



International Journal of Research Publication and Reviews

Journal Homepage: www.ijrpr.com ISSN 2582-7421

Strength and Dynamic Modulus of Elasticity Characteristics of Concrete Made with Coal Bottom Ash and Glass Fiber

Suraj Kumar Singh¹, Bikram Prasad²

¹(Post Graduate Student, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA)

²(Professor, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA)

ABSTRACT

Extensive experimental investigation on glass fibre reinforced and Grinding coal bottom ash concrete was carried out by researchers. Glass fibre mesh is more effective in resisting bending and punching shear. It is seen from the exploratory outcomes and its examination that the compressive quality of concrete, part rigidity of solid increments with expansion of low Percentage of glass strands. The 0.2%, 0.45% and 0.7% expansion of glass and 10%GCBA strands into the solid shows better outcome in mechanical properties and solidness. Addition of 0.2% glass fibres by weight of cement shows maximum increase in Compressive strength and Flexural strength varying 10% to 15%, and 10% to 15% respectively with respect to PC mix without fibres at 28 days of curing. And also dynamic modulus of elasticity increase upto 0.2% glass fiber use with 10% GCBA. The glass fibers bridge across the cracks causing interconnecting voids to be minimum. UPV value found to be higher for concrete containing 0.45%GF by weight of cement with 10%GCBA. Further in future use of glass fiber upto 0.2% and 10% GCBA then obtained more strength and durability compare with control mix respectively.

Keywords: -GCBA, GF, Compressive strength, Tensile strength, UPV, Dynamic modulus of Elasticity, Durability.

1. Introduction

The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. Researchers all over the world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions. Management of coal combustion merchandise has created an undertaking for utilities and regulators. In many countries coal combustion products are classified as dangerous materials and utilization of them is limited. From the alternative hand, the coal combustion products have chemical and physical residences that make them appropriate for engineering and production works. In the perspective of the worldwide reasonable advancements.

2. Literature reviews

Kanstad et.al (2000) played out an examination to address the impact of silica seethe on the early age break affectability of HPC. Tests were performed on concrete containing silica smolder extending from 0 to 15%, with a w/c proportion of 0.40. Tests carried on reasonable temperatures, rigidity, modulus of versatility, and autogenously shrinkage. All tests were directed under isothermal conditions. Information were gathered for 7 days for autogenously shrinkage. It was watched that an expansion in silica rage content raises the rigidity and modulus of flexibility yet in addition causes more auto genous shrinkage. In spite of the higher drying shrinkage, expanding the curing time could decrease this.

Kumar et.al (2020) studies on research on glass fiber different percentage use in this study find mechanical and durability of concrete results obtained by clear that both strength and durability increase use with glass fiber in concrete. Find many tests like CS, TS, FS, and modulus of elasticity of concrete etc.

Kamran and Raza (2026) studies and carried out it is clear that use of steel fiber and glass fiber both are using in concrete strength increase in construction industries. It is clear that increment of all concrete properties like compressive strength, tensile strength and flexural strength also improvement and other hand durability of like CSAT ISAT, UPV, Permeability also increase properties of concrete for future in construction use glass fibere fill all concrete parameters.

3. Materials and Methodology

3.1 Cement

Ordinary Portland cement (OPC) from a single lot was used throughout the course of the investigation. The physical properties of the cement as determined from various tests 30 conforming to Indian Standard IS: 1489-1991(Part-1) are listed in Table 3.1. All the tests were carried out as per recommendations of IS: 4031-1988. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture.

3.2 Fine aggregate

River sand was utilized as fine total. The particular gravity and fineness modulus was 2.58 and 2.88 separately. Smashed precise rock metal from a neighborhood source was utilized as coarse total. The particular gravity was 2.72, flakiness list of 4.61 percent and prolongation list of 3.91.

3.3 Course Aggregate

The coarse aggregate with a maximum size 12.5mm having a specific gravity 2.67 and fineness modulus of 6.49%. Angular recycled aggregates from a local source were used as coarse aggregate. The specific gravity was 2.69.

3.4 Glass Fibres

The glass strands utilized are of Cem-FIL Anti-Crack HD with modulus of flexibility 72 GPa, Filament width 14 microns, particular gravity 2.68, length 12 mm and having the angle proportion of 857, the quantity of filaments per kg is 212 million filaments.

3.5 Admixture

Water-reducing and set-retarding admixtures are permitted in order to increase the workability of the concrete. Super plasticizer CONPLAST SP 430 was used for the workability.

4. Result and Discussion on Experimental Tests

4.1 Workability of Concrete Mixes

The workability of concrete mixes was found out by slump test as per procedure given in chapter 3. w/b ratio was kept constant 0.4 for all the concrete mixes. Super-plasticizer SP 430 was used to maintain the required slump. Dosage of super-plasticizer was varied from 1.0% to 1.25% by weight of binder depending up on the type of mix. The workability results of different concrete mixes were shown in Table 4.1

Table 4.1 Workability & Compaction factor values for different concrete mixes

Mix no.	Description	Super plasticizer (%) by weight of binder	Slump (mm)
1	90%OPC+10%GCBA+0%GF	1.00	109
2	90%OPC+10% GCBA +0.2%GF	1.00	101
3	90%OPC+10% GCBA +0.45%GF	1.00	101
4	90%OPC+10% GCBA +0.7%GF	1.00	99
5	90%OPC+10% GCBA +0.8%GF	1.00	98
6	90%OPC+10% GCBA +1.0%GF	1.00	90
7	90%OPC+10% GCBA +1.50%GF	1.25	90
8	90%OPC+10% GCBA +2.0%GF	1.25	89

Table 4.1 shows that as the addition of glass fibres to concrete mix increases, the workability of concrete mix was found to decrease as compared to control mix. The addition of glass fibres into concrete mix further decreases the workability. To achieve the required slump super plasticizer was added to concrete mix.

4.2 Compressive Strength

The results of the compressive strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The compressive strength test was conducted at curing ages of 7, 14, 28 and 56 days. It found that addition of GF 0.2% to 1.0% by weight of OPC shows increase in compressive strength of the concrete mixes compared with control mix of concrete. It can also be observed from the Fig 4.1 that the maximum compressive strength at 7, 28 and 56 days of curing was obtained for a mix containing 90%OPC+10%GCBA with fraction of fibres 0.2% by weight of binder. Compared to control mix of concrete, concrete containing 0.2%GF the compressive strength of concrete mix was found to increase at 28 days of curing. At 2.0%GF addition, the compressive strength of concrete mix was found to decrease at 28 days of curing compared with control mix of concrete. The maximum value of compressive strength obtained for concrete mix with 90%OPC+10%GCBA+0.2%GF was 40.50MPa and addition increase of fiber in concrete mix after decrease compressive strength of concrete

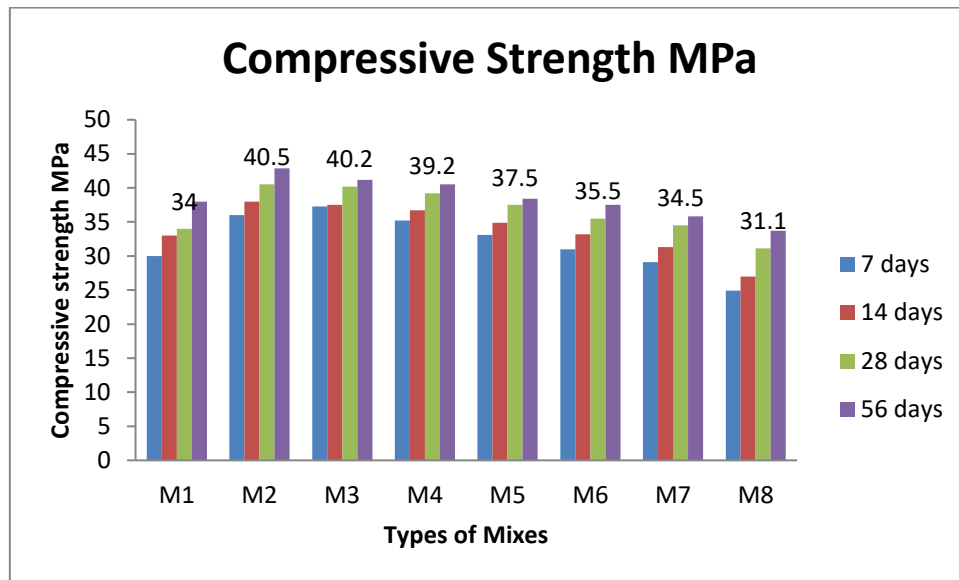


Fig. 4.1 Variation of compressive strength of concrete with age

4.3 Split Tensile Strength Test Results

The results of the splitting tensile strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The splitting tensile strength test was conducted at curing ages of 7, 14, 28 and 56 days. Fig.4.2 it found that the splitting tensile strength test results of glass fiber reinforced concrete shows that in general there are increases in splitting tensile strength with glass fiber addition in concrete. It found the maximum tensile strength obtained at mix from M2 at 0.2% addition of glass fiber value is 5.3MPa at 28 day and 5.11MPa at 56 days respectively. Further increase percentage of glass fiber in concrete after decrease strength of concrete

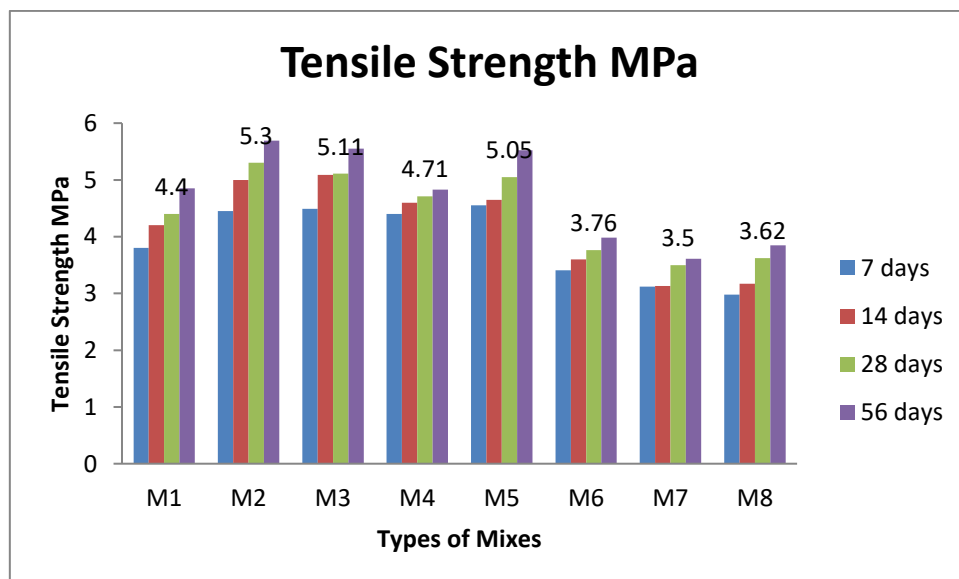
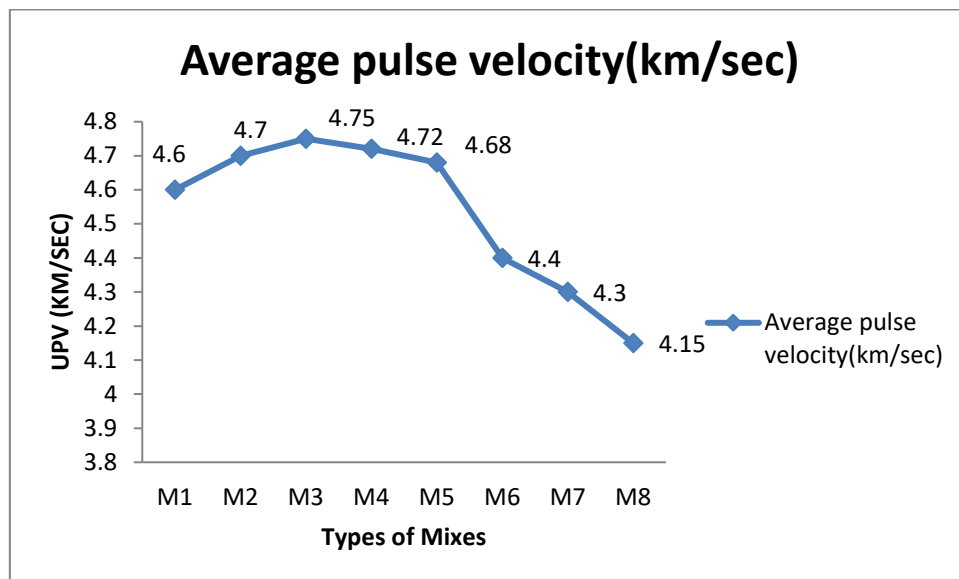


Fig. 4.2 Variation of split tensile strength of concrete with age

4.4 UPV Test Results

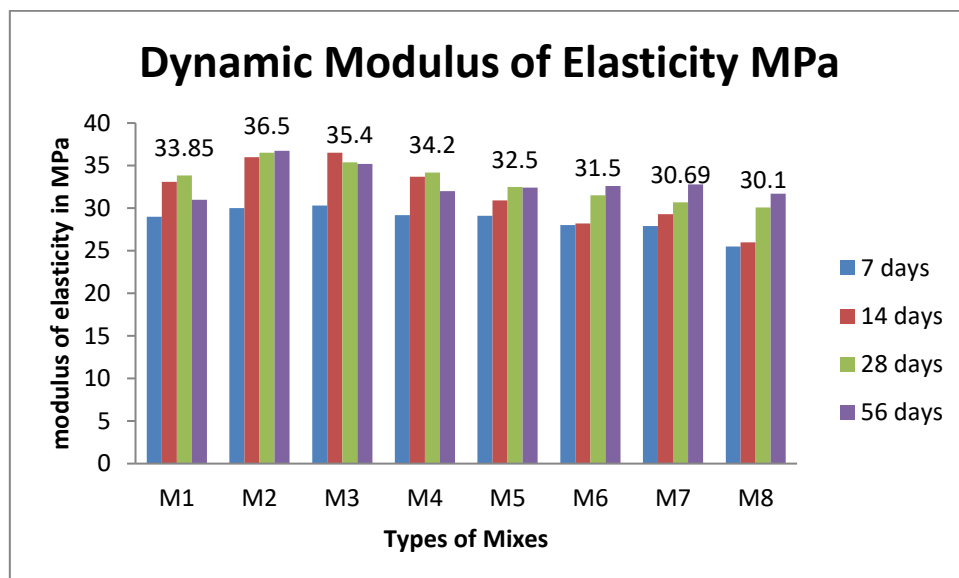
The results of the UPV tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The UPV test was conducted at curing ages of 56 days. The UPV test results of all the mixes at different curing ages are shown in Table 4.4.



It was observed that concrete mix containing 90%OPC+10% GCBA +0.45%GF showed highest value of UPV than all the values i.e. 4.75(km/sec) at 56 days of curing respectively. Concrete mix containing 90%OPC+10% GCBA +2.0%GF showed lowest UPV value i.e. 4.15(km/sec) at 56 days respectively. Further, the UPV values decrease with increasing glass fiber in concrete compare with control mix.in future using of glass fiber upto 0.45% obtained more UPV value which is indicated more homogeneity of mix.

4.5 Dynamic modulus of Elasticity

The dynamic modulus of elasticity of different concrete mixes at different ages of curing are calculated and are presented as below.



It was found that dynamic modulus of elasticity improve when used of glass fiber with small dosage levels of 0.2% & 0.45% by weight of cement.

5. CONCLUSIONS

5.1 Introduction

In the current investigation, glass fibres (GF) and GCBA were used to examine the strength and, Dynamic modulus of elasticity and UPV test. The experimental data obtained has been analyzed and discussed in Chapter-4, to fulfil to the best of ability, the objectives set forth for the present investigation. This chapter gives the broad conclusions that are drawn from the investigation.

Based on the scope of work carried out in this investigation, following conclusions are drawn.

- a. It was observed that addition of glass fiber in concrete thereafter Reduction in bleeding in the concrete mixes up to 2.0% by weight of cement.
- b. It was found that as the addition of glass fibres to concrete mix increases, the workability of concrete mix was found to decrease as compared to control mix.
- c. At ideal dose of glass strands the expansion in compressive quality of glass fiber concrete blends contrasted and control blend of cement at 28 days compressive quality is seen from 10% to 15%.
- d. It is clear that the split tensile strength maximum calculated at used of glass fiber up to 0.2%. Thereafter increase percentage of glass fiber after decrease split tensile strength.
- e. It was found that addition of the glass fibres strands improves the compressive strength, tensile strength, durability, load carrying capacity of ordinary reinforced cement concrete with small dosage levels of 0.2% & 0.45% by weight of cement.
- f. UPV value found to be higher for concrete containing 0.45%GF by weight of cement. Compare with control mix after used more percentage of GF after decrease quality of concrete.
- g. It was found that dynamic modulus of elasticity improve when used of glass fiber with small dosage levels of 0.2% & 0.45% by weight of cement.

REFERENCES

1. ACI committee 544. 1982. State-of-the-report on fibre reinforced concrete, (ACI 544.1R-82), Concrete International: Design and Construction. 4(5): 9-30, American Concrete Institute, Detroit, Michigan, USA.
2. ACI Committee 544. 1989. Measurement of properties of fibre reinforced concrete, (ACI 544.2R-889). American Concrete Institute, Detroit, Michigan, USA.
3. Ali, M., Liu, A., Sou, H., Chouw, N. (2012). Mechanical and dynamic properties of coconut fiber reinforced concrete. *Construction and Building Materials*, 30, 814–825.
4. Asokan, P., Osmani, M., Price, A. (2010). Improvement of the mechanical properties of glass fiber reinforced plastic waste powder filled concrete. *Construction and Building Materials*, 24(4), 448–460.
5. ASTM C 1585 -04 (2007) Standard test method for measurement of rate of absorption of water by hydraulic-cement concretes.
6. ASTM C 1240-11 “standard specification for silica fume used in cementitious mixtures”.
7. ASTM C494/C494M-11 “Standard specifications for chemical admixtures for concrete”
8. Avci, A., Akdemir, A., Arikan, H., (2005). Mixed-mode fracture behavior of glass fiber reinforced polymer concrete. *Cement and Concrete Research*, 35(2), 243–247.
9. Barhum, R., Mechtcherine, V., (2012). Effect of short, dispersed glass and carbon fibres on the behaviour of textile-reinforced concrete under tensile loading. *Engineering Fracture Mechanics*, 92, 56–71.
10. Barluenga, G., Hernández-Olivares, F., (2007). Cracking control of concretes modified with short AR-glass fibers at early age. Experimental results on standard concrete and SCC. *Cement and Concrete Research*, 37(12), 1624–1638.
11. Behnood A., and Ghandehari M., (2009). “Comparison of compressive and splitting tensile strength of high-strength concrete with and without polypropylene fibers heated to high temperatures”. *Construction and Building Materials* 27 (2012) 73–77.
12. Bhanja, S., B. Sengupta, b., (2003) “Modified water- cement ratio law for silica fume concretes “. *Cement and Concrete research*, 33, pp 447-450.
13. BS 1881-208 (1996) Testing concrete — Part 208: Recommendations for the determination of the initial surface absorption of concrete. BSI 389 Chiswick High Road London W4 4AL.

14. Dinesh Kumar , L.K. Rex , V.S. Sethuraman , V. Gokulnath , B. Saravanan (2020) High performance glass fiber reinforced concrete. [10.1016/j.matpr.2020.06.174](https://doi.org/10.1016/j.matpr.2020.06.174) Pages: 784-788 Volume: [Volume 33, Part 1](#).
15. Muhammad Kamran and Syed Safdar Raza (2026). performance evaluation of fiber-reinforced concrete incorporating steel and glass fibers. [Vol. 3 No. 03 \(2026\): Mar 2026](#) *Engineering and Technology*.