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The Management and Challenges of Termites Infestation of Buildings in the Federal Polytechnic Damaturu Yobe State Nigeria

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Abstract

The major problem in tropical climates like Yobe state is the propensity that timber and other cellulous materials of building structures may be attacked by termites due to the "white ants" forming colonies in the ground where a nest housing the queen is found. In the Federal Polytechnic Damaturu, the termites have created an obvious eyesore which hitherto reduces the value of the institution's buildings, both physically and economically. Therefore, this paper aimed to find ways to managing termites attack on buildings of the institution. It has examined the extent of destruction to the properties, and also evaluated the type of maintenance management system adopted by the school authority. This research discovered that termite's activities or damages are found on the roofs, walls or the façade of the buildings, intersection of walls and floors. In fact the junction of the walls is particularly vulnerably affected. This has also lead to the conclusion that they have established colonies on the roofs of most buildings in the school. Since termite management involves reducing the chances that major damage is caused to the buildings by termite infestation, long-term protection can be achieved through a planned or scheduled chemical fumigation of the buildings or the use of physical barriers (or both) to prevent termites from penetrating the structures. Proper construction techniques, such as foundation trench treatment with concentrated anti-termites solution, isolating wood from the soil, and the use of physical barrier to exclude subterranean termites are practical approaches to preventing termites on the buildings. Scheduled maintenance management system should be adopted for at least at the beginning of every academic semester (every 4months) with cleaning, and clearing of debris of construction materials and removal of stumps around the school buildings against termites attack

Keywords: *Termites, Pre-Construction Treatment, Post-Construction Treatment, and Scheduled Maintenance*

Background to the Study

Termites can be found throughout the world largely in the tropical and sub-tropical countries. They are social insects, feeding on cellulosic material and live in colonies. Termites comprise the order Isoptera with six families, 170 genera and 2600 species, of which six specie are their destructive tendency. They feed on wood in discriminately, and tend to destroy timber and other wooden materials of importance to man and this brought them into direct competition with man. However, their beneficial aspect to man is very significant. In most countries, especially in Nigeria where termites exist in abundance, they are edible. Their burrowing into the soil increases the rate of percolation of water into the soil thereby promoting water absorbent of the soil. Their feeding habit include decomposition of dead trees, and incorporation into the soil, mineral nutrients of thee tree. Termites like bees and ants, are flying insects that in lives colonies and have workers and soldiers.

They become a problem not just as nuisance insects in the house, but because they can eat wood and damage the house structure. In addition to wood termites also eat paper, bark mulch, and dead tree roots. They can also damage cotton, burlap, and other plant fibers. Termites colonies are usually underground nests, this fact, coupled with their ability to enter a dwelling through a very small masonry gap and that their wood dining leaves no sawdust means that they can go undetected for a very long time, workers are less than ¼ (6.35 millimeters) long, but colonies can grow to have millions of workers. Because they may eat wood from the inside out, there may be no signs at damage to visible wood for a long time.

Termites are insects living in colonies. They disperse from their colony of origin in a series of flights or swarms at precise time of the year. Adult are attracted to lights, where pairing begins. The swarmers on reaching the ground shed their wings and started searching for a suitable place to initiate a colony. The makes are attracted to the females by a scent or pheromone. They dig into the wood or moist soil depending on the species and form a chamber. Mating occurs within the nuptial chamber, and the Queen once fertilized, initiates the new colony as they begins to lay eggs. Termites live in a true social group with a division of labour among the different caste of individual; reproductive adult, soldiers and workers (Noirot, 2000). Termites have a complex life cycle with the development from other members of the group. According to Edward and will (1986), there are three general developmental stages: immature and adult in termite's life cycle known as incomplete metamorphosis. The role of the winged adult is dispersal and reproduction, the actual work of the colony (Fascher and Jenkins, 2000) winged adults (Alates or warmers) represent a primary cast of individual within the termites colony. They are sometimes called white ants. However, they are not ants, because the true ants belong to the order Hymenoptera, while termites belong to the order isotera (Grimaldi and Engel, 2005). Engel and Krishna (2004) ground termites into (6) families, 170 General and about 2600 species, of which 300 species are said to be of economic importance. Termites can be divided into three general categories based on their habitat: damp wood, dry wood and subterranean (Paul and Reuben, 2005).

According to Paul and Reuben (2005) damp wood termites do not present wide spread past problems, but can be problematic under certain condition, dry wood termites are significant and costly pests, while the subterranean termites are the major urban pests. The interaction of termite with man arises as a result of man interference with natural food supply of termite and with its environment (Edwards and Mill, 1986). However since their food supply is mainly wood and woody tissues of plant, they do come into direct competition with man resulting in great loss of properties and amenities. Although the destructive activities on the other hand include the production of organic matter from dead wood and woody tissues of plants, and thereby restore organic matter to the soil and air (Ohiagu, 1979). They are also utilized as food by various animals including man, and they are of highly nutritive value (Harris, 1970).

Literature Review

There are many different types and species of termites active in the country. Below are the most common types of termites found throughout the country.

i. Subterranean Termites: - Subterranean termites are social insect that lives in colonies consisting of many individuals. Subterranean termites are found throughout North American and are the most common types of termites encountered in homes. A common indication at subterranean termites' dark areas or blisters in wood flooring. However, subterranean termite will only eat the spring wood, leaving the grain and exterior surface intact thus, the damage can go unnoticed.

ii. Dry Wood Termite:- Dry wood termites are commonly found in coastal states in the south and south west of the country. They are not as prolific as some other species, but the damages they cause can be substantial especially as they can go undetected for a long time before they are discovered. Their diet mainly consists of house wood, utility poles, furniture and dying trees. Dry wood termites do not require any contact with soil and prefer areas with low moisture content.

iii. Dampwood Termites:- Damp wood termites typically infest damp and decaying timber. This species is commonly found in the pacific coast states; they live in moist wood and do not require soil contact. Damp wood termites produce fecal pallets that are an indication of infestation, several species and swarm to set up new nests during the year from January to October.

Causes of Building Termites Infestation

I. Moisture: Termites are attracted to areas where moisture accumulates in and around your home, including damp basement, laundry rooms, bathrooms and leaky foundation, and walls.

ii. Wood: Termites will eat any kind of wood mulch, rotting wood, new wood, painted wood and treated wood; they will even eat wall paper and shat paper.

iii. Foliage: Untreated trees, plants and foliage around your home may attract termites. Keep foliage and wood mulch at least 28 inches from your homes foundation to make entry more difficult for termites and other destructive pests.

iv. Air: Stagnant, moist air in your home provides the perfect breeding ground for termites, so keeping the air circulating and dry is essential if you wish to avoid them. Put electric fans in areas that attract moisture, empty flower pots and other of standing water, and ventilate areas that remain consistently moist, such as the bathroom, laundry room, attic and basement.

v. Renovation: Scrap lumber from a home renovation stored near your home may be infested with termites and should be burned to ensure that your home does not become infested.

vi. Earth: If any portion of your home is in direct contact with the soil or plant material in your yard, you may be giving easy access to termites. Again, keep all foliage, soil and mulching at least 28 inches from your homes foundation.

vii. Mulch: Wood mulch is attractive to termites. Use mulch sparingly around the foundation of your home and be sure to choose mulch types that are less likely to attract pests, such as rubber mulch or treated cedar.

viii. Openings in Your Homes Foundation, Roof, and Walls: In their search for moisture and food, termites will take advantage at any breach in your homes integrity. Even cracks in your foundation concrete offer opportunities for subterranean termites to gather material for the construction of their mud tube, the tunnels by which they travel in their foraging. Periodically inspects your homes entry doors and windows and reapply caulk where any might be distressed or missing.

ix. Geography: You may live in a state or region that is particularly susceptible to termite infestations. Home owners in warmer, wetter state such as those of the south and Gulf coast are typically more likely to experience difficulties with termite, you can also consult the limited state forest service map of termite infestation probability (TIP) zones to determine your homes level act risk to infestation due to level environment factors. Though some areas of the country have attacked, remember that termites are found in every state except Alaska so doesn't let your guard down.

Destructive and Economic Effects of Termites

The destructive effects of termites to man, whenever they interact with each other's is very enormous. It includes the damage done to the timber used in building and for other purpose (Su and Scheffrahn, 2000, Sornuwat, 1961). Lee and wood (1997) reported that some of the termites species involved are the soil inhabitants. Harris (1961) reported

that the building research institute, Accra suggested the annual cost of repairing building damage by termite in West Africa was 10% of their capital cost. In addition to the attack on buildings, termites also damage man made fabrics (Textile materials), plastics (polythene, polyvinyl chloride) and some metal foils. Therefore, this economic importance extends to countries like Britain which import from termite infested zone. The destructive activities of termites as a result of their feeding habits cannot be over emphasized. It includes the damages done to agricultural crop such as cash crop and food crops (Abe etal 200), timbers in building, post, fences, damages to clothes, book, underground cables and air field, earth dams and irrigation canals. They also reduce watering retaining capacity of the soil, by removing the plant cover and thus promote erosion to some extent (Lee and Wood, 1971). The damage done to all these element and component are great and amount to millions of naira. Despite the destructive activities of man, their beneficial effect is enormous (Ahmad and Yaacob 1997). Termites mound material which is very fine can be made hard and used in making roads tennis courts, bricks use in building and also used as a source of pottery clay (Su and scheffrahn, 2000).

Anti-Termite Treatment

Anti termite treatment may be divided into the two (2) categories as pre- construction treatment, and post- construction treatment

Pre- Construction Treatment

i. Site preparation: This treatment is started right at the initial stage. The operation consists of removal of stumps, roots, logs waste wood and other fibrous matter from soil at the construction site. This is essential since the termites thrive on these materials, if termites mounds are detected these should be destructed with the use of insecticide solution. Pre- construction treatment can be divided into three operations.

ii. Soil treatment: The best and only reliable method to protect building against termite is to apply chemical treatment soil at the time of construction of the building. This should be done in such way that a complete chemical barrier is created between the ground in where the termites come and damage wood works in the building. The emulsion should be applied evenly with a watering can or sprayer at the following stages:

a. Stage i: In foundation pits, to treat the bottom and sides up to a height of about 30cm. the emulsion required is at the rates of 5 litres per square metre

b. Stage ii: The refill earth on both sides of all built up walls, for width of 30cm and depth of 45cm approximately. The emulsion required is at the rate of 5 litres per square metre.

c. Stage iii: Before laying the floor, the entire leveled surface is to be treated at the rate of 5 litres of emulsion per square metre. The stages of treatment are shown diagrammatically in Plate1 below.

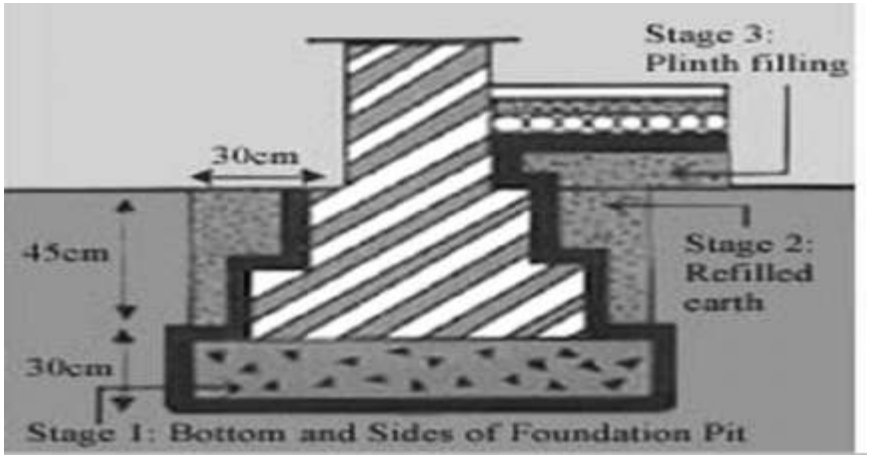

Plate1: Stages of Soil Treatment

iii. Structural Barrier: Continuous impermeable physical structural barrier may be provided continuously at plinth level to prevent entry to termite through walls. These barriers may be in form of concrete layer it may be 5 to 7.5cm thick. It is preferable to keep the layer projecting about 5 to 7.5cm internally and externally.

Post- Construction Treatment

It is a maintenance treatment for those buildings which are already under attack of termites. As stated earlier, the termites even after entering the building, maintain their contact with their nest or colony in the ground, through shelter tubes or tunnels lined with soil. This fact is well utilized in the anti-termite treatment. It is essential to carryout inspection to estimate the magnitude of spread of termites in the building, and to detect the points of entry of termites in the building. These points may be in near vicinity of columns, basements, steps leading from ground, bathroom and lavatories, leaking pipes, drains etc.

Control of Termites

The menace of the activities of termites is enormous; therefore, there is need to control the activities of termites, so as to bring their activities to a manageable level. The control of termites involves non-chemical and chemical control methods.

i. Non- Chemical Control Methods:

This is an alternative to chemical control of termites (i.e. to control active infestation), which involve a long term measure and focus on prevention.

1. Mud Tube Removal: Removing tube provide a method to determine if termites is to remain active after treatment or if the termites re appear in the same area later. Scraping away mud tube as the sole means of control may not be possible and probably unwise in many cases such as with slab construction, where much of the termite activity is inaccessible. The tubes are an indication that termite are active around the house

2. Debris Removal: This method involves the removal of cellulose debris. Removing the debris helps reduce food resources that could be used by termites. Thus items made up of wood, cardboard or paper, which can serve as food for termites should be removed from the building premises. Also tree stumps that are left under house during construction should be removed.

3. Pathogenic Fungi: This is a biological control method of termites. Termites dwell in an environment that contains micro organisms, including many that are lethal to them. One of these pathogenic fungi, metarlizium anisophiliae has been developing commercially into a product called Bioblast accessible termites' infestation above ground. The spores germinate and fungus penetrates the insect cuticle (i.e. the outer skin) the fungus grows inside the insect's body and eventually kills it.

4. Mechanical Barriers: In this control method, termites- resistant building materials are use during construction. These materials are most easily installed in new construction; however some materials can be fit to existing houses, although the cost may be significant.

5. Heat: Heat is a non chemical option for whole structure treatment. Excessive heat kills dry wood termites by disrupting cellular membranes and denaturing enzymes needed for their survival. The treatment process involves heating all wood in the structure to a minimum of 120ºf, and holding this temperature for at least 33minutes. The advantage of this method is the ability to treat the entire structure without the use of chemical, and the relatively short period of time the structure must be vacated, hours instead of days, as with the use of fumigants. Due to the development of more powerful and efficient heaters, larger homes can be efficiently treated with heat.

6. High Voltage Electricity or Electrocution: This is a non- chemical method of controlling dry wood termites. The device use high voltage (90,000 volts) but low currents (less than 0.5 amps). The dry wood termites die as a result of electric shock, delayed mortality may occur due to the destruction of intestinal protozoa. The limitation in this method includes detection accuracy and the possible reduced influence on from the interfering action of common building materials e.g. Metal, concrete, and glass.

7. Wood Replacement: The effectiveness of wood replacement as a control method for termites is highly dependent on detection accuracy, the extent and location of the infestation. Wood replacement may be expensive to accomplish.

ii. Chemical Method of Termites Control

1. Soil Barrier Termiticides: The method involves creating a chemical barrier in the soil, which is toxic to termites contacting it. Many also have repellent Characteristics. The effectiveness of the termiticides over a long period of time is achieved when applied as a continuous barrier in the next to and under the foundation.

If there are untreated gaps in the soil, termites may circumvent the chemical treatment therefore, treatment during preconstruction, provide more uniform coverage. Termicides that act by creating a chemical barrier in the Soil include Bufenthin (Talster, cypermethrin c Demon, prevail, and permethrin (Dragnet, prelude).

2. Treated- Zone Termiticides: This termiticide are non-repellent to termites, but show delay toxicity as termite forage through the treated soil, which they do not avoid. Termites contact the active ingredient as they penetrate treated zone which causes delay mortality and also allow the termite to be overcome by lethal microbes. The toxicant is passed to the nest mates through grooming activities and social food exchange (trophallaxis).

3. Dust: Dust can be use a standalone treatment or as a part of a combined approach. The dust settles to the termites, which then carry the dust back to the nest. The termites clean themselves at the dust and ingest the active ingredient. The active ingredient is spread throughout the colony, through grooming which is a social activity by the termite. If enough active ingredients are ingested, then it is possible to eliminate the entire colony. The active ingredient in the dust may include Arsenic trioxide, fipronil and Triflumuron. Scheffrahn et al (2001) reported that newly established colony of dry wood termites crytotermes brevies could be prevented using dust formulations of commercially available disodium tetrahydrate.

4. Fumigants: Fumigants (e) sulfuryl fluoride treated all infestation simultaneously and has high level of efficiency, if correctly applied. Sulfuryl fluoride kills the dry wood termites in about 3 days. Fumigation advantage over localized treatment is that it may eliminate infestation that is hidden from view. It is necessary to vacate the structure for 2-3days, while it is being treated and then ventilated.

5. Bait: Bait technology uses wood or cellulose matrix favoured by termites that is impregnated with a slow-acting toxic chemicals as active ingredient. Termite workers feed upon the bait and transfers it by grooming activities and social food exchange (trophallaxis) to other Colonies members, eventually reducing or eliminating the entire Colony. Bait products that are available include sentricon (R) colony elimination system (hexaflumoron, recruit (R) bait), first line termites' defense system (sulfluramid) subterfuge (R) termites (hydramethynon) and outpost (R) termite bait response (diflubenzuron).

History and Evaluation of the Federal Polytechnic Damaturu Building Complexes

The then nascent Yobe state government appreciated the need to improve the condition and quality of education, particularly technical education in the state. In consonance with this thinking, a decision was taken toward the end of 1992 to establish a Yobe State Polytechnic Damaturu, the state capital. While necessary facilities and personnel were being put in place for the take-off of the state polytechnic, the federal government notified the state government of its decision to establish a Federal

Polytechnic Damaturu. And it was established may 1993 by virtue of the federal polytechnic (Amendment No.2) decree of 1993. With the appointment of pioneer rector for the polytechnic, Yobe state government handed over secretariat to the federal polytechnic. The institution took-off with six (6) Academic departments which gradually expanded over the year to twelve (12) Academic departments today. (Students Handbook Fedpodam, 2012/2013).

Most of the polytechnic buildings are old structures inherited by the polytechnic from the then TC, which have been in existence for about 40years now, with the staff quarters serving as accommodation units to all the non- academic and academic staff of the institution. This consists of 103 blocks of flats; these are also not left out by the attack of termites, lacking maintenance attention as well. The academic area covers classrooms, lecture theatres, laboratories, and administrative offices. While some of the administrative complexes were built in the recent years, especially the rector's office, the sports office and library complex, most of the academic buildings are old TC inherited structures, later converted and renovated for use. But they are all generally affected by termites with the exclusion of rector's office and library complex which have better external works put in place, and also attract regular maintenance. The student Hostels and Accommodation area are also old and badly affected as well as some are inherited from the then TC College. There are (7) seven Hostel blocks; three (3) of which are for the female students, while the remaining (4) four are for male students. While recently, the school built additional three (3) new hostels and renovated all the old ones, all the hostels are also vulnerable to termite attack.

All the buildings are suffering from termites attack and cracks, and crying for renovation. Incomplete pre-construction treatments was observed in and around staff residential quarters as termite mould, stump, logs, waste wood and other fibrous matter from household are noticed around the buildings. See plate 2. This is very bad as the termites thrive on these materials. The best and only reliable method to protect building against termites is to apply chemical treatment to the soil at the time of construction of the building. This should be done in such a way that a complete chemical barrier is created between the ground from where the termites come and damage wood work in the building. It was observed that external works like roof gutter and drainage system, landscaping, terracing, hardcore concreting are not put in place. Lack of the external works and scheduled maintenance breeds termite's infestation. Therefore having it will definitely make it difficult for the penetration of termites.

Problem of Termites Attack on Fedpoly Damaturu Buildings

The major problem in tropical climates like Yobe State is the possibility that timber and the entire building may be attacked by termites due to the “white ants” forming colonies in the ground where a nest housing the queen is found. In Federal Polytechnic Damaturu, the termites have created an obvious eyesore which hitherto reduces the value of the institution's building properties, both physically and economically, and making the school to be patting away with thousands of naira which ought to have been

used for other developmental projects. So getting out of this mess has called for a serious concern for professionals in this noble institution, and as such necessitated for this research. One of the best ways to prevent termite infestation is to use the most reliable preconstruction termite treatment of timber used in the construction of buildings. Most often, the contractors and the works department of the school don't pay enough attention to this crucial aspect of building new structures which could save the eventual property or building owner thousands of naira, and energy and time.

Research Methodology

The method for the study of this research involved a qualitative analysis of the institution's buildings and its entire built surroundings as well as the use of published and unpublished related literature. Studying existing related cases of termites attack is prerequisite to engaging in the processes of analysis, synthesis and evaluation of termites attack on FEDPODAM buildings. To this end, the structured case studies of the institution buildings were made. This helped to ascertain the strength and weakness of some of the buildings, and also the extent of damage the termites have done to them. For the purpose of this research, the entire polytechnic community was divided into Academic Area and Office Complexes, Staff Residential Quarters, Students' Hostels & Accommodation Area for effective examination.

The procedure for data collection involved visits to institution's buildings and taking a visual analysis of their extent of termites attack, and also surfing of web as well to determine how termites attack has been managed in other places. These buildings were then evaluated on the bases of maintenance measure put in place at preconstruction stage, and post construction stages respectively. A visual survey was carried out by visiting and identifying what has been damaged of the institution's buildings to ascertain the level of attack, and preventive measure and the type of maintenance management system adopted. This was further substantiated by the use of pictures or photograph. Data collected on this research were document in form of drawings, maps, and pictures or photograph

Plate 2: Stumps, Cutaway Tree, & Broken Blocks Forming A Hiding Place for Termites

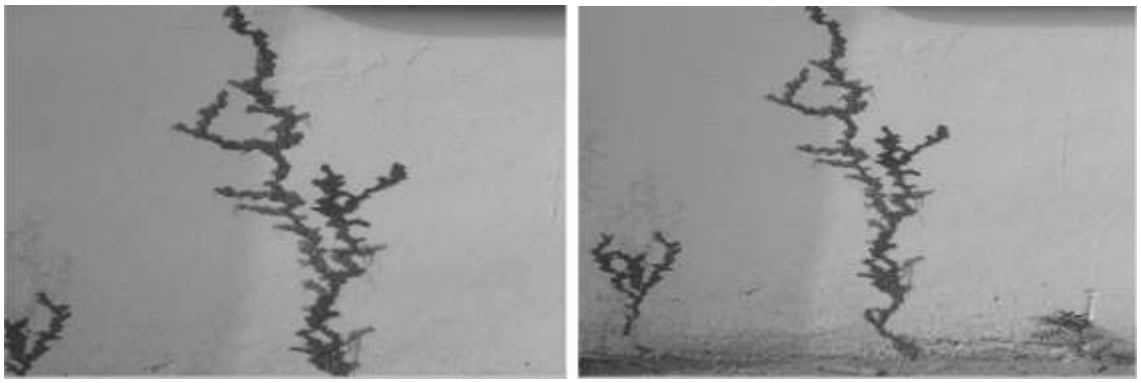

Plate 3: Termite Moulds on the Walls and Façade of The Institution's Building

Plate 4: A Unit of Staff Quarters Ravaged By Termites with Possible Colonies in the Roof

Plate 5: The Vulnerability of the Intersection of Floor to Wall of the Hostel Buildings

Plate 6: Minimum Preservative Chemical Treatment of Timber by Brushing during the Reconstruction of School of Environmental Studies Complex

Summary of Findings

A careful examination of untreated buildings and lack of proper and scheduled maintenance management system by the institution shows that damage by termites and evidence of their activities are not difficult to find in and around the FEDPODAM buildings. Often, and obviously such termite's activities or damage are found on the roofs, walls or the façade of the buildings, intersection of walls and floors. In fact the junctions of the walls are particularly vulnerable affected. This has also lead to the conclusion that they have established colonies on the roofs of most buildings in the school. It was discovered that only 5% of the buildings are not suffering from termite attack because they are given regular maintenance, and have good external works in place which helps in keeping termites at bay.

Conclusion

Termite management involves reducing the chances that major damage is caused to the buildings by termite infestation. Long-term protection can be achieved by the application of chemicals or physical barriers (or both) to prevent termite termites from penetrating the structures as we have seen the enormous destruction caused by the attack on the buildings.

Recommendations

While the Works Department and Physical Planning Unit of the Polytechnic is hereby this research referred to check and make use of the recommendation for preservative treatment and method of treatment as contained in the clause 4.8 of the Nigerian Code of Practice NCP 020, and clause 6 of BS 5268-5 for copper/chromium/arsenic (CCA), boron diffusion and creosote to be used, in order to better control the population of termites and their attack on buildings in the Federal Polytechnic Damaturu, Yobe State and in other places in the tropics, the following precautions are recommended to be taken to reduce the risk of termite attack;

i. The area around the building should be inspected for termite nests, which should be dug out and treated with insecticide. During the excavation work for the foundations and hardcore bed the exposed soil should be treated with insecticide. The ground floor concrete should be raised above the adjoining ground level and should project beyond the outer wall face. Continuous impenetrable physical structural barriers should be provided continuously to plinth level to prevent entry to termites through wall. These barriers may be concrete layer, and may be 5 to 7.5cm thick. It is preferable to keep the layer projecting about 5 to 7.5cm internally and externally. Metal barrier may consist of non-corrodible sheets of copper or galvanized iron, of 0.8mm thick. These sheets are likely to be damaged, in that case, they become ineffective against termites movement.

ii. The timber used for roof members, floor joist and doors and window frames should be treated with preservative chemicals by brushing, which gives minimum protection or by steeping which gives good penetration and avoids areas being missed or by pressure impregnation, which is the commercial method and the most effective. Proper construction techniques, such as isolating wood from the soil, and the use of physical barrier to exclude subterranean termites are practical approaches to preventing termites on structures.

iii. While termite resistant material should be recommended for the construction of buildings especially the basement floors to avoid attack, wherever termite's tubes are detected, it should be destroyed after injecting anti-termites emulsion into it. If the attack is severe, the soil around the building, and soil under or may be applied to dept of 30cm below ground level. To prevent the entry of termites through in masonry,12mm their hole are drilled at 30cm c/c at downward angle of the sides of walls at plinth level and chemical emulsion is pumped to these under pressure. These holes are then sealed. This treatment of drilling punch and pumping chemical emulsion out at critical location such as walls, column bases, place of embedment of door and windows etc similar holes drilled in damaged wood work also and then oil based chemical emulsion is pumped in these.

iv. Schedule maintenance management system should be adopted for at least at the beginning of every academic semester (every 4months) clearing and fumigation of the school buildings against termites attack. It is a maintenance treatment for those buildings which are already under attack of termites. It is essential to carryout inspection to estimate the magnitude of spread of termites in the building, and to detect the points of entry of termites into the building. These points may be in near vicinity of columns, basements, steps leading from ground, bathrooms and lavatories, leaking pipes, drain etc. and the places where wood work is embedded in ground.

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