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Termite Social Insect Impact on Soil Geotechnical Properties

Ayininuola, G.M.
(Department of Civil Engineering, University of Ibadan, Ibadan, Nigeria)

Abstract : *Termites attack on building materials such as planks is highly destructive. The positive contribution of termites to the environmental soil was examined in the research. Five termitaria were selected at random from the University of Ibadan, Ibadan, Nigeria. Soil samples were taken at the cores of termitaria and also at 5m and 10m of either side of termitaria. The 25 soil samples geotechnical properties such as shear strength, California bearing ratio (CBR) among others were analyzed. The result revealed that the geotechnical properties of termitaria are far better than the adjacent or surrounding soils. The improvement was traced to the activities of termites in termitaria.*
Keywords: *Termitaria, Termites, California bearing ration, Shear strength.*

I. INTRODUCTION

Termites are social insects that live in nests (termitaria) of their own construction. Termite workers build and maintain nest to house their colonies. These are elaborate structures made using a combination of soil, mud, chewed wood / cellulose, saliva and feces [1]. Termites play integral roles in soil development being one of the primary soil producers in arid and semi-arid systems [2]. Therefore, the association of termite population with soil processes led to designate termites as Soil Ecosystem Engineers [3]. Generally, termites thrive by consuming detritus materials and build molds in which they control. Molds always grow above their initial concealing earth surface [4]. A cemented surface on termitaria may serve to reduce erosion [5].

Termite mold material and lime were used as partial replacement of cement in plastering and results showed that compressive strength of mortar cubes increased with age and decreased with increasing replacement of cement with lime and termitaria [6]. Termites' activities significantly increased exchangeable cations, micro-nutrients, organic matter content and pH of mold soil while soil acidity was decreased in an Oxisol of Cerrado region of Brazil [7]. In Nigeria, it was discovered that unconfined compressive strength of termitaria was significantly higher than those of neighbouring soils [8]. Also, increase in organic matter in termitaria was recorded on compare with adjacent soils of Podili and Talupula in India [9]. Furthermore, higher organic content, C/N ratio, Ca, Mg, K and P in termitaria of Macroternees and Odontotermes spices than the surrounding soil were observed in Nigeria [10]. Besides, within and from one geological zone to another in the University of Ibadan, Ibadan, and variation in termitaria properties have been observed [11]. Termitaria have higher values of silt and clay and lower value of sand in relation with the surrounding soil [12]. The percentages of organic content, carbon and nitrogen contents in termitaria were found to be higher than the surrounding soils [2 and 13].

In civil engineering discipline, soil is very important because nearly all structures are constructed in or on the surface of the earth. Therefore, the nature of the soil at locations is very vital to Civil Engineers. The earth underneath the foundation is heterogeneous materials that are considered in design and construction of structures. Prior to foundation design, site investigation is embarked upon and the results are used in the design exercise. Since soil is heterogeneous in nature, during setting-out aspect of project construction, termitaria are seen and these structures are different from the surrounding soil by physical inspection and need to be investigated. Decision must be taken either to remove them completely or used them to level the ground. Therefore, the study examined the variability in the geotechnical properties of termitaria and the adjacent surrounding soils.

II. MATERIALS AND METHOD

Five different termitaria were selected in the University of Ibadan for the samples collection. Soil samples were collected at the center of termitaria and at two points adjacent to termitaria (5 meters and 10 meters at one side and also at opposite side) as shown in Fig. 1. Therefore, at each termitarium location five sample collection points were established. Referring to Fig. 1, soil samples were collected from point A center of termitarium, point B 5 meters away from termitarium, point C 10 meters from termitarium, point D on other side 5 meters from termitarium and point F 5 meters from point D. Altogether, 25 soil samples were collected from five termitaria areas. The samples were taken to laboratory where their geotechnical properties such as particle size analysis, California bearing ratio (CBR) and shear strength were determined in accordance with standard [14].

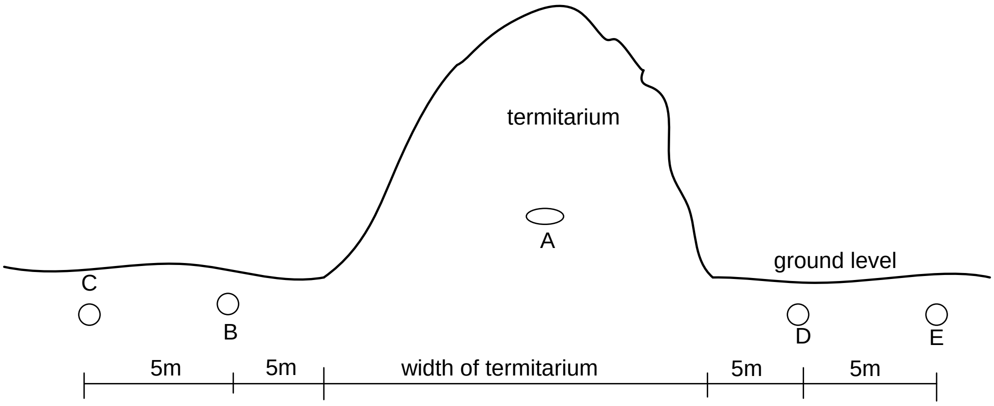

Fig. 1: Typical sampling position

III. RESULTS AND DISCUSSION

The particle analysis results showed that the 25 soil samples were well graded. The large concentration of particles was within the range of 0.075mm to 4.75mm. The termitaria have higher concentration of particle size below 0.075mm than the surrounding soil in the range of 25 to 33% of molds. This revealed that termitaria have higher clay and silt content than the surrounding soils. The shear strength of all the soil samples shown in Table 1 revealed that cohesion values of termitaria were higher than the adjacent soils. The termites' activity is responsible for higher values of cohesion obtained. Besides, the angle of friction values obtained for termitaria were higher than those of adjacent soils. This further attested to the fact that termites' activities in their colonies promoted forces of attraction and adhesion among the soil particles of termitaria. These findings are in agreement with earlier findings [8 and 12]. The CBR values of termitaria were higher than the surrounding soils which were attributed to termites' activities in the termitaria.

III. CONCLUSION

The study set out to investigate the effect of termites' social insects on soils. The five sample locations used revealed that termites' activities in their termitaria promoted adhesive, friction force and cohesive properties of soils that resulted to higher CBR and shear strength observed. Consequently, if termitaria are encountered during construction, there is no need to removed them but can be used for earthwork.

Table 1: Geotechnical properties of termitaria and their surroundings

Sample location	Sample label	Sample point	Shear strength c' (kN/m^2)	Ø' (^{o})	CBR
1	1C	10m from termitarium	60	28	59
	1B	5m from termitarium	78	13	61
	1A	core of termitarium	82	35	64
	1D	5m from termitarium	62	24	54
	1E	10m from termitarium	52	33	53
2	2C	10m from termitarium	42	26	74
	2B	5m from termitarium	65	20	75
	2A	core of termitarium	78	30	79
	2D	5m from termitarium	59	19	76
	2E	10m from termitarium	42	24	76
3	3C	10m from termitarium	79	19	80
	3B	5m from termitarium	82	17	78
	3A	core of termitarium	90	30	85
	3D	5m from termitarium	80	17	76
	3E	10m from termitarium	72	13	77
	4C	10m from termitarium	40	14	61
	4B	5m from termitarium	46	16	70

4	4A	core of termitarium	75	24	73
	4D	5m from termitarium	50	16	63
	4E	10m from termitarium	45	12	54
	5C	10m from termitarium	58	16	59
	5B	5m from termitarium	78	17	57
5	5A	core of termitarium	88	27	64
	5D	5m from termitarium	60	14	60
	5E	10m from termitarium	55	20	69

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