

# COMPARISON OF REBOUND NUMBERS FOR M20 CONCRETE WITH SILICA FUME

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## Abstract

The concrete is one of the most important for all the construction work. The main role of the concrete based on cement, steel. To improve the strength and durable of the concrete to add the admixture. Silica fume is added to the fresh concrete to improve the durability, ductility and strengthen of the concrete. Because, the silicon dioxide with carbon it which gives silica and carbon monoxide. It is very good permeability and also abrasion resistance. For this present study M20 grade of concrete shall be designed, partial replacement of cement with silica fume will be incorporating the strength for varying percentage, such as 0%, 5%, 10%, 15%, 20% by weight of cement with rebound hammer value Vs compressive strength.

**Keywords:** Ordinary Portland cement, Micro silica, compressive strength, tensile strength, Flexural strength

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## 1. INTRODUCTION

Micro silica produced by the raw materials such as Carbon (coke, coal, wood chips), Quartz with temperature at 2000 degree Celsius will get Silicon metal, off gas into the Bag house filter finally get the powder form. It's color varying from white and gray. It is very fine particles to fill the voids in the concrete and its to improve the strength.

Micro silica is also available in the packaging. It contain silicon dioxide is more than 95%, moisture content 1%, bulk density range from 450-650 kg/m<sup>3</sup>. The PH value is 6 to 6.5. The carbon content is higher than others. It is very good binder between the aggregates and also reduced with shrinkage. (1)

Micro silica is good thermal conductivity and reducing the bleeding of the concrete

## 2. BACKGROUND/RESEARCH SIGNIFICANCE

### 2.1 Materials

**1. CEMENT:** - The OPC 43 grade cement is used.

**Table 1:** Physical properties of cement:

| S.No | Characteristics            | Value obtained experimentally |
|------|----------------------------|-------------------------------|
| 1    | Normal consistency         | 29%                           |
| 2    | Fineness (90 micron sieve) | 1%                            |
| 3    | Initial Setting time       | 32 minutes                    |
| 4    | Specific gravity           | 2.97                          |

Compressive Strength of Cement:-

| Days    | Compressive Strength in MPa |
|---------|-----------------------------|
| 7 Days  | 23                          |
| 14 Days | 33                          |
| 28 DAYS | 43                          |

**2. FINE AGGREGATE:-** The local river sand is used.

**Table 2:** Physical Properties of Fine Aggregate:

| S. No | Characteristics  | Value obtained experimentally |
|-------|------------------|-------------------------------|
| 1     | Fineness         | 2.60                          |
| 2     | Specific gravity | 2.60                          |

**3. COARSE AGGREGATE:** Locally available coarse aggregate used.

**Table 3:** Physical properties of coarse aggregate

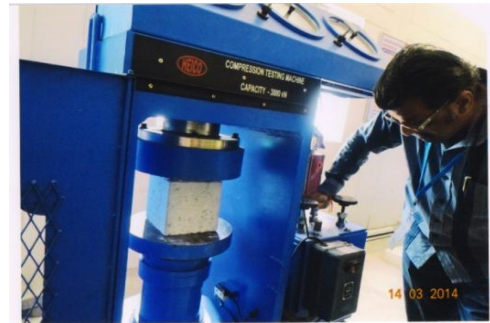
| S. No | Characteristics  | Value obtained experimentally |
|-------|------------------|-------------------------------|
| 1     | Fineness         | 6.29                          |
| 2     | Specific gravity | 2.60                          |

**4. SILICA-FUME:-** Silica-fume is obtained from Nuchems Ltd, Bangalore in Karnataka state.(2)

**Table 4:** Physical properties

| MICRO SILICA (Silica Fumes) Physical Properties |                             |
|---|-----------------------------|
| Product   | Crystalline Silica (quartz) |

|   |  |
|---|--|
| Molecular Formula                         | SiO <sub>2</sub>   |
| Physical State                            | Powder   |
| Appearance and Odor                       | White Powder, Odorless   |
| Specific Gravity (H <sub>2</sub> O = 1.0) | 2.65 g/cm  |
| Boiling Point                             | 2230°F   |
| Melting                                   | 1710°F   |
| Solubility in Water                       | Insoluble  |
| Molecular Weight                          | 60.09 g/mol  |
| Solvent Solubility                        | Soluble in hydrofluoric acid. Slightly soluble in alkali and hot concentrated phosphoric acid. Insoluble in acids and organic solvents |



5. **WATER:** - It is used for casting and curing of specimen.

**3. EXPERIMENTAL STUDY**

In general the mix design (M20) is arrived based on the physical properties of materials and according to with IS: 10262:2009

**Table 5:** Mix-proportion

| Water cement ratio | Cement | Fine Aggregate | Coarse Aggregate |
|--------------------|--------|----------------|------------------|
| 0.50               | 1      | 1.52           | 3.15             |

**3.1. Compressive Strength Test**

Totally 45 concrete cubes were cast and it is allowed for 7days,14 days and 28 days curing. After during, cubes were tested in compression Testing Machine (CTM) to determine the ultimate load. Replacement made of 0%, 5%, 10%, 15%, and 20%. For this study the water cement ratio of 0.50 is maintained uniformly.



**Fig 1**

**Fig2:** Compressive strength of Cubes

**Table 6:** Compressive Strength of Cubes

| % of Silica fume used | 7 days Compressive Strength in MPa | 14 days Compressive Strength in MPa | 28 days Compressive Strength in MPa |
|-----------------------|------------------------------------|-------------------------------------|-------------------------------------|
| 0%                    | 17.77                              | 20.31                               | 25.39                               |
| 5%                    | 19.55                              | 22.34                               | 27.93                               |
| 10%                   | 21.33                              | 24.38                               | 30.47                               |
| 15%                   | 23.11                              | 26.41                               | 33.01                               |
| 20%                   | 24.44                              | 27.93                               | 34.92                               |

**3.2 Tensile Strength Test**

Totally 30 cylinders of M20 grade concrete were cast. Replacement made of 0%, 5%, 10%, 15% and 20%. For the study the water cement ratio of 0.50 is maintained uniformly.



**Fig3.** Tensile Strength Cylinders

**Table 7:** Tensile Strength of Cylinders

| % of Silica fume used | 7 days Tensile Strength in MPa | 14 days Tensile Strength in MPa | 28 days Tensile Strength in MPa |
|-----------------------|--------------------------------|---------------------------------|---------------------------------|
| 0%                    | 1.36                           | 1.56                            | 1.94                            |
| 5%                    | 1.36                           | 1.56                            | 1.94                            |
| 10%                   | 1.36                           | 1.56                            | 1.94                            |
| 15%                   | 1.42                           | 1.63                            | 2.03                            |
| 20%                   | 1.48                           | 1.69                            | 2.12                            |

**3.3. Flexural Strength Test**

Totally 36 prisms of M20 grade concrete were cast. Replacement made of 0%, 5%, 10%, 15% and 20%. For the study the water cement ratio of 0.50 is maintained uniformly.



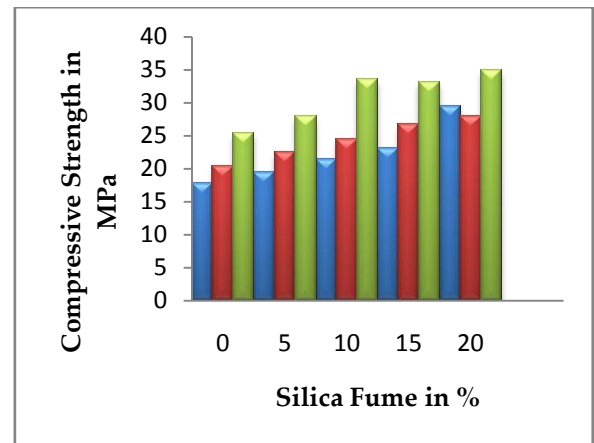
**Fig 4:** Flexural Strength test

**Table 8:** Flexural Strength of Prisms:

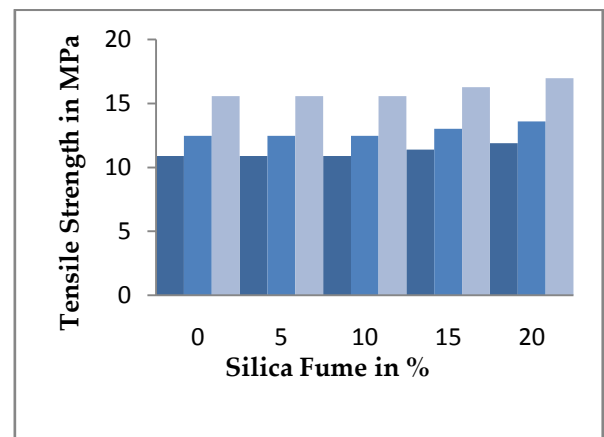
| % of Silica fume used | 14 days Tensile Strength in MPa | 28 days Tensile Strength in MPa |
|-----------------------|---------------------------------|---------------------------------|
| 0%                    | 2.09                            | 2.99                            |
| 5%                    | 2.23                            | 3.19                            |
| 10%                   | 2.36                            | 3.37                            |
| 15%                   | 2.47                            | 3.54                            |
| 20%                   | 2.61                            | 3.74                            |

**4. RESULT AND DISCUSSION**

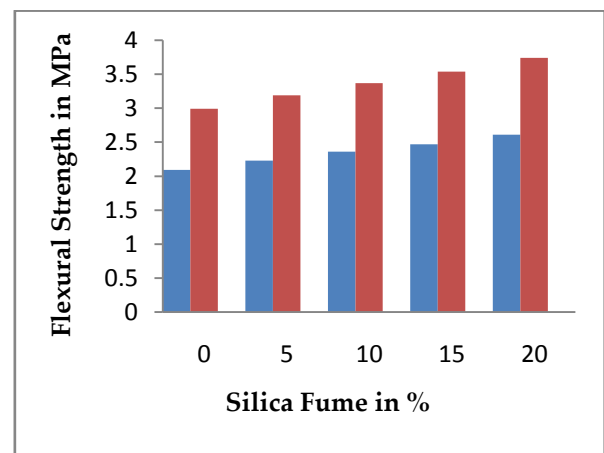
The results obtained from the experimental investigations are shown graphically. All the values are the average of the three specimens tested. The compression strength of cubes, split tensile strength of cylinders, flexural strength of prisms is shown in figure 5, 6, and 7 respectively.



**Fig 5:** Compressive strength at 7, 14, and 28 days with 0%, 5%, 10%, 15%, and 20% of silica fume.



**Fig 6:** Tensile Strength at 7, 14, and 28 days with 0%, 5%, 10%, 15%, and 20% of silica fume.



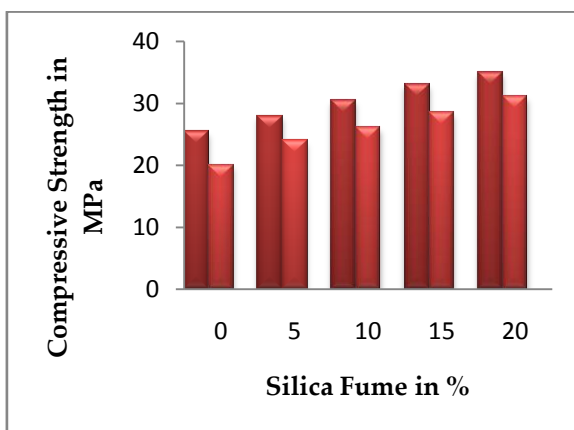
**Fig 7:** Flexural Strength at 14, and 28 days with 0%, 5%, 10%, 15%, and 20% of silica fume.



**Fig 8:** Rebound hammer compressive strength test

**Table 9:** Comparison of Compressive testing machine  $V_s$  Rebound Number

| % of Silica fume used | 28 Days Compressive Strength in Compression testing machine MPa | 28Days Compressive Strength in Rebound Number in MPa |
|-----------------------|---|--|
| 0%                    | 25.39   | 20   |
| 5%                    | 27.93   | 24   |
| 10%                   | 30.47   | 26   |
| 15%                   | 33.01   | 28.50  |
| 20%                   | 34.92   | 31   |



**Fig 9:** Comparison of Compressive testing machine  $V_s$  Rebound Number Value

## 5. CONCLUSIONS

- After the 28 days the compressive strength of the cube is little higher than to compare the Rebound number.
- Rebound number clear value obtained by the conventional concrete.
- Rebound number in Silica fume mix proportion is underestimate value of the strength.

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