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Research Article

Experimental Study On Fundamental Strength Properties And Workability Of Date Palm Fibre Reinfoced Concrete

Engr. Noshad Ali[1], Engr. Dr. Zaheer Ahmed*[2], Engr. Abdul Rahim Khan[3] , Engr. Aqeel Ahmed[4], Engr. Dr. Naveed Anjum[5]

[1] *SWEDISH College of Engineering and Technolgy, Rahim Yar Khan, Punjab, Department of Civil Engineering, Pakistan, noshadrizvi1990@gmail.com*
[2]*Khawaja Fareed University of Engineering & Information Technology64200 RYK, Punjab, Department of Civil Engineering, Pakistan* *dr.zaheer@kfueit.edu.pk*
[3]*Department of Civil, Environment and Transportation Systems College of Engineering and Technology, Allama Iqbal Campus. University of Sargodha 4010, Punjab Pakistan, abdul.rahim@uos.edu.pk*
[4]*Department of Civil, Environment and Transportation Systems College of Engineering and Technology, Allama Iqbal Campus. University of Sargodha 4010, Punjab Pakistan, aqeel.ahmed@uos.edu.pk.*
[5]*Khawaja Fareed University of Engineering & Information Technology64200 RYK, Punjab, Department of Civil Engineering, Pakistan , naveed.anjum@kfueit.edu.pk.*

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Abstract – Concrete is considered to be chief construction material. It possesses versatile properties but it is not independent of the weaknesses. Concrete is strong in compression but it is week in tension in order to improve tensile strength of concrete various attempts are made one of the options is to add the fibers in concrete . This study is paying attention on to investigate experimentally the effect of date palm fibers on workability and fundamental strength properties of concrete. Date palm fibers of ½" and 1" length are added from 1% to 5% by weight of cement in concrete of 1:2:4 proportion with 0.5 w/c ratio is cast and tested. The effect of length and dosage of date palm fibers is investigated in terms of workability (slump value) , compressive strength (cube crushing strength) and tensile strength (cylinder splitting tensile test) these are composed with those of normal concrete without of DP fiber , Thus in all 6 batches with cube and cylinders of standard size are cost and tested for evaluation of the compressive and tensile strength respectively .the workability of the concrete is evaluated by adopting slump cone test .

The result reveal the effect of DP fiber on add the three studies the workability decreases with the increase in DP fibers concrete where the compressive strength and tensile strength increases with the addition of DP fibers but up to specific dosage the extent of enhancement in tensile strength is more remarkable in case of tensile strength as compared to the compressive strength.

Keywords – Workability, Date Palm Fibers, Strength Properties.

I. INTRODUCTION

In the world of construction concrete is one material which is used above all the others. Concrete is made up with three fundamental constituents being cement, aggregate, water. Further aggregate is of the two kinds (coarse and fine) based on the size. The binding of the aggregates is achieved due to the binding property of cement as a result of hydration process occurred when water is added in dry mix of concrete, whereas the aggregates provide volume to the concrete. However the aggregates do not have any participation in the chemical reaction (hydration process). In construction industry concrete is considered to be as chief material due to its versatility in terms of casting, readily availability of its ingredients, easy to cast and molding in any shape with different colors and texture. Concrete is a quasi-elastic material and it is strong in compression but weak in tension [4, 5, 8]. Tensile strength of the concrete is about 10% of its ultimate compressive strength [9]. To overcome the issue of low tensile strength and other weaknesses of concrete has been the major concern of the other researchers and other stakeholders. One of the options adopted is to use the fibers in concrete as fiber reinforcement. The effect of fibers on different properties of concrete is Investigated/ studied and the results are reported in the literature. Steel fibers are one of the types of fibers being successfully used in concrete as fiber reinforcement [10]. In these days, the use of fibers as reinforcement for cement matrices is an active area of research in order to use local materials for improving the properties of the cement matrix [11], i.e. their tensile and flexural strength [12], in addition the increase of ductility and crack resistance1[13]. The most broadly synthetic fibers [14]and natural fiber [15, 17] used are artificial fibers such as (rubber fiber [14], polypropylene [5], acrylic, glass fibers [3] aramid, nylon fibers [12]. According to various authors, all properties of likely fibers cannot be enhanced at the same time because fibers have their own personality. They suggested that suitable fiber should be second-hand for exacting function. They also recommended having criteria for acceptance of natural fibers, because fiber has variable properties in different regions [16].They also told that some plants are cultivated by over many generations and some are wild plants, trees and creepers which grow in jungles. Infect that, any material in its fibrous form is stronger than in bulk form and these strong fibers are used to reinforce the weak materials [19].

1. Aim and Objectives

Following objectives are studied during this experimental work.

1. Palm fibres effect on workability of concrete was checked.
2. Compressive strength of concrete was conducted with date palm fibres as fibre reinforcement in concrete.
3. Cylindrical splitting tensile strength of concrete was conducted with date palm fibres as fibre reinforcement in concrete.
4. The results of palm fibres were compared with results of concrete casted without fibres, means ordinary concrete..

- To determine workability of concrete for different proportions of sugarcane bagasse ash by conducting slump test.
- To examine the compressive strength of concrete when sugarcane bagasse ash is used as a fractional substitute for cement.
- To investigate the splitting tensile strength of concrete when sugarcane bagasse ash is utilized as a fractional replacement for cement.

II. MATERIALS AND METHODS

1.1 Cement

When concrete is produced cement is considered to be one of the essential ingredients because it is acts as the binder material. The types and properties of cements have a greater role in the general recital of the concrete in fresh and hardened conditions. The cement act in accordance with ASTM C150-05 (2005) and BS 12 (1991), Type-I was used during this experimental study. The cement was bought from the local market of Nawabshah, Sindh, Pakistan with name of ‘Lucky Cement`, which is manufactured by Luck Cement Industries.

1.2 Fine aggregates

To Fine aggregates obtained from Hills, which was bought from the nearby market. The fine aggregates were kept in tray and washed with portable water to remove the clay and other organic minerals. After washing the sand was dried in air for two to three days up to surface saturated dried condition. It was passed from sieve # 4 and retained on sieve #200.

1.3 Coarse aggregates

Crushed coarse aggregate of 19 mm maximum and 4.75 minimum sizes were used as coarse aggregate. Prior to using the crushed aggregate were washed with water in ordered to remove dust from aggregate surface and dried in air for two to three days. After that those are used for casting the samplesfor hardened strength properties of concrete.

1.4 Water

Before using the water for casting of concrete, it should be ensured that water is free of allorganic minerals. Openly the potable water is well known to be suitable for the producing of the cement grouts, cement mortars and cement concrete. During this experimental drinkable water used to caste the concrete samples for testing purpose.

1.5 Dates Palm Fibers

These Fibbers were added in concrete to overcome the inherent deficiencies of the concrete when it is subjected to the tensile loads. Different types of fibers are being used in concrete as fiber reinforcement to address the issue. One of the options of the fiber types is the use of the agricultural/ natural fibers. Date Palm fibers are also the type of the natural fibers obtained from Date palm trees. Date palm fibers may be from the surface core of the stem of the tree or these also may be obtained from the leaves of the date palm tree. During current study the date palm fibers are obtained from its leaves. In this regard the branches were cut from the date palm tree available in the residential area of the university which is situated in front of the university campus. The branches were first washed to remove dust and other undesirable particles stuck with the leaves and then left in open air to dry for about 5-7 days. Then the dry leaves were plucked from the branches and were cut in the required length for their use as fibers in concrete. The leaves were cut in half inch and one inch length.

1.6 Mix Proportion

The concrete proportion was fixed at 1:2:4 (cement: Fine Aggregate: Coarse Aggregate). The batching was performed in terms of weight.

1.7 Dosage of Dates Palm Fibers

In The date palm fibers were added by the total weight of cement .Also a batch of normal concrete without date palm fiber was cast to compare the results. All the six batches of the concrete are cast with different percentage of date palm fiber dosage such as 1% to 5% with an increment of 1% by weight of cement.

2. Shape, Size and curing of Specimens

The standard size of cubes was 100mm x 100mm x 100mm for compressive strength and Standard sizes for cylindrical splitting tensile strength of concrete cylinders of standard size 100 mm x 200mm height were cast and water pond curing was don during this study to cure the concrete specimens. Instantaneously after demoulding from frame, the specimens were placed into a water tank containing clean potable water up to the testing age (28 Days) and after completion of curing age the specimens were tested.

2.2 Testing of the Specimens

Following tests were conducted during this experimental work

2.2.1 Workability Test

It may be observed that decrease is of the order of 6.9% , 8.6% , 11.3% , 12.8% and 14.6% with the fiber added 1% , 2% ,3% ,4% ,5% respectively. This refers that in case of workability, the dosage of fibers should be kept lowest possible with content water cement ratio. If necessary then w/c ratio should be adjusted in order to maintain the required workability.

Table.1 Average workability of concrete without and with date palm fibers

Batch	***Date palm fiber (%)***	***Slump (mm)***	***Decrease in Slump***			
			w.r.t increments in fiber (mm)	***w.r.t B-1 (mm)***	***w.r.t increments in fiber (%)***	***w.r.t B-1 (%)***
B-1	0	62	...			
B-2	1	58	4	4	6.5	6.5
B-3	2	53	5	9	8.6	14.5
B-4	3	47	6	15	11.3	24.2
B-5	4	41	6	21	12.8	33.9
B-6	5	35	6	27	14.6	43.5

2.2.2 Compressive Strength Test

The Compressive strength of concrete with different percentage of date palm fibers are determined by casting and testing standard size cube specimen. Effect of DP fibers on compressive strength is studied in terms of the dosage and length of fibers. The maximum compressive strength of concrete obtained is 26.2 MPa and 26 MPa with 1% DP fibers having ½" and 1" length. The order of the increase in percentage is 28.2 % and 29.3% when compare to that of normal concrete. The compressive strength can be compute by using following formula.

fcu= P/A.

Table.2 Average compressive strength of concrete with date palm fiber (1/2" length)

S. No	**Batch**	**Date Palm Fiber (%)**	**Average compressive strength**	
			MPa	**Psi**
1	B-1	0	20.3	2938
2	B-2	1%	26.2	3799
3	B-3	2%	23.0	3335
4	B-4	3%	15.1	2187
5	B-5	4%	14.9	2161
6	B-6	5%	11.1	1612

Table.3 Average compressive strength of concrete with date palm fiber (1" length)

S. No	*Batch*	*Date Palm Fiber (%)*	*Average compressive strength*	
			MPa	*Psi*
1	B-1	0%	20.3	2938
2	B-2	1%	26.0	3766
3	B-3	2%	24.2	3512
4	B-4	3%	17.6	2549
5	B-5	4%	15.3	2224
6	B-6	5%	15.2	2198

2.2.3 Splitting Tensile Strength Test

The average splitting tensile strength of concrete with ½" and 1" long DP fibers was carried out. Tensile strength of concrete is also affected by the addition of DP fibers. A maximum value of tensile strength 3.12 MPa is achieved in case of 1% fibers of 1" length is added in the concrete. This increase is of the order of the 63.4% when compared to the tensile strength of normal concrete i.e 1.91 MPa. In case of ½" fiber also the maximum tensile strength is achieved at 1% DP fibers which 2.74 MPa is being 43.5% greater than that of normal fibers. The splitting tensile strength can be compute by using following formula

$ft=2P/\pi LD.$

Table.4 Average splitting tensile strength of concrete with date palm fiber (1/2" length)

S. No	*Batch*	*Date Palm Fiber (%)*	*Average splitting tensile strength*	
			MPa	*Psi*
1	B-1	0%	1.91	277
2	B-2	1%	2.74	397
3	B-3	2%	2.51	364
4	B-4	3%	1.77	257
5	B-5	4%	1.48	215
6	B-6	5%	1.57	228

Table.5 Average splitting tensile strength of concrete with date palm fiber (1" length)

S. No	*Batch*	*Date Palm Fiber (%)*	*Average compressive strength*	
			MPa	*Psi*
1	B-1	0%	1.91	277
2	B-2	1%	3.12	452
3	B-3	2%	2.83	410
4	B-4	3%	2.46	357
5	B-5	4%	2.15	312
6	B-6	5%	1.72	249

III. RESULTS

From the experimentalinvestigation the following conclusions are drawn:

1. Workability of concrete is affected with the addition of D.P fibers. Workability of concrete decreases with increase in the D.P fibers. Decrease in slump of 27mm is observed which is 43.5% less than that of the normal concrete which is found to be 62 mm.
2. Workability behavior of concrete increases that the addition of D.P fibers may be limited to the minimum dosage at the fixed water cement ratio. However if the D.P fibers dosage is necessary to increase then w/c ratio may be adjusted accordingly in order to maintain the required workability (slump value).
3. Average compressive strength of concrete is also affected with the addition of D.P fibers. The average compressive strength increases with the addition of D.P fibers up to certain level of dosage of DP fibers.
4. Maximum compressive strength obtained is 26.2 MPa in case of 1% and ½" long added in concrete. This compressive strength is 29.3% greater than that of normal concrete.
5. The minimum compressive strength obtained is 11.1 MPa which is 45% less than that of normal concrete.
6. The length of D.P fibers in case of the compressive strength of concrete difference is marginal to be ignored. In both the cases maximum strength are achieved 1% D.P fibers which is decreases with the further addition of dpfibers beyond 1%.
7. Likewise compressive strength, the maximum values of tensile strength in both the cases of length of D.P fibers are obtained with 1% fibers.
8. However D.P fibers length has pronounced effect on tensile strength.
9. The maximum tensile strength achieved is 3.12 MPa and 2.74 MPa when 1% D.P fiber of 1" and 1/2" length is added in the concrete which are 63.4% and 43.5% greater than that of 1.91 MPa obtained for normal concrete.
10. Tensile strength of concrete with D.P fibers with different dosage (from 1% to 5%) 1/2"and 1" length with the standard values when compare to the compressive strength of respective both and normal.
11. The tensile strength ranges between 7% and 15%.

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