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The Effect of the Apparent Ratio of Steel Fiber Concrete on the Compressive Strength Fibers with Additives

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ABSTRACT

Conventional concrete is a relatively brittle material, while the fibers in concrete construction, in addition to cement, aggregates, water and additives for fibers used in concrete mix, because it has more strength and vitality is to prevent cracking and fiber strands are actively limiting the width of the cracks is concrete action and increased capacity utilization, it is superior to conventional concrete. The use of fibers in concrete to changes in compressive strength, tensile strength, flexural strength, shear strength, resistance to dynamic loads, cross-resistance to cracking, the rate of energy absorption, the rate of shrinkage, creep and wear of the surface. As a result, the behavior of fiber concrete strength should be studied. This article is the result of laboratory research and the effects of length to diameter ratio of steel fiber concrete on the compressive strength of the fiber in the manufacture of additives, including micro silica and the lubricant is used for the analysis.

KEYWORDS: Fiber Concrete, Steel Fibers, Compressive Strength, Fiber Length to Diameter Ratio, Micro Silica, Superplasticizer

1. INTRODUCTION

To improve the strength of concrete has always done a lot of research. Including research Add pozzolan or cement replacement materials in concrete. Silica or silica fume of ferrosilicon industry that comes with gases emitted from electric arc furnace. Research and studies carried out indicate that the pozzolanic-silica additives due to very fine particles and separate high percentage (90%) non-crystalline silica to produce high-strength concrete [1]. The use of micro-silica concrete adjacent coast are new structural engineers were concerned because the characteristic of the pozzolanic micro silica, Use it to improve the mechanical properties and durability of concrete increase in developing countries is increasing. Gentlemen smooth and Assad discussed Allahzadh the aggregate and the micro-silica fibers on the mechanical properties of lightweight aggregate concrete with compressive strength of concrete research and believed to have increased the time and amount of SF [2]. Fiber concrete is a concrete construction that used of fiber, cement, water, sand and additives are mixed with fibers. Fiber cause continuity, tensile strength, increase flexibility and reduce cracks in concrete. Concrete has recognized as a product of several components designed to reach the final specification. Concrete is the most widely used materials in civil engineering that use it are added on a daily basis. In the meantime, on the one hand with the progress of science and technology and the emergence of more complex systems on the other hand the growing trend of construction development at the macro level, the need for more use of new building materials more efficient, is a very sensible [3]. Paresh et al. [4] on concrete assessment fiber and its role in the repair of concrete structures using fiber research have been considered useful for repairing structures. Shah [5] to increase the tensile strength of concrete by fiber research and has come to the conclusion that the tensile strength of concrete can be increased by fiber. Using Pozzolanic materials can improve the microstructure of cement paste by filling small voids in the cement improves strength properties and increase the reliability of the products [6]. The use of different fibers in concrete and concrete construction fiber as an effective step in preventing the spread of micro-cracks and concrete tensile strength is weakness [7]. Add fiber in addition to the compressive strength of concrete also affect the behavior after the peak. Fiber materials imprisoned and the crack propagation delays. As a result of an increase in the height and shape of the strain after the peak production [3]. Replacing fume mortar and cement due to the lower density of the material in the cement concrete density is reduced and the total percentage of replacement is more, this reduction is greater [8]. Ramezanianpour [9] studied the partial replacement of Portland cement with supplementary cementitious materials such as overhead ground blast furnace, fly ash and silica fume have studied this material to replace the cement know. Concrete fiber flexibility, as well as the properties of plastic materials makes fiber concrete failure is not sudden. Because the steel

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fibers in the concrete body is three-dimensional and multi-dimensional scatter In other words, if a crack is usually expected deformation in different directions, created fiber connections and prevents the propagation of cracks. The fiber strands are actively involved in limiting the width of cracks and micro-cracks formed much work and the result of the operation of concrete can be increased. The types of fibers used in concrete can be made of plastic fibers, glass, natural, polyethylene, asbestos, nylon and steel name in various shapes and sizes can be produced. Some of the fibers are shown in Table 1 [10].

Table 1. Profile of fibers used in fiber concrete				
Туре	Density	Max Strain	Young's Modulus	Tensile Strength
Asbestos	3.2 gr/cm3	~ 0.6 %	12-20×10-3 Ksi	80-140 Ksi
Glass	2.5 gr/cm3	1.5~3.5 %	10×10-3 Ksi	150-550 Ksi
Polyethylene	0.95 gr/cm3	0.0~ 1.0%	0.02-0.06×10-3 Ksi	~ 100 Ksi
Steel	7.8 gr/cm3	0.5-35%	29 ×10-3 Ksi	40-400 Ksi

Steel fibers has high tensile strength and modulus of elasticity is 200Gpa. The stress-strain characteristics of ductile and less creep shows [4]. Steel fibers with different materials, in terms of tensile strength as well as simple and straight or hooky to enhance the adhesion tension with concrete - can be built. Steel fibers with a high modulus and strain to failure was due to good formability and high tensile strength fiber is considered the most suitable and most economical [10]. Angled steel fibers and fiber stretching out a great impact resistance. Fiber deviation of the resistance to tensile stresses in the strain they will have a considerable impact. Theoretical modeling in the 60s showed that in the two and three-dimensional fiber distribution to a third and a ninth degree of their influence to arrange the next one will be reduced by [11]. Madani et al. [11] on concrete logged in ductility and tensile strength fiber also have research and steel fiber reinforced concrete rebar And.btn preferred fiber improves the function of the structure against earthquakes [11]. Reinforced concrete structures with steel fibers excellent performance at extreme dynamic loads [12]. The Fig. 1. Below shows a variety of shapes steel fibers [10].



Figure 1. Types of steel fibers [10]

2. History:

Failure of the cement produced by the break because it is crisp. Concrete reinforced by short fibers randomly and were irregular and for fixing cracks in concrete tensile EVER. In the past, the fibers used to strengthen brittle mortar was the most famous and the most popular due to the cheapness and availability of adobe bricks and mortar thatch straw is to reinforce the coating to cracking after drying comes, and now also the cheapest type of mortar used in rural areas of the country [13]. Antoine [14] in 1985 suggested that adding fiber in the form of wires attached to concrete a new building material production. In a series of experiments for concrete strength by 191 short fibers was conducted by Porter. He added stud to concrete, increasing the tensile strength of concrete comminution achieved [14]. In the 1950s, the Soviet Union for the first time in America in 1960 after the country conducted research on the use of steel fibers in the matrix brittle cracks formed at the stress concentration is reduced. Concrete reinforcement fibers in the name of the world is known as fiber reinforcement plastic (FRP) are a variety of fibers such as glass fibers (GFRP) aramid fibers (AFRP) and carbon fiber (CFRP) have been formed in a resin binder It is world-famous. This material is one of the most materials in cold regions such as North America, Canada and some European countries associated with the aggregates used for air

conditioning. The use of carbon fiber panels for the further strengthening and several bridges have been common in Japan and in some European countries it is used.

Fiber rupture in all cases, especially ones like direct tensile, bending, impact and cut, causing fatigue and strain, the mechanical properties of concrete and mortar production. Concrete reinforcement fibers in the form of tension, from the field to the fibers by cutting surface. If the surface is rough fiber trend will be just a conflict between fiber and matrix. With the field of tension between fiber and matrix cracking divided and then the tension increasingly transmitted to the fibers [15, 16]. Hassanzadeh et al. [17] examined the effect of different pozzolan mortar performance and environment research sulfate have. Super pozzolan is silica fume, a very significant effect on the correct application to increase the strength and durability of concrete. Silica fume concrete in generating heat to a large extent is caused by the same mechanisms that lead to increased durability and strength are the filling effect and pozzolanic reaction. Silica can lead to reduced heat generation to be concrete. Heat generating more than a warm one gram of ordinary Portland cement and silica fume in some cases it would be more than 2 times. However, higher proliferation resistance silica fume (from 2 to about 4 times the cement), the possibility of reducing the total amount of cement concrete to achieve a specific resistance provided and thus can lead to reduced use of silica fume concrete is generating heat.

Cioffi et al. [18] on the impact of fly ash, silica fume and two zeolites with the different oxide forming on the concrete mix in which cement is replaced zeolite to 40 percent. The results showed that SCC has zeolite slump flow values in the range of 60 to 70 cm is produced [18]. Saad et al. [19] have reported that substitution of 10% by weight of Portland cement with silica fume improves the physical-mechanical property and microstructure of concrete after high temperature is. Sadrmomtaz et al. [20] on the effects of different temperatures on cement containing silica fume have research and the result of this research has shown that exercise can reduce high-temperature strength and increase the percentage of weight loss. Ghandehari et al. [21] studied the effect of temperatures of 100, 200, 300 and 600°C on mechanical properties of high strength concrete and silica fume with a succession of 0, 6, 10% by weight of cement have been used. The results showed the highest compressive strength and tensile residual cement containing silica fume is ten percent. Morsy et al. [22] about the behavior of nano-concrete mortar Fired at high temperatures and research have found that silica fume and fly ash as an effective way to increase the strength of concrete are fire. Mr. M.Rashid Hameed study on flexural properties of metal fiber-reinforced concrete are mixed [3]. Shkrchy Zadeh et al. [17], studied on the effects of replacement of silica and water content of chloride ions have penetrated the cement. Nima et al. [24] or in the paper tensile strength of concrete with steel fibers were examined.

3. MATERIALS AND METHODS

Sand and gravel used in making concrete fibers with a diameter of 12.5 millimeters. Sand and also of ordinary Portland cement was. Consumer superplasticizer based on naphthalene sulfate and silica micro powder is in accordance with the standards ASTM c1204. The amount of aggregate, cement, water, silica fume and superplasticizer in the preparation of various examples is given in Table 3. Water-cement ratio in the non-use of these lubricants is 40/0 and 25/0 when using this lubricant. The specific gravity of sand and gravel in 1510 was 1,430 kilograms per cubic meter. Sand to sand ratio is approximately 2: 1. Aggregate grading curve shown in Figure 2.



Fig. 2. Aggregate grading curve

Table 2. The amount of water in the sample of concrete materials and fibers				
Cement kg/m ³	Micro Silica kg/m^3	Superplasticizer lit/m^3	Sand kg/m^3	Gravel kg/m ³
350	40	12	960	1057

First sand and cement to produce concrete and micro silica powder according to the respective proportions were weighed and then mixed together and then the fibers needed with respect to the mixture of aggregate and cement weighing on sprayed was. After thorough mixing and re-mixing of water required and the super plasticizer added to the

mixture and after stirring the mixture was poured on the remaining water and re-mix was stirred until the mixture is uniform in terms of moisture. Mixing method was manually in all cases. Concrete vibrating action in all samples was performed on a vibrating table. Steel fibers used in the research is the collection of waste steel chips with a maximum diameter of 0.1 mm is equivalent to the fiber type and fiber length can be provided according to need. Because the diameter of the fiber is different and so are virtually inseparable in both the research and tested but its length can be changeable and eligible. The compressive strength of concrete cube net without fiber is given in Table 3.

Table 3. Res	sults of the cor	pressive strengt	h of concrete	cube net v	vith additives
		pressive serenge			The second of the second

Curing Way	Compressive Strength kg/cm^2	Average Compressive Strength kg/cm^2
Without Additives	448.7, 420.6, 435.1	434.8
Push To Add	964.6, 921.4, 943.5	942.8

4. RESULTS

Test samples to determine the compressive strength of concrete fiber - based regulations JSCE Japan that height is twice the size in diameter. Both high and low level of pressure that is placed in the jaw pressure is necessary in order to avoid the occurrence of stress concentration, is quite clear. Based on the recommendations of the bylaw JSCE, the maximum surface roughness should be 2.0 mm. The cylindrical mold used to this type for its two upper and lower surfaces are perfectly smooth and polished, and lead. The minimum pressure of 3 According to the regulations, the average compressive strength indicates the strength of three samples each series. Compressive strength of concrete fiber sample can be determined by Equation 1 in the equation, σ_c : compressive strength by kg/cm^2 , P: The maximum

$$\sigma_c = \frac{4P}{\pi D^2}$$

(1)

force to rupture the sample in terms of kg and D: diameter of the cylinder in.

In Figure 2 test results for concrete compressive strength and ultra-micro fiber with additives, including lubricants by kg/cm^2 with $\phi_{152 \times 305mm}$ for 80 and 120 kg of fibers per cubic meter of concrete in front of the apparent descent ℓ/d fibers are given. In Figure 3 test results for concrete compressive strength fibers with lubricant additives, including micro and ultra kg/cm^2 in terms of fiber volume fraction is given by l/d = 60 with $\phi_{152 \times 305mm}$. In Figure 4 the compressive strength of concrete fiber additives and without additives by taking fiber volume fraction is given.



Figure. 3. The compressive strength of concrete in the face of apparent fibers with $\phi 152 \times 305 \, mm$



Fig. 4. Concrete compressive strength fibers with a fiber volume $\phi 152 \times 305 \, mm$ against percent



Fig. 5. Compressive strength of concrete with fiber additives and without additives

5. Conclusions

According to the results of experiments performed with the increase of fiber, fiber concrete compressive strength may be increased or reduced resistance. The only effect of steel fibers in concrete compressive fibers samples, can be a relative increase in resistance to cracking.

If a very small percentage of steel fibers in concrete used, the impact resistance of the fiber in the flow or too little

fiber concrete will be left. According to Figure 2 if S represents the compressive stress in kg/cm² and $\frac{\ell}{d}$ represent the

bulk of the fibers used in concrete relations with concrete $R^2 = 1$ and super micro fibers produced with the mixture according to the proposed plan in place.

$$\sigma = -0.0063(\frac{\ell}{d})^3 + 1.5581(\frac{\ell}{d})^2 - 128.37\frac{\ell}{d} + 4359.5 \xrightarrow{if} \frac{\ell}{d} = 80\frac{kg}{m^3}$$
(2)
$$\sigma = -0.0058(\frac{\ell}{d})^3 + 1.3782(\frac{\ell}{d})^2 - 109.33\frac{\ell}{d} + 3820.8 \xrightarrow{if} \frac{\ell}{d} = 120\frac{kg}{m^3}$$
(3)

According to Figure 3, if σ represents the compressive stress in kg/cm^2 and ξ represents the percentage of fibers by volume is the following relationship $R^2 = 0.9863$ the fibers produced with micro and ultra-lubricating concrete mix design is provided in accordance with established.

$$\sigma = 1572222.22\xi^3 - 259333.33\xi^2 + 9915.40\xi + 843.4 \tag{4}$$

According to Figure 4 the best result of the incorporation of 3% of steel fibers in concrete with additives produced without additives. Special purpose applications, such as producing resistant steel fiber used in wall ovens, etc. should be considered.

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