# MECHANICAL BEHAVIOR OF FIBER-REINFORCED LIGHTWEIGHT CONCRETE

**Sardorbek Rustamov**
E-mail: sardorbek060894@gmail.com
**Uzbekistan, Fergana,**
**Fergana Polytechnic Institute**

**Abstract:** The primary aim of this research is to examine the mechanical behavior of fiber-reinforced lightweight concrete. To evaluate the effectiveness of fiber type in lightweight concrete the compressive strength were performed at 28 days. The results showed that using fibers in lightweight concrete improved the compressive strength.
**Keywords:** fiber-reinforced lightweight concrete; lightweight aggregate; PVA fiber; steel fiber; compressive strength

The utilization of lightweight concrete is widespread in the construction field. This type of concrete offers advantages such as dead-load reduction, better fire resistance, and lower thermal conductivity. Lightweight aggregate concrete is usually fabricated using different types of lightweight aggregate materials such as expanded clay and shale, slate, pumice, and lytag. Lightweight aggregate is an important component in the production of lightweight concrete. The unit weight and strength of lightweight concrete is sufficiently lower than normal weight concrete, due to cellular structure of lightweight aggregates. The application of different types of aggregate affects the strength of concrete in various ways, and it was found that the properties and volume fraction of the aggregate affect the compressive strength of concrete. Elsewhere, it was highlighted that for some lightweight aggregates, the compressive strength was decided with the type of aggregate and increases as the density increase. The most widely used lightweight aggregate, however, is expanded clay. It was found that the addition of

fibers in pumice lightweight concrete did not affect the compressive strength, while it was increased by 30% after mixing in the expanded clay aggregate [3-41].

Despite its benefits, the brittleness of lightweight concrete is greater than that of normal-weight concrete, thus limiting its broader use in the construction industry. Different types of fibers can be utilized to improve the mechanical properties of lightweight concrete, and in different amounts. For example, the incorporation of fibers into an expanded clay mixture essentially improves the compressive strength of concrete. It was concluded that steel fiber-reinforced lightweight aggregate concrete possesses numerous advantages, including such as good heat-insulating property, anti-seismic performance, and fire resistance. Furthermore, the use of fibers affects the properties of concrete positively (impact strength and toughness), as well as increasing the durability and decreasing the susceptibility of early age cracks. It could provide the full transformation from brittle to more ductile material. It has been proven that the incorporation of fibers in lightweight concrete enhances the long-lasting serviceability of the concrete and that fiber- reinforced lightweight concrete offers many benefits to the construction industry. It was concluded that the use of polyvinyl alcohol (PVA) fiber with concrete has many advantages, including a high aspect ratio, high tensile strength, good water affinity, good adaptability with cement, and good bond formation within the cement matrix. Additionally, researches highlighted that PVA fiber can extend and distribute the applied load over the cement matrix. Moreover, found that PVA fiber is superior for stopping cracks, has high elastic modulus, and possesses excellent tensile and molecular bond strength as well [1-10].

Fiber-reinforced concrete demonstrates better durability in service than concrete without fibers, and the type and volume fraction of the fibers has a significant effect on the properties of the fiber-reinforced concrete. It has been reported that the addition of steel fiber in the amount of 1-1.5% by volume can increase tensile strength by up to 100%, flexural strength from 1 to 1.8 times, and compressive strength by 10-25% .

It can be concluded that, the addition of fibers shows a significant effect on the mechanical properties of lightweight concrete. The workability of fiber-reinforced

concrete usually decreases with increasing the volume fraction of fibers. Moreover, by increasing the dosage of fiber the density of lightweight concrete usually increases respectively, while steel fiber shows the highest density. The compressive and splitting tensile strength of fiber-reinforced lightweight concrete usually increases with increasing the volume fraction of fibers[7-41].

## References

1. Campione, G., Miraglia, N. and Papia, M. (2001), “Mechanical properties of steel fibre reinforced lightweight concrete with pumice stone or expanded clay aggregates”, Mater. Struct., 34(4), 201-210. https://doi.org/10.1007/BF02480589.

2. Domagała, L. (2011), “Modification of properties of structural lightweight concrete with steel fibres”, J. Civil Eng. Manage., 17(1), 36-44. https://doi.org/10.3846/13923730.2011.553923.

3. Mahkamov Y. M., Mirzababaeva S. M. Strength of bending reinforced concrete elements under action of transverse forces under influence of high temperatures //Academicia: An International Multidisciplinary Research Journal. – 2020. – Т. 10. – №. 5. – С. 618-624.

**4.** Makhkamov Y. M., Mirzababaeva S. M. Rigidity of bent reinforced concrete elements under the action of shear forces and high temperatures //Scientific-technical journal. – 2021. – Т. 4. – №. 3. – С. 93-97.

5. Deformation of reinforcement and concrete of bended concrete structures with fiberglass reinforcement YM Makhkamov, SM Mirzababayeva - Asian Journal of Multidimensional Research, 2021

6. Мирзаахмедова, У. А., Мирзабабаева, С. М., Абобакирова, З. А., & Умаров, Ш. А. (2021). Надежности И Долговечности Энергоэффективные Строительные Конструкций. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 48-51.

7. Mirzaakhmedova U. A. Inspection of concrete in reinforced concrete elements //Asian Journal of Multidimensional Research. – 2021. – Т. 10. – №. 9. – С. 621-628.

8. Mirzaakhmedov A. T., Mirzaakhmedova U. A. Prestressed losses from shrinkage and nonlinear creep of concrete of reinforced concrete rod systems //EPRA International journal of research and development (IJRD). – 2020. – Т. 5. – №. 5. – С. 588-593.

9. Abobakirova Z. A. Reasonable design of cement compositionfor refactory concrete //Asian Journal of Multidimensional Research. – 2021. – Т. 10. – №. 9. – С. 556-563.

10. Goncharova N. I., Abobakirova Z. A. Reception mixed knitting with microadditive and gelpolimer the additive //Scientific-technical journal. – 2021. – Т. 4. – №. 2. – С. 87-91.

11. Goncharova N. I., Abobakirova Z. A., Kimsanov Z. Technological Features of Magnetic Activation of Cement Paste" Advanced Research in Science //Engineering and Technology. – 2019. – Т. 6. – №. 5. – С. 12.

12. Goncharova N. I., Abobakirova Z. A., Mukhamedzanov A. R. Capillary permeability of concrete in salt media in dry hot climate //AIP Conference Proceedings. – AIP Publishing LLC, 2020. – Т. 2281. – №. 1. – С. 020028.

13. Asrorovna A. Z. Effects Of A Dry Hot Climate And Salt Aggression On The Permeability Of Concrete //The American Journal of Engineering and Technology. – 2021. – Т. 3. – №. 06. – С. 6-10.

14. Abobakirova Z. A. Regulation Of The Resistance Of Cement Concrete With Polymer Additive And Activated Liquid Medium //The American Journal of Applied sciences. – 2021. – Т. 3. – №. 04. – С. 172-177.

15. Мирзабабева, С. М. (2021). Определение Величины Усушки Древесины Хвойных Пород Исползуемых В Условиях Сухого Жаркого Климата. CENTRAL ASIAN JOURNAL OF ARTS AND DESIGN, 2(11), 40-47.

16. Гончарова, Н. И., Абобакирова, З. А., Мухамедзянов, А. Р., & Мирзабабаева, С. М. (2021). Применение Шлаковых Вяжущих В Конструкционных Солестойких Бетонах. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 32-35.

17. Мирзабабаева, С. М., Мирзаахмедова, У. А., Абобакирова, З. А., & Умаров, Ш. А. (2021). Влияние Повышенных И Высоких Температур На Деформативность Бетонов. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 40-43.

18. Мирзаахмедова, У. А., Мирзабабаева, С. М., Абобакирова, З. А., & Умаров, Ш. А. (2021). Надежности И Долговечности Энергоэффективные Строительные Конструкций. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 48-51.

19. Мирзаахмедов А. Т., Мирзаахмедова У. А. Алгоритм расчета железобетонных балок прямоугольного сечения с односторонней сжатой полкой //Проблемы современной науки и образования. – 2019. – №. 12-2 (145). – С. 50-56.

20. Sardorbek Rustamov, Sang Woo Kim, Minho Kwon, Jinsup Kim; Mechanical behavior of fiber-reinforced lightweight concrete subjected to repeated freezing and thawing, Construction and Building Materials

21. Mahkamov, Y. M., & Mirzababaeva, S. M. (2020). Strength of bending reinforced concrete elements under action of transverse forces under influence of high temperatures. ACADEMICIA: An International Multidisciplinary Research Journal, 10(5), 618-624.

22. Мирзабабаева С. М., Мирзаахмедова Ў. А. ДРЕВЕСИНЫ И СТРОИТЕЛЬСТВО //RESEARCH AND EDUCATION. – 2022. – С. 96.

23. Davlyatov S. M., Makhsudov B. A. Technologies for producing high-strength gypsum from gypsum-containing wastes of sulfur production-flotation tailings //ACADEMICIA: An International Multidisciplinary Research Journal. – 2020. – Т. 10. – №. 10. – С. 724-728.

24. Ахмедов Ж. Д. Оптимизация преднапряженных перекрестных ферменных систем //Промислове будівництво та інженерні споруди. К.: ВАТ “Укрдніпроектстальконструкція ім. ВМ Шимановського. – 2010. – Т. 4.

25. Akhrarovich A. K., Muradovich D. S. Calculation of cylindrical shells of tower type, reinforced along the generatrix by circular panels //European science review. – 2016. – №. 3-4. – С. 283-286.

26. Muratovich D. S. Study of functioning of reservoirs in the form of cylindrical shells //European science review. – 2016. – №. 9-10.

27. Adilhodzhaev A. et al. The study of the interaction of adhesive with the substrate surface in a new composite material based on modified gypsum and treated rice straw //European Journal of Molecular & Clinical Medicine. – 2020. – Т. 7. – №. 2. – С. 683-689.

28. Гончарова Н. И., Абобакирова З. А. БИТУМИНИРОВАННЫЙ БЕТОН ДЛЯ ПОДЗЕМНЫХ КОНСТРУКЦИЙ ЗДАНИЙ //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 6. – С. 122-125.

29. Абобакирова З. А., Бобофозилов О. ИСПОЛЗОВАНИЕ ШЛАКОВЫХ ВЯЖУЩИХ В КОНСТРУКЦИОННЫХ СОЛЕСТОЙКИХ БЕТОНАХ //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 6.

30. Абобакирова З. А., кизи Мирзаева З. А. СЕЙСМИК ҲУДУДЛАРДА БИНОЛАРНИ ЭКСПЛУАТАЦИЯ ҚИЛИШНИНГ ЎЗИГА ХОС ХУСУСИЯТЛАРИ //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 6. – С. 147-151.

31. Абобакирова З. А., угли Содиков С. С. СВОЙСТВА ЦЕМЕНТНОГО КАМНЯ ОПТИМАЛЬНОГО СОСТАВА С ДОБАВКАМИ В УСЛОВИЯХ СУХОГО ЖАРКОГО КЛИМАТА //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 6. – С. 81-85.

32. Кодиров, Г. М., Набиев, М. Н., & Умаров, Ш. А. (2021). Микроклимат В Помещениях Общественных Зданиях. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 36-39.

33. Umarov, S. A. (2021). Development of deformations in the reinforcement of beams with composite reinforcement. Asian Journal of Multidimensional Research, 10(9), 511-517.

34. Akhrarovich, A. X., Mamajonovich, M. Y., & Abdugofurovich, U. S. (2021). Development Of Deformations In The Reinforcement Of Beams With Composite Reinforcement. The American Journal Of Applied Sciences, 3(05), 196-202.

35. Goncharova N. I., Abobakirova Z. A., Mukhamedzanov A. R. Capillary permeability of concrete in salt media in dry hot climate //AIP Conference Proceedings. – AIP Publishing LLC, 2020. – Т. 2281. – №. 1. – С. 020028.

36. Гончарова Н. И. и др. Применение Шлаковых Вяжущих В Конструкционных Солестойких Бетонах //Таълим ва Ривожланиш Таҳлили онлайн илмий журнали. – 2021. – Т. 1. – №. 6. – С. 32-35.

37. Ivanovna G. N., Asrorovna A. Z., Ravilovich M. A. The Choice of Configuration of Buildings When Designing in Seismic Areas //CENTRAL ASIAN JOURNAL OF ARTS AND DESIGN. – 2021. – Т. 2. – №. 11. – С. 32-39.

38. Тошпулатов, С. У., & Умаров, Ш. А. (2021). ИНСТРУМЕНТАЛЬНО-УЧЕБНО-ДИНАМИЧЕСКИЕ ХАРАКТЕРИСТИКИ СРЕДНЕЙ ШКОЛЫ И КОНСТРУКТИВНЫЕ РЕШЕНИЯ СРЕДНЕЙ ШКОЛЫ№ 2 Г. ФЕРГАНЫ. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 10-15.

39. Умаров, Ш. А. (2021). Исследование Деформационного Состояния Композиционных Арматурных Балок. Таълим ва Ривожланиш Таҳлили онлайн илмий журнали, 1(6), 60-64.

40. Abdukadirova M. A. The Role Of Builder And Building In The Development Of The Country Is Invaluable //The American Journal of Interdisciplinary Innovations Research. – 2021. – Т. 3. – №. 05. – С. 81-84.

41. Berdaliyeva Y. X. et al. Gis Dasturlari Yordamida Geografik Asos Qatlamlarini Joylashtirish Va Ularni Boshqarish //International Conferences On Learning And Teaching. – 2022. – Т. 1. – №. 6. – С. 312-314