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# Use of Plastic Fibers in Concrete with Partial Replacement of Sand with Fly Ash

Ahraz Javeed Reshi
*Practicing Chartered Civil Engineer*

***Abstract:*** ***The concrete is a brittle material with high compressive strength but less tensile strength, thus addition of plastic fibers has resulted in better enhancement of compressive strength and better crack control with addition of Fly Ash proving to be precise replacement of Sand by partial means. The values of 1% Plastic Fiber and 20% Fly Ash has helped in obtaining considerable results. Cube specimens of 150*150*150 MM with Values Of 0%,1%,2% And 2.5% Plastic Fibers by weight of cement and Values of 0%,20%,40%,50% Fly Ash were replaced by weight of sand and were casted. At higher values of Addition significant changes in slump values have been noticed, with slump values falling to as low as less than 80 mm, but at low addition of values of plastic fiber and fly ash i.e. till 2% plastic fibers and 40% fly ash it has been observed that concrete is workable with slump values ranging from 80-110 mm.The concrete used for this research purpose was design mix of compressive strength of 30 N/mm$^2$ with a target mean strength of 37.5 N/mm$^2$ at 28 days of curing. The main reason of study was to see whether there is any enhancement of compressive strength, crack control for impacts and shrinkages with proper utilisation of Plastic fibers and Fly Ash in concrete.***

***Keywords: Concrete, Plastic Fiber, Fly Ash, Compressive Strength, Crack Control***

## I. INTRODUCTION

Plain concrete has low tensile strength, less ductility, destructive and brittle failure, the addition of *Polypropylene Plastic fiber* helps to control cracking due to plastic shrinkage, reduces the permeability of concrete thus reduces bleeding of concrete too. Without any fiber in the concrete there is development of the cracks due to plastic shrinkage, drying shrinkage and other reasons of changes in volume of concrete. Apart from these, plastic fibers are very economical and its utilisation in concrete can be easily achieved, also elsewhere the use of river sand is getting limited now due to its illegal extraction and impulse generation of fly ash its vital to keep the research going in order to find any replacement of sand. Plastic fibers have proved to be a vital research material which has resulted in commendable results throughout, by addition of plastic fibers in concrete there has been an enhancement in compressive strength with better crack control, indicated by the failure patterns on compressive testing on moulds done in past researches With the replacement of sand with Fly Ash the results proved productive as the sand was replaced in percentiles in values to sand which later showed better workability of concrete and its better consumption to provide environment friendly nature of concrete. In previous researches there has been results where grades of *M*20,*M*40 has showed considerable enhancement of compressive strength.[1,2]

## II. MATERIALS USED

### *A. Cement*

For this executed research, *ordinary Portland cement type* (43) grade was used having specific gravity of 3.15.

### *B. Fine Aggregates*

Fine Aggregates conforming to *zone I* was used with a specific gravity of 2.62, testing of sand was done as per IS 383-1970, Water Absorption of Fine aggregates was found to be 0.5%. [,3,4]

### *C. Coarse Aggregates*

Maximum Aggregates size was of 20mm with a specific gravity of 2.66, the grading test was done as per IS 383-1970.Water absorption of Coarse aggregates was found to be 0.3%. [5]

### *D. Water*

Potable Water was used which was free from any impurities and any existing odour, the *pH* value of water was not less than 6. [6]

*E. Fly Ash*

Fly Ash was used with accordance to IS 3812.[7]

*F. Plastic Fibers*

View of Plastic fibers (refer with: Fig 1)

Fig 1

## III. METHODOLOGY

The concrete used for this research purpose was design mix of *M30* grade of concrete designed as per IS 10262:2009, All the concrete ingredients were checked in accordance with the *Indian standards.* Mix design used throughout this research of *M30* grade of concrete was having proportions of 1:1.73:2.63 where 1 indicates the ratio of *cement* and 1.73 indicates the ratio of *fine aggregates* whereas 2.63 indicates the ratio of *coarse aggregates* used in the batching of concrete. The adopted *water cement ratio* for the design mix was of 0.45, There was no addition of any *Chemical admixtures* in the concrete. The cubes consisting of 6 numbers with a grade of *M30*, for all the taken values were casted as per IS 516-1959.The cubes were de moulded after 24 hours and were cured for 7 and 28 days accordingly. [6,8,9]

*A. Testing Details*

*Compressive strength* tests of concrete cubes casted with different percentages of plastic fibers as well as fly ash was conducted at 7 and 28 days to find out the compressive strength of concrete whether by means of Replacement of plastic fibres and fly ash has there been any increase in *compressive strength* or not in comparison to conventional plain concrete. Testing of specimens is shown (refer with: Fig 2).[10]

## IV. TEST RESULTS

Fig 2

The 7- and 28-days cube *compressive strength* of plain and fiber reinforced concrete cube specimens obtained from conducted tests are tabulated (refer with: Table 1, Table 2)

Table 1 (Results obtained at 7 days)

| Grade of Concrete | Sample No. | %age of Plastic Fiber | %age of Fly Ash | Load (KN) | Compressive Strength ($N/MM^2$) | Average Compressive strength ($N/MM^2$) |
|---|---|---|---|---|---|---|
| *M30* | 1 | 0 | 0 | 450 | 20 | 20.41 |
| | 1 | 0 | 0 | 466 | 20.71 | |
| | 1 | 0 | 0 | 462 | 20.53 | |
| *M30* | 2 | 1 | 20 | 499 | 22.17 | 20.73 |
| | 2 | 1 | 40 | 466 | 20.71 | |
| | 2 | 1 | 50 | 435 | 19.33 | |
| *M30* | 3 | 2 | 20 | 356 | 15.82 | 15.45 |
| | 3 | 2 | 40 | 349 | 15.51 | |
| | 3 | 2 | 50 | 338 | 15.02 | |
| *M30* | 4 | 2.5 | 20 | 331 | 14.7 | 14.45 |
| | 4 | 2.5 | 40 | 326 | 14.48 | |
| | 4 | 2.5 | 50 | 319 | 14.17 | |

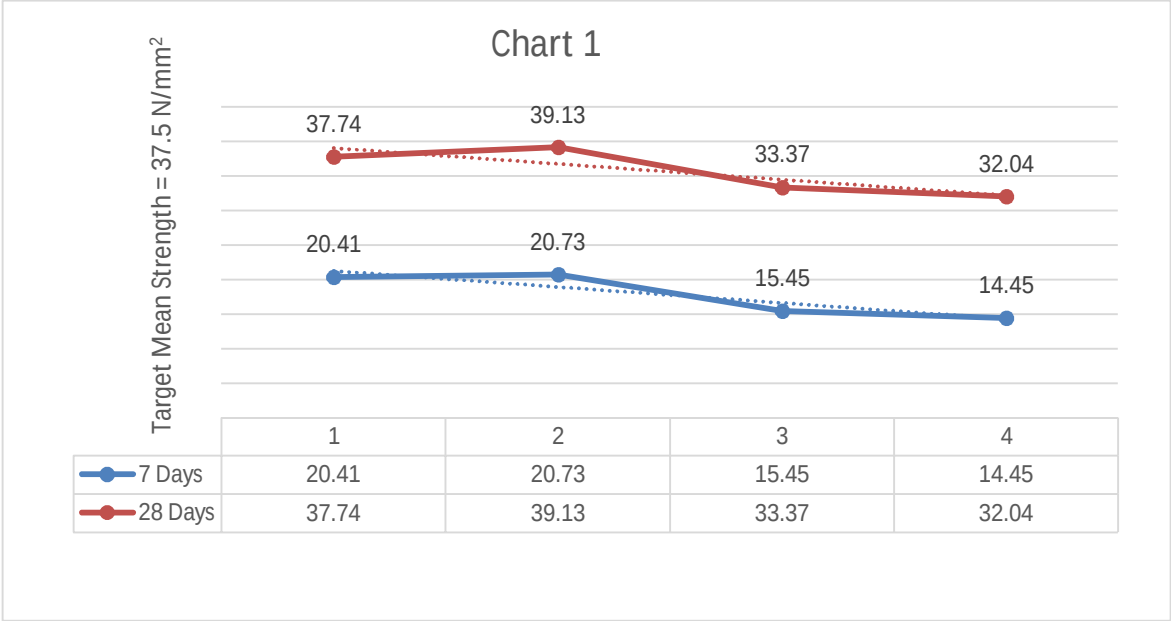
Table 2 (Results obtained at 28 days)

| Grade of Concrete | Sample no | %age of Plastic Fiber | %age of Fly Ash | Load (KN) | Compressive Strength ($N/MM^2$) | Average Compressive strength ($N/MM^2$) |
|---|---|---|---|---|---|---|
| *M30* | 1 | 0 | 0 | 849 | 37.73 | 37.74 |
| | 1 | 0 | 0 | 851 | 37.82 | |
| | 1 | 0 | 0 | 848 | 37.68 | |
| *M30* | 2 | 1 | 20 | 904 | 40.17 | 39.13 |
| | 2 | 1 | 40 | 888 | 39.46 | |
| | 2 | 1 | 50 | 850 | 37.77 | |
| *M30* | 3 | 2 | 20 | 800 | 35.55 | 33.37 |
| | 3 | 2 | 40 | 750 | 33.33 | |
| | 3 | 2 | 50 | 703 | 31.24 | |
| *M30* | 4 | 2.5 | 20 | 779 | 34.62 | 32.04 |
| | 4 | 2.5 | 40 | 714 | 31.73 | |
| | 4 | 2.5 | 50 | 670 | 29.77 | |

## V. CONCLUSION

Pointed below are the conclusions, based on the experimental results obtained from the investigations

1) The Introduction of *Plastic Fibers* proved to enhance the compressive strength of concrete by *7.12% i.e 2.67 N/mm$^2$*. when plastic fibers were added in *1* percent to cementitious material and *20 %* of *Fly ash* was replaced with sand.
2) By means of Average *compressive strength* of concrete there was an increase of *4.1% i.e 1.39 N/mm$^2$* in the *compressive strength* of concrete.
3) Better crack control in terms of failure patterns of cubes reinforced with *plastic fibers* was noticed in comparison to plain concrete cubes
4) Addition of *Plastic Fibers* proved to obtain the cohesiveness among the concrete ingredients during its mixing process.
5) The results proved that sand can be replaced with *Fly ash* in concrete by percentile means by weight to sand as satisfactory results were obtained from the research.
6) By addition of *Fly Ash* with replacement to sand by percentile means it was also observed that the concrete mix produced had better workability in comparison to the concrete where only sand was used without any addition of *Fly Ash.*
7) For Graphical Representation of Individual and average Enhancement of compressive strength in concrete (refer with: chart 1)




| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 7 Days | 20.41 | 20.73 | 15.45 | 14.45 |
| 28 Days | 37.74 | 39.13 | 33.37 | 32.04 |

## VI. ACKNOWLEDGEMENT

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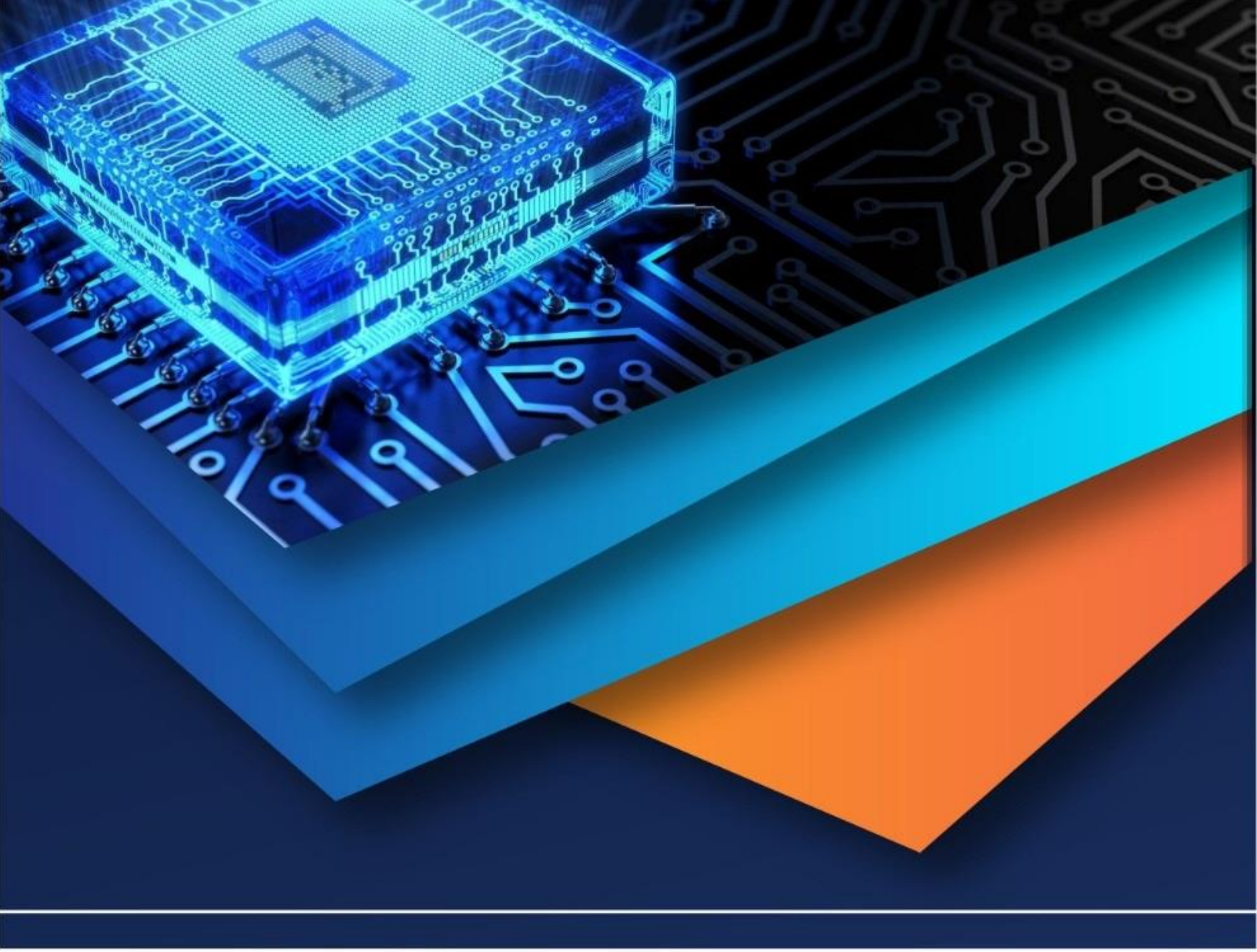

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