International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 08 | Aug 2018 www.irjet.net p-ISSN: 2395-0072

# Experimental Study on Partial Replacement of Cement by Fly Ash & Fine Aggregate by Foundry Sand for M20 Grade Concrete

**Mallesh M[1], Chiranjeevi B[2], Nandeesh M[3]**

[1]*Associate professor, Dept of civil Engineering, UBDT, Davanagere-577004, Karnataka, India*
[2]*PG Student, Dept of civil Engineering, UBDT, Davanagere-577004, Karnataka, India*
[3]*Asst professor, Dept of civil Engineering, BITS, Warangal-506331, Telangana, India*

---

**Abstract -** *The infrastructures are developing day by day so demand is more for concrete. The construction activity is readily depend on concrete directly or indirectly. By this significant demand for natural resources like sand etc., are depleting day by day and heavy releases of carbon dioxide gas in cement manufacturing process, destruction of environment taking place. To overcome these problems, partially use of industrial waste in place of cement and sand are necessary in the production of concrete. In this study an attempt has been made with a M20 mix proportion. Experimental study is conducted to evaluate the strength characteristics of hardened concrete. Properties of concrete have been assessed by partially replacing cement with Fly-Ash and sand with waste foundry sand. The cement has been replaced by Fly-Ash in the range of 0%, 10%, 20% and 25% by weight of cement. The sand has been replaced by Waste foundry sand in the range of 0%, 10%, 20%, 25% and 30% by weight of sand. Concrete cubes were casted and tested after 7 days and 28 days of curing for compressive strength and compared the results with the control cube specimens. The optimum mix of Fly-Ash and Waste foundry sand is determined.*

***Key Words*: Industrial waste, Fly Ash (FA), Foundry Sand (FS), River Sand (RS), Compressive strength**

## 1. INTRODUCTION

Now a day's apart from concrete is the most important and widely used as structural material in construction field. From prior days the concrete is utilized for all the development works. With respect to as India concerned. The development industry is specially subjected to the concrete in this way since its quality. It is considered as the significant piece of development in India and further more is around the world. There are different materials which locally accessible and furthermore practical to acquire the best possible quality of the concrete in development. We can get the compressive quality of cement by including those material among all material in the concrete development so the correct quality can be get by utilizing fly ash for M20 level cement and furthermore among all material the foundry sand can likewise be utilized for solid development and we can without much of a stretch substitution fine total by foundry sand since foundry sand is thinner at that point fine total essentially the foundry sand can be utilized to give the metal a role because of getting waste foundry sand from metal throwing procedure, and this waste foundry sand can likewise be utilized as a part of cement rather than fine total to overcome with issue of incremental request of fine total or fine sand with consider above point into thought the examination of a trial think about is on the halfway substitution of bond by fly ash and fine total by squander foundry sand use for M20 level of cement in development.

## 2. MATERIALS AND METHODOLOGY

**1. Cement**: Ordinary Portland Cement (OPC) of 43 grade (Ultratech) confirming to (IS 8112 -1989) was used. To find the quality of cement, few tests have been conducted in the Laboratory. The results have been tabulated in table.1

**Table 1 Lab test result on Cement**

| SI No | Parameter | Value |
|---|---|---|
| 1 | Specific gravity | 3.12 |
| 2 | Standard Consistency | 30% |
| 3 | Initial setting time | 52min |
| 4 | Final setting time | 310min |
| 5 | Fineness | 4% |
| 6 | 3 days Compressive strength | 25.5Mpa |
| 7 | 7 days Compressive strength | 36.4Mpa |

**2. Fine aggregate:** The locally available natural river sand belonging to zone-1 and passing through 4.75mm sieve of IS 383-1970 was used for the project work. The results have been tabulated in table.2

**Table 2 Test Results of Fine Aggregate**

| | |
|---|---|
| Fineness Modulus | 3.12 |
| Specific Gravity | 2.475 |
| Grade zone as per IS: 383-1970 | zone -1 |

**3. Coarse aggregate:** The coarse aggregate comprising 20mm & 12.5mm in saturated surface dry condition were used. The coarse aggregate used as 20 mm graded aggregate as per IS: 383 -1970 specification. The results have been tabulated in table.3

**Table 3 Test Results of Coarse Aggregate**

| | |
|---|---|
| Specific Gravity | 2.616 |
| Shape | Angular |
| Size | 20mm & 12.5 mm |

**4. Fly Ash:** The fly ash is mainly two classes one is class F & class C in this experimental work we used class F fly ash.Fly ash is blended in cement at the rate of 10-25% by weight of cement in steps of 10%.fly ash used is brought from Rayachuru thermal power station. The results have been tabulated in table.4

**Table 4 Test Results of Fly ash**

| | |
|---|---|
| Colour | Dark Gray |
| Fineness | 3% |
| Specific gravity | 1.92 |

**5. Foundry Sand (FS):** Foundry sand is high silica sand with identical material characteristics. It is a by-product obtained from ferrous and non-ferrous metal from casting industry and was obtained from Pradeep industry Ltd, Hrihara industrial area, Davanagere Dist. The results have been tabulated in table.5

**Table 5 Test results of waste foundry sand**

| | |
|---|---|
| Colour | Black |
| Fineness modulus | 3.2 |
| Specific Gravity | 2.40 |

**6. Water:** Water is a vital element of concrete as it effectively took an interest in chemical response with cement, clean versatile water which is accessible in our college ground is utilized. The water used for casting and curing should satisfy as per IS 456-2000.

**3. METHODOLOGY:** The mix proportions of concrete are modified for using Fly ash and foundry sand as a partial replacement of cement and fine aggregates respectively. The cubes were cast by replacing cement with 0%, 10%, 20%, & 30% Fly ash similarly fine aggregate with 0%, 10%, 20%, 25% & 30% Foundry sand. Specimens are cast as per mix design (M20) and the compressive strength tests are conducted after proper curing of cubes (150mm x 150mm x150mm), from the studies, optimum results are found out and compared with the control concrete cubes. Making of quality concrete cubes (150x150x150mm) requires special care at every stage like preparation of moulds, batching, Mixing, Placing, De-Moulding, Curing, Compacting, and Testing. The experimental work is divided in to 5 trails. Each trail has constant fly ash replacement for cement and varying waste foundry sand replacement for fine aggregate in the range 0%, 10, 20, 25, & 30%. Different combination of replacement ratios of Fly ash and waste foundry sand are tabulated below.

**Table 6: Combination of Replacement ratios of Fly ash & Foundry sand**

| **Fly ash % Replacement with cement** | **Foundry sand % Replacement with Fine aggregates** | | | | |
|---|---|---|---|---|---|
| 0 | 0 | 10 | 20 | 25 | 30 |
| 10 | 0 | 10 | 20 | 25 | 30 |
| 20 | 0 | 10 | 20 | 25 | 30 |
| 25 | 0 | 10 | 20 | 25 | 30 |

For each trail, two sets of cubes (6 specimens) were casted. One set of cubes were tested for compressive strength after 7 days of curing and other set of cubes were tested after 28 days of curing.

**Mix design:** The M20 grade concrete is adopted for the present work. Detailed mix proportion is obtained as per code IS: 10262-2009.

**Table 7 Mix Proportion**

| Ingredients | Water in liters | Cement in kg | River sand in kg | Coarse aggregates in kg | |
|---|---|---|---|---|---|
| | | | | 20 mm (50%) | 12.5 mm (50%) |
| Quantity | 155.31 | 310.62 | 635.152 | 619.55 | 619.55 |
| Mix ratio by weight | 0.5 | 1 | 2.044 | 1.99 | 1.99 |

## 4. RESULTS AND DISCUSSIONS

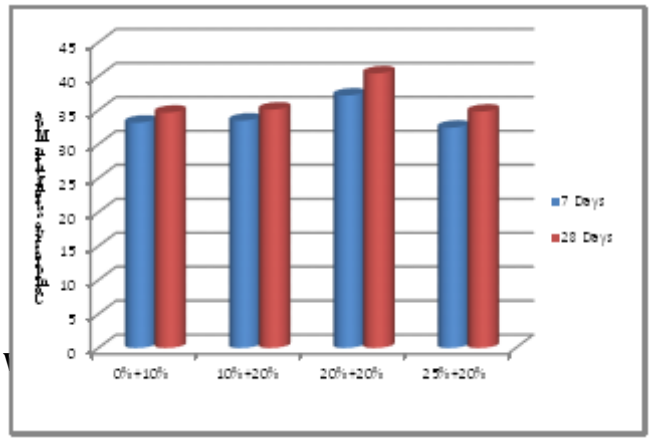
The Compressive strength results of 7 days and 28days are tabulated for different replacement ratios for M20 Grade concrete mix. The results are tabulated as varying replacement for sand with restricted replacement for cement.

**Table 8 Compressive Strength of Concrete**

| **SI.N0** | **Mix (FA+FS) in %** | **Compressive Strength (Mpa)** | |
|---|---|---|---|
| | | **7days** | **28days** |
| **1** | **Conventional** | **27.55** | **30.96** |
| **2** | **0+10** | **33.18** | **34.66** |
| 3 | 0+15 | 31.85 | 34.22 |
| 4 | 0+20 | 30.96 | 33.18 |
| 5 | 0+25 | 26.22 | 28.88 |
| 6 | 0+30 | 24 | 28.14 |
| 7 | 10+0 | 29.33 | 32.74 |
| 8 | 10+10 | 31.40 | 33.48 |

| | | | |
|---|---|---|---|
| **9** | **10+20** | **33.48** | **35.11** |
| 10 | 10+25 | 28.30 | 30.66 |
| 11 | 10+30 | 26.96 | 29.48 |
| 12 | 20+0 | 32.14 | 34.66 |
| 13 | 20+10 | 33.62 | 36 |
| **14** | **20+20** | **37.18** | **40.44** |
| 15 | 20+25 | 32.30 | 35.55 |
| 16 | 20+30 | 30.81 | 33.92 |
| 18 | 25+10 | 30.51 | 32.29 |
| **19** | **25+20** | **32.44** | **34.81** |
| 20 | 25+25 | 29.03 | 31.55 |
| 21 | 25+30 | 27.84 | 29.19 |

**Optimum Compressive strength of concrete:** The results of Compressive strength of concrete cubes for 7 days & 28 days are tabulated for varying % of replacement of cement by fly ash and varying % of replacement of Fine aggregate (river sand) by Foundry sand for optimum mix. It is observed that the optimum compressive strength for 7 days & 28 days are observed for 20% of replacement of the cement by fly ash and 20% of replacement of the fine aggregate by foundry sand.




The concrete behaviour is studied by partia1 rep1acement of Cement by Fly ash & Fine aggregate by Foundry sand. The following Conclusions have been taken from the obtained results.

In this study, For M20 grade of concrete the mean target strength is achieved by partial replacement of cement by fly ash and fine aggregates by foundry sand.

From this experimental study, the optimum replacement ratio for M20 grade of concrete mix are 20% replacement of Cement by Fly ash & 20% replacement of Fine aggregate by Foundry sand, which gives nearly 30% more Compressive strength than results of conventional concrete of M20 mix.

From this experimental study, we can conclude that it has turned out to be good approach to transfer the industrial by products and wastes such as fly ash and foundry sand.

**REFERENCES**

1.Abhishek B K et.al "A new approach of using foundry sand for enhancing concrete mechanical properties" international research journal of engineering and technology (IRJET) e-ISSN:2395-0056,p-ISSN:23950072,volume:05 Issue:03 Mar-2018 PP-325

2.Amrutha K et.al "Partial replacement of fine aggregate by used foundry sand in concrete" international research journal of engineering and technology (IRJET) e-ISSN:2395-0056 p-ISSN: 2395-0072 volume:04 Issue:03 | Mar-2017 pp-165-169

3.Jayasankar.R et.al "Studies on concrete using Fly ash, Rice Husk ash and Egg shell Powder" International journal of civil and structural engineering ISSN 0976-4399 Volume-01 No-03,2010 pp-362-372.

4. Pendhari Ankush R et.al "Partical replacement of sand by waste foundry sand" international research journal of engineering and technology (IRJET) e-ISSN: 2395-0056 p-ISSN: 2395-0072 volume: 04 Issue: 05 | Mar-2017 pp-2771-2776.

5.Shantmurti Upadhyaya et.al "Effects of Fly ash on compressive strength of M20 design concrete" Internatinal journal of advancements in research & technology, ISSN 2278-7763 Volume 3,Issue 9, Sep-2014

6. S.Sridhar et.al "Usage of waste foundry sand in concrete" SSRG International journal of civil engineering (SSRG-IJCE)-ISSN: 2348-8352 volume-02 Issue-12 December-2015 PP-05-12

7. S.Sundararaman et.a1 "Partial replacement of cement with Fly ash and Silica Fume for Sustainable construction" International research journal of engineering and technology (IRJET) e-ISSN: 2395-0056 p-ISSN: 2395-0072 Volume: 03 Issue: 05 May-2016 pp-752-755

8. M.S.Shetty "Concrete Technology" Text book.

9. IS: 10262:2009 (Specification for concrete mix design).

10. IS: 456: 2000 (Plain & Reinforced concrete- code of Partice).

11. IS: 383:1970 (Specification for coarse & fine aggregate)

12. IS: 8112:1989 (Specification for 43 grade ordinary Portland cement)