Structural Behaviour of Beam Column Joint Using Hybrid Fibers

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***Abstract*- : In this project work, structural behaviour of the beam column joint was studied, when the concrete is altered with the hybrid fibre. To improve the efficiency of the concrete beam column joint fibre is used in M25 grade of concrete. Structural behaviour of the beam column joint was studied in experimentation manner by imposing load on the beam on both conventional and contemporary specimens. The ultimate load carrying capacity of the beam column joint was compared and studied.**

***Index Terms*- Hybrid Fibre, Steel Fibre, Polypropylene Fibre, Beam Column Joint, Structural Element**

INTRODUCTION

Beam Column joint is the most important structural element in an RC Structure, but in practice while designing there is no concentration is provided to design beam column joint. Lot of building are failed due to failure caused in the beam column joint. To avoid the failure of beam column joint, it is need to design the beam column joint. To increase the performance of the beam column joint fibre can be used. Many researches have been already done to increase the performance of the concrete by using the fibre. To improve performance of fibre concrete, hybrid fibre is used in this project. As expected the project results have been shown increased performance of beam column joint.

HYBRID FIBRE:

The combination of the two or more than that is said to be hybrid fibre. For this project work, steel fibre and polypropylene fibre is used as combination. 0.5% of the steel fibre and 1% of polypropylene fibre is used.

MATERIAL USED:

For this experiment, M30 Grade of concrete is used. River sand is used for this project work with the specific gravity of 2.65 and blue metal stone is used as coarse aggregate with the specific gravity of 2.7 conforming to IS:383-1970. A super plasticizer was added with dosage of 1% by weight of the cement. The aspect ratio of the fibre used in this project work is 60. M30 Grade concrete mix is design as per IS:10262-1982. And water cement ration is used as 0.40.

STRUCTURAL ELEMENT DETAILS:

The size of the column is 200mm breadth and 120mm depth with height of 600mm, and the size of beam is 120mm breadth and 170mm depth with beam length of 450mm. The height of the column from the soffit of the beam is 215mm. Column strips are provided at 50 mm centre to centre distance with 6 Numbers of 6mm diameter rod. Beam shear rods are provided at 50mm centre to centre distance with 6 Numbers of 6mm diameter rod. For column 8 Numbers of 8mm diameter rod is provided. For beam 3 Numbers of 10mm Tension rod and 3 Numbers of 10mm Compression rod.

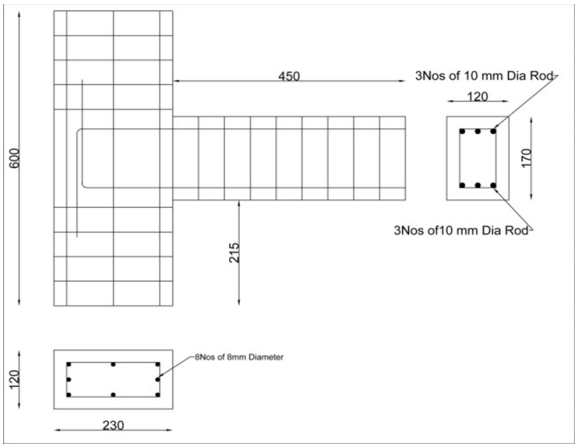


Fig-1: Structural Detail

EXPERIMENTAL SETUP

For testing of beam column joint, loading frame was used. The capacity of the loading frame is 500 kN.

To check the performance of the beam column joint of the conventional element and hybrid concrete beam column joint, the entire specimen where tested for the ultimate load for failure. Column ended are restrained and load was applied at the end of the beam. The test setup is shown in the below picture.

Fig-2: Experimental Setup

BASIC TEST RESULTS

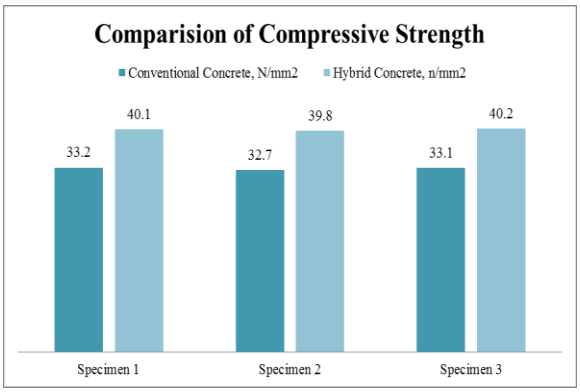
To ensure the properties of the concrete used in this project, basic tests are done. After 28 days curing the concrete tested to check the compressive strength, split tensile strength and flexural strength of the concrete.

Both conventional concrete and hybrid fibre concrete specimens are casted. Three numbers of specimens are casted for cubes, cylinder and prism. All the specimens are tested. Test results are tabulated below.

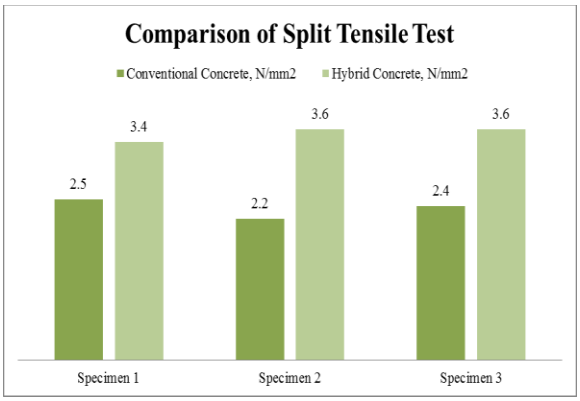
Basic Test Results					
Test	Specimen No	Conventional Concrete, N/mm^2	Mean Value for Conventional Concrete, N/mm^2	Hybrid Fibre Concrete, N/mm^2	Mean Value For Hybrid Concrete, N/mm^2
Compressive Strength Test	1	33.2	33.0	40.1	40.034
	2	32.7		39.8	
	3	33.1		40.2	
Split Tensile Test	1	2.5	2.367	3.4	3.534
	2	2.2		3.6	
	3	2.4		3.6	
Flexural Test	1	4.1	4.134	5.9	5.734
	2	4.3		5.8	
	3	4.0		5.5	

Table: 1 – Basic Test Results

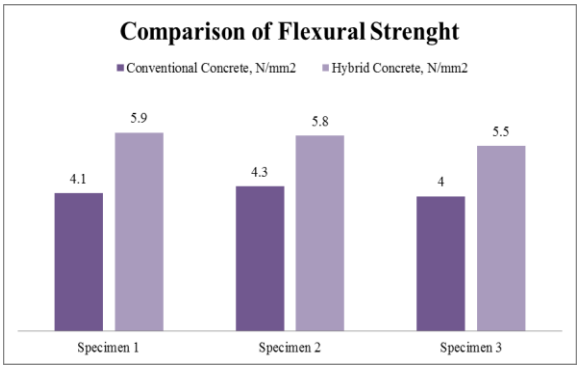
For the above results comparison of results is shown as follows



Graph-1: Comparison of Compressive Strength



Graph-2: Comparison of Split Tensile Test



Graph-3 Comparison of Flexural Strength

RESULT

Testing was carried over after completion of all basic tests. In this test the load was applied at the end of the beam and the column end are restrained at each end. Thus the failure load (Ultimate Load) was identified when the appearance of first crack. The test results are plotted in table as follows.

Conventional Beam Column Joint							
Specimen 1		Specimen 2		Specimen 3		Mean Value	
Load, kN	Deflection, mm	Load, kN	Deflection, mm	Load, kN	Deflection, mm	Load, kN	Deflection, mm
0	0	0	0	0	0	0	0
4	1	4.5	1.1	5	1	4.5	1.03
9	1.5	8	1.7	9	1.8	8.67	1.67
13.5	2.1	12	2.0	13	2.2	12.83	2.1
17	3.0	18	2.9	16	3.2	17	3.03
21	4.5	20	4.1	19	4.0	20	4.2
25	5.1	26	5.0	24	4.9	25	5.03
28	5.7	27	5.6	29	5.5	28	5.6
32	6	33	6.1	34	5.9	33	6

Table-2: Load Deflection Result for Conventional Beam Column Joint.

From the above test results it clearly shows that the ultimate load carrying capacity of the conventional beam column joint is 33kN, which has deflection of 6mm. For the hybrid beam column joint the test results are shown in table -3.

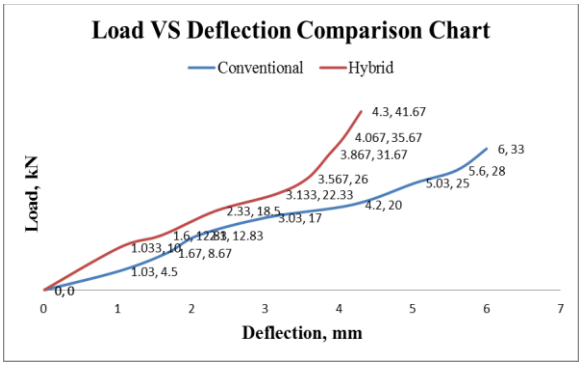
Hybrid Beam Column Joint							
Specimen 1		Specimen 2		Specimen 3		Mean Value	
Load, kN	Deflection, mm	Load, kN	Deflection, mm	Load, kN	Deflection, mm	Load, kN	Deflection, mm
0	0	0	0	0	0	0	0
9	1	10	1.1	11	1	10	1.033
13	1.5	13	1.7	12.5	1.6	12.83	1.6
18.5	2.2	18	2.4	19	2.4	18.5	2.33
22	3.1	23	3.2	22	3.1	22.33	3.133
26	3.5	26	3.6	26	3.6	26	3.567
31	3.9	31	3.9	33	3.8	31.67	3.867
35	4.2	35	4	37	4.0	35.67	4.067
40	4.5	42	4.3	43	4.1	41.67	4.30

Table-3: Load Deflection Results for Conventional Beam Column Joint

From the testing result of the hybrid beam column joint it is very clear that the ultimate load was increased and the deflection of the beam is decreased in significant value. The ultimate load for the hybrid beam column joint is 41.67kN, exactly 8.67kN load was increased in hybrid beam column joint when compared with the conventional beam column joint and the approximately about 1.7mm deflection was reduced.

CONCLUSION

From the test results, load vs Deflection graph is plotted for both conventional and hybrid beam column joint for comparison.



Graph-4: Load VS Deflection Comparison Chart

From the above comparison of load vs deflection for conventional and hybrid beam column joint, it is very clear that the hybrid beam column joint will perform better than the conventional beam column joint. As expected the hybrid beam column joint take more load than the conventional beam column joint and deflection of the hybrid beam column joint is less when compared with the conventional beam column joint. ‘

REFERENCE

[1] Angelo Masi , Giuseppe Santarsiero (2013) “Study of the seismic behaviour of external RC beam–column joints through experimental tests and numerical simulations” Engineering Structures vol 52, pp. 207–219

[2] Ben Young (2008) “Experimental and numerical investigation of high strength stainless steel structures” Journal of Constructional Steel Research, vol 64, pp. 1225–1230.

[3] Gardner .L, Insausti .A (2010) “Elevated temperature material properties of stainless steel alloys” Journal of Constructional Steel Research, vol 66, pp. 634-647.

[4] Holschemacher .K, Mueller .T (2010) “Effect of steel fibres on mechanical properties of high-strength concrete” Materials and Design, vol 31, pp.2604–2615.

[5] Jaehong Kim, James LaFave.M (2007) “Key influence parameters for the joint shear behaviour of reinforced concrete (RC) beam–column connections” Engineering Structures, vol 29,pp 2523–2539

[6] El-Sayed Mashaly, Mohamed El-Heweity (2010) “A new beam-column model for seismic analysis of RC frames” Alexandria Engineering Journal, vol 51, pp. 53-60.

[7] Gardner .L, Insausti .A (2010) “Elevated temperature material properties of stainless steel alloys” Journal of Constructional Steel Research, vol 66, pp. 634-647.