	7		H	0.14	0.66	1.05	
	8	7		H	0.21	0.48	0.51	
	9	7		H	0.04	0.18	0.2	

J/PFRC/1P



J/SFRC/1P								
CRACK ID		LOAD	FAILURE ZONE	WIDTH AT PROGRESSIVE LOAD (mm)				REMARKS
		(tn)		11.00tn	12.00tn	13.00tn	13.60tn	
A	0	4.5	FLEXURE SHEAR	0.19	0.34	0.78	0.81	
	1	4.5		0.21	0.23	0.62	0.71	
	2	5		H	0.45	0.51	0.78	
	3	5		H	0.21	0.34	0.37	
B	0	8	FLEXURE	0.18	1.94	3.01	4.24	Predominant crack
	1	8		0.13	0.42	1.12	2.36	
	2	9		0.81	0.54	1.38	2.84	
	3	10		0.65	0.64	1.78	3.52	
	4	10		0.08	0.21	0.52	0.78	
	5	12.5		–	–	H	H	
C	0	4.5	FLEXURE SHEAR	0.11	0.12	0.31	0.57	
	1	4.5		0.16	0.24	0.35	0.61	
	2	5.5		0.23	0.4	0.84	0.98	
	3	5		0.32	0.41	0.78	1.05	
	4	6		0.19	0.42	0.51	0.78	
	5	6		H	H	H	H	
J/SFRC/1P								
