THE USA JOURNALS
THE AMERICAN JOURNAL OF ENGINEERING AND TECHNOLOGY (ISSN – 2689-0984)
VOLUME 06 ISSUE10

PUBLISHED DATE: - 30-10-2024
DOI: - https://doi.org/10.37547/tajet/Volume06Issue10-18
PAGE NO.: - 164-168

RESEARCH ARTICLE
Open Access

STRENGTH AND DEFORMABILITY OF BASALT FIBER-REINFORCED CONCRETE

Xolmirzaev Sattor Abdujabborovich
Professor, Doctor of Technical Sciences at Namangan Engineering-Construction Institute, Uzbekistan

Gulamiddinov Sarvarjon Gayratjonovich
PhD Candidate, Namangan Engineering-Construction Institute, Uzbekistan

Abstract
The article examines the strength and deformability of concrete reinforced with basalt fiber and includes experimental results. Based on the results of the conducted experiments, optimal parameters were identified.

Keywords Basalt fiber, concrete strength, concrete curing intensity, compressive strength.

INTRODUCTION

Concrete reinforced with basalt fiber exhibits higher strength compared to concrete without basalt fiber. Tests were conducted to determine the nature of the change in strength of basalt fiber-reinforced concrete over time. Samples prepared for testing consisted of two types of materials: concrete cubes with basalt fiber and concrete cubes without basalt fiber. Tests were conducted over periods of 28, 90, 180, and 360 days. The most rapid increase in the strength of basalt fiber-reinforced concrete was observed in the period up to 28 days. However, the subsequent strength increase was greater in the samples with basalt fiber than in the samples without it. The difference in strength between samples with and without basalt fiber after 28 days ranged from 17-41% after one year compared to the 28-day strength.

Based on the test results, the compressive strength of concrete with basalt fiber is higher than that of concrete without basalt fiber. As can be seen from Table 1, the compressive strength of concrete with basalt fiber remains higher over time than that of concrete without basalt fiber. The analysis results show that regardless of the testing method, the compressive strength of basalt fiber-reinforced concrete is on average 30-40% higher than that of concrete without basalt fiber.

The highest value of the modulus of deformation was observed in 28-day samples of concrete with basalt fiber. In tests conducted after 90 days, the modulus of deformation for basalt fiber-reinforced concrete increased by 17%, while the modulus of deformation for concrete without basalt fiber remained nearly unchanged (Table 2). This behavior is related to the curing dynamics of basalt fiber-reinforced concrete. In the initial stage, the intensity of curing and the effect of high temperature accelerate cement hydration, which hinders the increase in the modulus of deformation. Research indicates that the reduction in the modulus of deformation of samples with compressive strength of 16.0 MPa does not exceed 24-13-11%.

The following formula is recommended for determining the modulus of deformation of basalt fiber-reinforced concrete:

$$E_{в} = 3130 * p * \sqrt[3]{R} * \beta_{B} \quad (1)$$

Here:

- R - the average density of concrete, t/m^3;
- R - the cubic strength of concrete, MPa;
- BB - the coefficient accounting for the reduction in strength of basalt fiber-reinforced concrete under normal conditions.

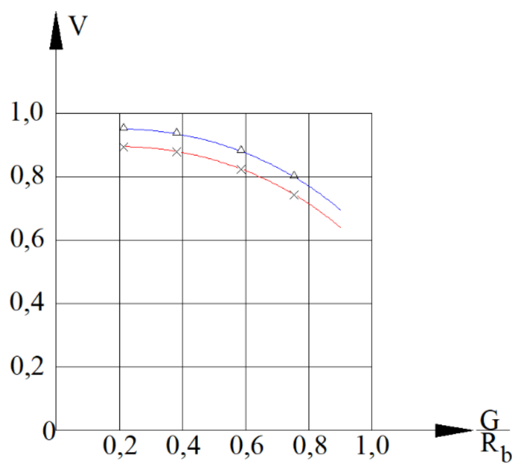

Figure 1. Elasticity Coefficient of Basalt Fiber-Reinforced Concrete

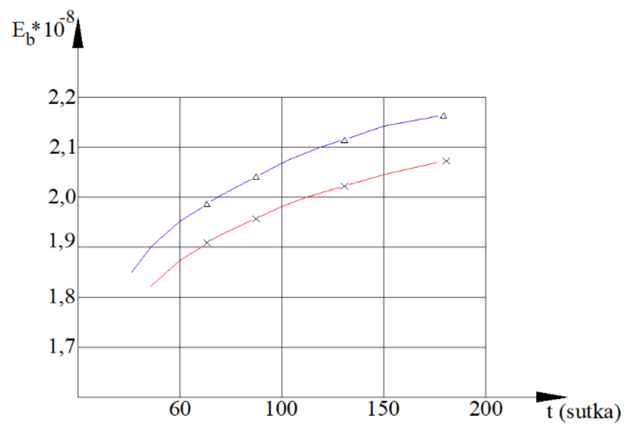

Figure 2. Ultimate Compressibility of Basalt Fiber-Reinforced Concrete

- x - Without basalt fiber
- Δ - With basalt fiber

The change in the cubic strength of basalt fiber-reinforced concrete and concrete without basalt fiber over time

Table 3.1.

№ пп	Condition of storage	The cubic compressive strength of basalt fiber-reinforced concrete (MPa) over time (in days) is as follows:	The work condition coefficient of basalt fiber-reinforced concrete at various times is as follows:	Recomended value

		28	60	90	180	360	28	60	90	180	360	
1.	Basalt fiber-reinforced	24.2 ------ 135	24,9 ----- 139	25,2 ------ 141	25,9 ----- 145	26,5 ----- 148	-	-	-	-	-	-
2.	Non-reinforced (without basalt fiber)	17,9 ----- 100	18,4 ----- 103	19,15 ----- 107	19,69 ------ 110	20,2 ------- 113	1,35	1,34	1,31	1,31	1,3	1,3

The preparation time of basalt fiber-reinforced concrete affects its strength and deformation properties.

Table 2.

Condition of storage	The age of concrete in days.	Volume weight (kg/m³)	***R,*** MPa	***$R_в$,*** MPa	$K_{вс}$	***$E_в$*** MPa	$\varepsilon_{вс}\cdot 10^{-5}$
Basalt fiber-reinforced	28	2410	16,5	13,7	0,83	13000	190
	60	2405	18,8	14,0	0,78	13800	194
	90	2390	18,6	14,3	0,76	15300	197
	180	2390	20,7	15,4	0,74	15800	208
	360	2390	23,2	16,8	0,72	16100	215
Non-reinforced (without basalt fiber)	28	2340	17,9	14,1	0,78	12400	205
	60	2320	18,1	14,2	0,78	12500	205
	90	2300	18,3	14,4	0,78	12500	241
	180	2280	19,04	14,9	0,78	13200	237
	360	2280	20,8	15,2	0,74	14000	259

The value of this coefficient is determined by the following formula:

Where:

- - Modulus of deformation of basalt fiber-reinforced concrete samples;
- - Modulus of deformation of concrete samples without basalt fiber.

For calculating reinforced concrete structures made from basalt fiber-reinforced concrete, .

Change in Ultimate Compressibility of Basalt Fiber-Reinforced Concrete

Table 3

т/р	Curing conditions	The change in the ultimate compressibility of basalt fiber-reinforced concrete under normal conditions.				
		28	60	90	180	360
1	Basalr fiber-reinrorced	196	202	209	227	236

2	Non-reinforced basalt	202	210	219	237	249

It can be concluded that the ultimate compressibility of basalt fiber-reinforced concrete varies slightly from its limiting value. The ultimate compressibility of basalt fiber-reinforced concrete depends on its curing conditions. As shown in Table 3, the ultimate compressibility of basalt fiber-reinforced concrete samples is 11% higher than that of samples without basalt fiber.

Experiments indicate that the actual value of ultimate compressibility in basalt fiber-reinforced concrete is relatively higher than that in concrete without basalt fiber, and this value depends on its strength as well as the time when the load is applied. The change in the ultimate compressibility of basalt fiber-reinforced concrete is presented in Table 3.

The increase in the average values of ultimate compressibility suggests that it should be viewed in conjunction with the age of the concrete at the time of loading and its curing conditions. The relationship between these factors can be determined using the following expression:

$$\varepsilon_{в} * 10^{-3} = -36{,}1 * \sqrt[3]{R^2} \qquad (3)$$

Here:

- R – the cubic strength of concrete (MPa) at the time the load is applied.

This expression (3) confirms the existence of a relationship between ultimate compressibility and its strength. The theoretical calculations conducted indicate that they are close to the experimental values. Since the ratio between the experimental values and theoretical calculations is shown to be 1.05, this confirms that formula (3) can be practically applied.

References

1. Александровский С.В. Учет температурно-влажностных воздействий при расчете бетонных и железобетонных конструкций (Под ред. А.А.Гвоздева.- М.: Стройиздат, 1964).
2. Аскаров Б. А., Мирзаев П. Т. Влияние режима длительного нагружения на прочность, жесткость, трещиностойкость преднапряженных сборно-монолитных керамзитобетонных балок. (Сборник научных трудов ТашПИ. Вып. 286 Ташкент 1979.
3. Аскаров Б.А. Ходжаев А.А. Железобетонные колонны из легкого бетона на основе лессовидных суглинков армированных высокопрочной сталью. Архитектура и строительство Узбекистана. 1990г №5.
4. Аскаров Б.А., Маилян Д.Р., Хасанов С.С. Механические свойства бетонов после предварительного обжатия в условиях сухого жаркого климата.-Ташкент.: ТашПИ, 1985.
5. Аскаров Б.А., Рахимов Б.Х., Нуритдинов Х.Н.

Учет местных напряжений бетонов на гравиеподобном заполнителе в условиях сухого жаркого климата при расчете на прочность железобетонных конструкций преднзначенных для эксплуатации в условиях сухого жаркого климата.- Ташкент: ТашПИ, 1985.

6. B.Maqsud o‘g‘li Po‘lat tolalari bilan dispers armaturalangan temirbeton Qurilishda innovatsiyalar, binolar va inshootlarning seysmik xavfsizligi, Xalqaro miqyosidagi ilmiy va ilmiy-texnik konferensiya NamMQI 15-17 dekabr, 2022 yil
7. B.Maqsud o‘g‘li “Повышение несущей способности строителных конструкций путем армирования железобетонных элементов сталной фиброй”. Zamonaviy mashinasozlikda innovasion texnologiyalarini qo‘llashning ilmiy asoslari: tajriba va istiqbollar mavzusida xalqaro miqiyosida ilmiy-amaliy konferensiya NamMQI 23-24 sentyabr 2022 yil.
8. Xakimov. Sh, B.Maqsud o‘g‘li Metal fibrotolalari bilan dispers armaturalangan temirbeton Farg‘ona politexnika instituti ilmiy-texnika jurnali. Maxsus 2-son ISSN 2181-7200, 2022y.
9. Martazayev.A, Bazalt tolalari bilan dispers armaturalangan ko‘ndalang egilishdagi temirbeton to‘sinning mustahkamligi va kuchlanganlik-deformatsiyalanuvchanlik holati ilmiy tadqiqot ishidan 2022y.
10. Бахотский И.В., прочност фибро железобетонных конструксий в условиях кручения с изгибом: Автореф. дис. канд. техн. наук. — М., 2013
11. Хегай М.О., Напряженно - деформированное остояние и прочност фибро железобетонных элементов круглого сечения при поперечном изгибе: Автореф. дис. канд. техн. наук. — М., 2013
12. Muminov K. K. et al. Physical Processes as a Result of Concrete Concrete in Dry-hot Climate Conditions //International Journal of Human Computing Studies. – Т. 3. – №. 2. – S. 1-6.
13. Razzakov S. J., Xolmirzaev S. A., Ugli B. M. Расчет усилий трещинообразования сжатых железобетонных элементов в условиях сухого жаркого климата //Символ науки. – 2015. – №. 3. – С. 57-60.
14. Muminov, K. K., Cholponov, O., Mamadov, B. A., oglu Bakhtiyor, M., & Akramova, D. Physical Processes as a Result of Concrete Concrete in Dry-hot Climate Conditions. International Journal of Human Computing Studies, 3(2), 1-6.
15. Mamadov B. et al. Reduction of Destructive Processes in Concrete Concrete Processing in Dry-hot Climate Conditions //International Journal on Integrated Education. – Т. 3. – №. 12. – S. 430-435.