JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 2, 2022, p. 1317 - 1328
https://publishoa.com
ISSN: 1309-3452

Analytical Investigation of Hybrid Fibbers in Reinforced Concrete Beams Under Cyclic Loading

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ABSTRACT

"Fiber reinforced concrete is the mostly commonly used special type of concrete. In fiber reinforced concrete mostly one fibers are used. In this investigation, an study is made to analyses the behavior of fiber reinforced concrete by hybridization of fibers. In this investigation polypropylene fiber and steel fiber are used in hybridization form to find the flexural behavior of fiber reinforced concrete beams under cyclic loading. A total of six mixes were prepared in which one mix is a conventional concrete. Two mixes were in mono fiber formation of 0.5% steel fiber and 0.5% of polypropylene fiber. Another three mixes were in hybrid formation of 0.12% steel fiber with 0.38% polypropylene fiber, 0.25% steel fiber with 0.25% polypropylene fiber and 0.38% steel fiber and 0.12% polypropylene fiber respectively. On analyzing the flexural behavior both by experimental investigation and by using ANSYS, it was found that the mix in the hybridation formation have more flexural properties."

KEYWORDS – Fiber Reinforced Concrete, Steel Fiber, Polypropylene Fiber, Ansys

1. INTRODUCTION

through and massive, artefact materials have atmosphere cut off, low inflexible nature and ruin strength effects (1-5). in any case constructing material materials have delicate resources (6, 7). to travel against the affected pliable and shear stresses in created up concrete and what's a lot of to form customary and usable essential material, the strongholds area unit given as consistent metallic bars and stirrups in concrete. For as long as fifty years, Associate in Nursing high score kind of work with alluded to as filaments has been applied in cement to compensate the weak belongings, named as Fiber concrete (FRC) by that messed up Associate in Nursing at discretional dissipated strands district unit unnatural to outfit Associate in Nursing astonishing horribly stowed away surface with driving edge power, versatility and strength assets. the exceptional that contains of concrete, great typically talking, coarse by and tremendous, water and broken separate strands locale unit known as Fiber strong Concrete. The strands sheathed cement are not one more to oversee work with (8-eleven). The basic separation among silver work with and separate metal filaments is that the consistent silver bars district unit applied to frame bigger the malleable and shear limits of cement though the occasion of broken strands extra fosters the post-breaking reaction through dominating the ruin starting and unroll (3, 12-sixteen). on this investigate work, a piece is framed to audit the flexural execution of fiber maintained cement through making use of metal and plastic strands.

2. MATERIALS USED

The most consistently applied substances for the tremendous like cement, aggregates (astonishing and coarse), water and important plasticizers had been used on this assessments. Concrete applied is normal strain driven concrete (OPC). Fine usually used is M-Sand. Each M-Sand and coarse totals are further from accessible Quarry affiliation. Normal adaptable water

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changed into applied for this appraisal. The strands used on this assessment become silver fiber and plastic fiber.

MIX PROPORTIONING

The fundamental examine joins augmenting and testing of six crazy for the principal half talking presentations Fiber supported cement (HFRC) overflows beneath flexural load. The bar models had been acquainted with four issue stacking. M40 evaluation of cement was used for expanding the reason for help event. the most work with fuses of two 10mm ampleness bars at one of a kind low and a couple of 8mm size bars at the apex with a shrewd front of 25mm. The shear guide conveys stirrups of 6mm aspect bars at 125mm fixation to wisdom insightful . The blend proportioning for this assessment is classed in Table one. The cross space and backing organizing of the point of support square measure showed in Figure 1.

Table 1. Mix proportions of HFRC beam

Mix	Cement kg/m^3	FA kg/m^3	CA kg/m^3	Water kg/m^3	SP kg/m^3	Steel Fibre (%)	PP Fibre (%)
BCM	395	715.28	1150	158	7.9	-	-
BST0.5	395	715.28	1150	158	7.9	0.5	-
BPP0.5	395	715.28	1150	158	7.9	0.5	-
BST0.25PP0.75	395	715.28	1150	158	7.9	0.12	0.38
BST0.5PP0.5	395	715.28	1150	158	7.9	0.25	0.25
BST0.75PP0.25	395	715.28	1150	158	7.9	0.38	0.12

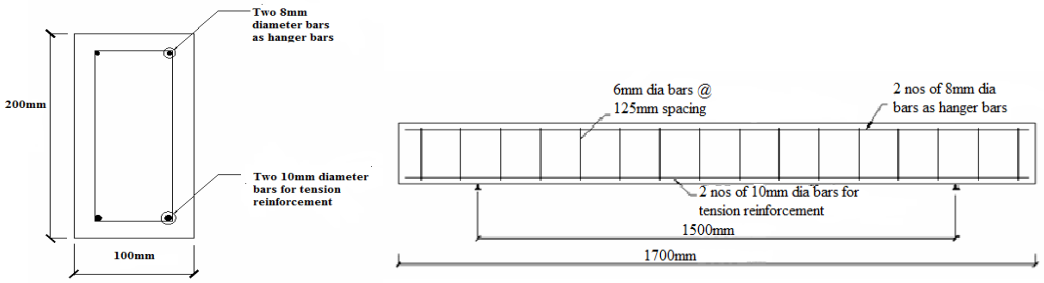

Figure 1. Cross Section and Reinforcement Detailing of Beam

3. CASTING AND CURING OF SPECIEMENS

How much shaft models projected became six enough blend and at extends the jazz band of half breed fiber made up concrete. The fiber content material incased the huge became issue to the level of cement. the legitimate fiber content material found for fiber became book. PP strands were additional with steel fiber as 25%-75%, 50% - 50% and 75%-25% single pillar became casted for each amount. unblemished and wide surface become utilized for readiness of cement. Past distending the shafts, it totally was demoulded and it become place into beneficial water for 28 days. The point of support model after mitigating sum is shown in Figure 2.

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Figure 2. Beams Cured and whitewashed

4. FLEXURAL TESTING OF BEAMS

Four explanation stacking figuring out was driving on the bar event to go watching out the flexural direct of direction of help models. The shaft case was set at the stacking machine and respected partner principally kept up with bar. The help reason becomes attempted upto the dissatisfaction. The squash models and starting breaks inside the shaft models region unit distinguished. The LVDT is as to inside the help reason to go peering out the redirection of the bar on account of crafted by the heap. The investigate course of action is shown in Figure three and furthermore the bar testing under cyclic stacking is shown in Figure 4.

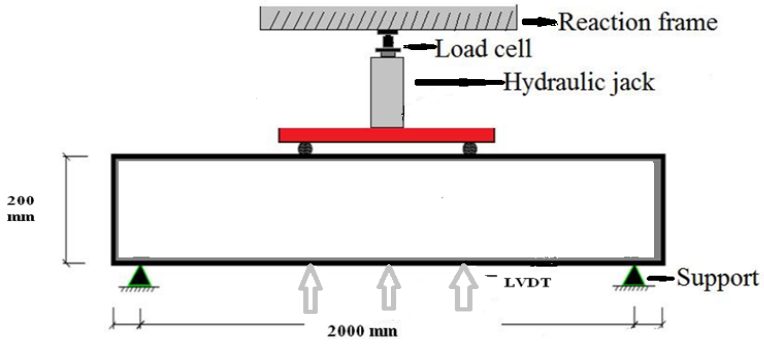

Figure 3. Typical Test Setup for Beam

Figure 4. Beam test setup under cyclic loading

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5. RESULTS AND DISCUSSIONS

6.1 Load Carrying Capacity

The explorative eventual outcomes of definite break trouble and first Crack store of HFRC transmits underneath cyclic stacking square measure summarized in Table a couple of. Table three shows the final word weight and redirections of HFRC emanates.

Table 2. Ultimate crack load and First Crack load of HFRC beams under cyclic loading

Mix	Cracking Load in kN	Ultimate Load in kN
BCM	28	45
BST0.5	34	50
BPP0.5	32	49
BST0.25PP0.75	35	51
BST0.5PP0.5	37	53
BST0.75PP0.25	39	57

From the experimental results it was observed that initial cracks were delayed in hybrid fibre reinforced concrete compare to single fibre reinforced concrete.

Table 3. Load Deflection Parameter in forward cycle

Mix	Ultimate Load in kN	Deflection in mm
BCM	45	18.10
BST0.5	50	24.1
BPP0.5	49	27.5
BST0.25BPP0.75	51	26.30
BST0.5BPP0.5	53	28.50
BST0.75BPP0.25	57	23.20

From the check consequences, a definitive burden for traditional pillar in forward cycle became 45 kN and therefore the referring to dodging is eighteen.10 mm. In metal sinewy instance with 0.5% amount component a definitive burden was 50kN and therefore the referring to diversion become 24.1 mm. The plastic sinewy part took associate intense heap of 49kN and therefore the evaluating redirection became 27.5 mm. In BST0.25PP0.75, a definitive burden at fifth cycle was 53kN and therefore the referring to dodging was 28.5 mm. BST0.5PP0.5 and BST0.75PP0.25 sent 53kN and 57kN as intense burden and 28.5 millimetre and confirmed 23.20 millimetre as severe dodging for my half. The load deflection behaviour curve for various mixes is shown from Figure 5 to Figure 10.

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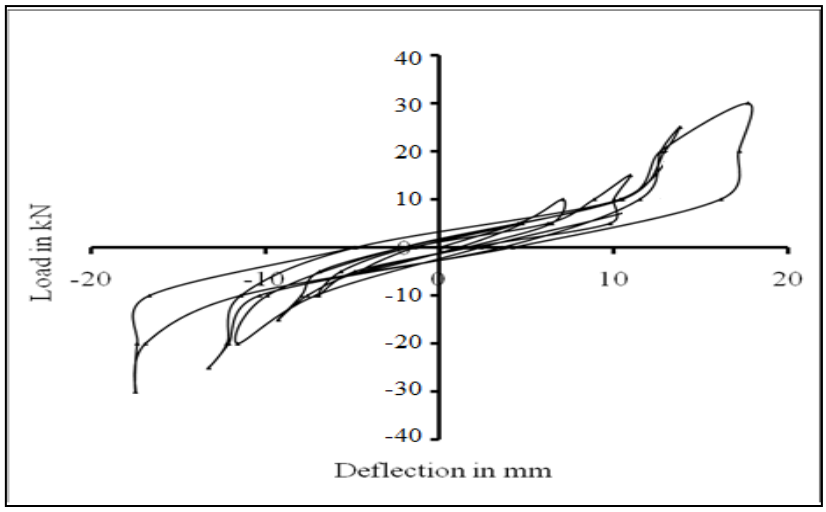

Figure 5. Load deflection behaviour of BCM

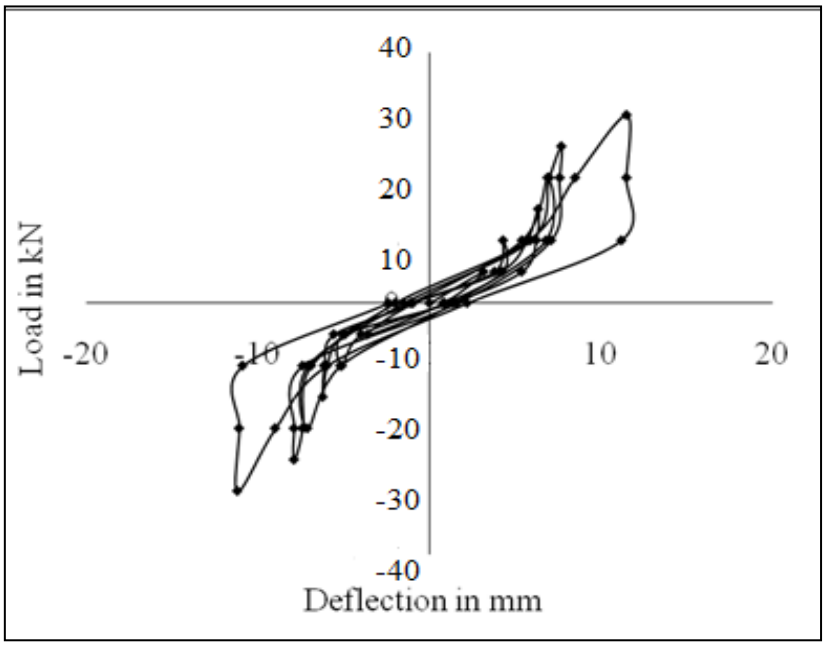

Figure 6. Load deflection behaviour of BST0.5

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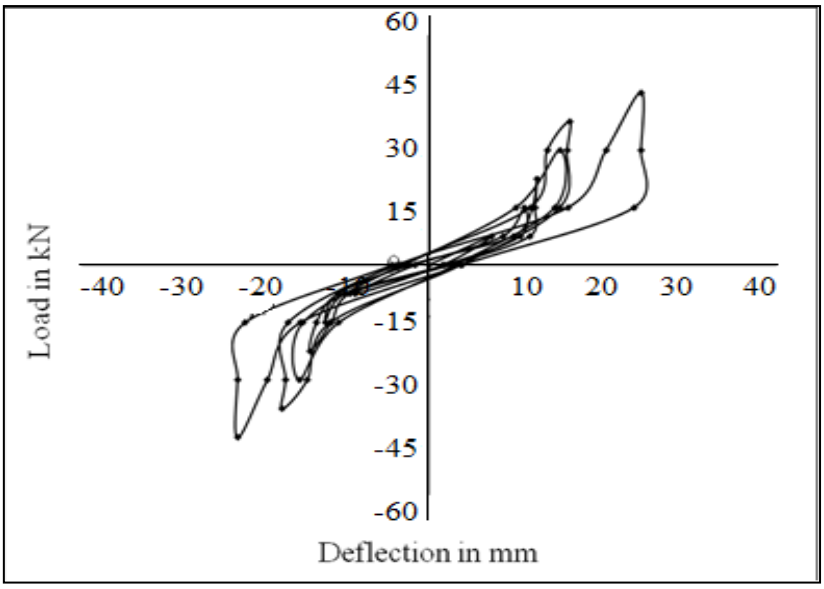

Figure 7. Load deflection behaviour of BPP0.5

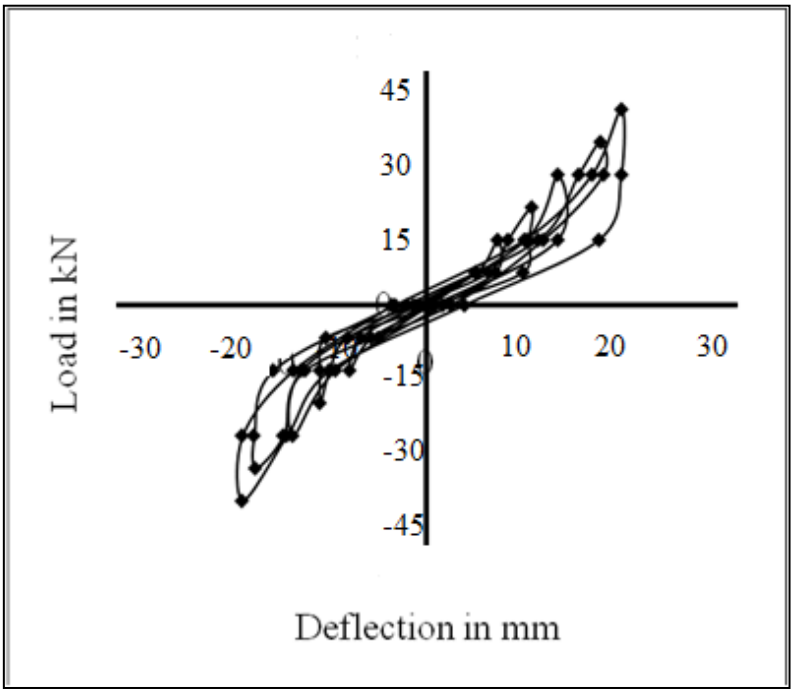

Figure 8. Load deflection behaviour of BST0.25PP0.75

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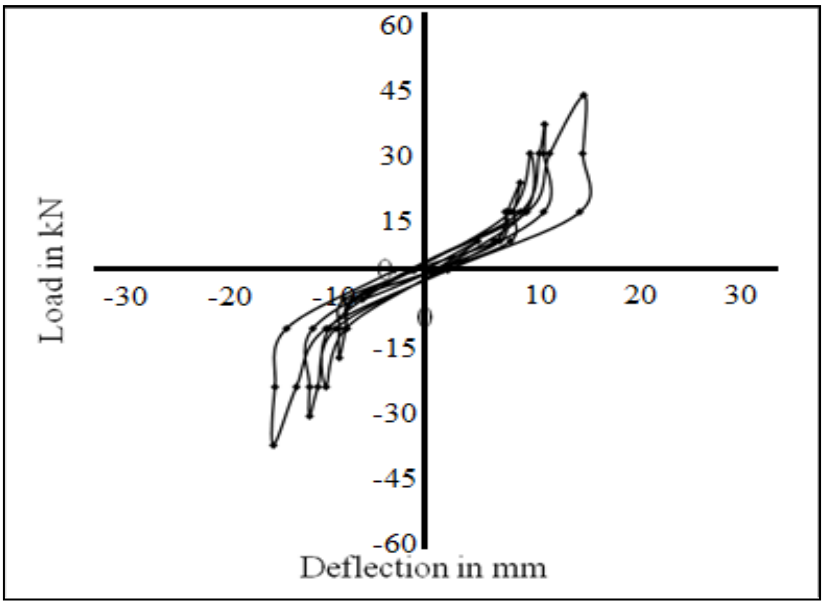

Figure 9. Load deflection behaviour of BST0.5PP0.5

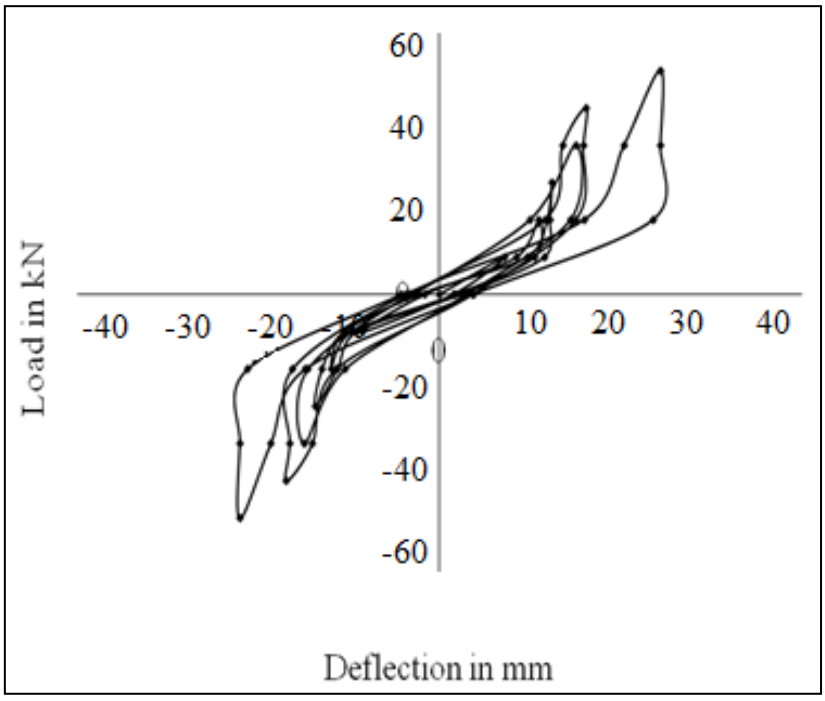

Figure 10. Load deflection behaviour of BST0.75PP0.25

5.2 Ductility Factor

Flexibility issue is that the limitation of the expectation included inelastic nature. It's miles the degree of unequivocal Deformation to Deformation close to the beginning Cracking explanation. The flexibility variable of HFRC emanates square measure showed in Table 4.

Table 4. Ductility Factor of HFRC Beams

Mix	Ultimate Deflection in mm	Yielding Deflection in mm	Ductility Factor

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BCM	18.1	3.63	4.98
BST0.5	24.1	3.9	6.17
BPP0.5	27.5	4.1	6.7
BST0.25PP0.75	26.3	4.43	5.93
BST0.5PP0.5	28.5	4.23	6.73
BST0.75PP0.25	23.2	2.5	9.28

From the wildcat outcomes it happen that pliancy has improved to bigger critical insistence for BST0.75PP0.25 than BST0.5specimen. all things considered, capacity of BPP0.5 model dressed to be extra uncommon than BST0.5 model. this might be seeing that strands along development clutch the region change surface with the assistance of partner across the breaks. This thusly develops the shop transaction constraint at uncommon weight.

6.3 ANSYS modelling of Beams

The results overcame ANSYS assessment for flexural emanates region unit talked in regards to and ANSYS showing of shaft is given from Figure eleven to work 16.

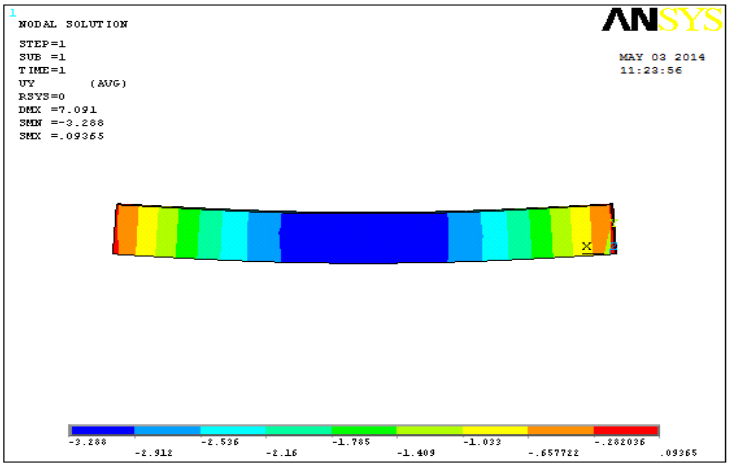

Figure 11. Deformation of BCM

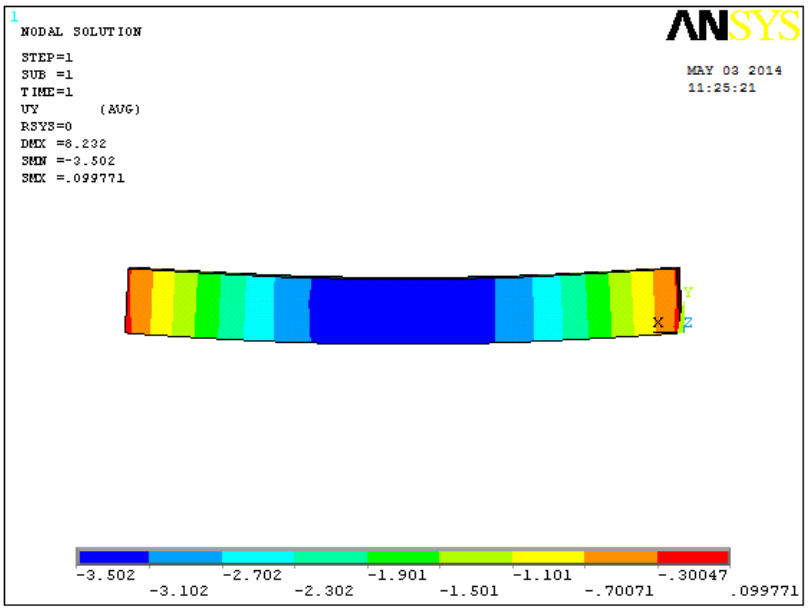

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Figure 12. Deformation of BST0.5

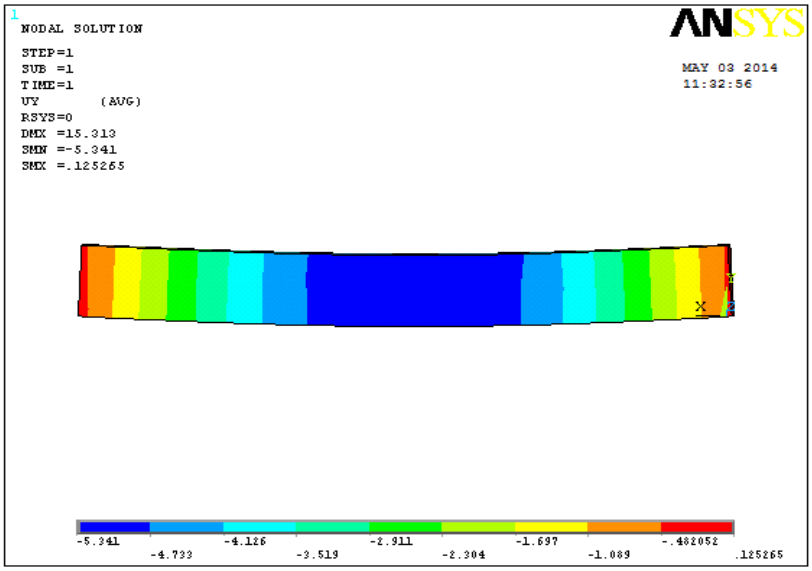

Figure 13. Deformation of BPP0.5

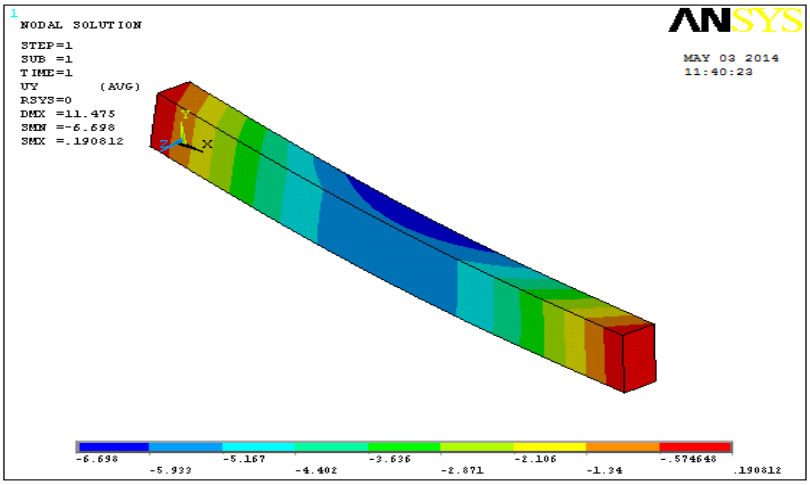

Figure 14. Deformation of BST0.25PP0.75

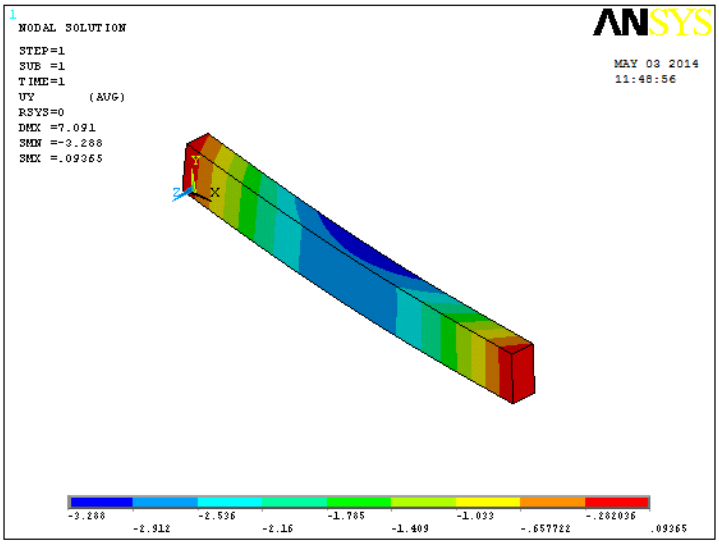

Figure 15. Deformation of BST0.5PP0.5

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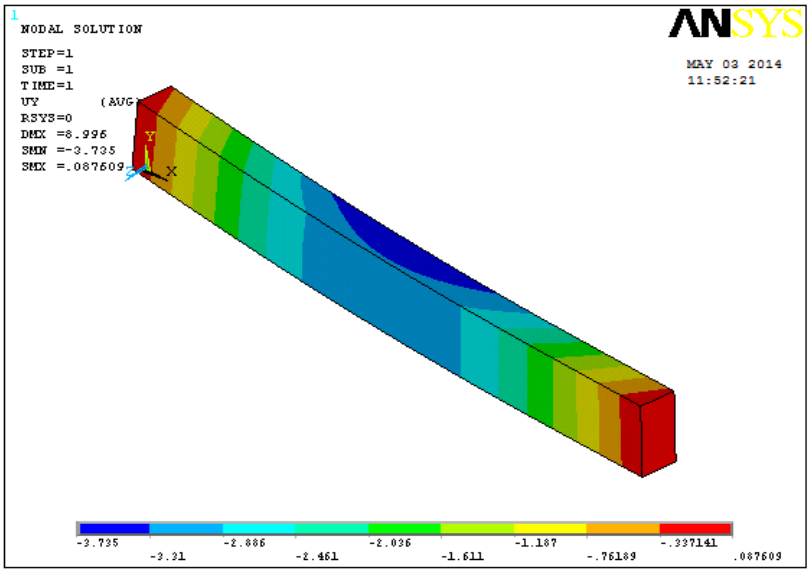

Figure 16. Deformation of BST0.75PP0.25

6.4 ANSYS Test Results and Discussions

The redirection values from the examination of model in ANSYS were noted at focal point of the bar and in this way the characteristics are presented in Table five. The assortment among preliminary and insightful characteristics are showed in Figure 17.

Table 5. Experimental and Analytical deflection

Mix	Experimental Deflection	Analytical Deflection	Deflection Variation (%)
BCM	18.10	19.34	6.92
BST0.5	24.1	25.8	7.1
BPP0.5	27.5	29.6	7.94
BST0.25PP0.75	26.30	28.27	7.57
BST0.5PP0.5	28.50	31.12	9.2
BST0.75PP0.25	23.20	25.19	8.63

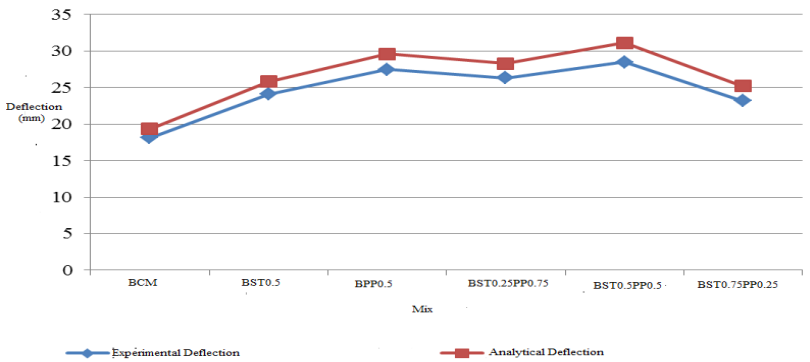

Figure 17. Experimental and Analytical deflection

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6. CONCLUSION

Based on the experimental and analytical studies, the following conclusions were arrived,

- ✓ "The load-deflection relationship has been established for HFRC beam under cyclic loading. The deflection versus cyclic loading profile showed uniform incremental deflections of the specimens for all combination."
- ✓ "Reinforced beam with a combination of Steel with 0.5 and Polypropylene with 0.5 showed better deflection when compared with the single fibre reinforced concrete and control mix."
- ✓ "The deflection obtained for BST0.75PP0.25 was 23.20 mm in the experimental study where as in analytical investigation the deflection obtained was 25.19 mm which is 8.63% greater than experimental study."
- ✓ "Comparison between the load-deflection results obtained from ANSYS and that from the experimental study shows that the ANSYS results were little higher than the experimental results."
- ✓ "Cracking load was increased by 8.82% and 14.7% for hybrid fibre reinforced beam specimens having fibre content of ST0.5PP0.5 and ST0.75PP0.25 respectively when compared to SFRC beam specimen. It was found that the addition of fibres bridges the cracking effects and delayed the formation of first crack."
- ✓ "The ultimate load carrying capacity was increased by 14% for hybrid BST0.75PP0.25 when compared to steel fibre BST0.5 beam specimen."
- ✓ "It can be seen that ductility was improved nearly 56% for the BST0.75PP0.25 specimen compared to BST0.25PP0.75 specimen."
- ✓ "Ductility of BPP0.5 specimen was greater than BST0.5 specimen. It was observed that when fibres in hybrid form can improve the ductility of the specimen. This is because fibres can arrest the crack propagation by bridging across the cracks. Due to this, the cracks could not propagate in the same plane and had to take a deviated path resulting in the higher energy demand for further propagation. Therefore, proper mixture of these two complementary fibres can make better properties of concrete."

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