BEAM BEHAVIOUR UNDER MONOTONIC LOADS

Fedol Ghazi
•
Bechar University B. P. 417, 08000 Bechar, Algeria
E-mail: gfedol@yahoo.fr

Pr: Hamouine Abdelmadjid
•
Bechar University B. P. 417, 08000 Bechar, Algeria
E-mail: ahamouine@gmail.com

Dr: Zouaoui Chikr el Mezouar
•
Bechar University B. P. 417, 08000 Bechar, Algeria
E-mail: *chikrtime@yahoo.fr*
Tel: 213 49 81 55 81/91; Fax: 213 49 81 52 44

Abstract

In this work we interest to study the beam behavior under monotonic loads in four point, to improve the mechanical properties of a concrete beam fiber and establish an identification card of the new concrete beams were comparing these beams witnesses.

Keywords: matrix materials, reinforcements, fiber characterization, charge arrow monotonous beam, ductility.

1. Introduction

From earlier the research were based on how to reinforce materials with fiber plantin order to increase there mechanical resistance and improve there stability. In the past they used the ‘’***Torchis ‘’ was*** of clay reinforced with straw put in place by compression.

(Kriker et al 2005) used the date palm fibers as building blocks in cement matrix composites. They showed that the increase in length and percentage of fibers improve the flexural strength and post-elastic hardness of the composite, but decrease the compressive strength.

The work presented here is an analysis of the behavior of fiber-reinforced beams armed as bellow:

- Study the effect of the incorporation of fibers in a cement matrix
- Study the recovery of fibers as reinforcements
- Determine the increase in flexural strength under monotonic loading increasing
- Observe the mode of cracking

The first set of standardized test used to determine the compressive strength and tensile strength in bending.

The second set concerns the 4-points bending beams (15x10x60 cm) that will be subjected to a monotonically increasing load until failure.

2. Presentation of the materials tested

2.1 Materials in base

For any current use of concrete fiber in the building was used aggregate crushers in the region with a dosage of 350 kg/m3 cement

2.1.1 Cement

The cement used is a type of cement CEMII 42.5 NA 442, physical properties are given in the table below

Table 1: The results of standard tests carried out on this cement are given in Table 2

Test	Chatelier expansion	specific surface (Blaine)mm^2/g	consistency normal
start End 2h50mn 4h06mn	hot cold 2.90 1.65	3891	26.91

Table 2: Mechanical resistance cement (bar)

tests	Age		
	2days	7days	28 days
Compression (b)	143.2	266.4	433.1
Flexion (b)	35.7	58.3	77.9

2.1.2 Mixing water

The water used in mixing is the tap (dam Djorf ettorba), the results of physicochemical analysis are as follows:

Table 3: Results of analysis of water-chemical physic

PH	Matter in suspension	Chlorides Mg/l	Sulfates Mg/l	Residue sec 105 C^0	Conductivity 25 C^0 µs/cm
8,13	Null	234,3	123,02	800,00	0,93

2.1.3 Aggregates

The gravels are Petro graphically micritic limestone partly dolomitize sandstone, sand consists mainly of these proportions: Silica and limestone following rigorous testing of these materials are characterized as follows:

Table 4: Particle size analysis has given us the following composition for a dosage of 350Kg/M3

Designation Class d/D	Product Sand 0/3	Gravel 3/8	Gravel 8/15
Mass volumique Absolute Apparent	2,5 t/m^3 1,85 t/m^3	 1,53 t/m^3	2,66 t/m^3 1,41 t/m^3
Surface properties%		1,0 %	0,80 %
Equivalent sable %	67 %		

Coefficient LA	21 %≤ 40 %	
Coefficient M.D.E	17 %≤ 35 %	
Nature	calcareous silico	Sandy dolomitic limestone
Fineness modulus	1,95	

Table 5 Composition of 1 m3 of concrete

	%	Volume absolute	Mass volumique absolut [t/m^3]	Mass [Kg]	Mass volumique Apparent [t/m^3]
Ciment	13,85	112,9	3,1	350	1
Sand (0/4)	37,15	302,7	2,5	756,7	1,85
Gravel(3/8)	16	130,4	2,66	346,9	1,53
Gravel(8/15)	33	268,ç	2,66	715,2	1,41
Concrete sec	100	815	/	2168,8	/
Water	/	185	1	185	1

According to this composition were obtained concrete firm for a 1cm subsidence ratio (E / C = 0.53), the collapse is obtained for a de6cm (E / C = 0.60), for a Mix = 1.5%; Mix in means the ratio of fiber relative to the aggregates,. Here is the composition of the concrete practice

Table 6: Composition of Concrete Practice Mix for 1 m3 of 1.5%

	%	Volume absolute	Mass volumique absolut [t/m^3]	Mass [Kg]	Mass volumique Apparent [t/m^3]
Ciment	14,29	112,9	3,1	350	1
Sand (0/4)	36,71	290	2,5	725	1,85
Gravel(3/8)	16	126,4	2,66	336,2	1,53
Gravel(8/15)	33	260,7	2,66	693,46	1,41
Concrete sec	100	790	/	2104,66	/
Water	/	210	1	210	1

The identifications of the various physical and mechanical aggregates showed conformance to specifications of standard NF P18 301 (Georges 1990), Also, aggregates (G1, G2 and S) shows no abnormality in their grading curves, and Based on these results in these fractions fall into classes 0 / 3, 3 / 8 and 8/15selon NF P18 560.

2.1.4 Fibre Plant

We use the leaves of palms date palms of the type of Taghit Oisis "Fegousse" to the saturated state antecedent research have shown a clear difference between concrete and full of dry fiber Fiber identification:

A) Property-mechanical: test is used for axial tractions a sample of 20 fiber dimensions 0.35 mm thick, with a length of 30mm and a width of 6 mm,

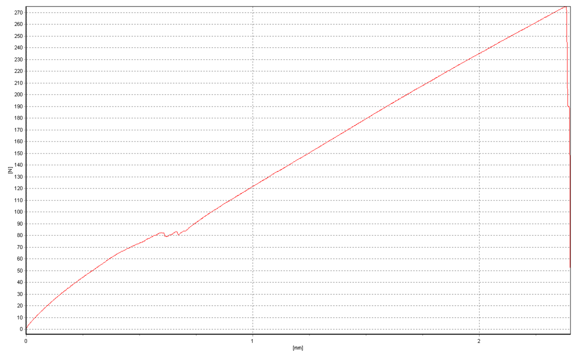


Figure 1: Tensile force in function of the elongation

The results are given in the following table:

Table 7: characteristics Mechanical of the fiber

Resistance to traction (Mpa)	The longer %	Coeff of absorption %	Modulus of elasticity (Mpa)
114	6,5	132	17,58

B) Adhesion Fibre – Concrete

The Essay adhesion pull-out test To evaluate the bond stress fiber matrix, we use the direct test method (pull-out), so we anchor the fiber in a cement matrix and then applying a tearing force on the fiber during the test is fixed fiber dimensions (length 150mm, width 7 mm, thickness 0.55mm), the only variable is the anchorage length we take the length and 3 cm respectively 1.5,2,2.5 are used specimens

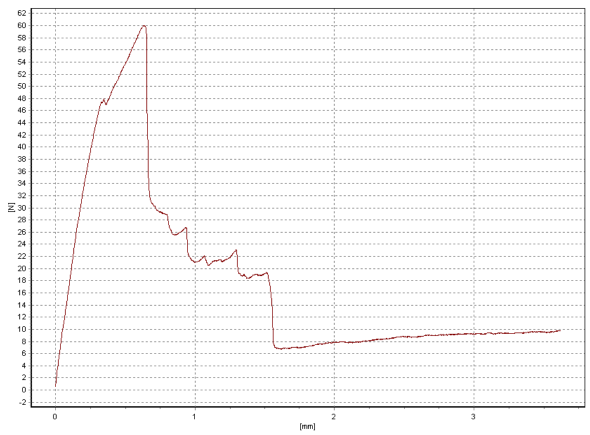


Figure 2: Breakout force versus slip

Analysis of the pull-out curve:

Pcr: the end of the elastic behavior, it is a critical shift Δcr (elastic zone)
Pmax is the maximum force before detachment, which corresponds to a shift Δmax
Δ0: the shift corresponding to the total detachment
After several direct axial pullout tests in the following figure summarizes the adhesion Force based on the anchorage length

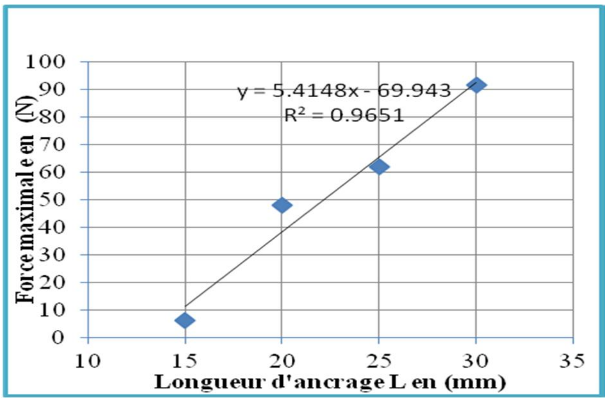


Figure 3-curve of the maximum force based on the anchorage length

3. Experimental Method

3.1 Compression test: Compression tests are carried out on cubes of 10x10x10 cm 3 after 28 days

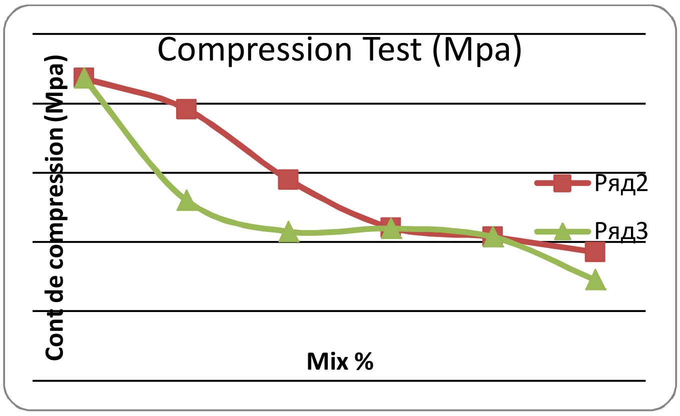


Figure 4: test on cubes of 10x10x10 cm 3 after 28 days

3.2 Tensile test 4-point bending

They summers 7X7X28 performed on samples after 28 days

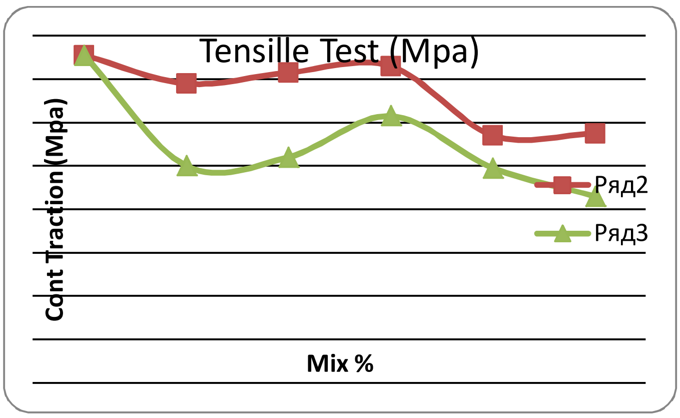


Figure 5: 7X7X28 performed on samples after 28 days

After compression tests and tensile Note that there is a considerable drop constraint (over 50%) are increasing the fiber content (Mix) as is consistent with studies Similar [2]

Reinforcement

For the longitudinal reinforcement is used under the terms of 4T10 non fragile (Section A.4.2 of BAEL)

For transverse reinforcement conditions of shear imposes Φ6 spacing of 7 cm at the supports.

We chose the minimum percentage to see the behavior of concrete in tension and compression.

4. Results of static tests:

4.1 Charge-arrow diagram

Analysis by the Mix

The results obtained can be classified our sample into 2 categories, the first consisting of the control concrete, and those of Mix 0.5%, 1.0%, the second category that of1, 5%, 2.0% and 3.0%. In the first category we find that the curves of the three components are combined in a first zone (zone without degradation) is the elastic zone and an area with a slight shift of the beginning of cracking (phase elasto-plstique) and finally a plastic phase that ends in failure. The tensile strength in bending of fiber-reinforced beams is 1.21% times more than the control concrete, for against the influence of fiber length appears in the arrow registered; it to an arrow of 2.46 mm for a fiber length of 6 cm and 2.54 mm for the fiber to 4cm Mix 0.5% in the second category there is clearly brought on beam ductility (an arrow of 3.8 mm for the Mix 3% to 6 cm fiber) against it by a break for a load of 55 KN of course this is a break due to compression

4.2 Module of elasticity

The modulus of elasticity is a constant mechanical stress of materials, is given by the slope of the first part of the diagram (σ, ε%) is an instantaneous modulus calculated first threshold. We note that for Mix 0.5% fiber is 4 cm in the same behavior materials by the cons there is a drop in module for the other

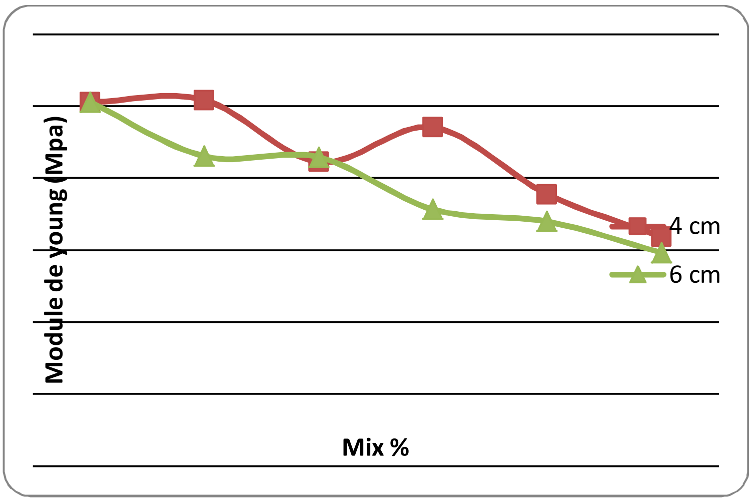


Figure 6 : Module of elasticity

4.3 Ductility Index

Among the important advantages of fiber concretes that improve the ductility of materials, which plays an important role in seismic areas (avoids sudden destruction of a building) is an important research in the future, so we see that the contribution of fibers to dramatically improve its ductility than the control concrete (Mix for 0.5%, 1% and 1.5%)

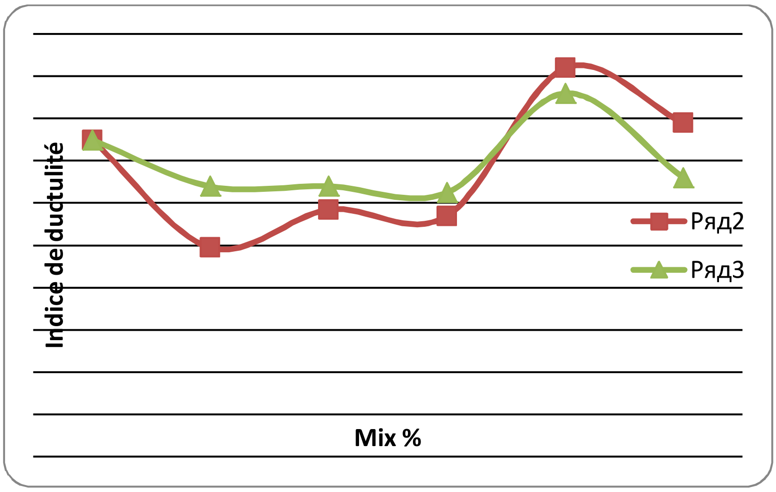
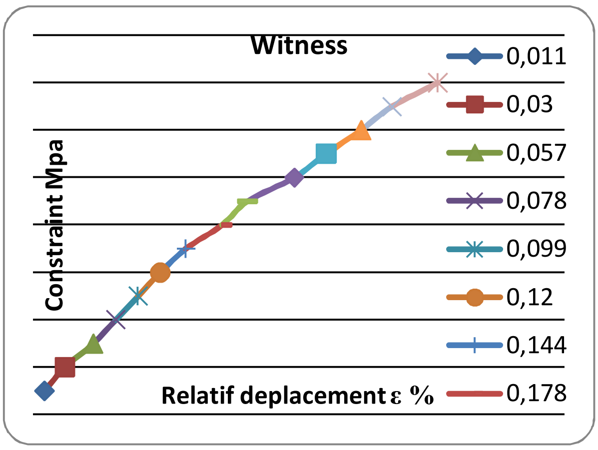


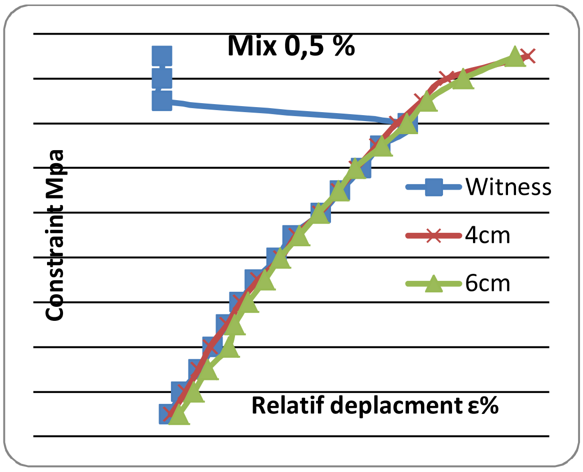
Figure 7 : Ductility Index

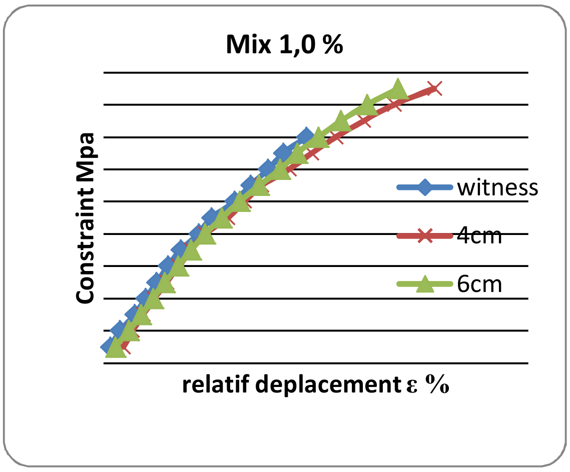
5. Conclusion

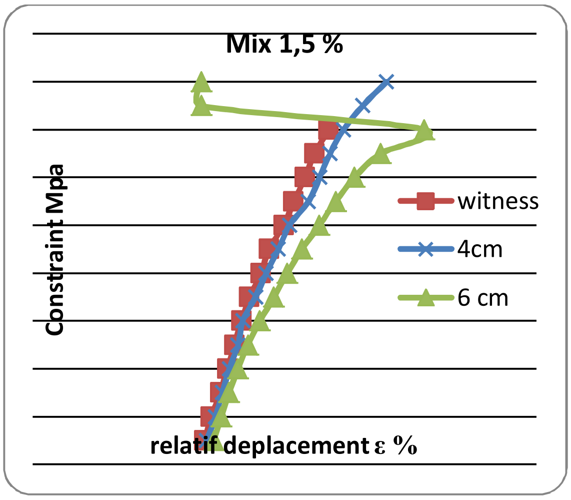
The incorporation of the fibers of date palms wet brings a significant improvement in the behavior of beams in four point bending ductility and its bearing capacity, noting that actual performance summers were obtained without requiring a particular choice of cement (CPJ 45) commonly used with a dosage of 350 kg/m3 or natural aggregates after the crusher, recalling that the compressive stress of the control concrete was 21.5 MPa, our goal was to explore the possibility of using fiber in the current building, after analyzing the different steps it is clear that the Mix 0.5% of the fibers of 4 cm gives the best results, the tensile strength was 1.21% higher than the control concrete by cons ductility was lower than the control concrete, the increase in fiber actually increased its plastic deformation for the Mix 0.5% (4 cm) is the strain at break is greater than that of control concrete by 50% but in a sharp decrease its compressive stress and tensile

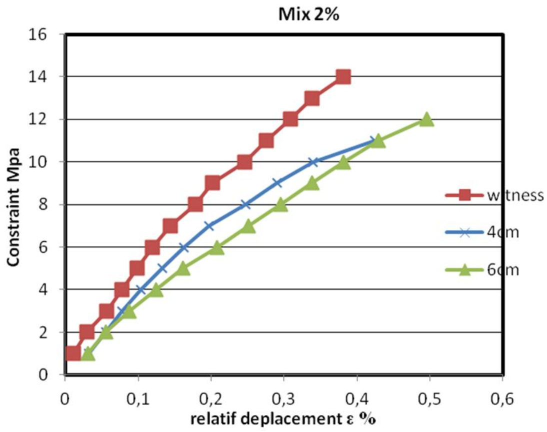
Results of tests:

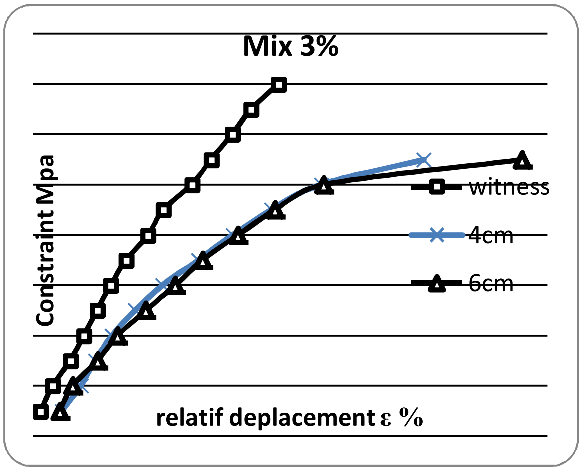












References:

[1] Abbani Said. «Caractérisation et durabilité des bétons renforcés de fibres végétales de palmier dattiers».2003.Mémoire de magister, Université d'Ouargla.

[2] Khenfer.M.M, MorlierP. 'Effet de la longueur des fibres sur les propriétés mécaniques des ciments renforcés de fibres cellulosiques'. *Materials and structures* (24)(1991)185-190.

[3] A. Kriker, G. Debicki, A. Bali, M. M. Khenfer, M. Chabannet 'Mechanical properties of date palm fibres and concrete reinforced with date palm fibres in hot-dry climate *Cement and Concrete Composites, Volume 27 (2005) 554-564*

[4] A.Kriker, A.Bali, G. Debicki, M. Bouziane, M. Chabannet 'Durability of date palm fibres and their use as reinforcement in hot dry climates *Cement and Concrete Composites' Volume 30 (2008) 639-648.*

[5] Nadia Benmansour « Etude des performances de produits renouvelables et locaux adaptés aux applications de l'isolation thermique dans le bâtiment »-Thèse de Magister Université Hadj Lakhdar, Batna (2011)

[6] G.Dreux et J.Festa « Nouveau guide du béton et de ses constituants » 8^{iem} édition Eyrolles 1998

[7] Cesar Juarez, Gerardo Fajardo « Caracterisation microstructurale des fibres naturelles pour des materiaux composites a base de ciment » Canadian Journal of Civil Engineering March 1, 2009.

[8] «Guide de bonnes pratiques pour l'utilisation des fibres dans le béton »-Réalisé par l'association béton Québec en collaboration avec les manufacturiers de fibres métalliques et de fibres synthétiques-janvier 2005.

[9] Hachani Imane et Khelif Rima « Etude de l'effet de la géométrie des fibres synthétiques sur les propriétés physico synthétiques sur les propriétés physico-mécaniques des mortiers à sable calcaire » mémoire d'ingénieur d'état (2009) Université Ammar Telidji à Laghouat.

[10] Mourad Chikhi « Métrologie et Modélisation des Transferts dans les Composites Naturels à Faible Coût pour l'Isolation Thermique dans le Bâtiment en Algérie » Thèse de Magister Université Hadj Lakhdar, Batna (2010)

[11] Pascal Casanova « Béton renforces de fibres » thèse de Doctorat l'Ecole Nationale des Ponts et Chaussées 26 juin 1995.

[12] Ali Kaflou « Etude du comportement des interfaces et des interphases dans les composites a fibres et a matrices céramiques » thèse de Doctorat L'Institut National des Sciences Appliquées de Lyon, 20 Mars 2006.

[13] J.M.Alwan , A.E.Naaman et W.Hansen « Pull-out Work of Steel Fibers From Cementitious Composites :Analyse Investigation » Department of Civil Engineering, 2340 G.G. Brown Building, College of Engineering, University of Michigan, Ann Arbor, MI 48109-2125, USA, 24 may 1991.

[14] H.Houari. « Contribution à l'étude du comportement du béton renforcé de fibres métalliques soumis à l'action des charges maintenues et cycliques. »1993. INSA Lyon.243 p.

[15] Valade. T. 'Comportement des bétons armés de fibres' *; Mémoire de D.E.A, L.C.P.C,* (Décembre 1987).

[16] Amina Djoudi, Mohammed Mouldi Khenfer, Abderrahim Bali «Etude d'un nouveau composite en platre renforce avec les fibres végétale du palmier »-1st International Conf erence on sustainable Built Environment Infrastructures in Developing Countries ENSET Oran (Algeria) – Octobre 12-14, 2009.

[17] Richane SACI « Prise en compte de l'orientation des fibres dans une poutre continue à matrice de béton » -Thèse de Magister Université Mohamed Boudiaf M'sila (juillet2004).