Properties of Mortar Incorporating Polyvinyl Alcohol Fibers with Cement Mortar of Clay Brick Masonry

Shivani Dholpuriya[1] Amrata Diwakar Jain[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]SIRT-E, Bhopal, India

Abstract — Polyvinyl alcohol fiber material is used in the concrete so that type of concrete is called also green concrete. Because of the expansion in the development of modern areas the power necessity of the nation is quickly expanding. India relies upon nuclear energy as its principal source, consequently expanding power prerequisites consistently. The current situation of our nation shows that 75% of the nation's all out introduced power which produce from coal-based is 90%. As per the Indian standard level of fly debris in Portland cement is restricted to 15 to 35% however, we are expanding the rate up to 45%, this addition gives higher functionality and lesser strength. The increment thickness of the mortar joint will directly reduce the compressive strength of the prism. The compressive strength test on the brick masonry sample example showed that the brickwork with a 7.0 mm thick mortar joint has higher compressive strength when contrasted with 10.0mm and 15.0 mm thick mortar joints. The compressive strength testing on the cube showed that the different water-cement ratio with fly ash gives higher workability but reduced compressive strength. 35% fly ash, 0.5 w/c ratios, 7mm thickness of mortar, and 1% PVA fiber are more economical because compressive strength and workability are also high.

Keywords: Mortar, PVA Fiber, Flyash, Prism Test, Slump Test, and Compressive Strength Test

I. INTRODUCTION

Rapid growth of population and spiraling urbanization demand infrastructure development and housing. The scarcity of affordable building materials and environmental impacts due to the excessive utilization of non-renewable resources is a serious concern of today. Huge demand for raw materials leads to uncontrolled quarrying, results in the removal of topsoil and thus negatively affects the flora and fauna of the terrain. It may lead to the extinction of certain useful species and the lowering of the water table. These frequent activities damage the natural ecosystem and adversely influence the quality of human life. Cement plays a significant role in all construction activities and its production is highly resource-intensive. Cement mortar is a homogeneous mixture of cement, sand, and water in a suitable proportion. Thus, the sand only can be utilized to prepare cement mortar. Cement Mortar is the strongest type of mortar and is therefore preferred for use in a different construction of structures subjected to heavy loading. The use of mortars of lower cement content is unsatisfactory since any notable reduction in cement contents leads to reduced workability and less cohesion and will produce porous joints with a tendency for low frost resistance. 1: 8 cement mortar is nearly twice as strong as 1: 3 lime mortar. When used for protective plaster, cement mortar provides a waterproof layer and protects the elements covered from weathering effects.

A. Effects of fly Ash as Partial Replacement of Cement in Concrete

The advancement of mortar technology can decrease the application of natural resources and energy sources and lessen the charge of pollutants on the environment. Natural resources have become costlier. Natural stone processing plants produce a large amount of stone dust with a vital impact on the environment and humans. The use of alternative materials provides a reduction in cost, energy savings, superior products, and lesser hazards in the environment. Stone blocks are altered into smaller blocks in order to give them the desired shape and size. During the altering process of fly ash, the original marble mass is lost by 25% in the form of dust. Annually, 250-400 tons of Stone waste are generated on-site. The fly ash produces from coal combustion near their unit although notified areas have been marked for disposing leading to serious environmental and dust pollution and covering vast area of land, especially after drying up of powder, so it is necessary to treat the marble waste quickly and use it in the construction industry.

B. Polyvinyl Alcohol Fibers (PVA): -

Various materials and types of fibers in combination with the concrete matrix have been the subject of several studies. (find more fiber types or concrete matrices by clicking links)

Fiber dosage boosts the energy absorption capacity of concrete and increases its robustness of concrete. It has good chemical resistance, great dimensional stability against heat and moisture, and significant corrosion resistance in harsh settings. For the time being, we'll concentrate on the advantages of adopting PVA Fibers. Polyvinyl alcohol (PVA) fiber properties are: -

- Poly Vinyl Alcohol (PVA) fiber offers good qualities for increasing the strength of concrete.
- It possesses a high modulus of elasticity, durability, tensile strength, and bond strength.
- These characteristics are required to increase the ductility of concrete.
  - PVA is a flexible material with a high tensile strength.
  - It has no odor and is soluble in water.
  - High strength and low elongation

C. Poly Vinyl Alcohol (PVA) fiber used

When a structural element is subjected to bending, the structural element has a very weak tensile force compared to compression, so reinforcement is required to withstand the tensile force. PVA Fibers' key advantage is its 'invisibility.' They may be cast all over the concrete with little to no visible effect on the completed surfaces. You can rest assured that PVA fiber can help to make its structures more resilient in any aspect. PVA fiber is good for concrete because of its

strong crack-fighting qualities, high modulus of elasticity, and excellent tensile.

D. Research Objectives

The principal objective of this thesis is to study the possible techniques of improving the properties of concrete that is made up with 15% or higher percentages of Flyash. Investigate the potential of PVA fibers in Mortar.

E. Procedure for Mortar Mixing

In the regular masonry work with block/stone as a structural unit, 1:3 to 1:6 was used. For reinforced brickwork is 1:2. For all work in dampness circumstances, used is 1:3. Also, for the architectural work and load-bearing structures is 1:6 and 1:2, respectively. The methodology for the mortar mix preparation. A dry container must be used to allow the materials to. Mortar holders should be pre-wetted before filling them with new mortar.

II. RESULTS

A. General

This chapter briefly describes the test results of the present study. It is cement mortar replacing the cement partially by fly ash. And PVA fiber used in mortar.

B. Slump value for different mixes using 0.55% water cement ratio

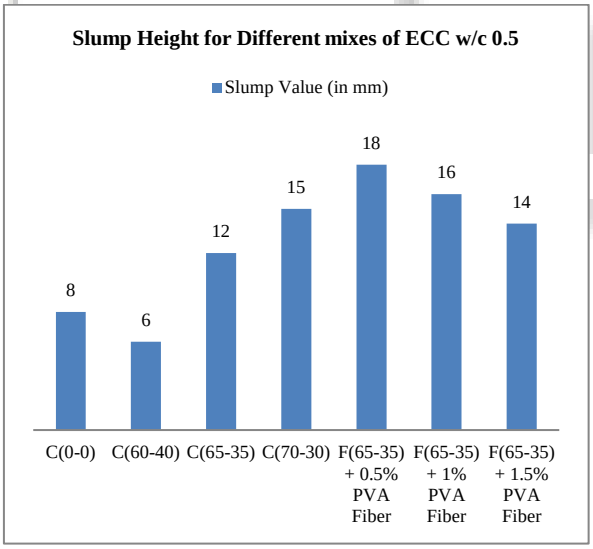

Fig. 1: Slump value for different mixes using 0.5% water cement ratio

C. Slump value for different mixes using 0.55% water cement ratio

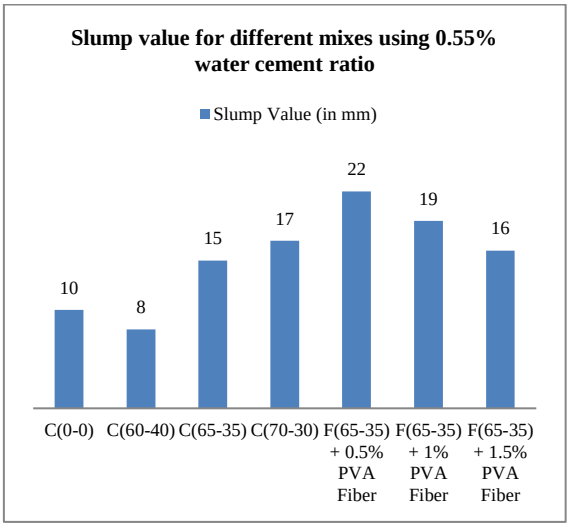

Fig. 2: Slump value for different mixes using 0.55% water cement ratio

D. Brik Prism test on mortar Compressive Strength (N/mm2)

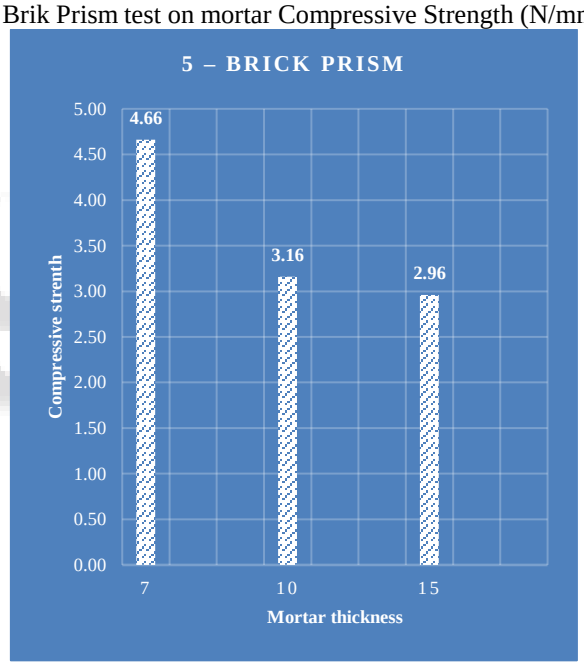

Fig. 3: Brik Prism test on mortar Compressive Strength (N/mm2)

D. Mortar (1:2) ratio compression test using 0.5% water cement ratio

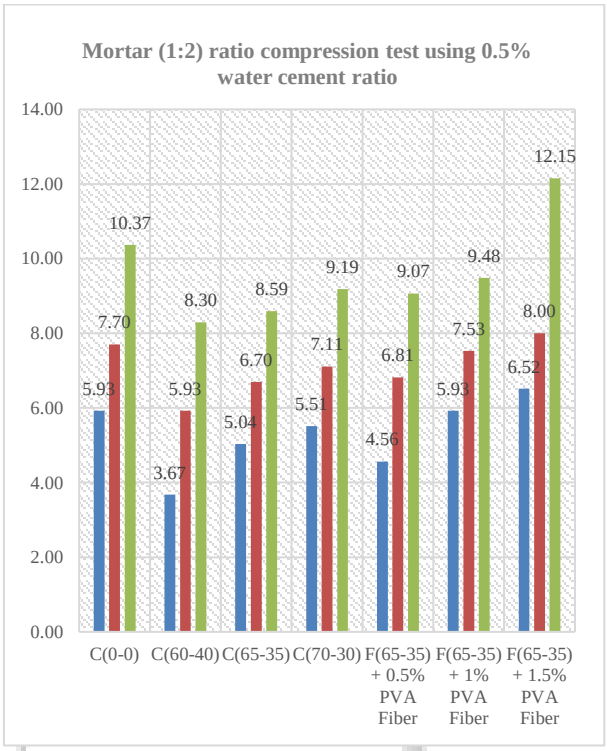

Figure 4 Mortar (1:2) ratio compression test using 0.5% water cement ratio

E. Mortar (1:2) ratio compression test using 0.55% water cement ratio

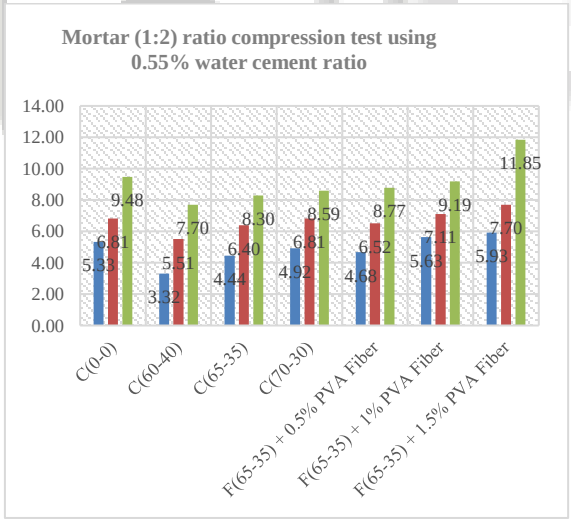

Fig. 5: Mortar (1:2) ratio compression test using 0.55% water cement ratio

III. Conclusion

- The increment thickness of the mortar joint will directly reduce the compressive strength of the prism.
- The compressive strength testing on the cube showed that the different water-cement ratio with fly ash gives higher workability but reduced compressive strength.
- 35% fly ash, 0.5 w/c ratios, 7mm thickness of mortar, and 1% PVA fiber are more economical because compressive strength and workability are also high.

References

[1] C. Lian, Y. Zhuge & S. Beecham. (2011). The relationship between porosity and strength for porous concrete. Construction and Building Materials, 25 , 4294 4298.

[2] An Cheng, Hui-Mi Hsu, Sao-Jeng Chao & Kae-Long Lin. (2011). Experimental Study on Properties of Pervious Concrete Made with Recycled Aggregate. Internal Journal of Pavement Research and Technology , 4 ,N0.2,104-110.

[3] Bradley J. Putman & Andrew I. Neptune. (2011). Comparison of test specimen preparation techniques for pervious concrete pavements. Construction and Building Materials, 25, 3480 3485.

[4] Ali Kadhim Sallal, 2018, „Design and analysis of ten storied building using ETABS software - 2016", International Journal of Research in Engineering and Technology, vol.4, issue 2, pp. 21-27.

[5] Deshpande, MS, Lale, SV, Pawar, YP, Pise, CP, Kadam, SS, Mohite, DD & Deshmukh, CM, 2017, „Study of seismic analysis of masonry wall structure", International Journal of Engineering Research and Application, vol. 7, issue 3 (part-6), pp. 1-8.

[6] Uygunoğlu, T., Şimşek, B., Ceran, Ö.B. and Eryeşil, Ö., 2021. Novel hybrid fiber reinforced mortar production using polyvinyl alcohol with a blend of graphene oxide and silver nanoparticles. Journal of Building Engineering, 44, p.102641.

[7] Dong, P., Ahmad, M.R., Chen, B., Munir, M.J. and Kazmi, S.M.S., 2021. A study on magnesium phosphate cement mortars reinforced by polyvinyl alcohol fibers. Construction and Building Materials, 302, p.124154.

[8] Yew, M.K., Bin Mahmud, H., Ang, B.C. and Yew, M.C., 2015. Effects of low volume fraction of polyvinyl alcohol fibers on the mechanical properties of oil palm shell lightweight concrete. Advances in Materials Science and Engineering, 2015.

