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Deflection characteristics of concrete beams reinforced with fan palm coated with water repellant agents

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A B S T R A C T

The use of fan palm as reinforcing material in building industry is gaining interest. Fan palm was found to have similar characteristics trend similar to that of steel, however, for its short-term uses it was found to deflect about four times of the equivalent steel reinforced concrete beams. In this study, deflection characteristics of the beams reinforced with fan palm coated with water repellant agents (Sulphur, Epoxyl and Bitumen) were examined. Fan palm specimens were sliced and smoothen to 10x10x500 mm. another set were uncoated to serve as control. 75 x 100x500 mm wooden mold were made as formwork. Fan palm reinforcement inserted and the concrete mixed of 1:2:4 poured and converted to filled the mould with the fan palm reinforcement. The mould were removed after 24 hours. The beams then removed and cured for 28 days in water. Day were then air dried for 2 hours before soaked in 0.1M NaOH solution for 7, 14, 28, 56, 90, 180, 270 and 365 days. they were then subjected to flexural deflection test on UTM machine. The result showed that beams reinforced with fan palm coated with bitumen suffer less deflection while those with uncoated fan palm suffered the highest deflection.

Introduction

The idea of using fan palm as a reinforcing material in concrete elements like beams, slabs and columns is gaining interest because of its economic advantage. Fan palm has characteristics strength behaviors similar to that of steel, although of lower ultimate tensile strength. In building industries, strength of the material is not only given due consideration but also serviceability conditions. It was reported that air dried fan palm ultimate tensile strength is just 1/3rd of the ultimate tensile strength of high yield steel. Also beams reinforced with fan palm deflect more than the equivalent beams reinforced with steel

(Ibi, 1988 Omotosho, 1988 and Audu, 1989).

The deflection of a structural member is one of the major criteria to be considered in limit state design of reinforced concrete member (BS 8110). A structural member must not only be able to sustained the load its carrying but must also not deflect excessively as the coat fear to the users. The idea of using coated fan palm as reinforcement to replace steel in structural member that carries light load was suggested by Audu (2015) after noticing that fan palm could be made durable in concrete by coating with bitumen before inserting into the concrete. There are earlier studies on the use of wood fibre as a possible replacement for steel in structural members for short term.

Adetifa (1988), Bystriakova *et al.* (2003) studied extensively on the physical, mechanical properties and the use of bamboo as reinforcements in concrete elements. The materials were found out to be highly susceptible to dimensional changes and lose strength with time in alkaline media and concrete elements reinforced with it had excessive deflection. Studies on the physical and mechanical characteristics and the use of fan palm as reinforcement for concrete elements for short-term uses of recent gained studied in the past decades. Fan palm, *Borassus aethiopum*, commonly called African fanpalm is a species of Borassus palm from Africa. Physical and mechanical properties of fan palm as reported by Fache (1983), Omotosho (1988) and Jimoh (1990) shows that its moisture content is between 10–12% air dried, fresh fan palm has moisture content as high as 100%. Air dried fan palm could only absorbed up to 7% moisture and hence stable dimensionally. The tensile strength of fan palm was reported to be within 70–150N/mm^2, Fache (1983), Omotosho (1988), the study on the load carrying capacities were carried on of fan palm reinforced concrete beams and slab by Omotosho (1988), Audu (1989), Ibi (1988). It was reported that fan palm reinforced members could carry 2 to 3 times the ultimate load of an equivalent unreinforced members. Omotosho (1988) further reported that fan palm reinforced members behave similarly to steel reinforced members provided the load did not exceed 55% of the failure load.

Concrete is a composite inert material comprising of a binder course (e.g cement), mineral filler (aggregates) and water, Neville (1989). Aggregates are of two types, fine and coarse. They are usually graded from sand to stone. There are two types of concrete; light weight concrete and dense concrete. The light weight concrete weighed between 1600 to 2000 kg/m^3, while the dense concrete has an average density of 2400 kg/m^3 (Orchad, 1976).

Decomposition of fibre in concrete is a consequence of the material being attacked by alkaline pore water in the concrete. One way to avoid or delay this decomposition could be to impregnate the fibre with an agent who reacts with certain fibre components and build up compounds which are difficult to dissolve in an alkaline environment. Different impregnating agents such as sodium silicate, sodium sulphate, magnesium sulphate, iron and copper compounds, barium salts, anti oxidants, hydroxylamine, etc have been used on sisal fibre but the results according to Gram, (1987) showed little improvement on the durability of the sisal fibre in a cement matrix. BS 8110, 1989 stipulate that the deflection of concrete beam should not exceed $^{L}/_{26}$, $^{L}/_{20}$, $^{L}/_{7}$ for continuous, simply support and cantilever beams respectively.

Materials and Methods

Flexural wooden molds of 75 mm x 100 mm x500 mm were made to accommodate the flexural reinforcements and provide forms for the fresh concrete beams. Concrete mix of 1:2:4 by weight were prepared with water cement ratio of 0.55 using concrete mixer. The prepared concrete was then poured in the mold and compacted manually using tampering rod. The molds were removed after 24 hours. The beams were cured for 28 days by wetting in the morning and evening.

After 28 days the beams were conditioned in the alkaline medial for the desired ages. The beams were completely immersed in alkaline solution. Flexural strength test were carried out at room temperature and as per the British Standard, BS 1881, 1983. The test was carried out on an Automatic Universal Testing Machine [(AUTM) which is shown in Figure 3.4]. Middle span line loading were applied on reinforced concrete beams at the compression zone of the AUTM. The specimens were placed on 100 tonnes capacity loading frame and a diaguage was attached to measure the deflection readings at mid span. The load was applied on the flexural specimens through the load engaging knob at the speed of 2 kN/min. the flexural stress was computed using equation:

$$F = \frac{125P - 140625}{1000}$$

Result and Discussion

The results of flexural deflections obtained from the tested fan palm reinforced concrete beams coated with blocking agents are presented in table 1. While figure 1, figure 2, figure 3, figure 4, figure 5, figure 6 and figure 7 presents the graphical deflection as the beams at 7, 28, 56, 90, 180, 270 and 365 days conditional in 0.1M Na0H solution. At 7 days, the mean deflections are close at computing loads but beam reinforced with fan palm coated with epoxy had the highest mean deflection of 44.37m at failure load of 8kN. At 14 days, the mean deflection are close for all the reinforce beams and also beams reinforced with epoxy had the maximum deflection of 44.33 mm at 14 days. While at 28 days, beam reinforced with sulphur suffered the highest deformation of 40.50 mm.

The results for the beams soaked in alkaline 56 days showed that beam specimens reinforced with fan palm coated with epoxy had the maximum deflection of fan palm at the failure load of 33.33. At 90 days, beams reinforced with fan palm coated with epoxy and sulphur suffered the maximum deflection of 33.33. At 180 days, out of the concrete beam reinforced with water repellant agents, beams reinforcement with epoxy still suffered the maximum flexural deflection of 40.00 mm. However beam reinforced with fanpalm coated with sulphure failed at higher load of 6kN.

At 270 days, it was observed from figure 8 that beam reinforced with fanpalm coated with sulphur had maximum deflection of 45.00 mm. At 365 days, concrete beams reinforced with epoxy had the maximum deflection of 45.00 mm. It was also observed that at 365, the deflections of the beams are not as closed as those between age 7–270 days. It could be said that at the age below 270, the deflection of the beam are close and the treatments applied do not have significant effect of the deflection of the beams. But at the age between 270 – 365 days, the effects of the treatment on the fan palm reinforcement on the deflection of the beams begin to manifest.

Table.1 Deflection of beams at 7 days

	Specimen	Deflection (mm)							
	LOAD (kN)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Uncounted	DU DU1	8.0	15.0	26.0	31.0	20.0	35.0	40.0	45.0
	DU2	8.5	13.0	20.0	29.0	30.0	34.0	38.0	42.0
	DU3	9.0	14.5	22.5	28.0	30.0	35.0	39.0	43.0
	DU	**8.50**	**14.17**	**22.83**	**29.33**	**30.67**	**34.67**	**39.00**	**43.00**
	DE DE1	8.5	18.0	21.0	SF	28.0	33.0	39.0	43.0
	DE2	7.5	17.5	20.0	SF	29.0	37.0	40.0	45.0
	DE3	8.5	19	21.5	SF	30.0	35.0	41.0	45.0
	DE	**8.17**	**18.67**	**20.87**	**SF**	**29.00**	**35.00**	**40.00**	**44.33**
Repellants	DS DS1	9.5	10.5	28.0	SF	31.0	33.0	37.0	40.0
	DS2	7.5	10.0	20.5	SF	32.0	34.0	37.0	39.0
	DS3	6.5	12.0	22.0	28.0	33.0	35.0	37.0	40.0
	DS	**7.83**	**10.83**	**23.50**	**28.00**	**32.00**	**34.00**	**37.00**	**39.67**
Water	DB DB1	8.5	12.0	17.0	18.0	28.0	32.0	34.0	36.0
	DB2	8.5	13.5	17.2	19.0	30.0	33.0	35.0	38.0
	DB3	9.0	13.0	16.5	19.5	24.0	30.0	33.0	37.0
	DB	**8.67**	**12.87**	**16.90**	**18.87**	**27.33**	**31.67**	**34.00**	**37.00**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Table.2 Deflection of beams at 14 days

	Specimen		Deflection (mm)							
	LOAD (kN)	**1**	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Uncounted	D_U D_{U1}	6.0	9.5	17.0	46.5	48.0	50.0	52.0	54.0	
	D_{U2}	6.4	10.5	19.0	40.0	32.0	35.0	38.0		SF
	D_{U3}	6.3	10.0	18.0		21.0	34.0	40.0	42.0	SF
	D_U	**6.23**	**10.00**	**18.00**	**43.20**	**37.00**	**39.67**	**43.33**	**46.00**	**SF**
	D_E D_{E1}	8.5	18.0	21.0	SF	28.0	33.0	39.0	43.0	SF
	D_{E2}	7.5	17.5	20.0	SF	29.0	37.0	40.0	45.0	SF
	D_{E3}	8.5	19.0	21.5	SF	30.0	35.0	41.0	45.0	SF
	D_E	**8.17**	**18.67**	**20.87**	**SF**	**29.00**	**35.00**	**40.00**	**44.33**	**SF**
Repellants	D_S D_{S1}	6.0	7.8	9.8	28.5	47.0			50.0	SF
	D_{S2}	7.5	10.0	20.5	SF	32.0	34.0	37.0	39.0	SF
	D_{S3}	6.5	12.0	22.0	28.0	33.0	35.0	37.0	40.0	SF
	D_S	**7.83**	**10.83**	**23.50**	**28.00**	**32.00**	**34.00**	**37.00**	**39.67**	**SF**
Water	D_B D_{B1}	8.5	12.0	17.0	18.0	28.0	32.0	34.0	36.0	40.0
	D_{B2}	8.5	13.5	17.2	19.0	30.0	33.0	35.0	38.0	41.0
	D_{B3}	9.0	13.0	16.5	19.5	24.0	30.0	33.0	37.0	38.0
	D_B	**8.67**	**12.87**	**16.90**	**18.87**	**27.33**	**31.67**	**34.00**	**37.00**	**39.67**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Table.3 Deflection of beams at 28 days

	Specimen Load P (kN)		1	2	3	4	5	6	7
	Deflection (mm)								
Uncounted	D_U	D_{U1}	8.0	15.0	23.0		28.0	33.0	38.0
		D_{U2}	8.0	16.0	15.0		25.0	30.0	35.0
		D_{U3}	7.0	18.0	26.0		26.0	32.0	40.0
		D_U	**7.67**	**16.33**	**23.50**		**26.33**	**31.67**	**37.67**
Repellants	D_E	D_{E1}	6.0	13.0	21.0		29.0	33.0	37.0
		D_{E2}							
		D_{E3}	6.0	13.0	21.0	29	31.0	34.0	38.0
		D_E	**6.00**	**13.00**	**21.00**	**29.00**	**30.00**	**33.50**	**37.50**
	D_S	D_{S1}	8.0	16.0	26.0	30.0	36.0	38.0	42.0
		D_{S2}	9.0	17.0	25.0	34.0	36.0	39.0	
		D_{S3}	8.5	15.0	24.0	38.0	33.0	35.0	39.0
		D_S	**8.50**	**15.00**	**24.00**	**36.00**	**37.00**	**37.33**	**40.50**
Water	D_B	D_{B1}	7.0	11.0	16.5	20.5	29.0	31.0	37.0
		D_{B2}	8.0	14.0	18.0	19.0	24.0	28.0	35.0
		D_{B3}	9.0	15.0	19.0	25.0	30.0	32.0	36.0
		D_B	**8.00**	**13.33**	**17.87**	**21.50**	**27.67**	**30.33**	**36.00**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Table.4 Deflection of beams at 56 days

	Specimen Load P (kN)		1	2	3	4	5	6	7
	Deflection (mm)								
Uncounted	D_U	D_{U1}	7.8	14.0	21.0	31.0	33.0	36.0	
		D_{U2}	8.7	13.5	21.5	32.0	34.0	38.0	
		D_{U3}	8.5	13.0	20.0	31.0	34.0	39.0	
		D_U	**8.33**	**13.5**	**20.83**	**31.33**	**33.67**	**37.67**	
Repellants	D_E	D_{E1}	8.0	19.0	21.5	30.0	32.0	33.0	37.0
		D_{E2}	7.5	16.5	22.5	31.5	33.0	35.0	
		D_{E3}	9.6	20.0	22.5	33.0	34.0	37.0	
		D_E	**8.37**	**18.50**	**22.50**	**32.17**	**33.00**	**35.00**	**37.00**
Water	D_S	D_{S1}	7.5	*18.0	20.0	29.5	32.0	34.0	
		D_{S2}	*4.5	11.5	17.1	29.1	32.0	35.0	
		D_{S3}	6.0	12.0	15.0		33.0	34.0	
		D_S	**6.85**	**13.83**	**17.37**	**23.90**	**32.33**	**34.33**	

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Table.5 Deflection of beams at 90 days

	Specimen	Load (kN) Deflection (mm)	1	2	3	4	5	6	7
Uncounted	D_U	D_{U1}	8.0	14.0	20.0		24.0	32.0	
		D_{U2}	8.5	14.0	25.0		28.0	38.0	
		D_{U3}	9		27.0				
		D_U	**8.50**	**14.00**	**24.00**		**26.00**	**35.00**	
Repellants	D_E	D_{E1}	8.1	15.0	18.0	25.0	28.0	33.0	
		D_{E2}	7.8	14.0	19.5	27.5	30.0	35.0	
		D_{E3}	8.5	12.0	21.0	24.3	27.0	32.0	
		D_E	**8.13**	**13.33**	**19.5**	**25.63**	**28.33**	**33.33**	
	D_S	D_{S1}	7.5	13.0	19.0	20.0	28.0	32.0	
		D_{S2}	7.5	12.0	18.0	22.0	29.0	33.0	
		D_{S3}	7.0	12.5	17.0		28.0	34.0	
		D_S	**7.33**	**12.50**	**18.00**	**21.00**	**28.33**	**33.00**	
Water	D_B	D_{B1}	8.0	12.5	18.5	20.0	24.0	28.0	34
		D_{B2}	8.1	12.5	18.5	24.0	26.0	30.0	
		D_{B3}	7.0		19.0	23.5	26.0	33.0	
		D_B	**7.77**	**12.5**	**18.67**	**22.5**	**25.33**	**30.33**	**34**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline:
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy:
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:
D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur

Table.6 Deflection of beams at 180 days

	Specimen	Load (kN) Deflection (mm)	1	2	3	4	5	6
Uncounted	D_U	D_{U1}	8.0	17.9	23.0	27.0	32.0	35.0
		D_{U2}	8.7	19.0	25.0	28.0	33.0	40.0
		D_{U3}	9.5	17.0	25.0	28.0	30.0	38.0
		D_U	**8.73**	**17.97**	**24.33**	**27.67**	**31.67**	**37.67**
	D_{UW}	D_{W1U}	7.5	15.0	22.0	39.0	39.0	41.0
		D_{uw2}	9.5	16.5	24.5	35.5	38.0	40.0
		D_{UW3}	8.0	17.0	23.5	33.0	36.0	39.0
		D_{UW}	**8.33**	**16.17**	**23.33**	**35.83**	**37.67**	**40.00**
Repellants	D_E	D_{E1}	8.0	13.5	18.0	25.0	33.0	36.0
		D_{E2}	8.5	14.0	20.0	27.0	37.0	38.0
		D_{E3}	7.6	14.0	20.0		40.0	43.0
	D_S	D_{S1}	7.5	18.0	20.2	35.0	36.0	38.0
		D_{S2}	6.0	20.0	26.0	37.0		
		D_{S3}	7.0	18.2	27.8	39.1	41.0	45.0
		D_S	**6.83**	**18.73**	**24.63**	**37.03**	**38.67**	**41.67**
Water	D_B	D_{B1}	7.0	13.0	18.0		24.0	30.0
		D_{B2}			8.5	12.5	19.5	
		D_{B3}	8.0	13.5	20.5		28.0	38.0
		D_B	**8.03**	**13.00**	**19.33**		**26.00**	**34.00**

Table.7 Deflection of beams at 270 days

	Specimen		Load (kN)					
	Deflection (mm)		**1**	**2**	**3**	**4**	**5**	**6**
Uncounted	D_U	D_{U1}	10.0	18.0	26.0	42.0		
		D_{U2}	10.5	19.5	26.5			
		D_{U3}	10.5	17.5	25.5	44.0	45.0	
		D_U	**10.33**	**18.33**	**26.00**	**43.00**	**45.00**	
Repellants	D_{UW}	D_{UW1}	9.5	17.0	24.0	42.0	43.0	
		D_{uw2}	9.5	17.5	25.0	41.0	45.0	
		D_{UW3}	9.0	18.5	25.0	40.0	42.0	
		D_{UW}	**9.33**	**18.00**	**24.67**	**41.00**	**43.33**	
Water	D_E	D_{E1}	8.5	14.0	19.0	32.0	34.0	40.0
		D_{E2}	9.0	14.5	20.0	37.0	39.0	44.0
		D_{E3}	8.3	13.8	19.5	37.0	39.0	45.0
		D_E	**8.60**	**14.10**	**19.50**	**35.33**	**37.33**	**43.00**
	D_S	D_{S1}	8.5	14.0	24.0	39.5	42.0	45.0
		D_{S2}	8.0	15.0	23.0	40.0	41.0	44.0
		D_{S3}	9.0	14.5	24.0	41.0	43.0	46.0
		D_S	**8.50**	**14.50**	**23.67**	**40.17**	**42.00**	**45.00**
	D_B	D_{B1}	7.3	14.0	22.0	29.0	32.0	38.0
		D_{B2}	8.0	13.5	21.0	28.5	31.0	38.0
		D_{B3}	8.5	13.3	21.5	30.0	33.0	39.0
		D_B	**7.93**	**13.39**	**21.50**	**29.17**	**32.00**	**38.33**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Figure.1 Flexural deflection of concrete beams reinforced with fanpalm specimens at 7 days in alkaline solution

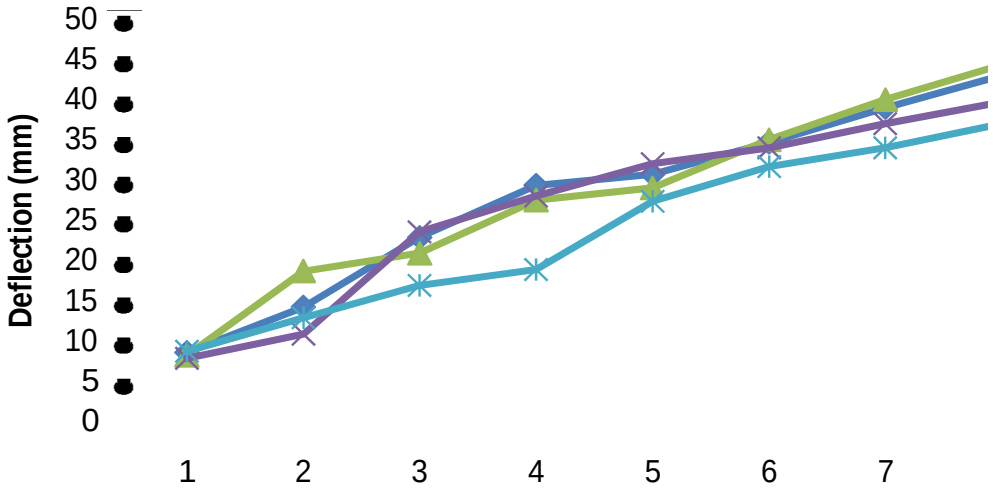
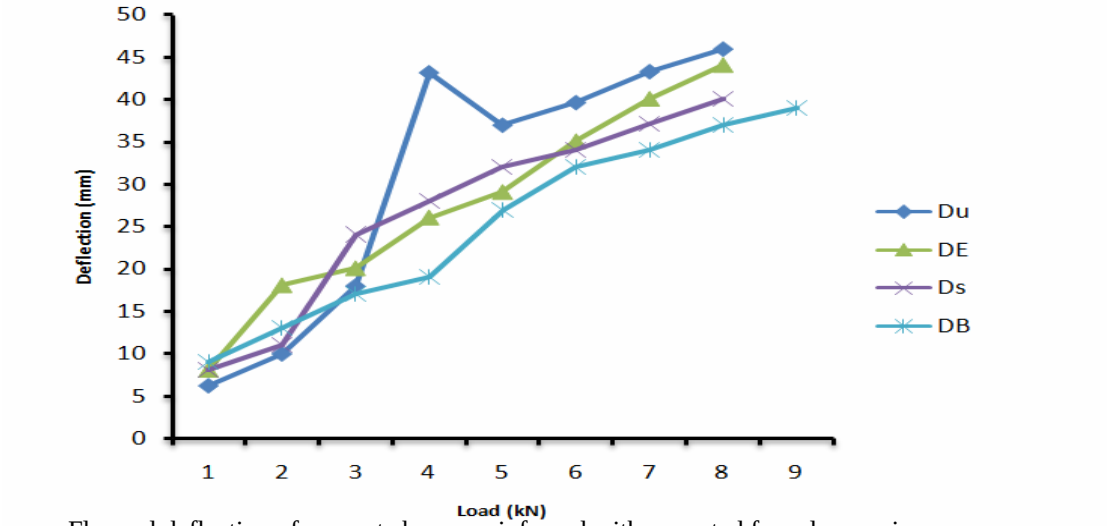


Table.8 Deflection of beams at 365 days

	Specimen	Load(kN) Deflection (mm) 1		2	3	4	5
Uncounted	D_U	D_{U1}	30.0	SF	SF	SF	
		D_{U2}	28.0	35.0	F	F	
		D_{U3}	29.0	40.0	45.0	F	
		D_U	**29.00**	**37.50**	**45.00**	F	F
	D_{UW}	D_{UW1}	30.0		F	F	F
		D_{uw2}	29.0	37.0	F	F	F
		D_{UW3}	30.0	38.0	42.0	F	F
		D_{UW}	**29.67**	**37.50**	**42.00**	F	F
Repellants	D_E	D_{E1}	30.0	41.0	F	F	F
		D_{E2}	28.0	40.0	45.0	F	F
		D_{E3}	25.0	SF	SF	SF	SF
		D_E	**27.67**	**40.50**	**45.00**	F	F
	D_S	D_{S1}	30.0	35.0	F	F	F
		D_{S2}	25.0	32.0	40.0	F	F
		D_{S3}	31.0	40.0	48.0	F	F
		D_S	**28.67**	**35.67**	**42.50**	F	F
Water	D_B	D_{B1}	25.0	33.0	40.0	50.0	62
		D_{B2}	25.5	33.0	41.5	52.0	63
		D_{B3}	26.0	35.0	45.0	51.0	61
		D_B	**25.50**	**33.67**	**42.17**	**51.00**	**62**

D_u = Deflection of Beams Reinforced with Uncoated Fanpalm in Alkaline: D_{WU} = Deflection of Beams Reinforced with Uncoated Fanpalm in Water
D_E =Deflection of Beams Reinforced with Fanpalm Coated with Epoxy: D_s = Deflection of Beams Reinforced with Fanpalm Coated with Sulphur
D_B = Deflection of Beams Reinforced with Fanpalm Coated with Bitumen:

Figure.2 Flexural deflection of concrete beams reinforced with fanpalm specimens at 14 days in alkaline solution



D_U: Flexural deflection of concrete beams reinforced with uncoated fanpalm specimens
D_E: Flexural deflection of concrete beams reinforced with Fan palm coated with epoxy solution
D_S: Flexural deflection of concrete beams reinforced with Fan palm coated with Sulphur solution
D_B: Flexural deflection of concrete beams reinforced with Fan palm coated with bitumen

Figure.3 Flexural deflection of concrete beams reinforced with fanpalm specimens at 28 days in alkaline solution

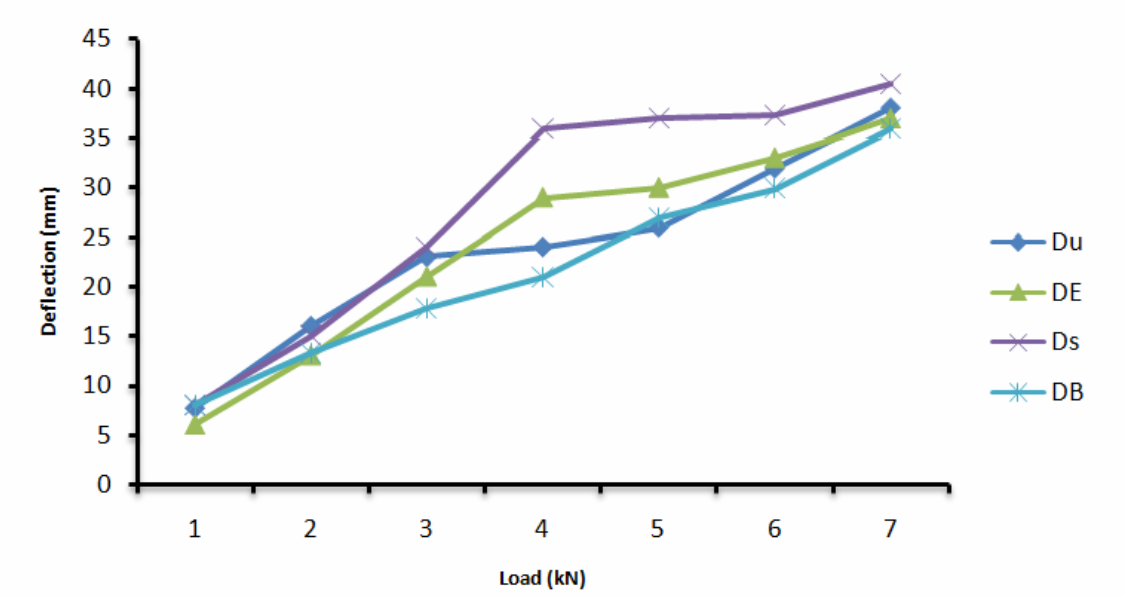
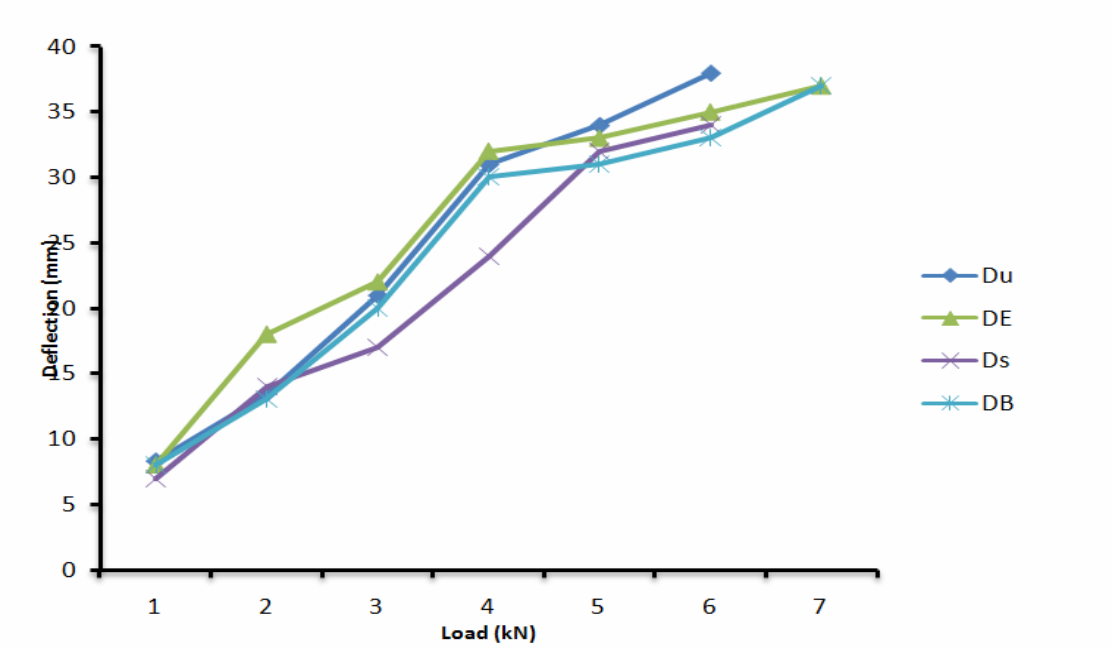


Figure.4 Flexural deflection of concrete beams reinforced with fanpalm specimens at 56 days in alkaline solution



D_U: Flexural deflection of concrete beams reinforced with uncoated fanpalm specimens
D_E: Flexural deflection of concrete beams reinforced with Fan palm coated with epoxy solution
D_S: Flexural deflection of concrete beams reinforced with Fan palm coated with Sulphur solution
D_B: Flexural deflection of concrete beams reinforced with Fan palm coated with bitumen

Figure.5 Flexural deflection of concrete beams reinforced with fanpalm specimens at 90 days in alkaline solution

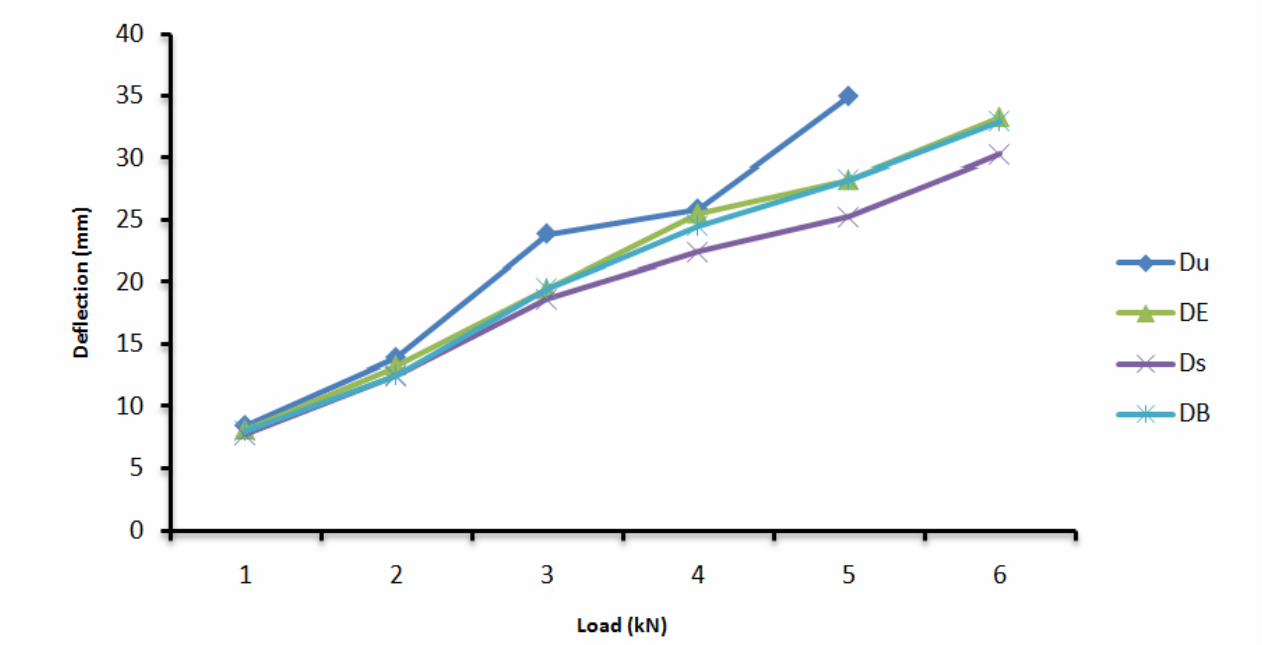
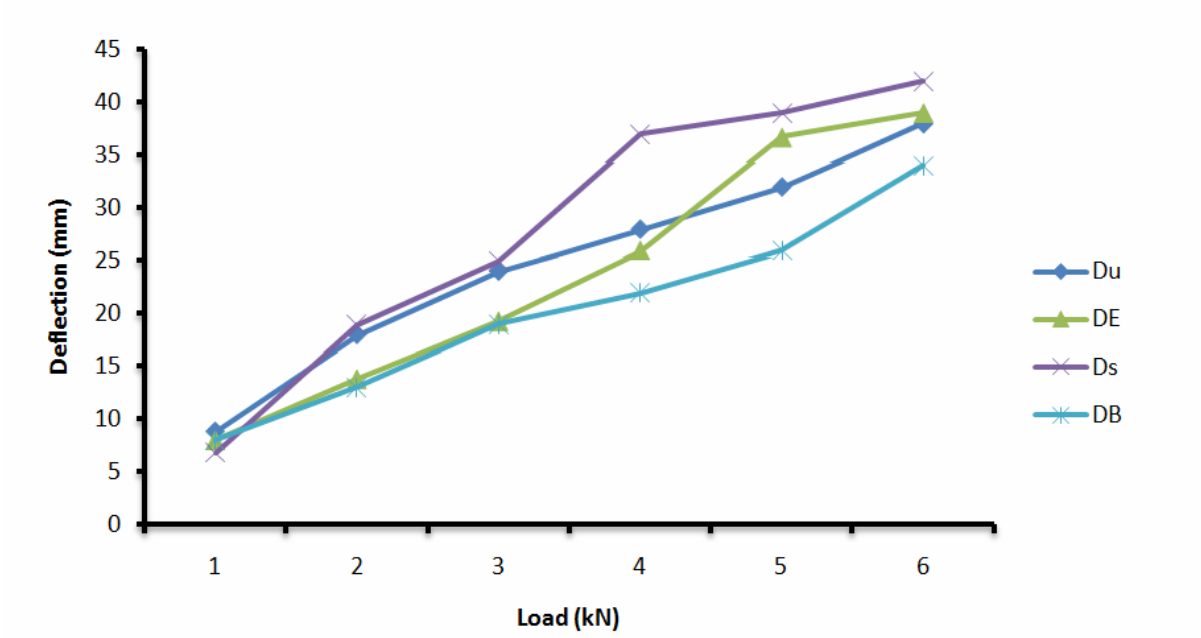


Figure.6 Flexural deflection of concrete beams reinforced with fanpalm specimens at 180 days in alkaline solution



D_U: Flexural deflection of concrete beams reinforced with uncoated fanpalm specimens
D_E: Flexural deflection of concrete beams reinforced with Fan palm coated with epoxy solution
D_S: Flexural deflection of concrete beams reinforced with Fan palm coated with Sulphur solution
D_B: Flexural deflection of concrete beams reinforced with Fan palm coated with bitumen

Figure.7 Flexural deflection of concrete beams reinforced with fanpalm specimens at 270 days in alkaline solution

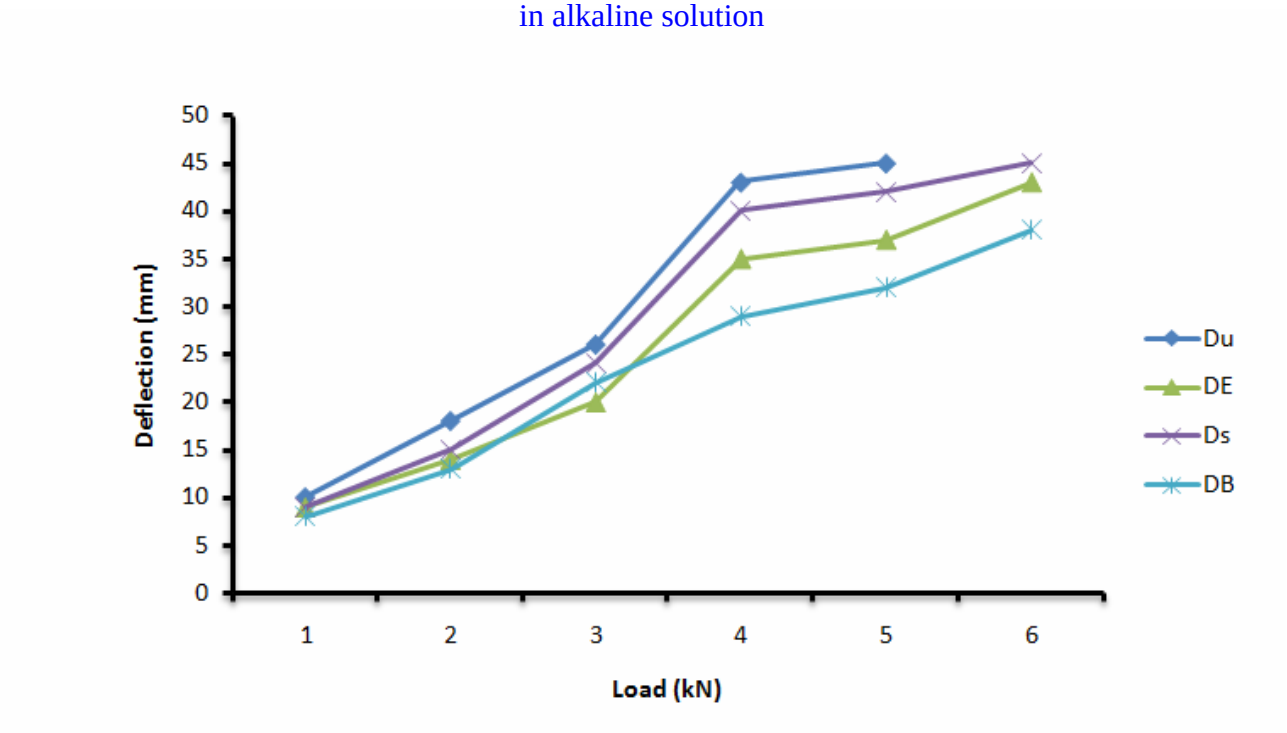
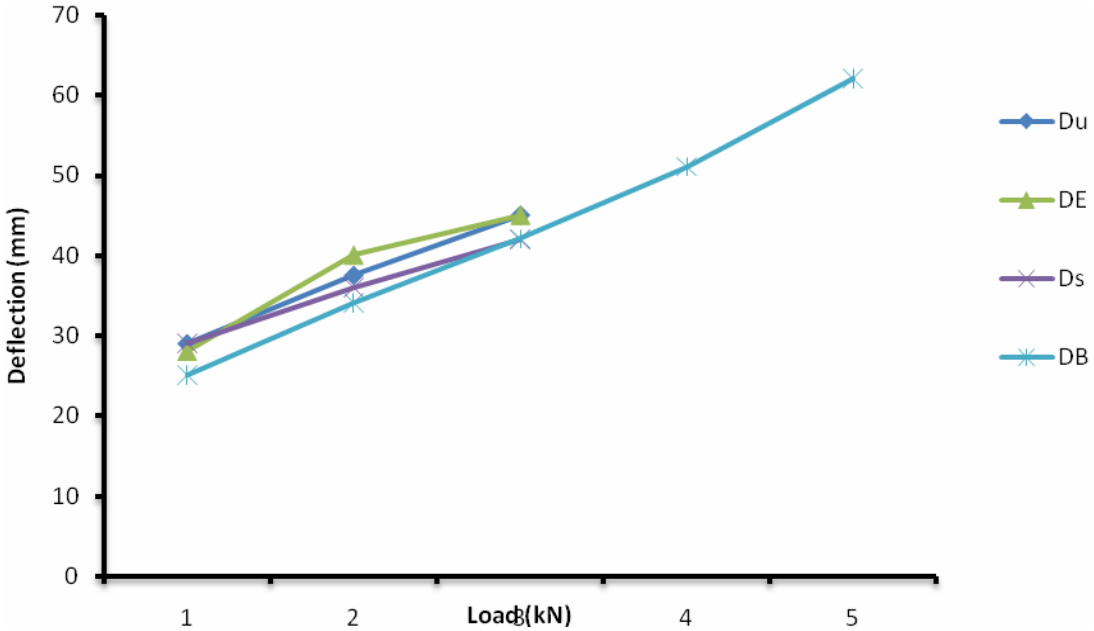


Figure.8 Flexural deflection of concrete beams reinforced with fanpalm specimens at 365 days in alkaline solution



D_U: Flexural deflection of concrete beams reinforced with uncoated fanpalm specimens

D_E: Flexural deflection of concrete beams reinforced with Fan palm coated with epoxy solution

D_S: Flexural deflection of concrete beams reinforced with Fan palm coated with Sulphur solution

D_B: Flexural deflection of concrete beams reinforced with Fan palm coated with bitumen

Also beams reinforced with uncoated fan palm suffered higher deflection compared with beam reinforced with coated fan palm.

Conclusion and Recommendation

Coating the fan palm specimen with blocking agents reduce the rate of deflection in alkaline ratio. Coating fan palm reinforced with bitumen will often protection to fan palm at the age above 270 days. Hence since at 365 days. it is expected that concrete would have manifest 98% of its flexural characteristics; failure and deflection. Fan palm coated with bitumen could be used reinforcement for concrete beams that carries light loads.

It is recommended that further studies be conducted on beams reinforced with fan palm coated with other agents.

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