

# Effects of Basalt Fibers with Different Volume Fractions on the Properties of Concrete

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**Abstract:** Basalt fiber is the most common inorganic non-metallic material in the field of construction at present, and the bending and cracking resistance is very excellent, has good mechanical and physical properties, is a new kind of green fiber. This paper discusses the effect of different volume content of basalt fiber on the mechanical properties, durability and fatigue properties of concrete, analyzes the research findings of different scholars at home and abroad, and draws corresponding conclusions.

**Keywords:** Basalt fiber; Mechanical properties; Durability; Fatigue; Adding amount; The length.

## 1. Introduction

Concrete is the most common and most used material in the housing construction industry. However, for plain concrete materials, brittle damage is a very serious matter, in order to

prevent such damage, fibers can be added to concrete members. Several fibers used in building structures in recent years are steel fiber, carbon fiber, glass fiber, polypropylene fiber and basalt fiber. As shown in Figure 1.

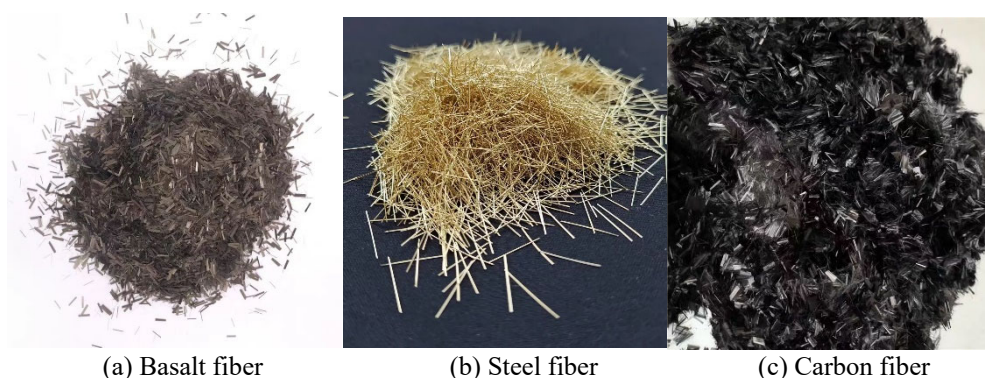


Figure 1. Photos of some fibers

Basalt fiber is a continuous fiber made from basalt stone molten at 1450°C -1500 °C and drawn by platinum-rhodium alloy wire drawing leakage plate at high speed. Basalt continuous fiber not only has high strength, but also has many excellent properties such as electrical insulation, corrosion resistance and high temperature resistance. This paper summarizes the research of basalt fiber concrete by many scholars at home and abroad, in order to provide reference for the application of basalt fiber in construction industry.

## 2. The Effect of Basalt Fiber on the Mechanical Properties of Concrete

Jiang Tianhua [1] In order to explore the effect of the interaction between rubber particles and basalt fibers on the mechanical properties of concrete, the compressive test of the test block was carried out with the basalt fiber content and length variables. The test results show that the incorporation of basalt fiber can improve the mechanical strength of concrete, and the comprehensive analysis shows that the volume content of basalt fiber is 0.1%, and the mechanical properties of concrete are the best when the length is 18mm.

Zhang Xiaofei [2] carried out axial compression test, splitting test and flexural resistance test on basalt fiber

reinforced concrete cube test blocks of different lengths. The results show that the mechanical properties of the concrete matrix after adding basalt fiber are improved, especially when the length is 18mm.

Shi Xudong [3] In order to study the influence of the fluidity of the basalt fiber reinforced concrete mixture, the surface of the basalt fiber was modified, and the compressive strength, flexural strength and splitting tensile strength of the modified test block were studied. The test results show that the increase of basalt fiber can reduce the fluidity of the mixture, and the modified basalt fiber is more tightly combined with concrete and other cementitious materials. When basalt fiber is added to 4kg/m<sup>3</sup>, the compressive strength, flexural strength and splitting tensile strength of the test block are increased by 6.83%, 12.7% and 21.46%, respectively.

Elshazli Mohamed T[4]The effects of different volume dosages on the mechanical properties of reinforced concrete were studied.The experimental results show that with the increase of fiber volume content, the slump of concrete is reduced. In addition, the flexural, tensile and compressive properties of the specimen have been improved.

It can be concluded that in recent years, scholars at home and abroad [5-7] have studied the mechanical properties of

concrete after adding basalt fibers, and found that the addition of basalt fibers can improve the compressive strength, flexural strength and splitting tensile strength of concrete, and it is concluded that the mechanical properties of basalt fiber reinforced concrete are the best when the volume content is 0.1% and the length is 18mm.

### 3. The Effect of Basalt Fiber on the Durability of Concrete

Wang Jian [8] In order to study the effect of basalt fiber on the durability of concrete in the concrete system, the durability test of concrete test blocks mixed with basalt fiber was studied. The following conclusions are drawn: (1) When the basalt fiber content is 0.2%, the corrosion resistance coefficient and mass loss rate of concrete are 75.5% and 4.3% respectively when the number of dry-wet alternation is 90, and the hydrochloric acid resistance grade is KS90.

Diana Mohamed Ali[9]The durability of basalt fiber and bamboo fiber reinforced concrete was studied, and the durability of concrete was evaluated by water absorption, corrosion and permeability. The results show that the specimens containing fibers have lower water permeability and higher compressive strength.

Xu Cundong and Li Bofei [10] et al. solved the problem of rapid decline in durability of early frozen concrete under salt-freeze coupling in the cold and arid areas of Northwest China. The durability of concrete under different basalt fiber volume content was studied, and the effect of basalt fiber on concrete under salt-freeze coupling at the microscopic level was explored by three detection methods. The results show that with the increase of the number of freeze-thaw cycles, the harmless pores of the test block after adding basalt fiber increases, thereby increasing the frost resistance durability of the concrete test block. It is concluded that when the dosage is 0.15%, the durability of the test block is the best.

In order to study the degradation of the corrosion resistance of basalt fibers in the chloride salt environment, Wang Zhenshan and Li Yakun [11] analyzed the cracks, water absorption and effective porosity of the test block placed in a concentration of 0.5% sodium chloride solution. The results showed that basalt fiber could inhibit the formation and development of cracks in acid-base environment, and the fiber content was the most favorable when the fiber content was 0.1%.

Based on the influence of many scholars [12-13] on the durability of basalt fiber in concrete system, it is concluded that the durability of concrete with a volume content of 0.1% is the best, and the addition of excessive basalt fiber will cause agglomeration, which will lead to the decline of concrete durability.

### 4. Effect of Basalt Fiber on Fatigue Properties of Concrete

Bai Jianwen and Zhao Yanru [14] conducted fatigue tests on four basalt fiber reinforced concrete test blocks under three-point bending at different rates, and fitted the double logarithmic fatigue equation under different failure probabilities. It is concluded that with the increase of basalt fiber content, the flexural fatigue life distribution of the test block is more uniform, the discrete type is smaller, and the fatigue life is greatly increased.

Li Weimin [15] used a Hopkinson pressure bar test device with a diameter of 8 mm to study the impact compression

properties of basalt fibers with different volumes at different strain rates, and analyzed them. The results show that when the volume content is increased recently, the compressive strength of the test block after adding fiber gradually increases compared with the plain concrete test block, but when the volume content is 0.2% and 0.3%, the deformation capacity of the test block does not have much advantage over that of plain concrete.

Xutao Zhang[16]The whole fatigue tensile process of basalt fiber reinforced concrete was analyzed, and the fatigue test process of fiber content and stress level on concrete was discussed. The results show that with the increase of fiber content, the fatigue life of concrete increases first and then decreases, but when the content exceeds 40%, the fatigue life begins to decrease. When the fiber content is the same, the fatigue life of the concrete decreases with the increase of stress level.

In summary, the fatigue life of the specimen is greatly enhanced after the addition of basalt fiber, but the fatigue life of concrete increases within a certain range of the dosage, but decreases after the critical value.

### 5. Conclusion

With the addition of basalt fibers, the mechanical properties, durability and fatigue properties of concrete begin to increase. When the content is 0.1%, the mechanical properties and durability of basalt fiber reinforced concrete reach the highest, but when the content exceeds 0.1%, the performance begins to decrease. When the content is 0.3%, the fatigue properties of basalt fiber reinforced concrete reach the highest.

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