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*Research Article*

# Effect of Industrial Waste Foundry Sand as Fine Aggregate on Concrete

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***Abstract***

*The basic principle of this paper is to research for M20 & M30 grade of concrete having mix proportion of 1:2.09:3.02 & 1: 1.98:3.88 with respectively water cement ratio having 0.45 & 0.42 to basic fundamental properties of concrete such as compressive strength, split tensile strength , flexural strength . This data received from research has analyzed & comparative study can be made in laboratory casted in controlled room temperature having 0.0% Foundry Sand. [F.S.] A relationship is governed with workability, compressive strength, split tensile strength, flexural strength, these data can be represented by mathematically & graphically.*

***Keywords:*** *concrete mix, foundry sand, compressive strength, split tensile, workability, compaction factor.*

## 1. Introduction

In twenty first century construction industries plays vital role in development of infrastructure sector. The use of natural resources as natural sand in concrete. The cost of concrete also very high, these problems can recover to use waste material. Now days huge production waste material from metal industries used foundry sand as byproducts of metal industries cause varies environmental problems. To use these waste of products in building material can help in reduction of stress on environment. Metal industries can used as silica sand which is uniform size, high quality silica content that is bound to form mould for casting of ferrous & non ferrous metal. Sand is used for metal casting industries, finer than normal sand natural sand. After the metal casting processes burnt sand is cannot be longer used it is removed from foundry as a waste for disposed known as " waste foundry sand " the used waste foundry sand as a partial substitutes or total substitutes by fine aggregate in concrete leads in production of economic, light, weight, high strength of concrete. The Concrete is a material which is composed of coarse aggregate, fine aggregate, cement & water each material in concrete contributes its strength or durability of so, by partial or material which harms the environment can be used for the development of low cost & eco-friendly building materials in the research work to study the varies percentages of fine aggregate with used foundry sand In this paper gives to use the foundry sand as a partial substitute by the fine aggregate in concrete, a research work is carried out on a concrete containing waste foundry sand in range 0%, 10%, 20%, 30%, by weight for M20 & M30 Grade of concrete.

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## 2. Material Specification

### *2.1 Cement*

The fresh cement is used for research work having grade of cement is 43grade (OPC) all properties of cement are tested by conforming IS -12269-1987.

**Table 1** Properties of cement

| Sr.no. | Description of materials | Properties |
|---|---|---|
| 1 | Specific gravity | 3.15 |
| 2 | Initial setting time | 80min. |
| 3 | Final setting time | 170 min |
| 4 | Standard consistency | 31% |

### *2.2. Water*

Distilled water having PH range 6.5 can be used for mixing research work.

### *2.3. Fine Aggregate*

Locally Available river sand having fineness moulds 4.44 and sill it content 2 % is used for casting or mixing work of concrete & passing through 4.75mm is sieves is used.

**Table 2** Properties of Fine Aggregate

| Sr.no. | Description of materials | Properties |
|---|---|---|
| 1 | Specific gravity | 2.75 |
| 2 | Fineness modulus | 4.46 |
| 3 | Loose bulk density kg/m$^3$ | 1060 |
| 4 | Compacted bulk density kg/m$^3$ | 1169 |
| 5 | Water absorption % | 1.34 |

*2.4. Coarse Aggregate.*

20 MSA crushed C.A. retained on 4.75mm is sieve available from local sources has been used.

**Table 3** Properties of Coarse Aggregate

| Sr.no. | Description of materials | Properties |
|---|---|---|
| 1 | Specific gravity | 2.696 |
| 2 | Fineness modulus | 7.950 |
| 3 | Loose bulk density kg/m$^3$ | 1290 |
| 4 | Compacted bulk density kg/m$^3$ | 1584 |
| 5 | Water absorption % | 1.343 |

2.5. Foundry Sand ( F.S.) : Foundry Sand is available in powder form and is procured form Manglore mineral Pvt. Ltd. Chincholi MIDC Solapur.

## 3. Experimental Procedure

*3.1. Mix Design:* The mix proportions of normal mix are respectively M20 & M 30 grade are 1:2.09:3.02 & 1:1.98:3.88 with water cement ratio having water cement ratio is 0.45 & 0.42 by referring the revised IS code- 10262-2009 mix design concrete.
*3.2 Batching, Mixing, & casting:* Cement measured & toughly mixed with foundry sand having varies percentages such as 0.0%, 10%, 20%, 30%, of M20 &M30 grade of was to repaired vibration was given to the can be moulds using surface vibrator the top surface of cubes was leveled & finished after 24 hours the cubes were de molded & were curved in curing tank for 7 days & 28 day. The overall specimen can be tested in material testing lab of W.I.T.

## 4 Experimental Results

*4.1 Fresh Concrete:* The fresh concrete properties slump, compaction factor & Density are shown in table 4.

**Table 4** Concrete mix proportions & Properties of fresh & Hardened Concrete

| Mix Type F.S. | Slump (mm) | Compaction Factor | Fresh Density (kg/m3) |
|---|---|---|---|
| A0 (0.0%&00%) | 75 | 0.95 | 2503.23 |
| A1 (10%F.S) | 75 | 0.96 | 2440.44 |
| A2 (20%F.S.) | 70 | 0.85 | 2388.22 |
| A3 (30%.F.S) | 70 | 0.91 | 2585.33 |

**Table 5** Concrete mix proportions M30 & Properties of Fresh & Hardened Concrete

| Mix Type F.S | Slump (mm) | Compaction Factor | Fresh Density (kg/m3) |
|---|---|---|---|
| A0 (0.0%&00%) | 75 | 0.95 | 2503.23 |
| A1 (10%F.S) | 70 | 0.96 | 2482.92 |
| A2 (20%F.S.) | 75 | 0.90 | 2406.00 |
| A3 (30%.F.S) | 70 | 0.90 | 2518.12 |

**Table.6** Result of Compressive Strength M20 at 7 days& 28 days

| Mix Type (F.S.%) | Compressive Strength(N/mm$^2$) | |
|---|---|---|
| | 7 Days | 28 Days |
| A0 (0.0%&00%) | 20.32 | 27.28 |
| A1 (10%F.S.) | 27.87 | 32.23 |
| A2 (20%F.S.) | 34.80 | 36.28 |
| A3 (30%F.S.) | 21.90 | 28.30 |

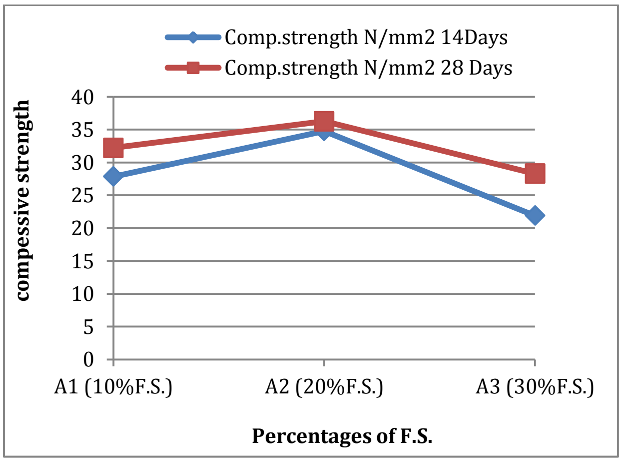


**Fig.1** Compressive strength Vs % of F.S

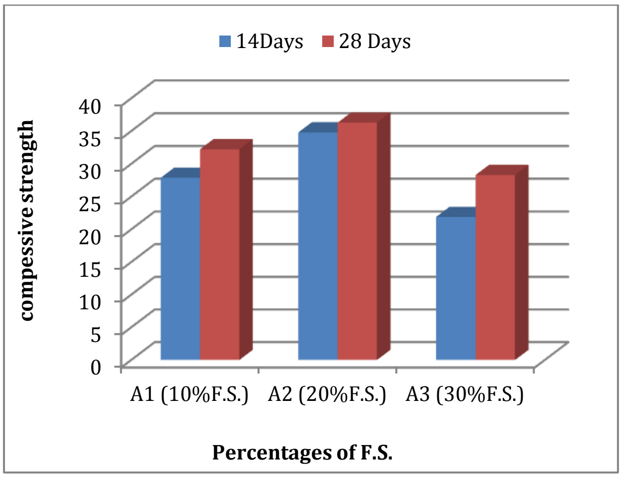


**Fig.2** Compressive strength Vs % of F.S.

**Table 7** Result of Compressive Strength M30 at 7 days& 28 days

| Mix Type (F.S. %) | Compressive Strength(N/mm$^2$) | |
|---|---|---|
| | 7 Days | 28 Days |
| A0 (0.0%&00%) | 22.23 | 28.33 |
| A1 (10%F.S.) | 25.37 | 29.88 |
| A2 (20%F.S.) | 24.05 | 22.34 |
| A3 (30%F.S.) | 22.85 | 21.32 |

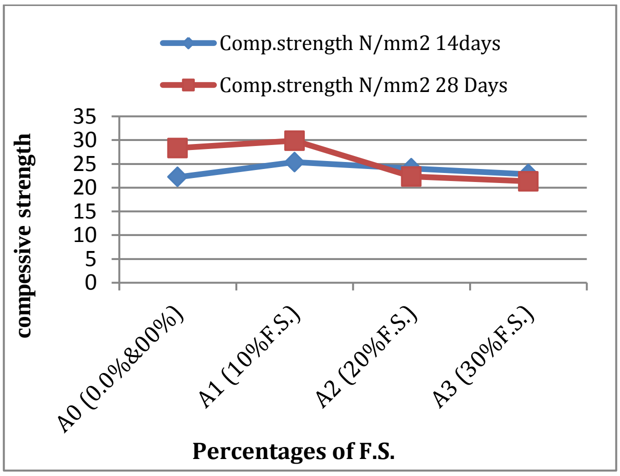


**Fig.3** Compressive strength Vs % of F.S

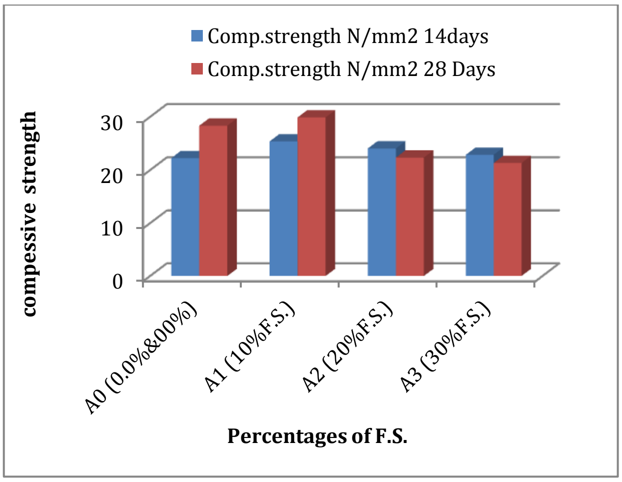


**Fig.4** shows Compressive strength Vs % of F.S.

**Table 8** Result of Flexural Strength M20 at 28 days

| Mix Type F.S. | Flexural Strength(N/mm$^2$) |
|---|---|
| | 28days |
| A0 (0.0%&00%) | 3.31 |
| A1 (10%F.S.) | 3.31 |
| A2 (205F.S.) | 3.31 |
| A3 (30%F.S) | 3.11 |

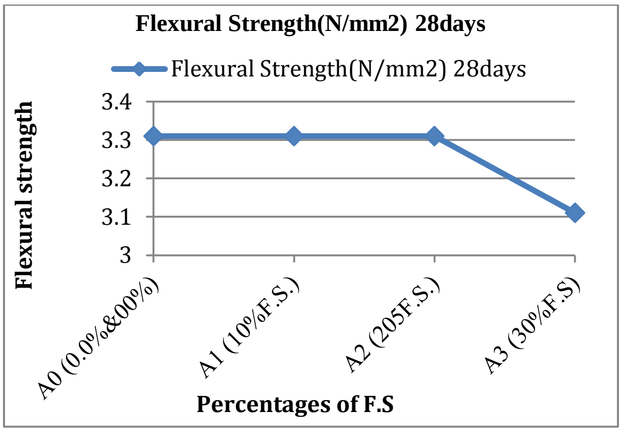


**Fig.5** Flexural strength Vs % of F.S.

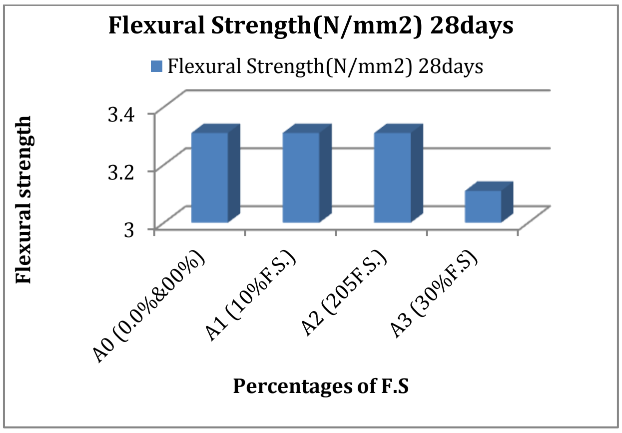


**Fig.6** Flexural strength Vs % of F.S.

**Table 9** Result of Flexural Strength M30 at 28 days

| Mix Type F.S. | Flexural Strength(N/mm2) |
|---|---|
| | 28days |
| A0 (0.0%&00%) | 3.33 |
| A1 (10%F.S.) | 3.25 |
| A2 (205F.S.) | 3.19 |
| A3 (30%F.S) | 3.17 |

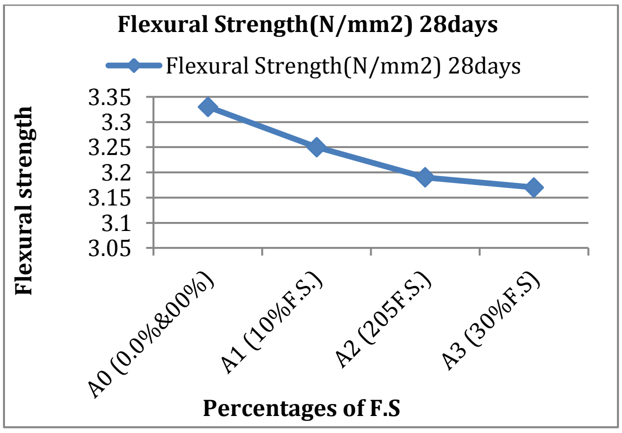


**Fig.7** Flexural strength Vs % of F.S.

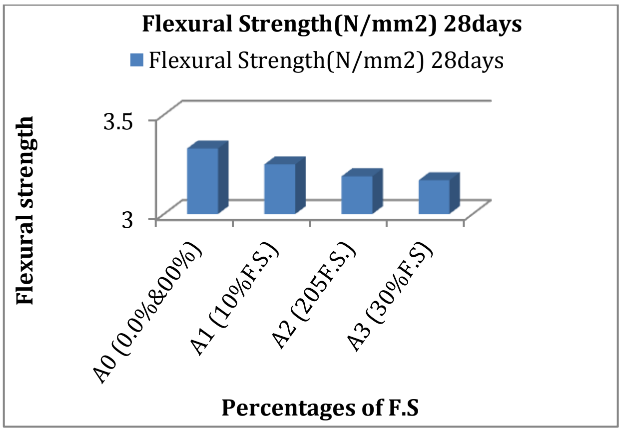


**Fig.8** Flexural strength Vs % of F.S.

**Table10.** Result of Spilt tensile Strength M20 at 28 days

| Mix Type F.S. | Spilt tensile Strength(N/mm$^2$) |
|---|---|
| | 28days |
| A0 (00%F.S.) | 3.27 |
| A1 (10%F.S.) | 3.27 |
| A2 (205F.S.) | 3.32 |
| A3 (30%F.S) | 3.14 |

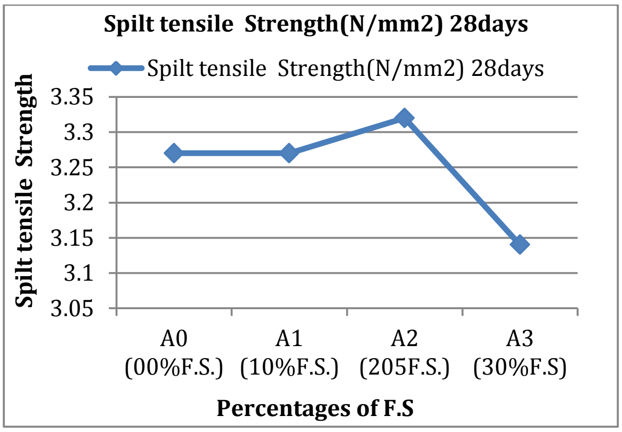


**Fig.9** Split tensile strength Vs % of F.S.

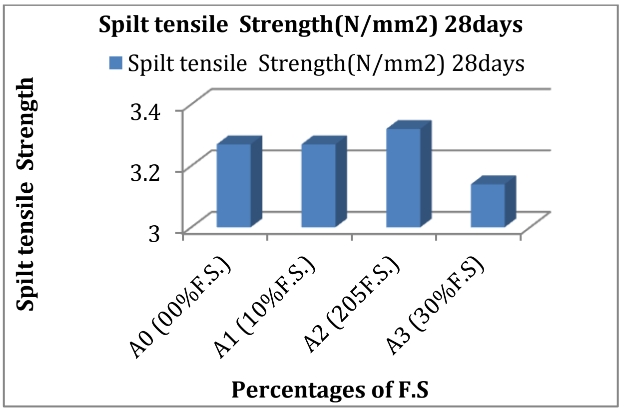


**Fig.10** shows Split tensile strength Vs % of F.S.

**Table 11** Result of Spilt tensile Strength M30 at 28 days

| Mix Type F.S. | Spilt tensile Strength(N/mm2) |
|---|---|
| | 28days |
| A0 (00%F.S) | 3.31 |
| A1 (10%F.S.) | 3.24 |
| A2 (205F.S.) | 3.20 |
| A3 (30%F.S) | 3.15 |

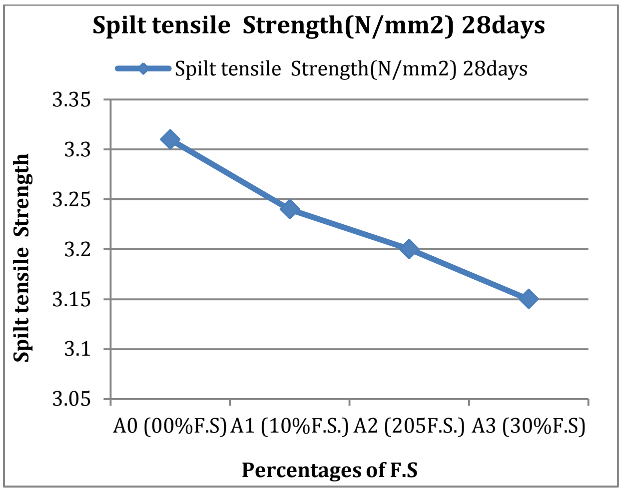


**Fig.11** Split tensile strength Vs % of F.S

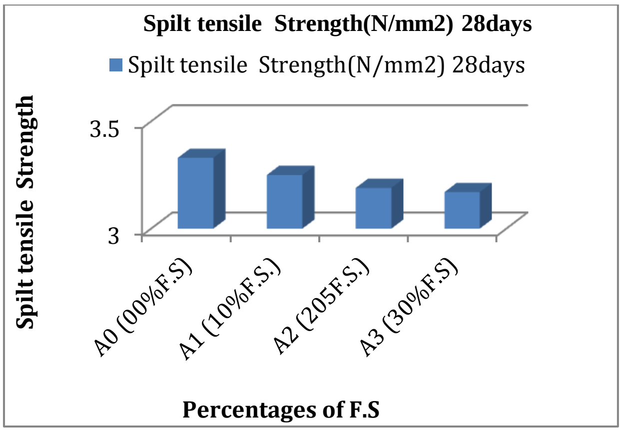


**Fig.12** Split tensile strength Vs % of F.S

## Conclusion

1) In fresh state flow of concrete is affected by foundry sand, fresh properties like, Compaction factor, Flow index are affected where slump remains near about the same.
2) Substitution of 30% of foundry sand results decrease in compressive strength for M20 & M30 grade of concrete when compared to mixes with natural sand
3) Substitution of 20% (A2) foundry sand in M20 grade concrete & 10% (A1) foundry sand in M30 grade concrete gives better results.

4) For particular mix of certain ingredient quantities volume of concrete reduces due to fine particles of foundry sand.
5) Flexural & Split tensile strength also decreases due to Substitution of foundry sand.
6) Substitution of foundry sand in concrete decreases Compaction factor & increase slump of concrete.

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