Maintenance Model of Hostel Buildings for Effective Performance and Aesthetics

O.Y.Ojedokun[1], T.O. Odewumi[2], J.K. Fasola[3]
(Department of Civil Engineering, the Polytechnic, Ibadan, Nigeria) [1, 2]
(Plaices Global Concept Limited, Ibadan Nigeria) [3]

Abstract : *Buildings are designed and built to sustain its initial functions and beauty for both the present and future users. Building required maintenance for high performance regardless of whether it meets the sustainability consideration or not. An important segment in the maintenance management system is the identification and analysis of defects in the buildings and the urgency of repair needed. Defect analysis is significance if higher institutions desire to succeed in modeling an efficient maintenance management system for their buildings and engineering services. Thus the aim of this project is to determine, evaluate and categorize the defects in institutional hostel buildings in Nigeria, using the four (4) Hostel buildings of The polytechnic, Ibadan as a case study. Questionnaires were administered on four (4) Hostel buildings of The polytechnic, Ibadan. With 83% response rate, the findings suggest that some defects require maintenance urgently than the others and on the basis of which it is concluded that resources should be directed to the more urgent ones while less urgent ones could be included in the subsequent maintenance programme. The research found that, Toilet and bathroom fittings, faulty electrical systems, faulty door locks, extinguisher, fire alarm, and Smoke Detector were the defects that respondents considered extremely urgent to maintain. The paper concludes by arguing that attention to aesthetics and maintenance management is a strategic issue in the management of buildings.*

Keywords: *Aesthetics, Defect Analysis, Maintenance, and Maintenance Management*

I. INTRODUCTION

Aesthetics and its maintenance have come to be regarded with little concern. Too often, aesthetics is viewed as an "extra" consideration that can only receive attention after the important "functional" requirements have been met and which can always be added on afterwards like a coat of paint. This lack of feeling for the value and essence of beauty leads to an unattractive built environment. For most people, their environment is the built environment. It is built by architects and engineers who are therefore responsible for its aesthetic qualities and maintenance.

Robert Benaim demonstrates that engineers can produce a distinct form of architecture, based on the refinement of their understanding of structural behavior, and on a search for rationality and economy [Robert Benaim, 2000].

If the general public, corporate organizations, governmental authorities and engineers see the potential for structural art and maintenance, then public works in the Late 20th century can be efficient, economic, and elegant [Billington and David P, 1983]. The cost of aesthetic

Quality is not always higher than the cost of poor design. In any event, attractive projects bring much greater long-term benefits to the public by increasing the development potential of communities. In fact, many designers are shedding the functional style and the modern movement in favor of historic reference and formal shaping of public spaces. An example is the recent trend to build "old style" baseball parks instead of parks with retractable domes and hotels in the outfield of United State of America [Liebenberg, A.C, 1991].

All aesthetic measures must be designed so that they are fully compatible with the project purpose and in no way compromise the safety, integrity or function of the project. For example, it may be appropriate to screen a floodwall with vegetative plantings but it would be inappropriate to plant trees directly on a levee that might endanger its structural integrity or diminish its hydraulic characteristics [Arthur E. Williams, 1991]. Maintenance budgets need to include costs for inspections, replacement of materials or finishes, cleaning and any unforeseen breakdowns or repairs. Budgeting for these items will become more accurate over time if detailed records of maintenance expenditure are kept. Budgets need a simple control system, with regular and frequent reports on actual and committed expenditure [Jan M. Noortwijk and Dan M. Frangopol, 2004].

II. MODELING MAINTENANCE

Maintaining structures in a safe condition during their entire service life has been recognized as a very critical issue worldwide. According to Das (1999) there are two types of maintenance work: preventive maintenance which if it is not done it will cost more at a later stage to keep the structure in a safe condition, and essential maintenance which is required to keep the structure safe. An essential part of modeling maintenance is taking account of the uncertainties in the deterioration and the time of failure. In this paper, a brief overview is given on how to model uncertain deterioration for the purpose of maintenance optimization. Without being complete, a time-dependent deterioration process can be modeled as:

2.1 Failure Rate Function

A lifetime distribution represents the uncertainty in the time to failure of a component or structure. Let the lifetime have a cumulative probability distribution $F(t)$ with probability density function $f(t)$, then the failure rate function is defined as:

$r(t) = f(t)/F(t)$…………(1) (Barlow and Proschan, 1965).

www.ijmer.com Vol. 2, Issue. 6, Nov-Dec. 2012 pp-4138-4143 ISSN: 2249-6645

2.2 Markov Model

A Markov deterioration model is based on the assumption that the condition of a component can be described in terms of a limited number of condition states. Transition probabilities link the current state with a maintenance action to a future state. Examples of maintenance optimization models based on Markovian deterioration are the Arizona Pavement Management System (Golabi et al., 1982) and the Bridge Management System PONTIS (Golabi and Shepard, 1997).

2.3 Stochastic Process

A convenient way in modeling the uncertainty in time-dependent deterioration is by regarding it as a stochastic process. Gamma processes have been applied to model the following deterioration processes: permanent coastal erosion of dunes (Van Noortwijk and Peerbolte, 2000), crest-level decline of dykes (Speijker et al., 2000), longshore rock transport near berm breakwaters (Van Noortwijk and Van Gelder, 1996), scour-hole development under the block mats of the Eastern-Scheldt barrier (Van Noortwijk and Klatter, 1999), current-induced rock displacement near the rock dumping of the Eastern-Scheldt barrier (Van Noortwijk et al., 1997), loss of steel thickness due to corrosion (Bakker et al., 1999), and corrosion of a hydrogen dryer (Kallen and Van Noortwijk, 2003).

As a basis for optimizing maintenance, the Dutch Ministry of Transport, Public Works and Water Management (Rijkswaterstaat) implemented the age replacement model with discounted cost. This model has been applied for justification and optimization of maintenance measures in the Netherlands (Klatter et al., 2002); detailed information on this model can be found in Van Noortwijk (1998) and Bakker et al. (1999). The criterion of expected discounted cost (net present value) over an unbounded horizon is used for comparing maintenance decisions

III. METHOD OF DATA ANALYSIS

A questionnaire survey approach was used to collect primary data. The questionnaire was divided into three parts. The first part is to give the respondent background information about the project, while the second part focuses on the respondent's profiles. The third section is sub divided into six, to provide feedback on the defects and urgency of repair required as associated with the buildings. The questionnaires were administered on all the 4 Hostels in the Polytechnic, Ibadan. The questionnaire was developed from works of authors including Olanrewaju, A.A. and Kafayah, S.T,(2008), Jones, et al. (2007). Seeley, I.H. (1987), and series of discussions with those concerned with the Polytechnic building maintenance.

Data analysis was performed using two different computer packages: Statistical Package for Social Science and Microsoft Excel to produce descriptive statistics. Descriptive Statistics provide information regarding the distributions of datasets or variables. It measure average (mean, median and mode), spread (variance and standard variation), skewness, kurtosis, maximum and minimum of values. Each of the statistics is require for achieving different objectives.

Measure of central tendency (average) summarizes data in a distribution into a single value or opinion that most represent the entire datasets, values or scores. In a research, respondents supplied different opinions on a concept or variable addressed to them. Often each of the variables cannot be explained in detail or does not even require to be explained individually. Therefore, a mid-score or value is determined to explain the varying values or opinions. Mean is the average or mid-score of a distribution. It is used to calculate the average of observations. The mean is the most stable of the three measure of average of score. The mean technique is used to calculate the average degree of defects in the buildings. Standard Deviation is to calculate the level of spread of each of the individual value from the mean score. The degree of urgency of each of the defects will be determined by the frequency of the respondents that agreed with each of the defects. For instance, where the mean score falls between 1.0 and 1.5 the defect is considered as not urgent at all. See **Table 1- Table 6** for other distributions.

This cut of point is used, because the lowest possible mean score is 1. However, it was understood, that natural scale originates from zero (0) which in this case is not require. Missing data (i.e. where the respondent refused to tick where applicable or there is multiple entry), could impact negatively on the outcome of the findings, however such effect could be improved during data analysis by either replacing the missing data with the mode or mean of the data. However, in this paper, the missing data will not be treated as such; instead we will prefer to leave the data raw as it were so that the outcomes will not in any way be influenced by the authors. Even though, this tends not to be a problem in the study as nearly all the questions were answered by the respondents.

IV. EXTENT OF DAMAGE/URGENCY OF REPAIR IN THE HOSTEL BUILDINGS

The outcomes on the extent of damage of the different defects are depicted in **Table 1** to **Table 6.** The Tables shows an overview of data obtained, the defects and the extent of damage and urgency of repair. The mean score indicates the degree of damage for each of the defects. The ranking score indicates the defect with the highest degree of damage for each of the defects.

TABLE 1: THE EXTENT OF DAMAGE OF FITTINGS IN HOSTEL ROOMS

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty door	1	168	27	4	2.17	9
Damaged window	34	113	42	11	2.15	10
Faulty door locks	32	60	78	30	2.53	7
Damaged roof structure	107	50	10	33	1.84	12
Damaged ceiling	65	40	22	73	2.52	8
Floor tile failure	32	62	62	44	2.59	6
Wall tile failure	24	61	63	52	2.72	3
Faulty bulbs	10	45	94	51	2.93	2
Faulty electrical sockets	0	45	105	50	3.02	1
Damaged Reading Tables	34	43	95	31	2.63	5
Damaged External wall paintings	61	106	12	21	1.96	11
Damaged Internal wall paintings	11	98	43	48	2.64	4

Source: Primary Survey 2012

FIGURE 1: COMPONENT BAR CHAT OF EXTENT OF DAMAGE OF FITTINGS IN HOSTEL ROOMS

From **Table 1** and **Fig. 1** above, Faulty electrical sockets were the most extremely rated defect (1) followed by Faulty bulbs (2). While the least considered defect was Damaged roof structure (12) after Damaged External wall paintings (11). In fact, 52.5% of the respondents consider Faulty electrical sockets as completely damage concurrently 47.0% of the respondents considered Faulty bulbs as completely damage. None of the respondent consider electrical socket as good. Although considerable size of the respondent (84.0%) considered Faulty door to be averagely damaged and only 0.5% of the respondent did not, while 56.5% considered Damaged window as averagely damaged. On the other hand, many (47.5%) of the respondent consider Reading Tables as completely damaged.

TABLE 2: THE EXTENT OF DAMAGE OF FITTINGS IN HOSTEL WARDROBES

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty door	31	119	31	19	2.19	5
Faulty door locks	21	75	75	29	2.56	2
Damaged Wardrobe Cabinet	32	73	56	39	2.51	4
Damaged External wall paintings	11	65	72	52	2.82	1
Damaged Internal wall paintings	21	87	51	41	2.56	3

Source: Primary Survey 2012

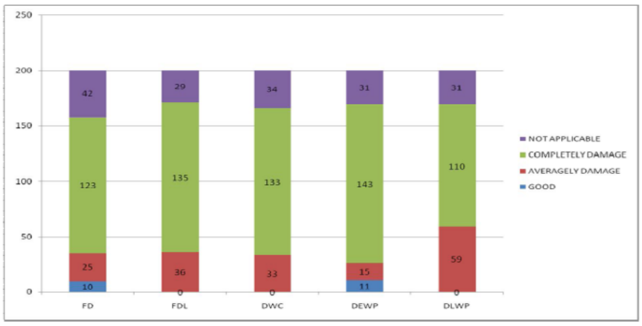

FIGURE 2: COMPONENT BAR CHAT OF EXTENT OF DAMAGE OF FITTINGS IN HOSTEL WARDROBES

From **Table 2** and **Fig. 2** above, Damaged External wall paintings were the most rated defect (1) of the wardrobes, followed by wardrobe door locks (2) while the least most considered defect was Faulty door (5) after Damaged Wardrobe Cabinet (4) and Damaged internal wall paintings of the wardrobes came third with 25.5% completely damaged . In fact, 36.0% of the respondents consider Damaged External Wall Paintings as completely damage concurrently 37.5% of the respondents considered Faulty door locks as completely damage. Although considerable size of the respondent (84.0%) considered Faulty door to be averagely damaged and only 0.5% of the respondent did not, while the same number of respondent (37.5%) considered Faulty door locks as averagely damaged and completely damaged concurrently.

TABLE 3: THE EXTENT OF DAMAGE OF FITTINGS IN HOSTEL KITCHENETTE

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty door	0	33	48	119	3.43	2
Faulty door locks	19	24	61	96	3.17	1
Damaged Kitchen Cabinet	10	32	71	87	3.18	3
Faulty bulbs	10	34	73	83	3.14	5
Faulty electrical sockets	21	12	84	74	3.14	4
Damaged External wall paintings	11	32	83	74	3.10	6
Damaged Internal wall paintings	11	66	82	41	2.7	7

Source: Primary Survey 2012

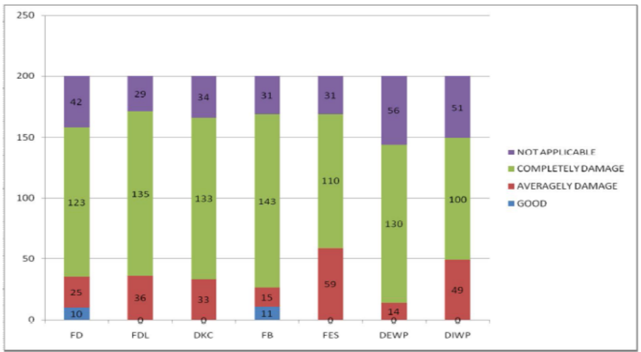

FIGURE 3: COMPONENT BAR CHAT OF EXTENT OF DAMAGE OF FITTINGS IN HOSTEL KITCHENETTE

Table 3 and **Fig. 3** above shows that, Faulty door locks was the most rated defect(1) of the kitchenette followed by Faulty door (2) while the least considered defect was Damaged Internal wall paintings (7) after Damaged External wall paintings (6). While Faulty electrical sockets have the highest value of complete damage as 42.0% of the respondent chose it as completely damaged defect, and Damaged external wall came next with 41.5 defect as considered by the respondent. Although considerable size of the respondent (59.5%) considered Faulty door of the kitchens as not applicable and none of the respondent mark it as good, this high rate of response to both conditions suggest that many of the hostels has no kitchen at all and those that has did not have any of their doors in good condition. While the mean value of all almost all the defects; Faulty door, Faulty door locks, Damaged Kitchen Cabinet, Faulty bulbs, Faulty electrical sockets and Damaged External wall paintings are all at very close range of 3.43, 3.17, 3.18, 3.14, and 3.10 respectively, This mean score indicates that degree of damage to all the fixtures and fittings of the kitchen are all almost the same.

TABLE 4: THE EXTENT OF DAMAGE OF FITTINGS IN HOSTEL TOILETS

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty door	10	25	123	42	2.98	5
Faulty door locks	0	36	135	29	2.96	7
Clogged water closet	0	33	133	34	3.00	4
Damaged water closet	11	15	143	31	2.97	6
Damaged Flushing System	0	59	110	31	2.86	8
Damaged Wash Hand Basin	0	14	130	56	3.21	1
Damaged Internal wall paintings	0	49	100	51	3.01	3
Floor tile failure	12	56	81	51	2.86	9
Wall tile failure	2	24	115	59	3.16	2

Source: Primary Survey 2012

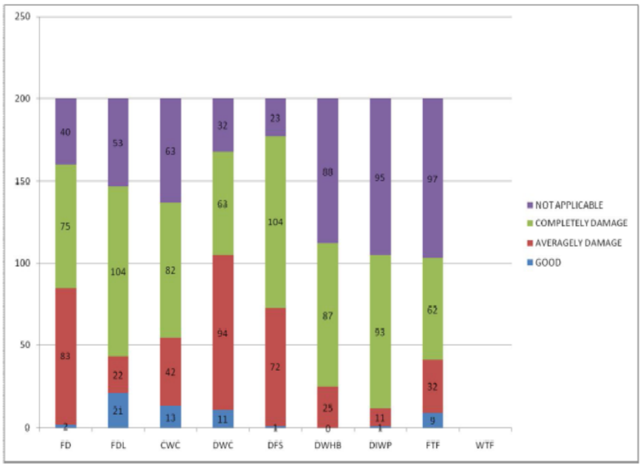

FIGURE 4: COMPONENT BAR CHAT OF EXTENT OF DAMAGE OF FITTINGS IN HOSTEL TOILETS

Table 4 and **Fig. 4** above shows that, with the exception of Floor tile failure, all the other fixtures and fittings of the toilet are completely damaged at more than 50% each as the overall responds of the respondent result shows each at: Faulty door (61.5%), Faulty door locks (67.5%), Clogged water closet(66.5%), Damaged water closet(71.5%), Damaged Flushing System(55.0), Damaged Wash Hand Basin(65.0), Damaged Internal wall paintings(50.0%), Wall tile failure(57.5%). Damaged Wash Hand Basin is the extremely rated defect with overall ranking value(1) followed by Wall tile failure (2) while the least considered defect was Floor tile failure(40.5%). While Damaged water closet have the highest value of complete damage as; 71.5% of the respondent chose it as completely damaged defect, and none of Faulty door locks, Clogged water closet, Damaged Flushing System, Damaged Wash Hand Basin, Damaged Internal wall paintings are in good condition.

TABLE 5: THE EXTENT OF DAMAGE OF FITTINGS IN HOSTEL BATHROOMS

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty door	1	44	114	41	2.98	3
Faulty door locks	12	23	132	33	2.93	7
Faulty Shower	22	24	124	30	2.81	8
Faulty bulbs	12	24	123	41	2.96	6
Faulty Towel Rail	10	35	104	51	2.98	4
Bad Soup Holder	1	44	93	62	3.08	2
Faulty Floor Drain	1	64	73	62	2.98	5
Faulty Wall Tile	1	48	69	82	3.16	1

Source: Primary Survey 2012

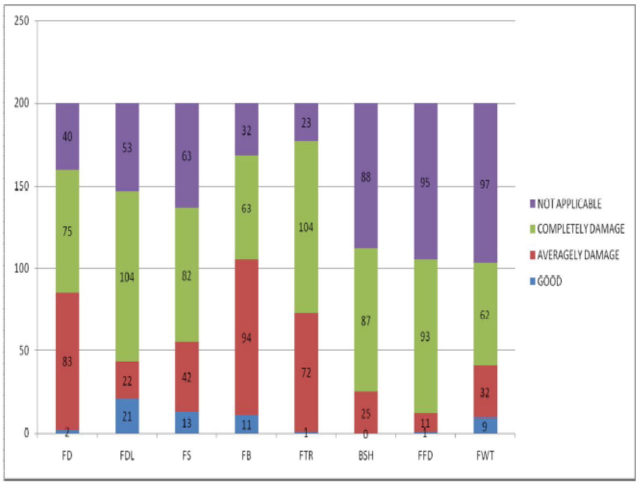

FIGURE 5: COMPONENT BAR CHAT OF EXTENT OF DAMAGE OF FITTINGS IN HOSTEL BATHROOMS

Table 5 and **Fig. 5** above shows that, Faulty Wall Tile is the defect with the highest overall ranking(1) followed by Bad Soup Holder (2) while the least most considered defect was Faulty Shower (8) after Faulty door locks (7), and it shows that five of the defect are damaged at more than 50% each as the overall responds of the respondent result shows each at: Faulty door (57.0%), Faulty door locks (66.0%), Faulty Shower (62.0%), Faulty bulbs (61.5%), Faulty Towel Rail (52.0%). While Faulty door locks have the highest value of complete damage; as 66.0% of the respondent chose it as completely damaged defect followed by Faulty Shower (62.0%), and Faulty bulbs (61.5%) of complete damage respectively, and only one of the 200respondents chose Faulty door, Bad Soup Holder, Faulty Floor Drain, and Faulty Wall Tile to be in good condition.

TABLE 6: SUMMARY OF THE EXTENT OF DAMAGES OF FITTINGS IN HOSTELS

DEFECT	GOOD	AVERAGELY DAMEGED	COMPLETELY DAMAGED	NOT APPLICABLE	MEAN	RANKING
Faulty electrical circuit	2	83	75	40	2.76	6
Faulty Stair Rails	21	22	104	53	2.94	5
Faulty Floor Rails	13	42	82	63	2.98	4
Faulty Taps	11	94	63	32	2.58	8
Collapse Drains	1	72	104	23	2.74	7
Faulty Smoke Detector	0	25	87	88	3.32	2
Faulty fire alarm	1	11	93	95	3.41	1
Faulty fire extinguisher	9	32	62	97	3.24	3

Source: Primary Survey 2012

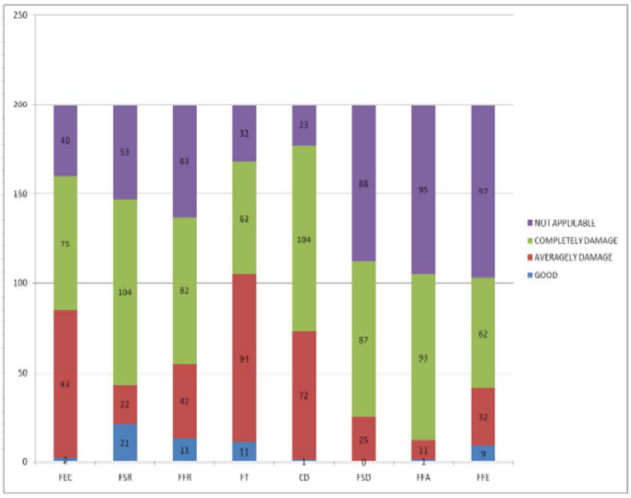

FIGURE 6: COMPONENT BAR CHAT OF SUMMARY OF EXTENT OF DAMAGES OF FITTINGS IN HOSTELS

From **Table 6** and **Fig. 6** above, Faulty fire alarm was the most rated general defect (1) followed by Faulty Smoke Detector (2) and Faulty fire extinguisher (3) respectively, while the least considered defect was Faulty Taps (8) after Collapse Drains (7). In fact, only 4.5% of the respondents consider Faulty fire extinguisher as good concurrently 0.5% of the respondents considered Faulty fire alarm as good and none of the respondent consider Faulty Smoke Detector as good. Although considerable size of the respondent (47.0%) considered Faulty Taps to be averagely damaged and only 5.5% of the respondent did consider it as good, while 41.5% considered Faulty electrical circuit as averagely damaged. On the other hand, many (52.0%) of the respondent consider Faulty Stair Rails and Collapse Drains as completely damaged.

V. CONCLUSION

This study has been able to identify that 57.0% of the respondents consider Faulty electrical sockets as extremely urgent concurrently 44.5% of the respondents considered Damaged Reading Tables and 43.5% Faulty bulbs as extremely urgent, while a highly considerable size of the respondent (94.0%) considered Faulty door to be very urgent and only 2.0% of the respondent did require for urgent repair, while 60.5% considered Damaged window as very urgent, considerable size of the respondent (39.0%) considered Faulty door locks to be extremely urgent for the wardrobes and next to it is Damaged Wardrobe Cabinet with extreme urgency of 31.0% concurrently 41.0% of the respondents considered Faulty door locks of the wardrobe as very urgent. However the research shows that 75% of the toilet fittings damage require extreme urgency of repair, responds shows that's 6 of the 9 defect on toilet fixtures and fittings require repair urgency of more than 50% each and the as the overall responds of the respondent result shows each at: extreme urgency of repair for Faulty door (60.0%), Faulty door locks (68.5%), Clogged water closet(64.0%), Damaged water closet(65.0%), Damaged Wash Hand Basin(61.0), Wall tile failure (49.5%). The other 3 defects are also considerably high as shown: Damaged Flushing System (49.5%), Damaged Internal wall paintings (40.5%), and floor tile failure (38.0%), while the bathrooms Faulty Shower require 62.5% urgency of repair. Moreover the result suggests that the Polytechnic Ibadan Hostels either has no fire extinguisher, fire alarm, and Smoke Detector or they are completely damaged as these three items have a very high number of respondents choosing them as not applicable.

Hence it is recommended that for adequate maintenance and prudence, effort should be directed to the above extremely urgent defects then the very urgent and finally to the once that are not very urgent. This is a way to ensure that the ever inadequate fund will be spent judiciously and users' satisfactions can be achieved and maximized accordingly. This model is equally recommended as applicable to other higher institutional Hostels across Nigeria.

REFERENCES

[1] Arthur E. Williams (1991), Memorandum for Major Subordinate Commands and District Commands, Policy Guidance Letter No. 29, Expenditures on Aesthetics at Civil Works Projects, Pp. 2

[2] Bakker, J.D., H.J. van der Graaf, and J.M. van Noortwijk (1999). Model of Lifetime-Extending Maintenance, *Proceedings of the 8th International Conference on Structural Faults and Repair, London, United Kingdom*, Edinburgh: Engineering Technics Press.

[3] Barlow, R.E., and F. Proschan (1965). *Mathematical Theory of Reliability*. New York: John Wiley and Sons.

[4] Billington and David P. (1983), The Tower and the Bridge: The New Art of Structural Engineering, New York: Basic Books, Inc., Pp. 3-15.

[5] Das, P.C. (1999). Prioritization of bridge maintenance needs, *Case Studies in Optimal Design and Maintenance Planning of Civil Infrastructure Systems*, ASCE, Reston, Virginia, Pp. 26-44.

[6] Golabi, K., R.B. Kulkarni, and G.B. Way (1982). A state-wise pavement management system. *Interfaces*, 12:5-21.

[7] Golabi, K., and R. Shepard (1997). Pontis: A system for maintenance optimization and improvement of US bridge networks. *Interfaces*, 27:71-88.

[8] Jan M. van Noortwijk and Dan M. Frangopol (2003), Deterioration and maintenance models for insuring safety of civil infrastructures at lowest life-cycle cost

[9] Jones K. and Sharp M. (2007); A New Performance Based Process Model for Built Asset Maintenance Facilities, Vol.25, No. 13/14, pp.525-535.

[10] Kallen, M.J., and J.M. Van Noortwijk (2003). Inspection and maintenance decisions based on imperfect inspections. In *Proceedings of the European Safety and Reliability Conference, Maastricht, The Netherlands, 2003*.

[11] Klatter, H.E., J.M. van Noortwijk, and N. Vrisou van Eck (2002). Bridge management in the Netherlands; Prioritisation based on network performance, *First International Conference on Bridge Maintenance, Safety and Management (IABMAS), Barcelona, Spain, 14-17 July 2002*.

[12] Liebenberg, A.C. (1991), "Aesthetic Evaluation of Bridges," Bridge Aesthetics around the World, Committee on General Structures—Subcommittee on Bridge Aesthetics, Transportation Research Board Washington D.C.: National Research Council, Pp. 1-9.

[13] Robert Benaim (2000), The Art of Engineering Structures from the Pantheon to the Jubilee Line, Engineering Architecture, Pp. 6

[14] Seeley I.H. (1987). *Building Maintenance*, 2nd Edition, Houndmills: Macmillan Press Limited, Pp 23 - 25.

[15] Speijker, L.J.P., J.M. van Noortwijk, M. Kok, and R.M. Cooke, (2000) Optimal maintenance decisions for dikes. *Probability in the Engineering and Informational Sciences*, 14(1):101-121.

[16] Van Noortwijk, J.M. (1998). Optimal replacement decisions for structures under stochastic deterioration, *Proceedings of the Eighth IFIP WG 7.5 Working Conference on Reliability and Optimization of Structural Systems, Kraków, Poland*, University of Michigan, Ann Arbor, 273-280.

[17] Van Noortwijk, J.M., and E.B. Peerbolte (2000). Optimal sand nourishment decisions. *Journal of Waterway, Port, Coastal, and Ocean Engineering*, 126(1):30-38.

[18] Van Noortwijk, J.M., and H.E. Klatter (1999). Optimal inspection decisions for the block mats of the Eastern-Scheldt barrier. *Reliability Engineering and System Safety*, 65(3):203-211.

[19] Van Noortwijk, J.M., M. Kok, and R.M. Cooke (1997). Optimal maintenance decisions for the sea-bed protection of the Eastern-Scheldt barrier, *Engineering Probabilistic Design and Maintenance for Flood Protection*, Kluwer Academic Publishers, Dordrecht, Pp 25-56.

[20] Van Noortwijk, J.M., and P.H.A.J.M. Van Gelder (1996). Optimal maintenance decisions for berm breakwaters. *Structural Safety*, 18(4):293-309.

[21] Olanrewaju A.A. and Kafayah S.T. (2008), The Need to maintain our buildings: Sustainable Development in Proceedings of PSIS Environ, 1st National Seminar on Environment, Development and Sustainability, Sabak Bernam Selangor Malaysia, Pp.1-5.