



## **A Partial Replacement of Cement by Bone Powder and Coarse Aggregate by Fibre Glass**

*Mr. Ajai Krishnakumar<sup>1</sup>, Mr. B. Sriramsundar<sup>2</sup>, Ms. T. Aswini.M.E.,<sup>3</sup>*

<sup>1,2</sup> Final Year student, <sup>3</sup> Assistant Professor, MRK Institute of Technology,

---

### **ABSTRACT:**

The objective of this project is to study and investigate of the replacement of bone powder by the cement and fibre glass for the coarse aggregate. Using M20 grade of concrete for mix design. The main objective of the project to reduce the raw material in concrete. Partially added the bone powder in the cement by 3%, 5% and 8% the bone powder makes calcium and give the high compressive strength. The materials are prepared test to using experimental work. Casted cubes and cylinders molding to tested for the compressive strength and tensile strength in 7 days, 14 days and 28 days.

**KEYWORDS:** Bone powder , compressive strength , tensile strength , fibre glass.

---

### **Scope of the project:**

- In the modern construction field, we use various materials as the replacement for concrete materials to lower the constructional cost.
- The aim of the project is not only make the less construction cost and also provide a good quality concrete with the replacement of bone powder and fibre glass for cement and coarse aggregate respectively.
- To minimize the waste of glass by using as a constructional material.
- To find the compressive strength and tensile strength of the proposed concrete compared with conventional concrete.
- Its cost is lower than conventional concrete
- It is lighter than nominal concrete.

---

### **1. Introduction:**

Concrete is one of the most used material in the construction field. In this modern world we use various materials for making concrete. In this project, we use bone powder and fibre glass as a partial replacement of cement and coarse aggregate respectively. Using the M20 grade of concrete to compare the strength of proposed concrete. The bone powder consist of more calcium content which increases the strength of the concrete. The partial replacement of cement by bone powder not only reduces the cost of making concrete and also improves the properties of concrete and reduces environmental pollution. The use of fibre glass as coarse aggregate in concrete makes the concrete light in weight. The glass replaced concrete is extremely strong and eliminates cracks and shrinkage in the surface of the concrete.

---

### **2. Materials used in concrete:**

#### **(a) Cement:**

The cement consists of various grades and the grades are related to the strength of the cement and it is also the binder used for the construction that sets harden the building strength. The cement used in this experiment is Ordinary Portland Cement (OPC) of 43 grade conforming to IS: 12269-1987.

#### **(b) Coarse aggregate:**

Coarse aggregate consists of rounded river gravel, crushed stone or manufactured aggregate with particles of size equal to or larger than 20 mm. The fractions from the 20mm sieve is used as coarse aggregate which was obtained from local quarry conforming IS:383.

#### **(c) Fine aggregate**

Locally available river sand passed through 600 $\mu$ m sieve is used in fine aggregate conforming to the requirements of IS 383-1970. The river sand is washed and screened to eliminate waste materials and over sized particles.

Aggregates provide dimensional stability and wear resistance for concrete. Not only do they provide strength and durability to concrete, but also influence the mechanical and physical properties of concrete. Aggregate act as a filler material and lower the cost in concrete. Aggregate should be hard, strong and free from undesirable impurities and chemically stable.

They should not interfere with the cement or any of the materials incorporated into concrete. They should be free from impurities and organic matters which may affect the hydration process of cement. The workability, strength, durability and moisture susceptibility of concrete and greatly influenced by characteristics of concrete.

#### (d) Water

Potable water available in laboratory was mixing and curing. Water is needed for hydration of cement and to provide workability during mixing and placing. PH value of 7.0 and conforming requirement of IS 456:2000 is used for making concrete and curing specimen as well.

#### (e) Bone powder

The bone of various animals are collected from the forest and used as the concrete material. The bone is rich in calcium content which increases the strength of the concrete. It leads to increases the hardened property of concrete. It is used as the partial replacement for cement in concrete.

#### (f) Fibre glass

Glass fibre are widely used in the construction industries, in this project glass fibre are cut into small pieces and used for the coarse aggregate. The characteristics of glass fibre is to give high strength of concrete, good temperature resistance, corrosion resistance and also available at low price.

---

### 3. Material preparation:

#### (a) Preparation of bone powder

The bone of various animals are collected from the forest and make them completely dry. The dried bones are broken into small pieces and then completely grained as fine as cement, so that it act as a great binding material in concrete.



Fig no 3.1 preparation of bone powder

#### (b) preparation of fibre glass

Fibre glass are collected from the various glass making industries and then broke the glass into small pieces and sieve them with 20mm sieve. It makes the concrete strength and also act as the temperature and corrosion resistance.



Fig 3.2 preparation of glass fibre

**4. Test on materials:**

- Specific gravity test for fine and coarse aggregate to find the strength and quality of the material.
- Sieve analysis testis conducted to find the fineness of the material, here 600µm sieve is used for fine aggregate and 20mm sieve is used for coarse aggregate and fibre glass.

**5. Concrete mix design:**

	Cement(kg/m <sup>3</sup> )	Fine aggregate(kg/m <sup>3</sup> )	Coarse aggregate(kg/m <sup>3</sup> )	Bone powder and glass(kg/m <sup>3</sup> )
Bone powder and glass(0%)	385	705	883	120
Bone powder and glass(3%)	380	650	800	200
Bone powder and glass(5%)	350	640	790	170
Bone powder and glass(10%)	340	680	810	165

**(i) Test on fresh concrete:**

**(a) Slump cone test**

This test is performed to check the consistency of freshly made concrete. Consistency is a term very closely related to workability. It is a term which describes the state of fresh concrete. It refers to ease with which the concrete flows. It is used to indicate the degree of wetness. Workability of concrete is mainly affected by consistency of concrete. Wetter mixer is more workable than dryer mix, but the concrete of same consistency may vary in workability.

**(ii) Test on hardened concrete:**

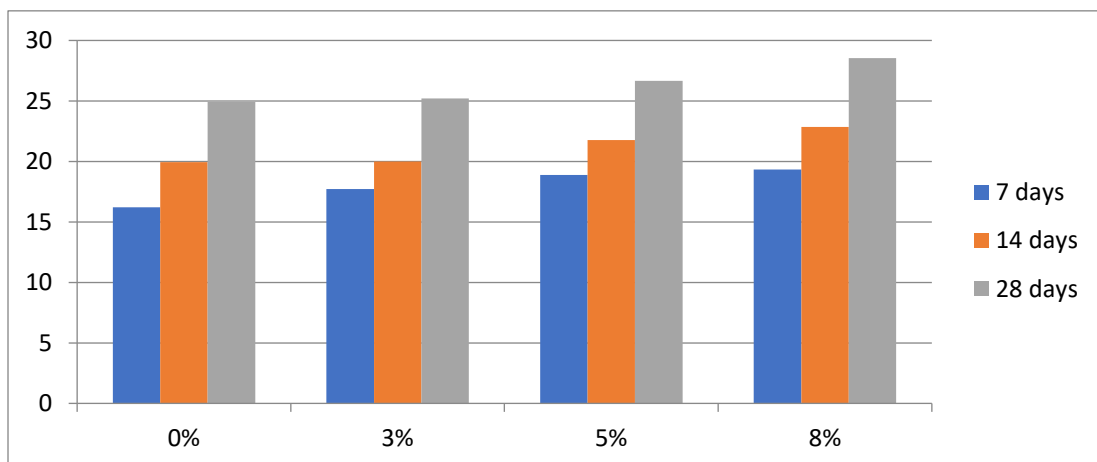
Concrete in combined of ordinary Portland cement ,fine aggregate, coarse aggregate,fibre glass, bone powder and water. Normally concrete is strong in compression and weak in tension. They are two types of test are conducted for hardened concrete are compression test and tensile strength.

**(a) Compressive strength test**

To determine the compressive strength of the proposed concrete, the cubes with the specified dimensions of 150\*150\*150\*mm were used. The specimen were cured for 28 days in the curing tank after completion of curing process the specimen were undergo for laboratory.

Concrete mix	7days of curing	14 days of curing	28 days of curing
Bone and glass(0%)	16.22	19.95	24.91
Bone and glass(3%)	17.73	19.99	25.2
Bone and glass(5%)	18.89	21.77	26.67
Bone and glass(8%)	19.33	22.84	28.54

**Compressive test result for proposed concrete**



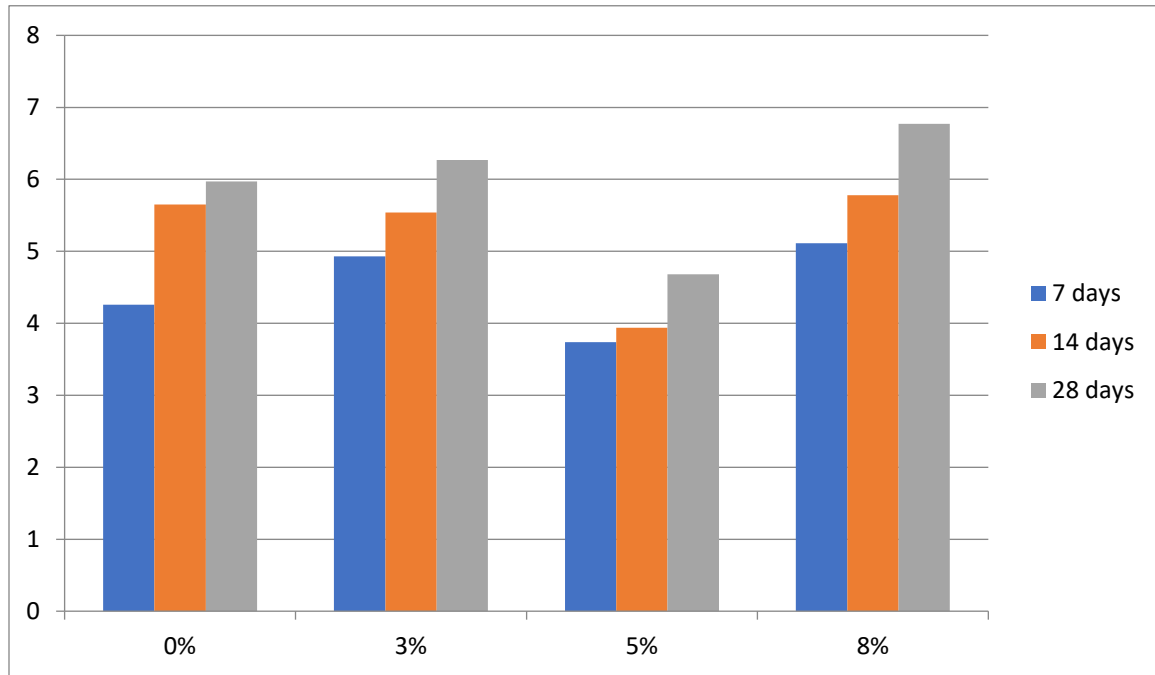
**Compressive strength N/mm<sup>2</sup>**

**(b) Tensile strength of the concrete**

Tensile strength is one of the basic and important properties of concrete. This split tensile strength are carried out cylinder specimen of 150mm diameter and 300 mm long.the proposed specimen is cured for 28 days in the curing tank. The test of 7,14 and 28 days are given below.

Concrete mixes	7 days of curing (N/mm <sup>2</sup> )	21 days of curing (N/mm <sup>2</sup> )	28 days of curing (N/mm <sup>2</sup> )
Bone and glass(0%)	4.26	5.65	5.97
Bone and glass(3%)	4.93	5.54	6.27
Bone and glass (5%)	3.74	3.94	4.68
Bone and glass (8%)	5.11	5.78	6.77

**Split tensile strength of concrete**



**Split tensile strength N/mm<sup>2</sup>**

### Conclusion:

In this project we use the partial replacement for cement and coarse aggregate by bone powder and fibre glass. The bone powder is rich in calcium content and it is hard in its property. When it is finely grained as the powder form as fine as cement, it acts as the great binding material in concrete. It is considered as one of the best replacements for cement in concrete. By adding the partial replacement of coarse aggregate by fibre glass leads to increase the property of the concrete and it also acts as the corrosion resistance, temperature resistance and makes the concrete light in weight. This replacement leads to increase the compressive and tensile strength of the concrete compared with nominal grade of concrete.

### References:

1. IS 456 : 800.
2. IS 10262: 2009 Concrete mix proportioning.
3. IS 516: 1959 Methods of test for strength of concrete.
4. IS 456-2000 "Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
5. IS 383 -1970 "Specifications for Coarse and Fine Aggregates from Natural Sources for Concrete", Bureau of Indian Standards, New Delhi.
6. Mr. V. R. Patil, Prof. A. K. Gupta, Prof. D. B. Desai, "Use Of Pervious Concrete In Construction Of Pavement For Improving Their Performance," IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE), PP: 54-56
7. Jing Yang\*, Guoliang Jiang, "Experimental study on properties of pervious concrete pavement materials," Cement and Concrete Research 33 (2003)

- 
8. M. Harshavarthana Balaji, M. R. Amarnaath, R. A. Kavin, S. Jaya pradeep, "Design of Eco Friendly Pervious Concrete," International Journal of Civil Engineering and Technology (IJCIET), Volume 6, Issue 2, February (2015), pp. 22-29
  9. Darshan S. Shah , Prof. Jayeshkumar Pitroda, Prof. J .J. Bhavsar, "Pervious Concrete: New Era For Rural Road Pavement," International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 8- August 2013, pp: 3495-3499
  10. Rasiah Sriravindrarah, Neo Derek Huai Wang, Lai Jian Wen Ervin, "Mix Design for Pervious Recycled Aggregate Concrete," International Journal of Concrete Structures and Materials, December 2012, Volume 6, Issue 4, pp 239–246.