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MAINTENANCE CULTURE AND ITS IMPACT ON THE CONSTRUCTION OF RESIDENTIAL BUILDINGS IN NIGERIA

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ABSTRACT

Building maintenance is a subject that has to be considered seriously if building is to live up to its expected life span. A questionnaire was designed and distributed to the occupants, both senior and junior staff of the estate and ministry of works respectively. From their responses, a severity index method was used in analyzing the data. These indices were used to rank the importance of each factor, which made it possible to cross-compare the relative importance of the variable factors by different respondent. Based on the analysis, it was found that the major cause of maintenance problems were post construction preventive maintenance management, design resolution, lack of funds, response time to maintain and usage. Since these factors are of human nature, the introduction of the culture of post construction preventive maintenance should be encouraged.

Keywords: *Maintenance, Construction, Impact, Property, Design*

INTRODUCTION

Maintenance culture is an attitude which is sadly lacking in Nigeria, whether in the home, office, school or factory. Mbamali (2003) added that poor maintenance culture has become a widely recognised problem in Nigeria. Maintenance culture in Nigeria is the lowest around the World, especially, in our principal towns and cities. In the rural areas, the story is different and pleasant to hear. The traditional practice of communal clearing of community owned places such as market; playground is in almost every village. In private homes it is customary to refurbish building interiors with mixtures of cow dung or natural red clay. The end result is attractive and totally indigenous. According to Wahab (1995) the nation accords low priority to property management. Faworaja (1996) In Mbamali (2003) asserted that we have no maintenance policy and therefore no such culture exists. Neglect of maintenance has accumulated consequences in rapid increase in the deterioration of the fabric and finishes of a building, accompanied by a harmful effect on the contents occupants (Seeley, 1987). Inadequate maintenance culture is a peculiar feature of almost every building in Nigeria. According to Rotimi and Mtallib (1995) is partly due to poor maintenance culture on one hand and partly due to the absence of an appropriate benchmark. Gurjit (1990) asserted that lack of proper maintenance culture bring the life of a building last before reaching the total obsolescence state. The declining maintenance culture in Nigeria and its effect on buildings has become a major problem to both the public and private sectors. This study examines the trend of maintenance culture and its effect on construction, and quality of materials, design and facilities as well as services used during constructing the building. A great portion of a Nation wealth is evident in the total value of its buildings; it is also an important factor in the production of the building to be preserved. A poorly maintained building in a decaying environment depresses the quality of live and contributes in some measures to anti social behaviour

which threatens the socio-political environment it finds itself in. This research is necessitated to look at the existing knowledge about continuous negligence on maintenance and its impact on construction as been suffered by residential buildings.

CONCEPT OF BUILDING MAINTENANCE

According to Sidney (1991) permanent structure requires less attention than temporary ones, any house owner will confirm that even the best constructed building needs constant attention. If the attention is delayed, what started as being something very minor is liable to turn quickly into an expensive operation? Similarly, Seeley (1987) asserted that no building can exist throughout its span without one form of maintenance or the other; it is to say that much can be done at the design stage in order to reduce the amount of subsequent maintenance work. According to Seeley (1997) maintenance work on a building should commence from the day the contractor leaves the site. The necessity for maintenance work on buildings is noted in the fact that all buildings, as well as the materials and components therein, deteriorate or suffer loss in aesthetic, strength and or functional value, with exposure to the elements of weather over time. The appearance and life span of a building and also the quality of the materials would be affected depending on the manner to which maintenance is adhered to, in the building (Seeley, 1987). If the design process is to be enhanced, the building team need to come together and contribute towards the building's maintainability at the project inception rather than leaving it for the maintenance personnel at the end of construction to battle with the curative measure (Adejimi, 1998). This sometimes according to Seeley (1997) causes frustration and annoyance to maintenance personnel when taking over new buildings and finding themselves faced with bad details, poor choice of finishes, materials and components and lack of basic information about the building and its services. According to Cornick (1996) "the root cause of the problems that the construction industry and its clients experience lie in the division of the responsibilities between the design aspects and the construction aspect" Alexander (1996) was direct in his criticism of the organization of the construction industry noted that the industry is unique in that the design process is separated from production. The successful completion of any building depends on many things, few of which are as important as the designer-contractor relationship. The two parties must be willing to work together so that the clients get maximum benefit from their joint expertise. The contract should feel able to contribute to the design process in matters relating to construction practice and the designer should be willing to receive, analyse and subsequently act on such recommendations.

CAUSES OF MAINTENANCE PROBLEMS

According to Stephen (2002) building services rarely perform as well as desired. The causes emanate from deficiencies in design, construction, commissioning, tenancy work and maintenance; many researchers have also observed that the generators of maintenance problems could be looked at under three main divisions.

1. Causes initiated during the design stage.
2. Causes initiated during the construction stage
3. Causes initiated during the usage stage or the user's carefree attitudes (Bad maintenance culture).

He further said that all these could be planned for during the design stage. Maintenance problems though do manifest during the use of the building, their causes might be during

the design stage. These made Dekker, (2002) Kelly (2002); Kachashkin (2002) to assert that "thinking on the maintenance should start in the design phase". According to Speight (2000) it is at the design stage that the maintenance burden can be positively influenced for better or for worse. Where the designer fails to make adequate consideration for minimizing maintenance problems, it always turns out to be a big problem when the building is eventually occupied for usage, the consideration for effective maintenance as one of the parameters for the building design. Cheetham (1992); Both (1999); Edwin and Curtis (2000) and Mc Call (2001) described how the occurrence of defects in the building fabric could result from many unrelated designs such as unsuitable materials. According to Arayela and Adams (2001) it is often said that building defects start on the drawing board, but in some cases, they can originate at an earlier stage. Inadequate brief may lay down totally unrealistic cost limits or fail to give vital information on the building. Design deficiencies could result in a building disaster if adequate attention is not to the design of bearing support, calculation errors, deformation, shrinkage problems, errors in assumed loading (especially wind), and changes in alteration of existing structures – all these could contribute substantially to building failures and disasters. Seeley (1997) also said that a skilful design can reduce the amount of maintenance work and also make it easier to perform, since good maintenance begins on the drawing board.

According to Zubairu (2001) the extent to which the various factors contribute to maintenance problems in government office buildings in Nigeria is as follows.

Inadequate architectural design	6%
Inadequate Structural design	7%
Inadequate electrical design	9%
Inadequate mechanical design	11%
Poor construction	12%
Use o poor quality components and materials	14%
Natural deterioration due to age and environment	18%
Misuse by occupants	18%
Others	5%

Building maintenance strategies

These can be divided into three:

- Corrective
- Preventive
- Condition – based

Corrective Maintenance

Corrective maintenance is the simplest type of Maintenance strategy, where an element in a building is used until it breaks down. It covers all activities, including replacement or repair of an element that has failed to a point at which it cannot perform its required function. Corrective maintenance is sometimes referred to as failure based maintenance. Corrective maintenance tasks often take place in an ad hoc manner in response to breakdowns or user requests (David and Arthur, 1989).

Corrective maintenance according to El-Haram, Horner and Munns (1997) can be extremely expensive for two reasons;

1) The failure of an item can cause a large amount of consequential damage to other elements in the building.
2) Failure of an item can occur at a time which is inconvenient to both user and the maintaining authority. This can make manpower and spare parts planning extremely difficult.

Preventive Maintenance

This was introduced to overcome the disadvantages of corrective maintenance, by reducing the probability of occurrence of failure and avoiding sudden failure. This strategy is referred to as time – based maintenance, planned maintenance or cyclic maintenance. Preventive maintenance tasks are performed in accordance with a predetermined plan at regular fixed intervals, which may be based on operating time (David, *et al* 1989).

Condition – Based Maintenance

Condition – based maintenance is defined as "maintenance carried out in response to a significant deterioration in a unit as indicated by a change in monitored parameter of the unit condition or performance" (Kelly and Harris, 1978).

The condition – based maintenance concept recognizes that a change on condition and/or performance of an item is the principal reason for carrying out maintenance. In this strategy, maintenance tasks are determined and planned by efficiently monitoring the building's elements such as walls, floors, roof and service equipment such as boilers, pumps, and heating system, to identify which element or piece of equipment requires maintenance before a major failure occurs. To gain the full advantage of applying condition – based maintenance, the condition of an item must be monitored to identify whether there is any evidence of change from a normal to an abnormal condition (David, *et al* 1989).

METHODOLOGY

The study reviewed relevant literature and administered structured questionnaire to occupants, senior staff and junior staff of ministry of works Bauchi State.

The result was analyzed using severity index. Severity index is the total number of respondents that ranked the variable factors as "very severe" and "Severe" factors.

The Severity index is given by (Okpala and Aneikwu, 1988).

$$F = F_4 + F_3 \text{ -} (1)$$

Where, F = Severity index

F_4 = number of respondents that ranked the factors as very severe factors (VSF)

F_3 = Number of respondents that ranked the factors as severe factors (SF).

The severity index of all the factors is calculated using equation (1). The factor with the highest value of severity index rating becomes the most important and consequently the one agreed as being the major causes of lack of maintenance.

DATA ANALYSIS AND DISCUSSION OF RESULT

The data is presented in Tables 1, 2 and 3 which give the seventy indices for the respondents.

Table 1: Occupant's Responses to Questionnaires

RANK (1)	VARIABLE FACTOR (2)	Very severe F4 (3)	Severe F3 (4)	Less severe F2 (5)	Not severe F1 (6)	Severity index F=4+F3 (7)	Percentage severity PS=F/Nx100 (8)
1.	Effects of lack of	17	10	0	0	27	100
2.	maintenance	21	6	0	0	27	100
3.	Lack of proper	17	9	1	0	26	96
4.	maintenance	9	16	2	0	25	93
5.	Maintenance repairs	12	12	2	1	24	89
6.	Environmental factor	6	18	3	0	24	89
7.	Design resolution	7	16	2	2	23	85
8.	Usage	11	11	4	1	22	81
9.	Number of occupants	9	12	4	2	21	78
10.	per building	16	4	5	2	20	74
11.	Maintenance defect	14	5	5	3	19	70
12.	Maintenance manual						
	Maintenance Utility	5	13	5	4	18	67
13.	Workmanship	8	9	3	7	17	63
14.	Post construction	5	10	4	8	15	56
15.	preventive	6	8	10	3	14	52
16.	maintenance	3	10	8	6	13	48
17.	Management	1	11	9	6	12	44
18.	Structural strength	1	11	13	2	12	44
19.	Specified materials						
	Leaking roof	4	7	6	10	11	41
20.	Damaged soak away	0	10	7	10	10	37
21.	pit	0	8	11	8	8	30
22.	Cracking of the walls	2	5	12	8	7	26
	Condition of the buildings						
	Response time to maintenance problems						
	Poor quality of materials used						
	Lack of funds						
	Causes of poor maintenance						

Table 2: Senior Staff Responses to Questionnaires

RANK (1)	VARIABLE FACTOR (2)	Very severe F4 (3)	Severe F3 (4)	Less severe F2 (5)	Not severe F1 (6)	Severity index F=4+F3 (7)	Percentage severity PS=F/Nx100 (8)
1	Effects of lack of maintenance	13	2	0	0	15	100
2	Lack of proper maintenance	13	1	1	0	14	93
3	Maintenance repairs	10	3	1	1	13	87
4	Environmental factor	7	5	1	2	12	80
5	Design resolution	4	8	3	0	12	80
6	Usage	9	2	2	2	11	73
7	Number of occupants/building	5	5	4	1	10	67
8	Maintenance defects	7	2	3	3	9	60
9	Maintenance manual	3	5	4	3	8	53
10	Maintenance utility	5	2	5	3	7	47
11	Workmanship	4	3	4	4	7	47
12	Post construction preventive mgt.	4	2	8	1	6	40
13	Structural strength	1	5	7	2	6	40
14	Specified materials	3	3	7	2	6	40
15	Leaking roof	2	3	6	4	5	33
16	Damaged soak away pit	2	3	9	1	5	33
17	Cracking of the walls	1	4	9	1	5	33
18	Condition of the buildings	2	2	11	0	4	27
19	Response time to maint. Problems	0	4	6	5	4	27
20	Use of poor quality material	0	3	6	6	3	20
21	Lack of funds	2	1	9	3	3	20
22	Causes of poor maintenance	1	1	11	2	2	13

Table 3: Junior Staff Responses to Questionnaires

RANK (1)	VARIABLE FACTOR (2)	Very severe F4 (3)	Severe F3 (4)	Less severe F2 (5)	Not severe F1 (6)	Severity index F=4+F3 (7)	Percentage severity PS=F/Nx100 (8)
1.	Effects of lack of	20	3	0	0	23	100
2.	maintenance	19	4	0	0	23	100
3.	Lack of proper	17	6	0	0	23	100
4.	maintenance	14	8	1	0	22	96
5.	Maintenance repairs	10	10	3	0	20	87
6.	Environmental factor	7	13	1	2	20	87
7.	Design resolution	3	13	5	2	16	70
8.	Usage	6	10	7	0	16	70
9.	Number of occupants	10	5	7	1	15	65
10.	per building	9	5	7	2	14	61
11.	Maintenance defect	11	3	8	1	14	61
12.	Maintenance manual						
	Maintenance Utility	9	4	9	1	13	57
13.	Workmanship	6	6	6	5	12	52
14.	Post construction	4	7	7	5	11	49
15.	preventive	3	7	4	9	10	43
16.	maintenance	4	5	10	4	9	39
17.	Management	6	2	13	2	8	35
18.	Structural strength	3	4	12	4	7	30
19.	Specified materials						
	Leaking roof	5	1	11	6	6	26
20.	Damaged soak away	2	4	15	2	6	26
21.	pit	2	3	7	11	5	22
22.	Cracking of the walls	2	2	8	11	4	17
	Condition of the buildings						
	Response time to maintenance problems						
	Poor quality of materials used						
	Lack of funds						
	Causes of poor maintenance						

Table 4: Rank Agreement Table for all Respondents

VARIABLE FACTOR (1)	Occupant's ranking (x) (2)	Senior staff ranking (Y) (3)	Junior staff ranking (Z) (4)	Sum of ranking (∑XYZ) (5)	Rank Agreement Factor (RA = ∑XYZ/N) (6)	Percentage agreement factor % (PAR = RAmax – Rai/Ramax (7)	Standard deviation (s) (∑ RA - ∑XYZ) (8)	Square's standard Deviation (S^2) (9)	Ranking (order) (10)
Post construction preventive	1	1	2	4	0.18	94	29.8	888.0	1
maint. Mgmt.	3	2	1	6	0.23	92	28.8	829.4	2
Design resolution	2	3	3	8	0.36	88	25.8	665.6	3
Lack of proper maintenance	4	6	4	14	0.64	79	19.8	392.0	4
Lack of funds	5	4	6	15	0.68	77	18.8	353.4	5
Response time to maintenance	6	5	9	20	0.91	70	13.8	190.4	6
Usage	17	8	5	23	1.05	65	10.8	116.6	7
Effects of lack of maintenance	8	7	10	25	1.14	62	8.8	77.4	8
Maintenance manual	9	10	12	31	1.41	53	2.8	7.8	9
Maintenance utility	11	9	11	31	1.41	53	2.8	7.8	10
Structural strength	13	13	7	33	1.50	50	0.8	0.6	11
Environmental factor	7	11	15	33	1.50	50	0.8	0.6	12
Maintenance repairs	12	12	14	38	1.73	42	4.0	16.0	13
Numbers of occupants/building	15	16	8	39	1.77	41	5.3	28.1	14
Maintenance defects	14	15	13	42	1.91	36	8.3	68.9	15
Workmanship	20	14	17	51	2.32	23	17.3	299.3	16
Specified material	17	18	16	51	2.32	23	17.3	299.3	17
Poor quality of materials	16	19	20	55	2.50	17	21.3	453.3	18
Causes of poor maintenance	18	20	18	56	2.55	15	22.3	497.3	19
Leaking roof	21	17	19	57	2.59	14	23.3	542.9	20

Damaged soak away pit Cracking of the walls Condition of the building	19 22	21 22	21 22	61 66	2.77 3.00	8 0	27.3 32.3	745.3 1043.3	21 22

Table 5: Analysis of Distribution and Responses on the Questionnaire.

RESPONDENTS (1)	**NUMBER DISTRIBUTED (2)**	**NUMBER RESPONED (3)**	**PERCENTAGE OF NUMBER DISTRIBUTED % (4)**	**PERCENTAGE OF TOTAL NUMBER OF RESPONSES & (5)**
OCCUPANTS	30	27	90	42
SENIOR STAFF	20	15	75	23
JUNIOR STAFF	30	23	77	35
TOTAL	**80**	**65**		**100**

Table 1 shows the rank agreement factors for all the respondents where as,
Table 5 reveals the percentages of the respondents.
Table 2 Analysis from occupants' response
About 42% of the total numbers were occupants of the State Low – cost Houses. The analysis shows that three factors were ranked/highest viz post constructive preventive maintenance management 100%, Design resolution 100% and lack of proper maintenance 96% are the factors responsible for maintenance problems.
Table 3 and 4 also revealed that the highest severity indexes were post constructive preventive maintenance management; Design resolution and lack of proper maintenance is serious husk in the pipeline of maintenance culture of residential building maintenance culture of residential building.
However, Table 5 shows the rank agreement for all the respondents, and from the table, reveal 3 .00 and 0.18 maximum and minimum rank agreement factors respectively. Among the twenty – two variables, six were rated high as thus.

(i) Post construction preventive maintenance management 94%
(ii) Design resolution 92%
(iii) Lack of proper maintenance 88%
(iv) Lack of funds 79%
(v) Response time to maintenance 77%
(vi) Usage 70%

(i) Post construction preventive maintenance management.
The research has shown that this variable factor was ranked highest in the problem of maintenance. This is to show that client should be aware of the need for maintenance management of their properties.

(ii) Design Resolution
From the result, this was ranked second highest due to poorly resolved design which leads to serious maintenance problem. However, design must suit the occupants taste.

(iii) Lack of proper maintenance

The effect of lack of proper maintenance mostly on the occupants is due to lack of maintenance culture. However, occupants have a share responsibility in the maintenance, culture especially in the residencies they are occupying.

(iv) Lack of funds
The source of funds for the maintenance of estates was from the government, which is usually not made readily available for the purpose of maintenance and often not even budgeted for.

(v) Response time to maintenance
Response time to maintenance is very slow which usually lead to further serious maintenance problems.
Usage due to unplanned control of use in building, it has constituted a great maintenance problem in the estate because of the misused and overused of residential buildings. Adequate plans should be made.

CONCLUSION

The present economic condition in the Country should not be a plausible reason for the neglect of both our public and private property. Maintenance ensures that buildings retain their structural and aesthetical qualities throughout its life span and minimize unnecessary expenditure. This encompasses having policies which ensures constant check, repairs, and enlightening the occupants on the best way of using properties.

RECOMMENDATION

The following recommendations were proffered:

(i) The government should allocate more funds for maintenance of properties and ensure that it is used for the purpose to which it is used for the purpose to which it is meant for.

(ii) The designers must take into account the problems of future maintenance the design stage.

(iii) The public should be enlightened on the need for maintenance culture.

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