TITLE PAGE

ANALYSIS OF MAINTENANCE EXPENDITURE FOR FINANCIAL PLANNING (A CASE STUDY OF NIGERIAN AIR FORCE BASE, JOS)

BY

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*

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DEDICATION

TO

The memories of the sinless infallable **Ahlul Bait** (Peace be upon them).

And to:

My parents, late *Hassan Enua* and *Khadiza Bufu*.

DECLARATION

I hereby declare that this thesis has been prepared by me and that it is a record of my study and that, to the best of my knowledge, it has neither been undertaken nor accepted anywhere before in fulfilment of the requirements for the award of any degree.

All quotations are indicated and sources of information are specifically acknowledged by means of references.

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CERTIFICATION

This thesis/dissertation entitled **THE ANALYSIS OF MAINTENANCE EXPENDITURE FOR FINANCIAL PLANNING** by **Isa Hassan Enua Mshelgaru** meets the regulations governing the award of the Degree of Masters of Science in Construction Management of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

This thesis explores the use of building maintenance records of the Nigerian Air Force Base, Jos, for the purposes of planning building maintenance work.

There is need to organise and manage the scarce resources usually available for maintenance work in a prudent manner. However, this is only possible if decisions are based on informed judgement. The study is concerned with data relating to maintenance expenditure on the various building facilities of the Base, which have to be completed tabled, juxtaposed and analysed in a manner that will make them usable in budgeting for maintenance work.

A major area of interest here is to keep or improve every building facility, its services and surrounds to a currently acceptable standard and as well as to sustain the utility and value of the facility.

The results of the study showed that with good planning skill and appropriate cost recording, maintenance records could be a useful tool for improving the efficiency of maintenance budgeting. Recommendations on how to improve the reliability of this information through appropriate methods of documentation have also been made.

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GLOSSARY OF TECHNICAL TERMS

Building Maintenance: Work other than daily and routine cleaning, necessary to maintain the performance of the building fabric and its services.

Maintenance Work: Operation carried out to bring an item to an efficient or satisfactory condition.

Planned Maintenance: Maintenance work organised and carried out with forethought, control systems and the use of records to a predetermined plan.

Preventive Maintenance: Work directed to the prevention of failure or breakdown of a facility within the expected life span of the facility to ensure its continued operation.

Unplanned Maintenance: Maintenance work resulting from unforeseen breakdown or damages due to external causes.

Repair: Restoration of an item to an acceptable condition by the renewal, replacement or mending of worn, damaged or decayed parts.

Physical Life of Building: The period which expires when the building ceases to be an economic preposition to maintain it.

Economic Life of a Building: That period of effective life of a building before replacement.

Budget: A financial or quantitative statement, prepared prior to a defined period of time of the policy to be pursued during that period for the purpose of obtaining a given objective.

Occupant: Person occupying a building, especially individual personnel or sectional offices.

Client: Person responsible for running and maintenance of a building, who may not be the legal owner or the legal owner's agent or representative.

Operatives: Skilled or semi-skilled maintenance tradesmen.

Maintenance Record: A written account or statement of facts on maintenance.

Corrective Maintenance: Is that repairs or replacement of work or damaged components after a failure has occurred.

Works and Services Squadron: Works and services department.

Nigerian Air Force Trade: Officially acceptable categories of handicraft occupations.

Barracks: Buildings used to house troops.

Base: A military settlement from which a combatant (one who fights) draws reinforcements of men, ammunition etc.

Station (Unit): An established place where military forces have their headquarters.

Wing: An Air Force Unit of three squadrons.

Senior Non-Commissioned Officer: An officer of the rank of Sergeant or Flight Sergeant. A senior rank in the cadre not entrusted with any power or authority.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

A building as well as its various elemental components will deteriorate at a rate relative to the type of materials used for its construction, workmanship and the extent of exposure to environmental conditions. Other factors will include structural movement and the use to which the building had been put. Thus, Markus (1979) observed that some building components will require frequent renewal, while others will last the life span of the building or may be replaced only due to obsolescence. These differences in life span suggest why some buildings last longer than others.

In any case, buildings will last long when the effect of these factors are controlled. This is because the life of a building as stated by Seeley (1987) is governed by these factors.

The building, right from the date of completion undergoes varying standard requirements that affect its physical, economic and social life. The British Standard 8210 (1986) observed that a building has both a resource and a capital asset values which can be preserved through regular maintenance.

Maintaining buildings is so much prone to several kinds of cost uncertainties, that financial matters of some maintenance departments seem to assume the Parkinson's law: 'living expenses expand even faster than the income meant to cover them.' It doesn't have to be so. The income can effectively be controlled to cater for the growing expenses.

The benefit of cost control is that it enables the management to observe current maintenance cost levels, compare them with a standard plan or norm and institute corrective actions to keep cost within acceptable bounds. It also helps to identify where corrective action is necessary and provides pointers as to what that action should be - Frank and Ronald, (1977). Commenting on the conditions of the efficiency of cost control, Robert (1980) observed that maintaining cost control of the many daily activities throughout the duration of the maintenance project is a prerequisite in attaining a successful and profitable job. Indeed, financial planning and monetary management skills lead to more productive and satisfactory developments. Financial planning involves so much, but since budgeting gives a better ground to organise money activity; budget will form a suitable basis for our money planning and control.

A budget is defined by Seeley (1987) as "financial and/or quantitative statement, prepared prior to a defined period of time of the policy to be pursued during that period for the purpose of obtaining a given objective. It is clear that budget primarily does the management functions of planning and control which can only be understood when related to the fundamentals of management. But even then, what we expect from budget depends on the nature of our activities and the reliability of the cost information obtainable from the Management Information System (MIS).

The objectives are as follow:

1) To review the maintenance culture of the Nigerian Air Force and of Jos Base in particular.
2) To examine the maintenance squadron - its management styles and activities.
3) To study the trends of past spending on building maintenance of the base.
4) To highlight the expenditure on the various elements and ascertain the sum of cost of maintenance work in order to set up the budget for particular years.
5) To show the relevance of the use of past maintenance records in monetary planning of future works.
6) To articulate proposals for the improvement of the use of this planning tool as well as explore other areas of its applications.

1.4 METHODOLOGY

To achieve the set objectives, the following procedures were followed.

First the entire trends of maintenance in the Nigerian Air Force was studied in details by visiting other sister bases around.That warranted insights into the nature of the maintenance system. There after, a method of cost analysis was chosen to approach the problem. The method implies breaking down the building structures into specific elemental components as follows:

A - Frame/wall

B - Doors/windows

C - Sanitary services (water and waste water services)

D - Electrical services

E - Finishes

F - Roofing and ceiling

G - External works

H - Miscellaneous works

The study covered nine years (1989 - 1997) and separate data was collected for residential and non residential buildings. Cost information was obtained from past maintenance cash records and records of self-helped spending of tenants on the building they are occupying. In addition, structured oral interviews (see appendix) were conducted to fill missing gaps.

Other primary data like modes of execution, organisational policies and work organising styles were obtained directly from the organization.

Finally, the whole information was brought together, sorted out and then subjected to various statistical methods to arrive at the targeted objectives. The results, obtained were presented in forms of charts, tables and graphs for easy interpretations.

1.5 SCOPE AND LIMITATIONS

Unplanned corrective was the type of maintenance practised in this base. Hence, the data collected were in accordance with this type of maintenance. It is, therefore outside the scope of the information derived here to be applied anywhere other than

unplanned corrective maintenance.

It is beyond the scope of this research work to separately determine the contributions of the labour involved in the maintenance exercise.

Other local conditions may have to be considered for applications elsewhere as these may have impact on the cost patterns established.

CHAPTER TWO

2.0 REVIEW OF MAINTENANCE BUDGETING AND COST CONTROL CONCEPTS

2.1.0 ORGANISING FOR MAINTENANCE WORK

Maintaining building and its surrounding is an important function. The necessity for preservation and the degree of effectiveness obtained from the resources available is rarely discussed. Old and dilapidated buildings are treasures to be cherished. Insall (1973), described these buildings as rough diamonds waiting to be cut and polished; while Markus (1974) maintained that sensitive care is bound to return even the most obsolete building to its vigorous former self. To a certain extent, these are quite true because even if the original use of the building cannot be preserved, the building can be rescued through proper maintenance.

The best approach to the maintenance of dilapidated structures as Insall (1973) claimed is to allow the structures express their own individuality rather than quarreling with it. For example, its dignity, naturality, formality, whether it suits ones personality or not are important features to consider. Amongst the recommended practice pointed out by Haskel (1973), are to bring out its qualities and avoid replacement only when repair is not feasible, using similar material, component, dimensions and finishes. Essentially, the sound repair and restoration of building is the use of correct materials. Marching materials for particular building repair can cause major problems due to differences of size affected by changes in production specifications of these

materials. But that should not deter the refurbishing of these buildings.

Before dealing with maintenance activities, let us look at the preliminary stage of maintenance. At this sub-system planning and scheduling of activities with respect to material, labour and equipment proportioning and distributions are dealt with. The work at this stage makes maintenance desirable and worthful or otherwise, and form important factors that determine the success of many maintenance work. Thus, professional approach is inevitable.

2.1.1 WORK MANAGEMENT

One of the main pre-occupations of the maintenance management is the allocation of resources within the environment of many variables and complex relationships that most be considered in the process. The best of these things that organizations need to do is to familiarize themselves with tools they can have at their disposal to save time or and to perform a task more accurately. The computer is definitely such a tool. But where all staff cannot be computer experts, alternatives have to be sought. Taylor and Walting (1979) generally proved successful management operations through adherence to what they described as 'Ten Golden Rules' outlined below:

i) Know your objective - why is the project being undertaken? Define the project requirements in detail.

ii) Keep firm control over requirement changes. That is, changes in requirements during the course of the project; be it change in need, safety, environmental protection law etc. Every

change in requirements can potentially affect the cost, performance or completion date of the project.

iii) Plan soundly. This can be made in a number of levels but aim at achieve the same objectives. In planning a project, one should remember the Sam O'Donavon's law which states that 'If things can go wrong, they will go wrong and at the most awkward time and place.' Meaning that as you plan, you must try to foresee everything that could possibly for wrong and prepare contingency plans.

iv) In conjunction to these, some decision-making and planning tools must be used; such as

   a) Statistical and probability theories.
   b) Operation research
   c) Charts and line of balance.
   d) Matrix and network analysis.

v) Define responsibilities. In theory it is always easy to define responsibilities clearly. In practice problems can arise. Pride, status, ambition, personal and organizational rivalry can all lead to blurring of responsibilities. Changes both in the project organization itself and in the environment in which it is implemented can cause confusion.

vi) Ensure a good flow of information. Timely and accurate information is essential for the success of every project. Do not just sit in the office receiving information. Rather, you should go out and see the progress yourself. Note that, bad news may be kept away from you.

vii) Identify and concentrate on critical items. This is a well established management law - the 80:20 rule. It says that in every situation 80 percent of the problems come from 20 percent of the activities. It has many variations and applications. The message is that one should not spread one's time and resources evenly. Spread 80 percent or more of your time on the 20 percent of a critical item and the balance on routine.

viii) Select sub-contractors with care. Ask yourself the following questions. Can the contractor be relied on the stay in business? Will he do what he has said he will do in terms of performance and delivery? Can he be relied on to help you at a cost, if the project runs into difficulties.

ix) Recognise the need for trade-off. Examination problems and see to what extent they can be overcome by trade-off cost against time and performance. Normally, any delay can be overcome, if it is foreseen early enough either by additional expenditure or by a reduction in performance. Similarly, cost can be reduced by permitting delay and or reducing specification through delay in itself brings some additional costs. Performance can sometime be improved by taking more time and spending more money.

x) Avoid unnecessary risks. This is another way of saying plan sensibly and plan things right through. Avoid using unproven project where one is by definition doing new things, one should try to be evolutionary rather than revolutionary; and only have new, unusual or special; facilities where it is

absolutely impossible to use what has already been used and proven. That is because if has x new items or 'first' expect one's risk to increase by at least x^2 if not by x^x.

Maintenance management core decisions involve processes of selection between the pr more alternative courses of action which the Ten Golden Rules can give a solid foundation to begin and lead to fruition.

2.1.2 ESTIMATING

Estimating involves calculating the cost of work on the basis of probabilities.All measurements are approximate and invariable , and the acceptance degree of accuracy depends on the purpose and methods of measurement. This are the statements made by Collier (1974) when describing the estimation for estimates. Since all estimates start with the measurement of work, it follows that estimates are approximate to a variable degree in their first, the pricing, the degree of approximation is even greater because of the difficulties in predicting all the probabilities of such things as labour productivity and site conditions. The object of the work measurement is to price the quantities in order to estimate the cost of the work. Looking into the types of project cost estimating, estimates can be categorised in terms of their purpose and accuracy as follows - (Dingle, 1997).

1) Type I: Screening estimate, ± approximate 40 percent.
2) Type II: Study estimate, ± approximate 25 percent.
3) Type III: Budget estimate, ± approximate 15 percent.
4) Type IV: Control estimate, ± approximate 10 percent or better.

One major unknown factor faced by a non experienced maintainer is the need to accurately assess the work for individual trades at the tender stage. It is not until each building has been cleaned up and checked that the exact amount of work required can be established. This can have a drastic effect on the planned programme of work and the cost involved. Who knows what one will find when architraves are removed or ceilings striped. What was thought to be a solid wall could be revealed as a rotten crumbling mass that need to be demolished and rebuild. To that effect, general principles of measurements are expounded in the 'standard method of measurement' (smm7) of building works. It covers small buildings and alteration and repair work. In its content also are outlines of operative units of measurements applicable to building work like execution and earthwork, underpining, roofing etc.

The ability to predict probabilities largely depends on the data available from past experience and the estimator's situation which is perhaps the mental use of data without mechanical means. Another difficult aspect of preparing a fair-cost estimate, a detailed definitive estimate, on a control budget based on the estimate is the labour component that is dealt with under labour pricing. Since estimates are forecasts of uncertain futures; uncertainty is here catered for by adding amounts in form of allowances and contingencies to the estimated cost of items and the associated functions. In effect, these allowances reduce the probability that the actual cost will over run the estimate. Because the effect of these additions is to increase the probability that the final maintenance cost will not exceed our

estimates; our confidence in the estimate increases as allowances are added.

In maintaining buildings, estimates are prepared for the following purposes.

i) Project economic appraisal.

ii) Studies on the optimization of design, implementation and operation.

iii) Assessment of probable impact of risks, change, and alternative courses of action.

iv) Establishing budget for project funding.

v) Providing the basis of project cost control during implementation.

vi) Providing the basis of final cost projection.

2.1.3 TIME VALUE OF EXPENDITURE

Many a times when work is estimated and budgeted for or contracted out at a certain figure, the value is inflated at a particular time as a result of time elongation and not due to design variations or change in specifications. This is a loss of value of money which denotes the difference between the money expended to carryout jobs at different points in time.

The phenomenon of this concept follows that when there is an inflation, for example of 45 percent, an item that cost N1000 last year can now be obtained at the cost of N1405. Meaning that the N1000 can purchase only 55% of the items today. This difference creates a vacuum in the entire budgetary system. And it also indicates that time is a crucial element in any monetary matter. In

a practical situation, during periods of high inflation the connection between time and the value of money is more readily apparent than in Calmer economic environments. At this level, people experience the loss of the purchasing power of their money in a short time.

A times, time plays very positive role in some businesses. When money is invested in compound rates, it can achieve very impressive returns. But in the case of maintenance work where money could be tied down in a form of uncompleted repaired structures, it rather works against us. Because only the negative role of the time is felt.

Apart from the loss of values of budgeted money due to change in time, there could also be a rise in the general price level of goods and services in the economy due to the free flow of supply and demand, people's changing needs and wants and numerous other factors. All of these factors put together can considerably ruin budget programmes or eventually render it worthless.

In dealing with monetary matters, a net present value is considered to give the time value of the money through discount of each flow. The expenditure is discounted to a single point in time - usually the start-up time. When using the discounted-cash-flow procedures for capital investment evaluation, it is necessary to know the present value of a sum to be received at a future time. The present value of a sum to be received in the future may be obtained using the following equation.

$$PV = S \left(\frac{1}{1+i}\right)^2$$

where

PV = present value

S = sum

i = inflation rate

n = number of years

2.1.4 PRICING MAINTENANCE WORKS

The most important aspect of cost estimating is the existence of any information or data which could be of assistance in the preparation of the estimate, all of which could have a fundamental bearing upon the accuracy of an estimator's forecast.

Pricing work means computing and applying unit prices to measured quantities to obtain an estimate of the probable cost of the work. The different classification of costs are: material cost, labour cost, equipment cost, job overhead cost, operating overhead cost and profit.

The first three classification are known as direct costs because they are by definition always attributed to the items of work of a specific maintenance job. While the last two categories are called indirect costs, since they do not directly attribute to a specific job. The job overhead cost lies between the other two groups of costs, in that it cannot be attributed to specific items of work. Thus, it is among the direct costs of a maintenance activity, which cannot always be priced by unit price. This is because it does not relate to specific item of work, but rather to the job as a whole.

At this juncture, the primary focus of interest is the direct cost relating to unit rates.

(i) MATERIAL COSTS

To answer the question, what is the price of a unit of a material? It is necessary to ask several questions in turn as:

- "What type and quality material is required?"
- "How much material do you want to buy?"
- "When do you want it delivered?"
- "Where do you want it delivered?"
- "From whom do you want to purchase the material?"
- "What is your relationship with the supplier?"

There is no such thing as a fixed price for anything. Price is subjected to supply and demand and is affected by many things as well.

QUALITY:- Higher quality material implies higher price. For instance, higher strength concrete is usually achieved by adding more cement to the mix, and cement cost ten times more than fine coarse aggregates.

QUANTITY:- Large quantity purchased attracts lower price. Because a large quantity of material may mean that certain fixed marketing cost are spread thinner, and freight costs may be reduced by a larger and more economical carrier.

TIME:- Time affects in several ways because it affects production and delivery of products - some materials are seasonal demand, time restraints and weather affected.

Materials required at a time outside of normal business hours incur overtime expenses. Other effects of time on price of material are changing market, fluctuating supplies and demand, inflation and many economic factors. Price in terms of time is, invariably tied to a specific date or atleast to a specific period of time.

PLACE AND LOCATION:- These two usually affect price through the means and distance of delivery and accessibility of the site. Freight costs are determined by the type of goods, quantity delivered and also handling and storage costs.

BUYER AND SELLER:- The credibility of the buyer as a customer and the market level at which he purchases affect the price of material. The supplier can be considered a buyer as well as a seller of goods and services and will have influence on prices. Similarly, the relationship between a lesser and lessee affect the rates at which plants and equipments are rented.

(ii) **LABOUR COST**

There are two major factors determining labour costs in maintenance work. The first is the cost associated with hourly wages, fringe benefits, payroll insurance and taxes and wages premiums. The second factor is productivity, the amounts of work that a worker or crew can accomplish in a defined period of time.

Unlike wages and other price components which may be essentially constant over the duration of an operation, productivity considerably fluctuates. To estimate and control productivity, one not only needs accurate, consistent and up-to-date records, but a great deal of experience and judgement as well.

(iii) PLANT AND EQUIPMENT COSTS

Plant and equipment costs are dealt with in several ways. In some estimates they are entered against the appropriate items of work. While in others, they are estimated separately at the end of an estimate.

In general, for maintenance estimates that do not require a large amount of heavy and expensive equipments, like in low rise buildings; estimator may have to allow for plant and equipment costs as a percentage of total cost or as a percentage of labour costs. The assumption that plant and equipment costs are about the same proportion of total costs in similar jobs, and cost accounts may show this proportion is fairly constant. Small tools are usually allowed for as a percentage of total labour costs.

Equipment costs have to be estimated in the same way as any other costs. If the equipment is leased the lessor has to calculate the rental rate he must charge. But if the equipment is in stock for use in direct labour operation, one will have to calculate a realistic rate per day before estimating the total costs.

The knowledge of costs as they develop and the actions taken to relate the costs to other maintenance actions can be brought to bear on the complete problem in a manner that contributes

positively to the whole maintenance process.

2.1.5 PROGRAMMING MAINTENANCE WORK

The repair and replacement work is costed and priorities are established, giving regards to cyclic arrangements. Work load is controlled to permit levelling out work peaks, control costs against budgets and forecasting of areas where reductions in the maintenance budget can be accommodated in the short term if spending has to be curtailed. All of these require work to be programmed in advance.

To programme maintenance work, the BS 8210 (1986) set out some points as necessary watch words as follows:

1) Maintenance work should be carried out at such times as are likely to minimise any adverse effect on output or function.
2) Programmes should be planned to obviate as far as possible any abortive work. This may arise if upgrading or conversion work is carried out after renovation work has been competed or if work such as rewiring is carried out after re-decoration.
3) Any delay in rectifying a defect should be kept to a minimum only if such a delay is likely to affect production output or function.
4) Maintenance work completed or being carried out, should comply with all strategy and other legal requirements.

Economic appraisals should be undertaken to obtain maximum benefits from the use of access equipments planned to be used. The costs of access elements can be reduced by giving attentions to their future requirements; such that maximum or multiple uses are

attained. Programmes should be drawn up in full consultations with clients, and allowances should be made for operational constraints, financial circumstances, legal requirements and availability of feedback data.

COST OF DELAY

Maintenance work is a one-time engagement of a limited duration. Continuous observation and rectification of defects at early stage is likely to reduce cost of maintenance.

The frequent inspection will serve as a guide to strick a balance between the cost of production and the likely increasing cost of repairs when delayed.

It is a wrong idea to attempt saving money through delaying emergency repairs like leaking roof. For, if it ever requires major replacement, it will cause serious dislocation of household, considerable inconvenience to tenants and even leads to accelerated deterioration of other parts of the building.

The illustration below shows the dramatic effect of delaying repair of a minor roof defect.

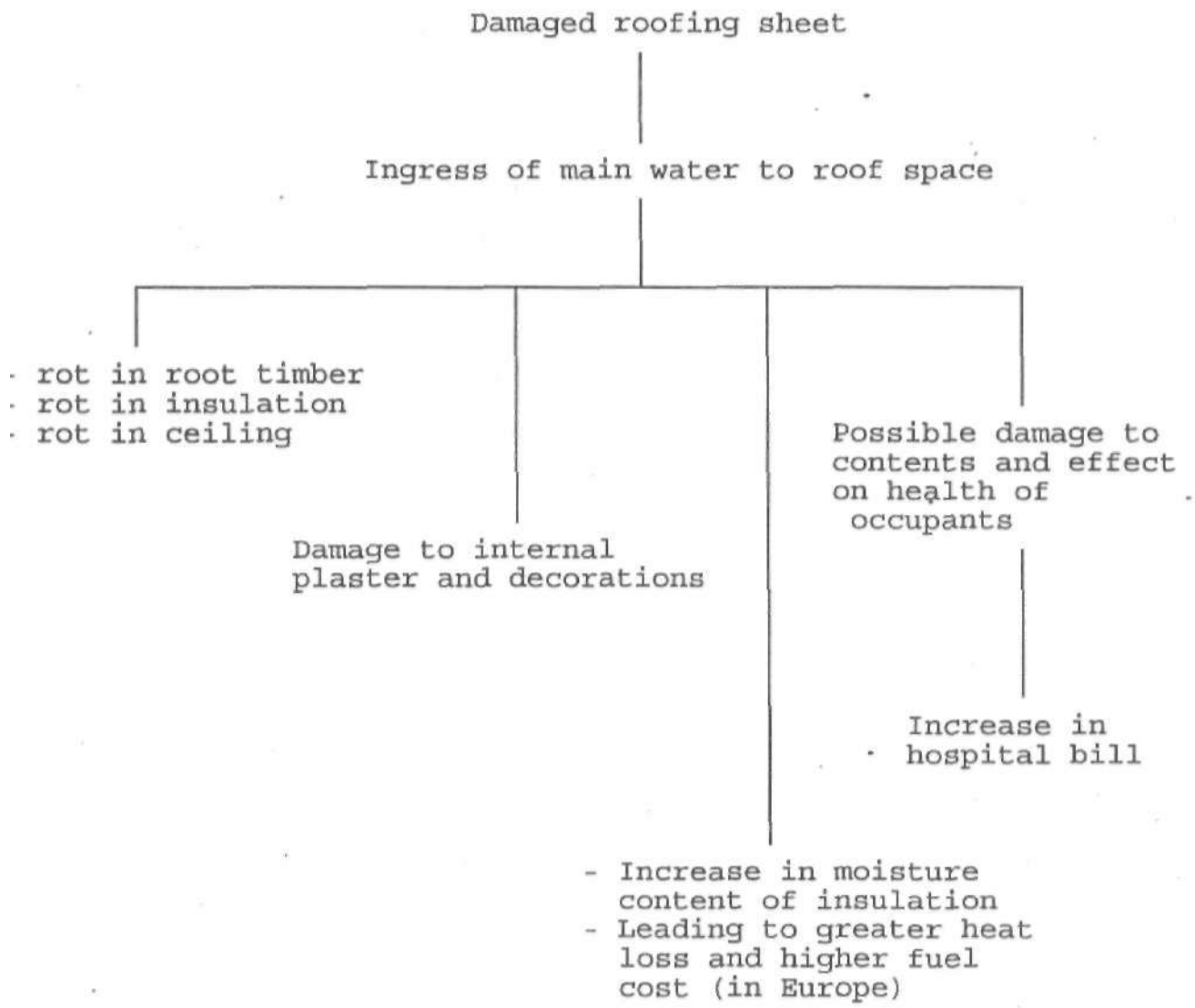


Fig. 2.1 Accelerated Deterioration on a Building.

2.2 COST CONTROL

In each maintenance activity, there are ever changing group of activities to be accomplished within definable cost limits. Unless accurate and effective cost control of the various activities of each project occurs on a timely basis, the overall cost of the entire project can quickly get out of control. In this instance, functions of cost control system can be likened to a domestic thermostat, in which the instrument measures the temperature, compares it with the desired range and then switches the temperature heating system 'on' or 'off' or leaves 'on' or 'off' depending on how the current temperature compares with the desired range. It is therefore obvious that the best method of assuring an organisation's profit is by effectively controlling the cost throughout the duration of the project. Without some means of measuring on a timely basis what costs are running throughout the duration of the job, cost can be quickly out of hand,with profit disappearing before the job is finished.

The selection of a system to use depends on the size and complexity of the operation, but more on the attitude and levels of sophisticated of the top management. The followings are systems of cost control cited by Frank and Ronald (1977).

a) **UNIT COSTING**:- In this system, costs of various types of work, such as mixing and placing concrete are recorded separately. The costs, both cumulatively and on a periodic basis, are divided by the quantity of work of each type which has been done.

b) **SYSTEM BASED ON THE PRINCIPLES OF STANDARD COSTING**:- Standard minute values are associated with the production of each component and converted to money value by reference to the hourly rates of the appropriate grades of operatives. Variances are calculated basically on comparing the value of the output with the cost of providing it. The variance is the amount by which the achieved profit differs from the budget profit. Alternatively, the value of workdone can be assessed in relation to the operation budget which in turn must reflect the amount that the operation is expected to be paid.

c) **BY OVERALL PROFIT AND LOSS**:- Such a system is useful only on very small operations of short duration involving few men and little construction equipments. When the operation is completed, the sums of money that was used is compared with the money incurred in purchasing materials, payment of labour, plants etc. The information this system produces can only be used to avoid the reoccurrence of gross errors in latter jobs.

d) **PERT/COST**:- The performance evaluation and review technique/cost method requires each job to be networked. The values of grouped activities are assessed in advance. The time update of the network provides the value of work done as a by product of the calculation. The value can be divided by cost code, provided that grouped activity information is similarly divided. Thus, when incurred costs are recorded against the same code, variances can be calculated for management information.

By instituting and maintaining effective job cost control methods, budgets can be established enabling trouble spots be detected easily and remedial actions be taken before profit disappears.

2.3 BUDGETING

Usually, some organisations plan their activities in advance, carryout the plan and adopt appropriate techniques of observation and reporting to ensure that the deviation from plans are properly analysed and handled. Yet some believed that they can run their businesses quite successfully without budget. But in most cases, particularly, where the business is truly successful, the essential ingredients of good budgeting are present, only that it has not been formalised into a system. Such informal system can work satisfactorily, particularly in smaller organizations and in those dominated by strong top executives.

The ingredients essential for the operation of a formal budget system consist of criteria or control standards. These may not be obvious, but upon probing deeply Reginald and Trentin (1971) opined that, one will find that every successful management has developed such guidelines and has formally or informally, consciously or unconsciously used them to run the organizations. Contrary to some views, budgeting is quite beyond financial functions performed by budget department or basically as a means of forecasting; especially, if by that it means predicting the outcome of events

rather than planning for a result and controlling to maximise the chance of achieving that result.

To introduce an effective budgeting procedure, critical and uncompromising study of the organisation and the department using the budget should be made to determine its strengths and weaknesses in relation to what it is trying to achieve. First of all, it has to test the validity of its objectives in relation to the skills and resources of the organization/department and to the particular competence required for its products.

The secret of making budgetary work lies on the effectiveness of the reporting and the insight into operations provided by variances from budget. What is done about variances is a matter of management judgement which very often makes the difference between a profitable year or a loss year. The budget effort can be effective only if the results are reported in such a manner that they gain the necessary attention from all levels of management. McAlpine (1976) observed the following guidelines in preparing budgetary reports. They are:

1) Only those items of cost which are basically incurred by the individual charged with the responsibility for a particular section/department should be included in the budget report of that section/department. Remember to avoid including allocation of general overhead or other items over which the section/department head has no control.
2) Only that information which is meaningful and necessary should be included in the report.

3) Only the minimum amount of detail appropriate for the organizational level for which the report is intended should be included.

4) Accounting and reporting of expenditures should be in accordance with the principles of responsibility reporting.

When these guides are followed, one can gain the accessibility required and the attention necessary for effective use of budgets.

In addition, there are some questions that have to be considered in drafting budget procedures as given by McAlpine (1976). They serve as aid to the general drafting procedure.

1) What budgets are included in the scheme? Who is responsible for preparing and coordinating them? What is the due safe for the completion of each budget?

2) What designs have to be made in the preparation of each budget?

3) What information will be required to guide these decisions?

4) What are the sources of this information? How will it be collated, analysed and interpreted to establish the fact?

The procedures should be based on a factual approach to decision making and in this connection, it has to be appreciated that decisions based on incomplete information can be as misleading as those based on wrong information.

2.3.1 FUNCTIONS OF BUDGET

As we know budget deals with any monetary activity. The Bank of America (1990) highlighted the following specific functions of budgets; viz:

i) Budget can help direct money to the places that will give the greatest satisfaction.

ii) They can boost self-discipline, give clear target, a way of keeping scores and reports for success.

iii) They can help ensure that money is there when needed.

iv) They can be research tools, helping gather information to make better spending decisions.

v) They can be powerful aids to investment strategies, helping to make sure you have the maximum amount of money available for extra return through investments. For instance, a good budget control can ensure that you have just enough money in your account to keep service charges to a minimum, and just enough to meet bills as they become due, so that every naira beyond that can be at work else where earning a maximum return.

vi) Budgets can be strong planning tools, forcing you to think ahead. And they can be aids to communications.

2.3.2 BUDGET AND MANAGEMENT INFORMATION SYSTEM

When budget is considered the basic system that integrates all operational plans to express the financial results and economic performance of the organisation; its ingredient information should be central in the management information system because the total financial consequences, resulting from the sum of all operating plans is the final measure of economic performance. Essentially, the management information itself is a marriage of a management system and information processing systems. By management system it spent the process by which management defines organizational

accountabilities, establishes subjective, set forth a plan of operation, and control performance to ensure that the objectives are met. It is a comprehensive system that provides information to all levels of management in an organization, so that the functions necessary to meet the objectives of the business can be effectively performed.

Obviously, within this broad framework a number of components are needed to provide a wide range of information to many different people. Under this concept, however, these component systems are interrelated in a way similar to the way in which functional duties are interrelated in a management organization to achieve a coordinated business purpose. The interrelationships and the flow of information, must be specified so that the flow is integrated to provide efficiency in the processing of data and to ensure that different functions do not receive different information describing the same condition or an activity.

The management information system releases cost standards price information, equipment capacities etc. to operating functions as the planning involves. Budgets so developed from such information is only funtional for the specific jobs designed for it. It does not fit any other job. There are various types of budgets to match every activity.

2.3.3 PROGRAMME BUDGET

This budgetary approach is the most common in the programmed activities of organisations, like a planned preventive maintenance. The programme or appropriation budget in this area represents the total cost of undertaking a series of individual projects.

As in most budgeting process, there is a top-down and bottom-up approach taken to establish the cost and content of these programmes. This upper limit may be derived from management's judgement as to a total amount necessary to keep in step with current growth rates and future expectations.

In both approaches to programme budgeting, there is a distinct need to provide some mechanisms that will assist management in identifying a preferred choice among the possible alternatives. Where a total budget is established initially, management will have to decide to allocate the funds to individual project at department levels, the management will decide on how to screen and select projects to be worked on.

2.3.4 CAPITAL EXPENDITURE BUDGET

The capital expenditure budget is concerned with long-range planning objectives - for example the next five (5) years. This sets the stage for the detailed planning for the first year, which is part of the budget preparation process. Long-range objective usually provides for expansion, distribution of facilities and other resources. Because the commitment of funds in capital project is irrevocable, plans and proposals for these expenditures are carefully examined.

An essential starting point in capital expenditure planning and control is the identification of proposals with corporate long-range objectives. This requires a definition, and rather complete description of both the objectives and the capital expenditure

proposal. Organization's objectives are often organised as present nature of the organisations and products and planned changes, volume and profitability policies, financing plans, relocations etc.

Capital expenditure proposal must then be sufficiently specific to permit their identification with objectives for expansion and change or to permit their justification on the basis of cost reduction, improvement or necessary replacements.

2.3.5 STEPS IN WRITING BUDGET

When we have full idea of what kind of budget we need the basic steps involved in writing the budget could be as stated by the Bank of America (1990) below.

1) **DETERMINE NET INCOME**:- First you need to determine what amount of money you are working with. It is easier to do that on an annual basis, but later you need monthly figures for writing your actual budget. Allowances for contingencies is made to cover for unforeseen expenses.

2) **DESCRIBE YOUR PAST SPENDING**:- This will make easier for you to develop the year to year comparisons you need later if you convert all your past spending to monthly totals. If you don't have a good, consolidated record of past spending, you will have to do some research to help you make better decisions to give you more pleasure for your money. It worth the effort and as already noted, you will want to convert all your past spending to monthly totals.

3) **WRITE YOURSELF A NEW BUDGET**:- Before you write your new budget, you may have to tiddle with the categories. The categories you use need to describe your objectives and your practices accurately. In setting categories remember the decisions you made about the purpose of your budget plan.

If you are using your budget to diagnose and control spending, remember that you are looking for things you can change, places where you can alter your habits to correct a problem or free up money for use elsewhere.

Here are some additional questions to help you examine and edit your budget.

i) First, can you find any leverage possibilities, items large enough that a 10 percent saving would make a difference?

ii) Second, is there hidden spending you should examine more closely?

iii) Thirdly, are there some relatively painless ways to get more out of your money? For instance, can you save on telephone expenses by getting rid of extensions or by using week ends and later hours more for long distance calls?

Based on these thoughts, modify or add categories to your budget to help you use it to track possibilities for change. You now have your own edited version of expenses categories. Now you will begin to spread money against them.

a) Where you already know, from last year, what the figure will be this year, enter the amount, taking into account whatever increase is predicted.

b) For lump sums, make your best guess as to whether they are the kinds of expenses that are likely to recur. If an item is recurring, enter it, divided by 12 for the monthly increment in the budget year monthly column. But if it was truly a freaking expense leave it off.

c) Scan other items from last year. Is there anything that is not typical? If you had zero work on walls and frames for example, are you likely to be so fortunate again this year? Put down a figure that seems most realistic. On the other hand, perhaps you spent a lot on rooting last years, was that mostly because of the abnormal increase in rainfall, and will that happen again? Adjust the number accordingly.

d) Think ahead. Is there anything big coming up this year that would be new? A cyclic replacement? Put down a figure for that, divided by 12.

e) Next consider how much reserve you need. It is worthwhile to think about this, because you may decide your most important priority, once you get a few air ahead. More important than any purchase is to create a buffer between you and disaster.

f) Now, at this stage, it is time to fine-tune your totals. If there are any blanks, put in your best guess based on what you have spent in the past.

g) Add up the columns.

h) Now go back to the income projection. Subtract the expenses budgeted from the income projection. If there is a surplus, you will have to boost some categories. If your result is

negative, you have the dismal job of distributing the shortage. And if you have a surplus, go down the column and consider which item you would like to increase. Put a plus sign next to them. If you have a negative result, go down the column and place a minus sign by items you think you can reduce.

If you have a surplus to distribute, put a few naira here, a few naira there, beside the plus items until the surplus is spent. You may want to priorities here, assigning money first to the items you must want to increase and if necessary, leaving some of the less important ones as they are. And if you are dealing with a negative, go to the items marked with a minus for reduction, put down an amount you can realistically cut, a few naira here and few Naira there until you have accounted for all the deficit. Beginning with the items, that are easiest to reduce or that you care the least about.

CHAPTER THREE

3.0 THE CASE STUDY

3.1 NIGERIAN AIR FORCE BASE, JOS

3.1.1 HISTORICAL BACKGROUND

The Nigerian Air Force Base, Jos came into existence in 1979 as a Regiment Training Unit. The Base consists of the barracks and schools all scattered along Jos-Bukuru road. The barracks and the boys military school occupy the site of the Old Airport after the complete movements of operations of the Airport to the new site at Heipang. The site as then, did not have any standing structures other than a waiting 'room adjacent to an administration block, a control tower and two hangers which were later converted to various non-dwelling uses by the station. These structures together with the present station headquarters' office complex and some others at the girls military school have long disjointed records; in that apart from the mining purposes some of them served in the past, there was trace that they were once sites for a Federal Government College. Today these buildings still remained firm and sound. Ready to put in more useful years of use. From time to time, renovations were carried out on them to suit them for the new uses.

Erections of new structures did not commence until in 1980 with the first phase that consisted of the officers' and order ranks' housing units and the temporary administration block of the boys military school annexed to the old students' hostel (known today as Corpers Lodge).

At that point in time, accommodation demands of the station was completely borne by the numerous rented quarters in the town outside the barracks. A policy that was sustained until 1992. Right before then, there was gradual actualisations of the remaining proposed phases together with subsequent newly developed concepts of expansion.

3.1.2 CLIMATE

Jos, the town of the Air Force Base is contained within the area of 8° 22'E to 9° 40'E and 8° 50'N to 10° 10'N and own its climate distinctly relative to the surrounding plain to its high elevation of 3,500 metres above sea level. This distinctiveness is to be measured not so much in terms of rainfall but in terms of temperature, evaporation and water balance (Hyde, 1986). It is said to be an oasis of climate splendous in blazing physical zone. The climate is largely determined by its altitude and its position across the seasonal migration of inter-tropical convergence zone (Nyam, 1997). The area experiences two sharply contrasting seasons that is wet and dry seasons. The seasonal cycle among various researchers roughly lie as follows:

i) November - February. Dry season is characterised by cool dry dusty harmattan within this period which blows across the Sahara. In the dry season, the night may be bitterly cold and the days bricks, especially in December and January, with warm period of increasing length towards the end of the season and an almost constant arid, dust-charge north winds; one or two

brief but violent rainstorm may occur during this season.

ii) August - October. A season of almost constant rain which can be very cold. Rainfall is relatively high over 1400mm (56") per annum concentrated in August to September. About 90 percent of the rainfalls within 7 months between April and October.

iii) October - November. Termination of the rainfalls, apart from a few storms of considerable violence.

iv) March - May. A season of extreme heat and frequent storm of considerable violence.

v) May - June. Rainy periods increasing in frequency and duration, th ough less violence.

The relative humidity of the area is low (Hyde, 1986). It is about 35 percent between November and March, that is, during the dry season. The weather at this point is very windy and dry, temperature usually drops below 15°c (59°f) during December and January. The larger period of rain means that the building components remain drenched for most part of the year. A situation which leads to dry rot and rusting of metal fabrics.

3.1.3 SOIL CONDITIONS

The soils are not homogenous over any recognised geological or geomorphorlogical units or zones within the region of the barracks. Its location is an upland region made up of soil between the rocky outcrops precambrian basement with intrusion of granite rocks of a high bearing capacity that does not lead to settlements. Despite the surrounding mining areas, there are no subsidence arising as a result of the mining traces of naturally occurring geological phenomenon such as land slipping and compressibility which could be malicious to buildings.

3.1.4 DRAINAGE

The drainage of the settlement was described by Hyde (1987) as the hydrological centre in the context of the region; in that, the water shed of the three major rivers system of the country come together at a place or point near Rayfield (the location of the barracks) in the southern district.

The plains are flooded during the raining season which last from April to September. In the dry season the flood recede leaving behind deposits of silts of varying extent (Nyam, 1997). The relatively higher altitude makes satisfactory disposal of surface water onto the low lying lands. This makes the land completely free from the possibilities of flooding. Living in the wet conditions are difficult and permanently wet site can give rise to unhealthy conditions for occupants and deterioration of building fabrics, such as those made up of timber, ferrous metal and even finishes.

3.1.5 THE LAYOUT

The settlement is a modified form of radburn layout, where houses with their proviate gardens backed onto culs-de-sac and fronted onto communal landscaped area, through, which foot paths give direct access to amenities without crossing a road. The primary aim of this kind of settlement arrangement is to separate pedestrians and vehicles and to secure more pleasant and safer residential environment. All buildings have an east/west aspect for maximum sunlight.

Only few office-blocks and hostels are storey buildings. The

rest enjoy the numerous advantages derived from the use of low - rise buildings, among which the following are inclusive.

i) Each flat has its facilities. Thus, intensity and misuse of facilities are reduced.

ii) Convenience - opposing to the difficulties stemming from the use of stairs and lifts that is unsuitable for children and have higher factors of safety.

iii) Absence of nuisance and damaging factors from adjoining tenants.

iv) High rise buildings are generally more costly to maintain, especially where it involves work on the external surfaces.

3.1.6 BUILDING FACILITIES

The studied structures consists of dwelling and non-dwelling facilities. They are of housing units, schools, office complexes and a medical centre. Basically, the residential structures consist of the following details.

17 five bedroom flat.

54 three " "

7 one " "

41 two " duplex

12 one " "

34 " " 10 units in a block

17 dormitories.

The non-residential buildings are

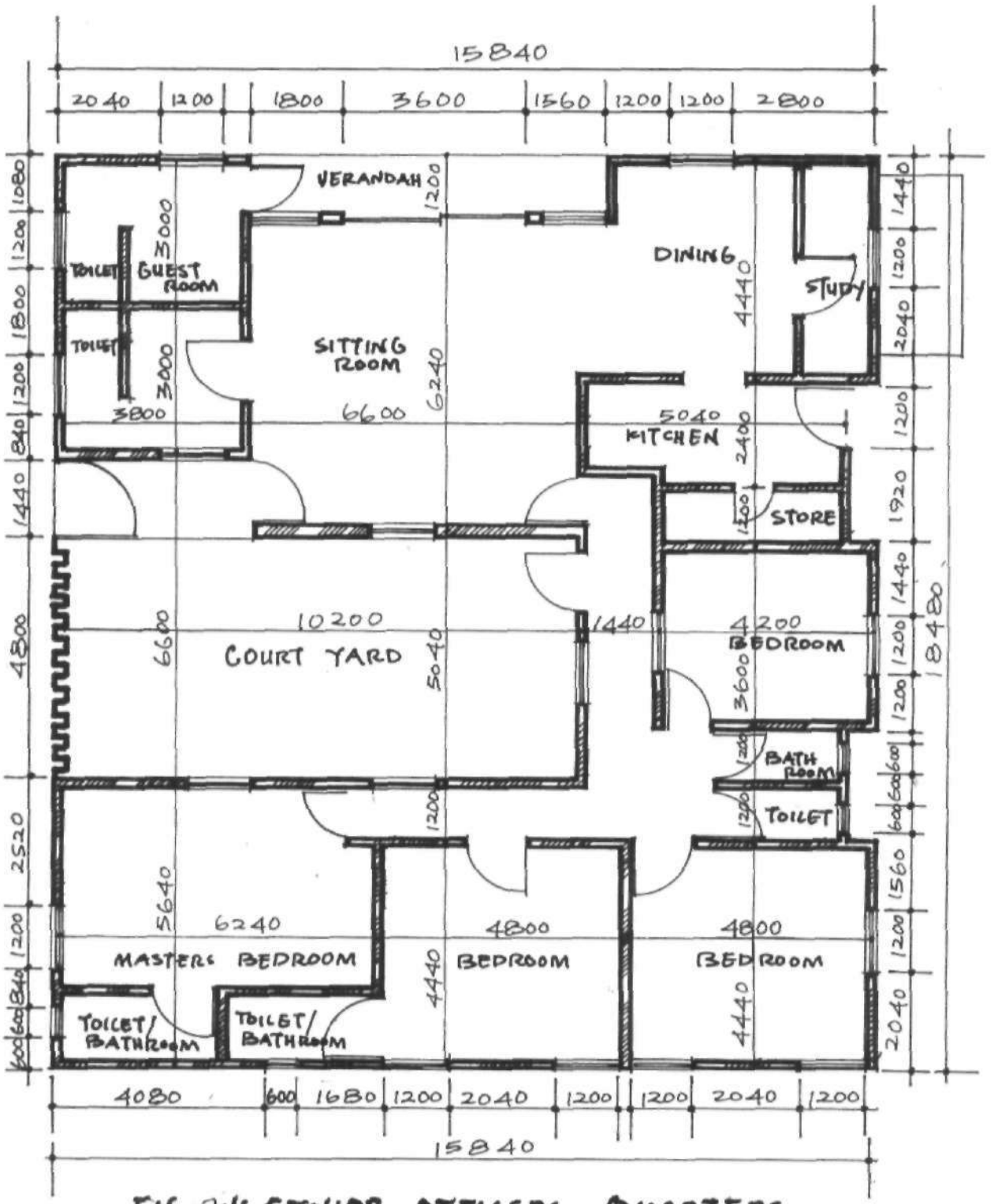
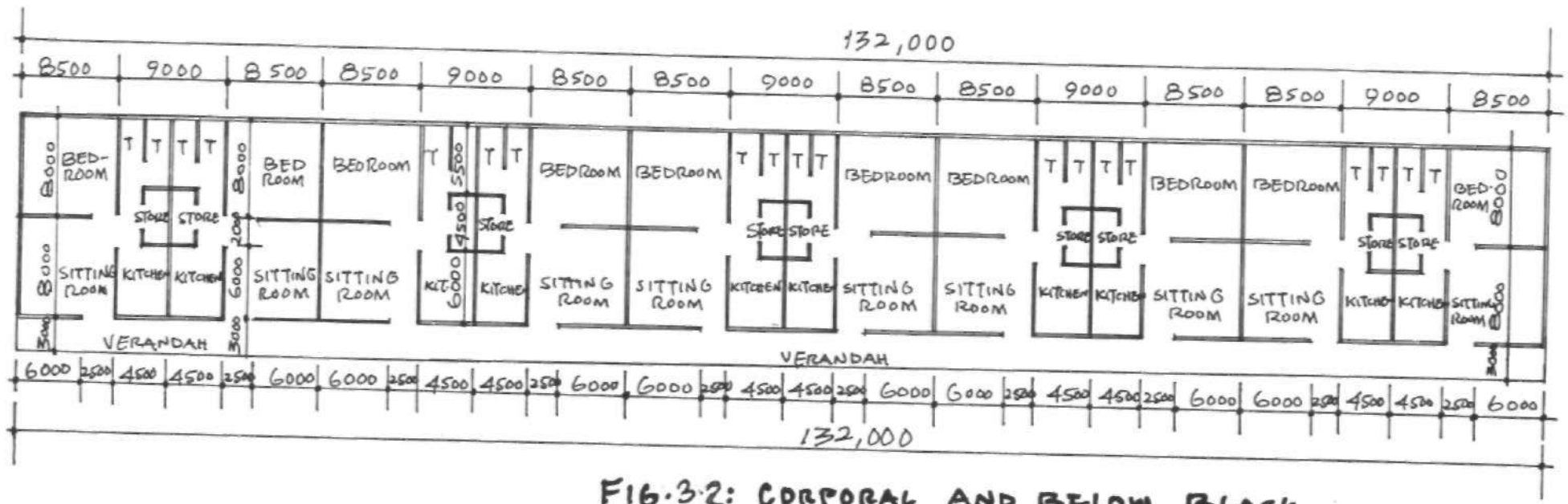


FIG.3.1: SENIOR OFFICERS QUARTERS
SCALE 1:120



FIG·3·2: CORPORAL AND BELOW BLOCK

SCALE 1:500

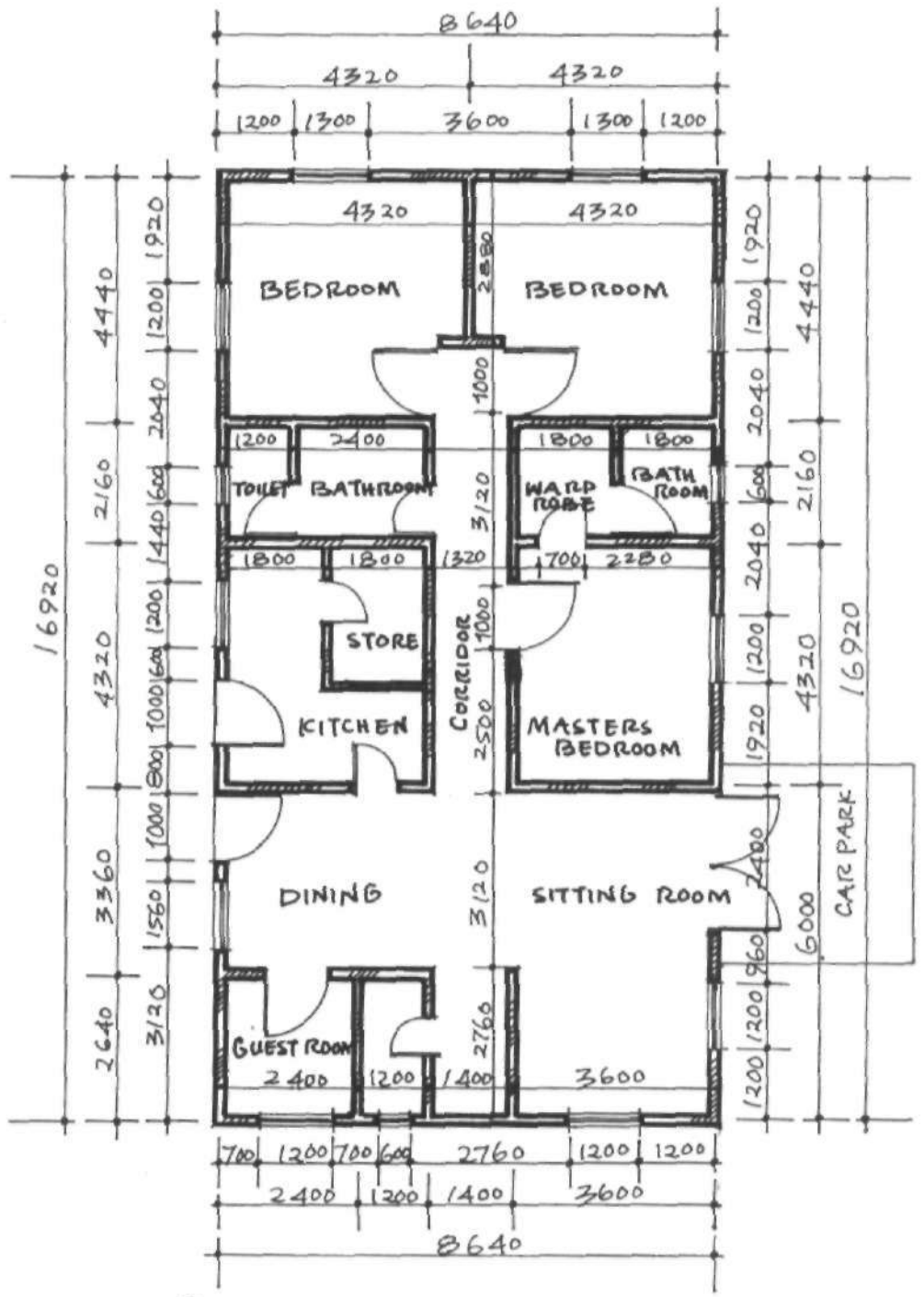


FIG 33: JUNIOR OFFICERS QUARTERS

SCALE 1:120

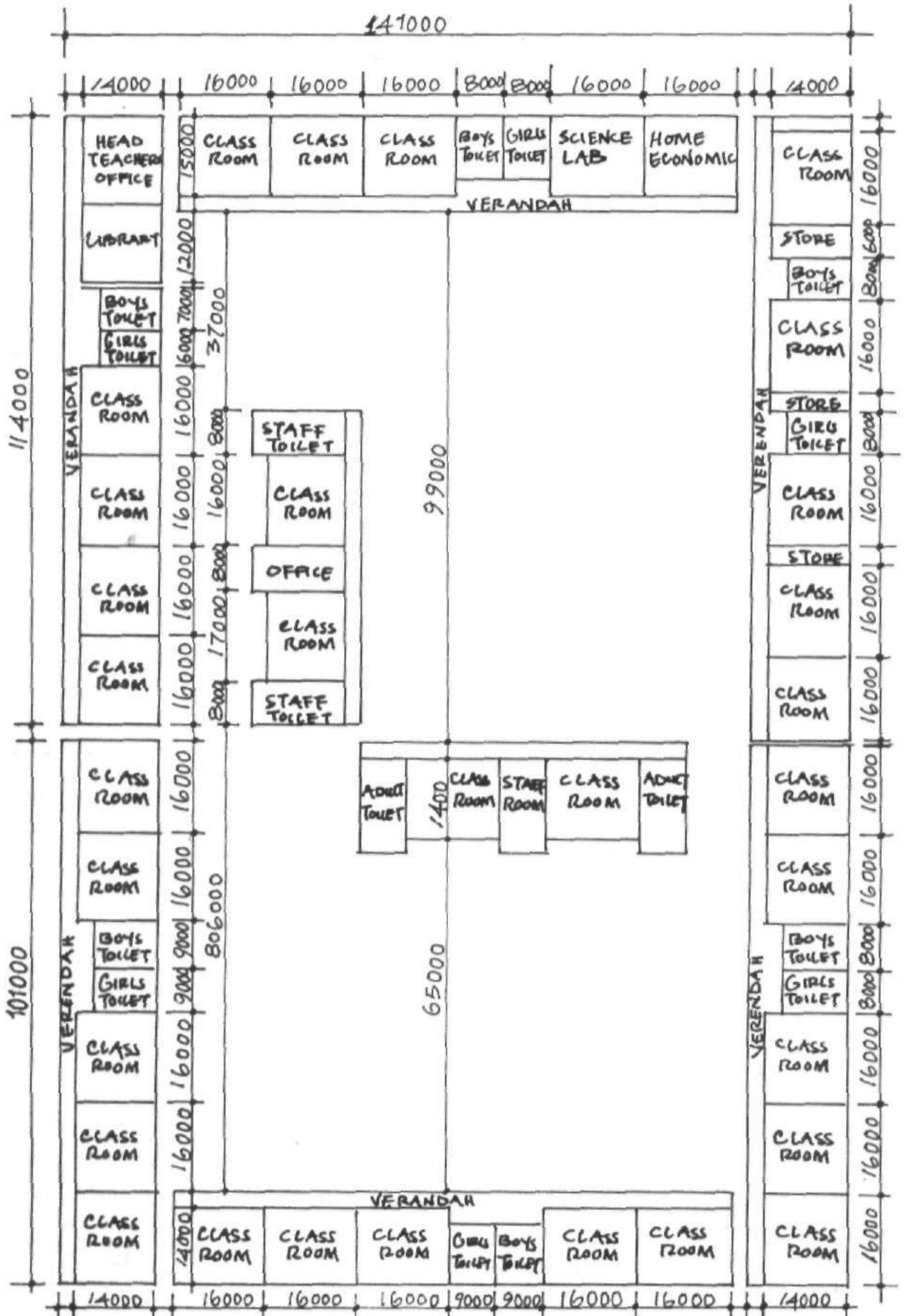


FIG:3.4 AIR FORCE PRIMARY SCHOOL - SCALE 1:1000

as follows:

14 office complex

7 class room blocks

1 60 bedspace medical centre

17 laboratories

2 libraries

2 halls

4 kitchens

4 dining halls

2 sick bays

3 places of worship

3 mess and transit

1 primary school

SOME FEATURES OF THE BUILDINGS

Greater percentage of the buildings are built in sand-crete block. And only few among the inherited ones have stone and pointed masonry walls and pillars. With the exception of this, the general wall finishes are in emulsion or gloss paints on motar plastered backgrounds. There is no any special treatment given to internal finishes that differs with the rendered faces.

Crittall-hope doors and windows and fabricated flush doors are the most common in use in the officers quarters, schools and medical centre, both for the internal and external openings. The use of louvered widows is found only in the junior personnels' dwellings.

Marching with the intensity of the annual rainfall at the highest point of the plateau, hiped roofs form most part of the roofing system which easily throw the massive rain-water away. Zinc and long span alluminium sheet in few places have been introduced in the most recently completed buildings; due to the nasty experience the management had with persistent leaking problem in flat concrete roof over the years.

3.1.7 WORKS AND SERVICES SQUADRON ORGANISATION

There are virtually six operational line maintenance sections in the work and services squadron of the unit. Each section is headed by a senior non commissioned officer (SNCO) who supervises work as executed. These sectional heads are usually trade soldiers above the rank of Corporal who are themselves classified under one of the Nigerian Air Force trades. They report to the supervisor not only on maintenance affairs, but also on military matters. The supervisor's office does the maintenance control functions.This office has a functional section whose activities stem from the office of the officer in charge (OC). All administrative and correspondence issues are directed to the administration officer (AO). He, the supervisor exerts functional activity by acting in the name of the OC over maintenance activities. His office is charged with the following duties:

1) Analysis and evaluation of maintenance with regards to costs and benefits.
2) Control of maintenance tools, and material stock levels.

3) Analysis and scheduling maintenance work.

4) Performing necessary maintenance paper such as requisitioning and estimating.

The Squadron Sergeant Major (SSM), plays the role of installing discipline and other military bearings among the personnel of the squadron in addition to his trade duties.

The operatives are trained technicians, but when it comes to execution of work, there is no clear-cut of duties and responsibilities for any tradesman. For example, a painter could be detailed for a plumbing work or a draughtman to be ganged with welders and so on. Such is the picture of the whole squadron in the eyes of the rest of the squadrons.

The squadron maintains buildings but is usually allocated dilapidated environments to live and work in. It is a common notion that personnel from the wing, whatever rank or qualification are associated with laboural work. This thought exists even at the top of the management. Apart from the inferiority experiences, such attitude ruin performances by disorganising activities and schedules. While others are kept to specific duties and their services protected and respected, one rampantly see a tenant driving to the squadron or even on the road to pick a technician to work for him; violating the normal booking and processing procedures. An attitude that can not be attempted in other places. The medical centre for example. The consequent impression is that everybody claimed to be a maintenance expert. People only turn to the squadron for estimates that enables them make financial claims; only to blame the work squadron of inefficiency when the work fails.

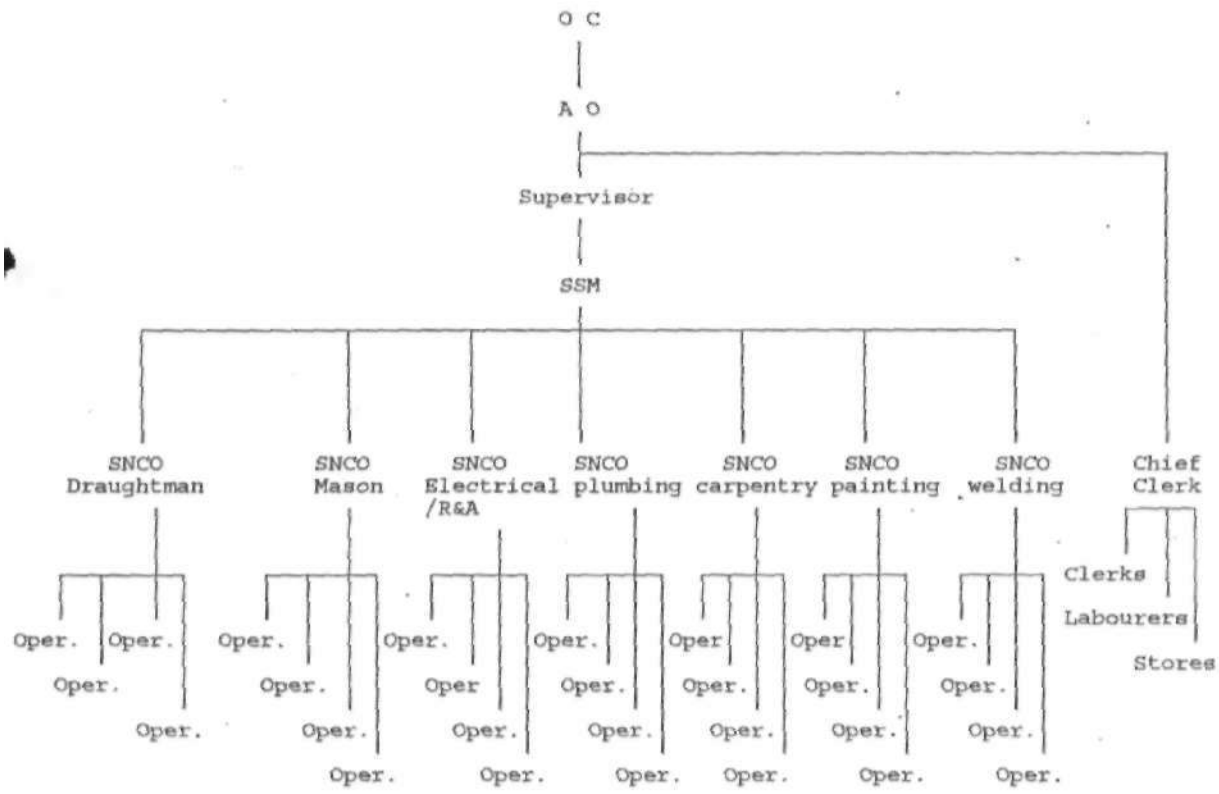


Fig.3.5 Works and Services Squadron Organisational Chart.

KEY:

OC - Officer in Charge

AO - Administrative Officer

SSM - Squadron Sergeant Major

SNCO - Senior Non-Commissioned Officer

Table 1 Composition of the Works and Services Squadron.

TRADE	Electrical/ (R&A)	Painting	Draught-manship	Masonry	Plumbing	Carpentry	Welding
No. of Operatives	12	2	2	5	4	7	1

3.1.8 COST CODING

Usually, a master cost control chart of account is used to arrange major groupings of meaningful segments of maintenance work. There is no single standard format of this segment being adopted. And for quite a long time now, the work centre of the Nigerian Air Force has been forming her segment on criteria that best suits her particular type of specifications of work and cost control system. The greatest problem faced was striking a good balance between two extensive list which become too detailed, hard to handle that eventually reduces overall effectiveness of the complete cost control system and a list that is brief with many items lumped together, that wouldn't give clear pictures needed to accurately monitor job costs.

On the issue of list preparation under group headings, the project estimate has been referenced as much estimates are prepared on an item-by-item basis. This is a principle generally practiced elsewhere. Some few examples of such segment headings are:

Labour

Material

Equipment

Job operating expenses

Field office expenses

Contract etc.

Each different project is broken down differently according to the scope of work encountered. In most occasions, the good list of the breakdown items, generally helped overall effectiveness of the cost control system.

CHAPTER FOUR

4.0 DATA COLLECTION , PRESENTATION AND ANALYSIS

4.1 PROCEDURES OF ANALYSIS

The data collected for the study so far were still raw. They contain some potentialities that could be magnified by suitable statistical analytical methods. The analysis of such quantitative data in this manner required rearrangements and classifications into particular forms. Each method adopted was found to reveal certain cost property as well as solving particular problems associated to it. The procedures are described below together with emphasis to the messages they are carrying.

4.1.1 TABULATION AND CHARTING

After the collection of the data, thorough sorting, recording and classification and arrangements into tables and charts were conducted in order to extract any meaningful information. The cost scores were entered into vertical and horizontal forms of tables and proportionate pictorial piecharts. Even at that point, certain forms of information still could not be discerned. For that reason there was need for further processing.

4.1.2 GRAPHIC REPRESENTATION

Further analysis led us to plotting the expenditure scores on graphs year by year. Here, clear images of how much money was expended on dwelling and non-dwelling buildings, based on seven specially synthesized functional elements was noticed.

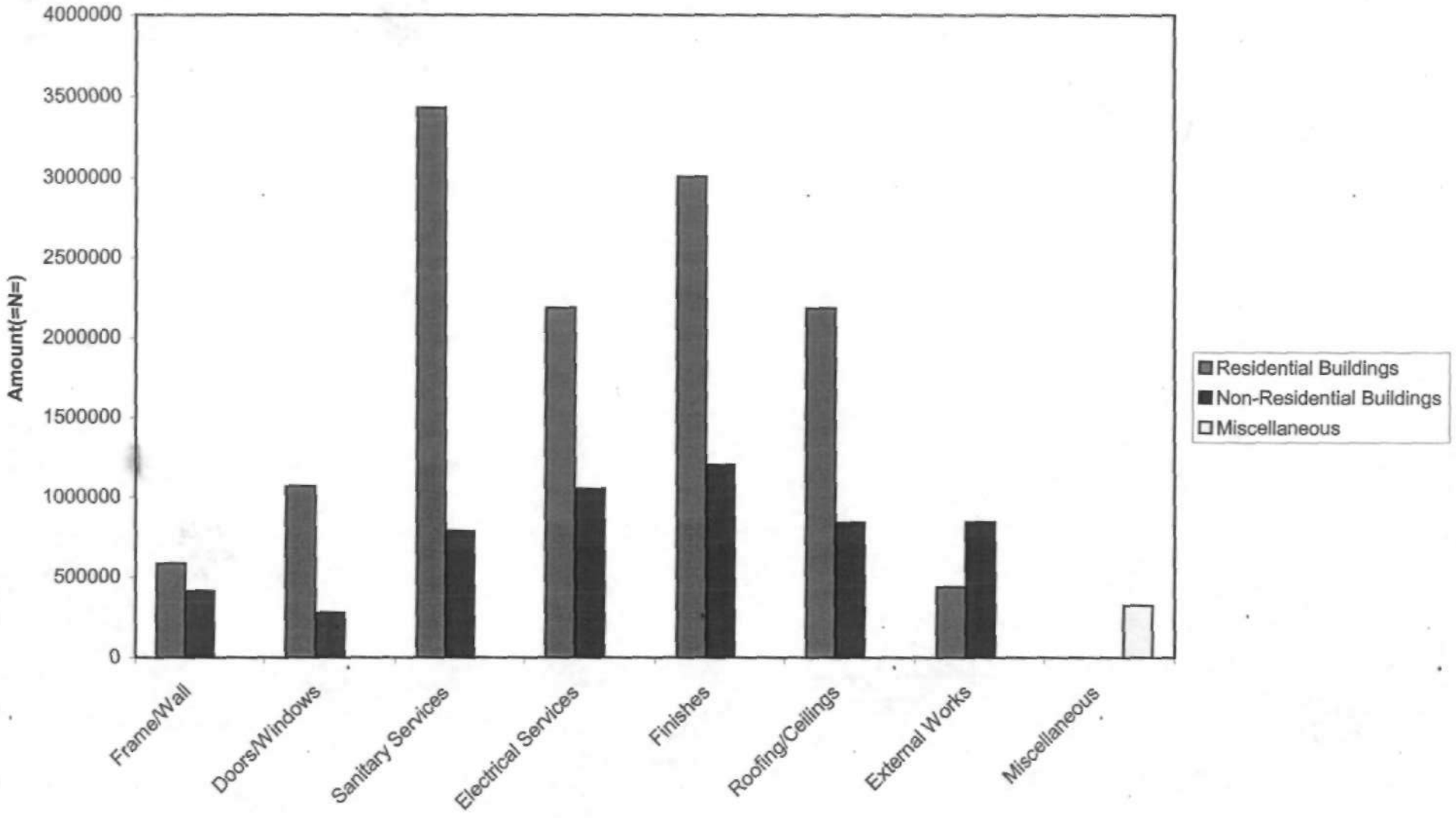


Fig 4.1: Total Maintenace Expenditure on Each Element

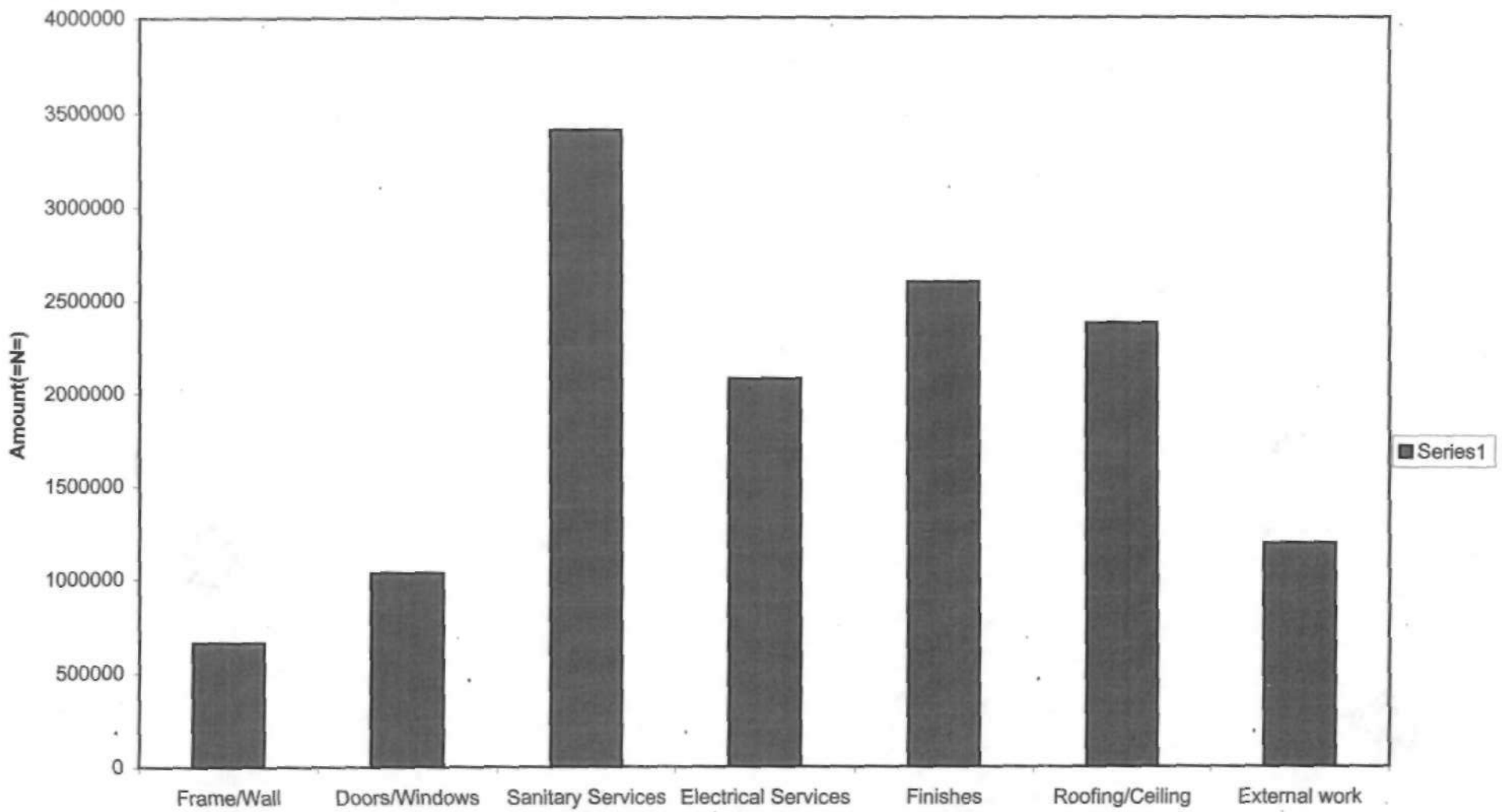


Fig 4.2: Total Maintenance Expenditure on Residential Buildings

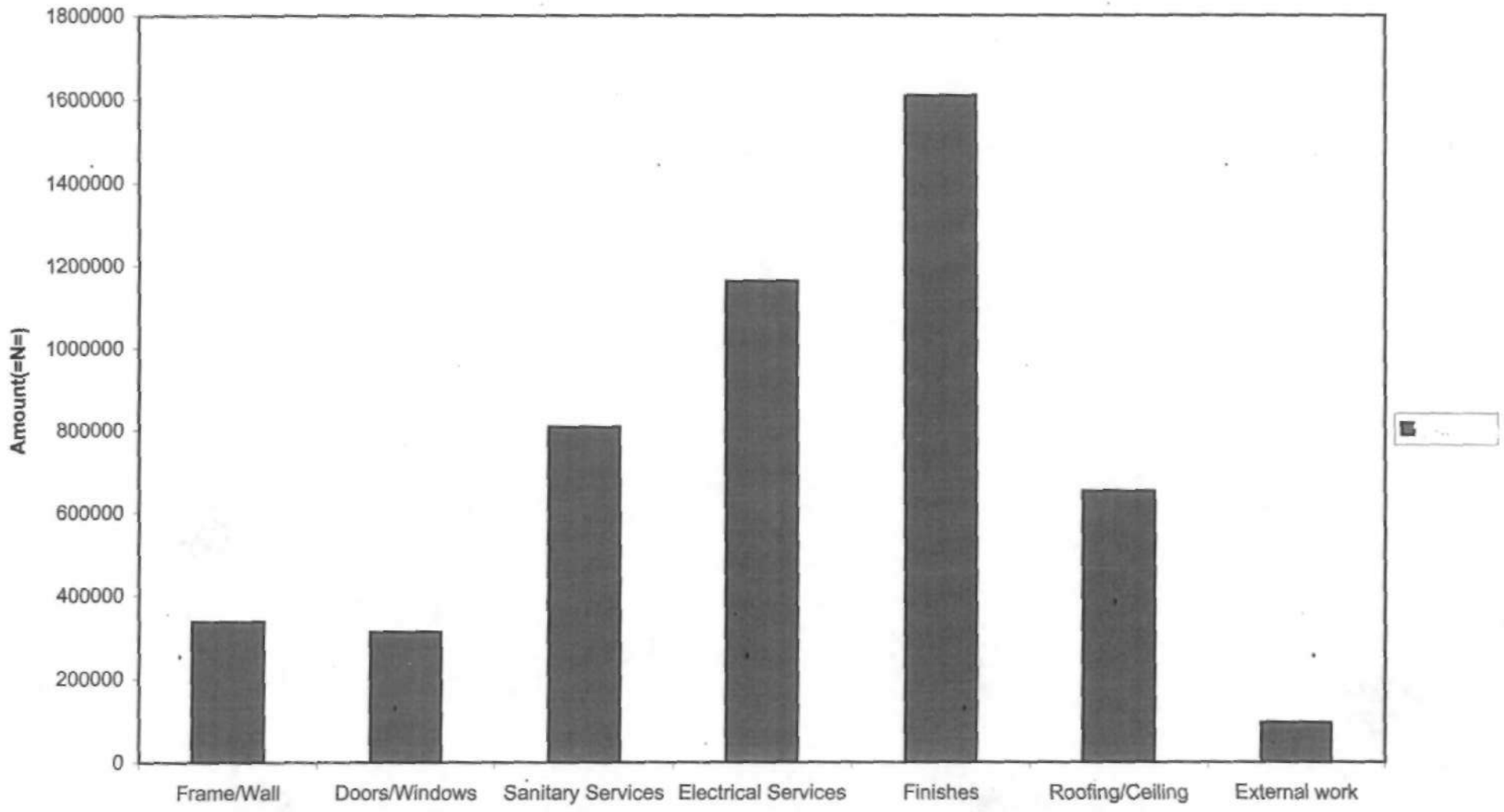


Fig 4.3: Total Maintenance Expenditure on Non-Residential Buildings

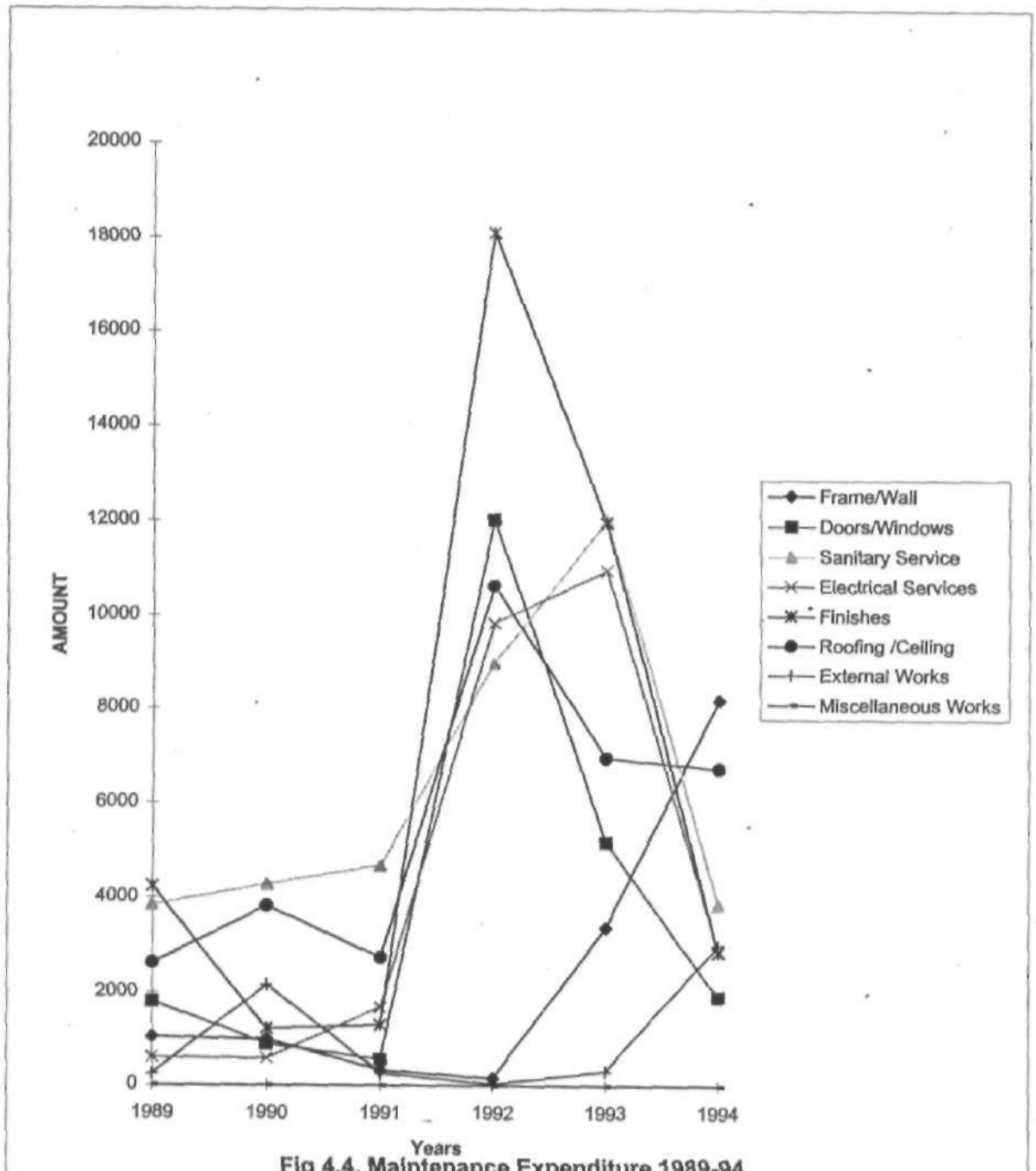


Fig 4.4, Maintenance Expenditure 1989-94

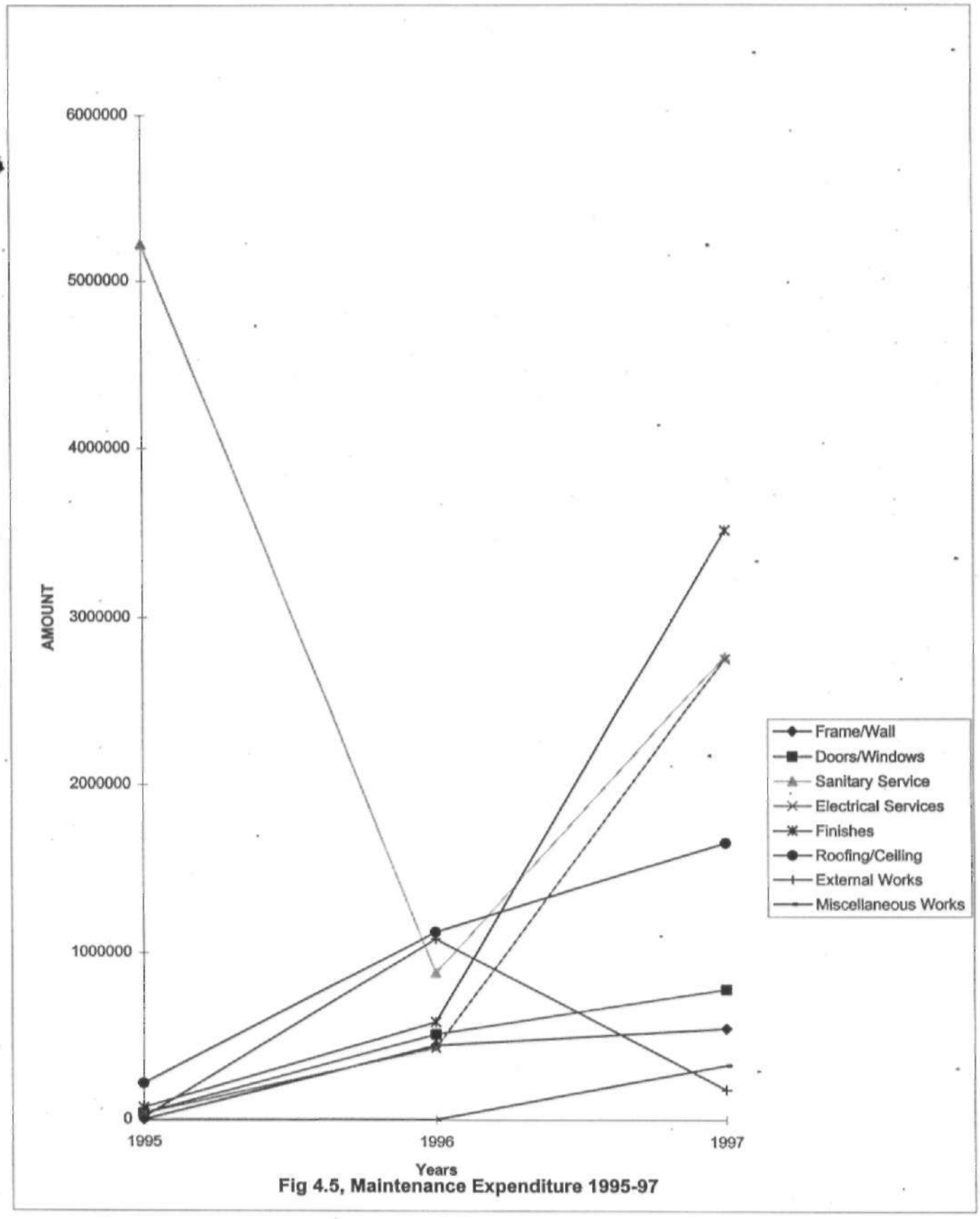


Fig 4.5, Maintenance Expenditure 1995-97

The overall expenses and the relative allocations of funds were vividly shaded out. The graphic distinguished many parameters and provided a compact description of the data set.

Despite the explicitly of the method, using the graphical descriptive method for making inferences could not yield to providing measurements of the relationships and reliability of our inferences. We may like to know the similarities of the graphical descriptions of the data to the corresponding figures of the population studied. To that effect, we could use one or more parameters to create mental images of the data set. These numbers are the numerical descriptive measures that follow.

4.1.3 AVERAGE UNIT COST OF WORK

For every yearly maintenance cost recorded, there was a corresponding number of operations, which subsequently summed up to give the number of work executed over the years. In figure 7, one can see which work cost less when it is to be carried out and the sort of work which if occurred several times, maintenance could prove unprofitable. The total cost of repair divided by the frequency gives a value indicating the average unit cost of such work. Thus, the most expensive unit rate of repair on the total was finishes with N105,126 average as well as having the most expensive single work executed in 1997. Even though sizes of work and components differ, average unit costs on a single composite base, has been computed to guide indiscriminate cost planning.

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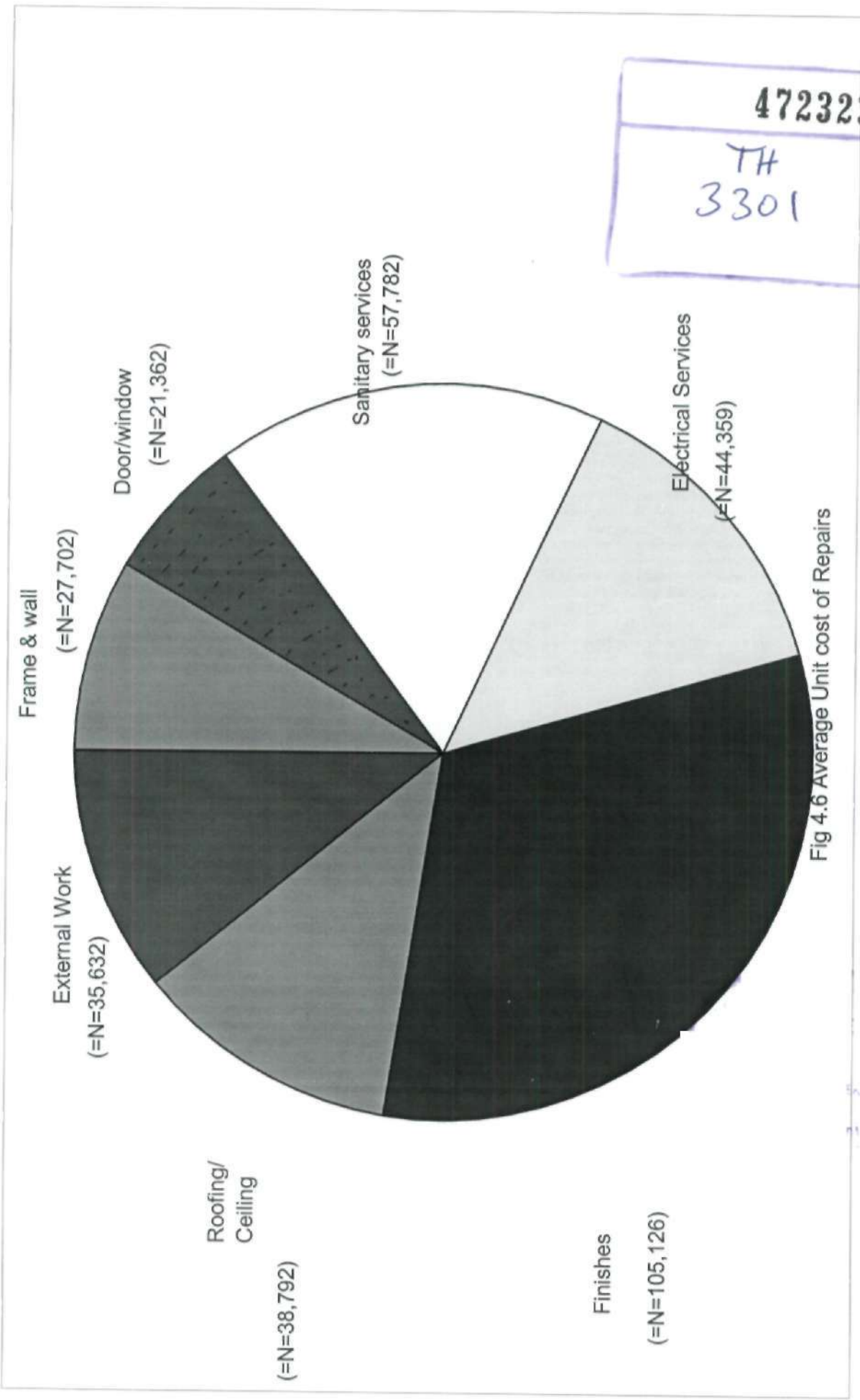


Fig 4.6 Average Unit cost of Repairs

4.1.4 ELEMENTAL CONTRIBUTIONS

The contributions rendered by each element at the end of the years indicates the percentage demanded by the elements; as can be seen on figure 8. The calculation was done by dividing element cost by the total yearly maintenance cost and then multiply by hundred.

Overall contributions were also obtained by the following formular in a similar way as above.

$$\frac{\text{Total expenditure on element}}{\text{Grand total expenditure}} \times 100$$

In its application, the overall contribution of door and window was

$$\frac{134577}{18636880} \times 100 = 7.22\%$$

7.22 percent indicates the overall contribution of the element on the whole year's maintenance.

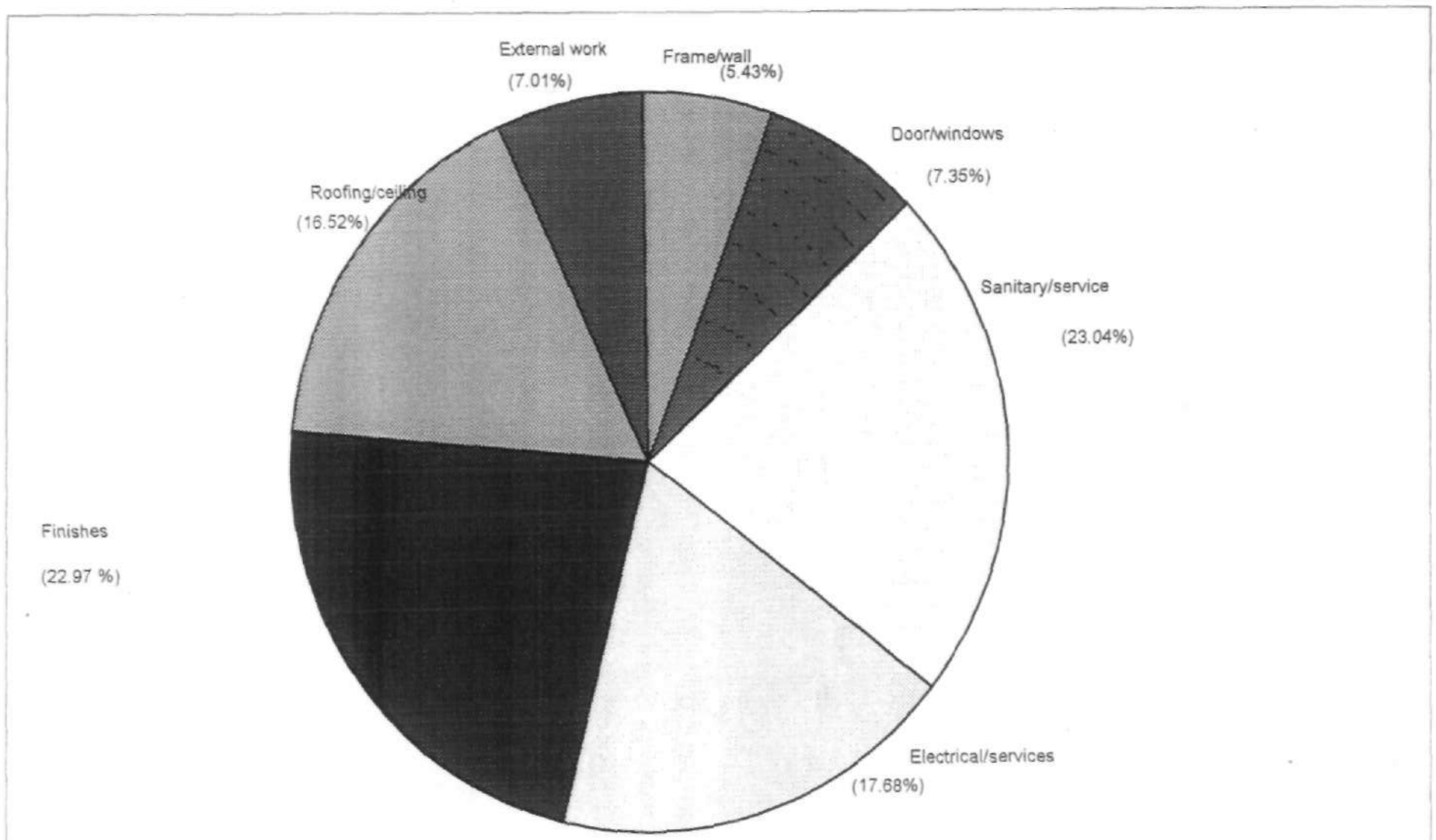


Fig 4.7 Contributions to Maintenance

4.1.5 CORRELATION AND UTILITY

The Pearson product moment coefficient of correlation 'r' measures the strength of the linear relationship between the variables X and Y. This will meant measuring the strength of the linear correlations that exist between the building components when substituted in turn with the X and Y variables. There are numerous versions of approach to this method. Each gives satisfactory results. The method chosen computes a sample of n measurements on X and Y with the following equations.

$$SSxy = \Sigma XiYi - \frac{(\Sigma Xi)(\Sigma Yi)}{n}$$

$$SSyy = \Sigma Y^2 i - \frac{(\Sigma Yi)^2}{n}$$

$$SSxx = \Sigma X^2 i - \frac{(\Sigma Xi)^2}{n}$$

The coefficient of correlation

$$r = \frac{SSxy}{\sqrt{SSxx \,.\, SSyy}}$$

For example, to find the simple correlation between frame/wall and door/window elements, the steps will be as below.

The elements frame/wall and door/window are represented by X and Y variables respectively.

Year	Expenditure on item X (,000)	Expenditure on item Y (,000)	ΣYi^2	$\Sigma XiYi$	ΣXi^2
1989	1.015	1.80	3.24	1.827	1.03
1990	0.969	0.868	0.753	0.84	0.94
1991	0.309	0.538	0.289	0.16	0.095
1992	0.152	12.00	144	1.824	0.023
1993	3.376	5.168	26.708	17.447	11.397
1994	8.142	1.891	3.576	15.396	66.29
1995	2.142	39.936	1594.88	85.543	4.59
1996	440.815	507.236	257288.36	223597.24	194317.86
1997	540.329	776.340	602703.80	419479.03	291955.43
Σ	997.249	1345777	861765.606	643799.30	486357.66

$$SSxy = 643199.3 - \frac{997.249 \times 1345.77}{9} = 494079.8814$$

$$Ssxx = 486357.66 - \frac{(997.249)^2}{9} = 375857.0413$$

$$r = \frac{494079.8814}{\sqrt{375857.0413 \times 660530.525}} = 0.9916$$

An interpretation is that, a value of r near or equal to zero implies little or no linear relationship between the elements frame/wall and door/window observed in this sample. In contrast, the closer r is to 1 or -1, the stronger the negative or positive linear relationship between the elements. And if r = 1 or r = -1, all the points fall exactly on the least square lines. The positive values of r means that Y increases as X increases. Thus, the sizes of the expenditures of the elements are highly correlated at least over that period of time. Table 2 shows the rest of the resulted calculations.

However, most of the results shows strong correlations between the elements and there exist causal relationship between the pairs too. High correlation does not only imply causality. The fact is that many things contributed to the increase in size of work and

expenditures. That is because organisation's expertise might considerably grow, the rate of inflation increased so much that naira at 1999 does not worth as much as naira at 1998; perhaps the scope to inter causal relationship on the basis of the high correlation may necessitate or require conditions being equal. In nut shell, the only safe conclusion from such a high correlations observed in the elements is that a linear trend exists between the sample elements. And on a general note, there is a significant relationship between all of the elements.

Table 2 Correlation Values

ELEMENTS	COEFFICIENT OF CORRELATION	STRENGTH OF RELATIONSHIP
A - B	0.9971	Strong Correlation
A - C	0.9616	"
A - D	0.9264	"
A - E	0.6299	"
A - F	0.9956	"
A - G	0.8702	"
A - H	0.8690	"
B - C	0.9794	"
B - D	0.9500	"
B - E	0.9531	"
B - F	0.9988	"
B - G	0.8339	"
B - H	0.9006	"
C - D	0.9817	"
C - E	0.9838	"
C - F	0.9807	"
C - G	0.7205	Average Correlation
C - H	0.9530	Strong Correlation
D - E	0.9990	"
D - F	0.9435	"
D - G	0.6208	Average Correlation
D - H	0.9913	Strong Correlation
E - F	0.9469	"
E - G	0.6283	Average Correlation
E - H	0.9899	Strong Correlation
F - G	0.8402	"
F - H	0.8918	"
G - H	0.5125	Weak Correlation

KEY:

A - Wall/frame

B - Doors/windows

C - Sanitary services

D - Electrical services

E - Finishes

F - Roofing/ceiling

G - External works

H - Miscellaneous

4.1.6 COMPOSITE RELATIVE CHANGE OF EXPENDITURE

Another benefit could be derived by characterizing the changes in expenditure over the years. This method measures the relative changes in each year compared with a base year period. The value obtained from this analysis measures the changes in the variable over time relative to the value of the variable during a specific base period (in this case 1994). It will show the index for a time series consisting of total expenditure of two or more components.

The first procedure is to calculate the totals of the elements on yearly basis. This is worked out on table 3. Then, the simple composite index is computed by dividing each year total by the chosen base year total (1994 total) and then multiply by hundred. The base year was selected to be 1994 because it is the year just before the rapid increase in expenditure, associated with dynamic increase in maintenance work.

The effect of the recession on those items is apparent. One can notice that there was dip in expenditure and the index reaching it lowest point in 1991. From these values, increase and decrease over relative points can be studied easily; As the index shows certain percentage of change with the past of time. The more the number of elements, the less significant change in one element that will have such a profound effect on the index.

Table 3 Composite Average (1994 = base year)

Year	Composite Index
1989	48.89
1990	47.58
1991	42.46
1992	203.69
1993	172.69
1994	100.00
1995	3178.50
1996	1836.70
1997	42611.80

4.1.7 FORECASTING THE EXPENSE

Being satisfied with the model describing the relationship between elements; they can be used to predict or estimate expenses on the basis of the money spent.

In such descriptive analysis, graphic and numeric techniques provide clear understanding of the time series. Usually, after graphing, one will often want to use it to make inferences about the future values of the time series. That is, forecasting future values. For instance, once one understood the past and the trends of the Dow Jones average of items; one will perhaps want to forecast its future trends before making and taking decisions for budgeting substantial works.

The most common uses of probabilities models can either be of the model for estimating the mean value of Y for specific value of X, or the use of the model that entails predicting a particular Y value for a given X. We shall adopt the second procedure which seems to sympathize more with the problem we have at hand. The difference of the two of course lies in the relative accuracy of the estimate and the prediction. These accuracies are best measured by the repeated sampling errors of the least squares line when it is used as an estimation and as a predictor respectively.

To make such forecasts and assess their reliability, a time series model must be constructed. The followings are useful theoretical formulations that help the time series analysts achieve a better understanding of the phenomena affecting the path followed by the time series and subsequent forecasting.

$$m = \frac{\Sigma xy - \frac{\Sigma X \, \Sigma Y}{N}}{\Sigma x^2 - \frac{(\Sigma X)^2}{N}}$$

$$c = \bar{Y} - m\bar{x}$$

Then, Y (time) in relation to cost x is obtained through a deterministic model,

$$\dot{Y} = mX + c$$

The model was applied on the element sanitary services as below:

T(,000)	Y (,000)	3 Years Moving Average
1.989	1.893	4.265
1.990	4.281	5.966
1.991	4.67	8.538
1.992	8.946	8.261
1.993	11.986	186.305
1.994	3.850	474.434
1.995	543.08	1393.505
1.996	876.373	
1.997	2761.061	

$\Sigma T = 17.937$

$(\Sigma T)^2 = 341.74$

$\Sigma T^2 = 35.75$

$\overline{T} = 1.993$

$\Sigma Y = 4218.09$

$\overline{Y} = 468.68$

$\Sigma YT = 8421.37$

$N = 9$

$$m = \frac{8421.37 - \frac{17.937 \times 5218.09}{9}}{35.75 - \frac{321.74}{9}}$$

$= 13244.968$

$C = \overline{Y} - m\overline{T}$

$= 468.68 + 13244.968 \times 1.993$

$= -25928.542$

Therefore, when x = 1998; y = 13244.968x1.989-25928.542 = 535

= 1999; Y = 548
= 2000; Y = 561
= 2001; Y = 575
= 2002; Y = 588
= 2003; Y = 601
= 2004; Y = 614
= 2005; Y = 628
= 2006; Y = 641
= 2007; Y = 654
= 2008; Y = 667
= 2009; Y = 681
= 2010; Y = 694

Short-term forecasts are more reliable than long-term. This is because of the effect of the accumulation of deviation and errors. In terms of the time series components, moving average smooths trends to de-emphasise or smooth most of the residual effects. The fact that the exponential smoothing uses past values of the series, the method becomes a useful tool for forecasting.

To be able to plan or programme very well, approximate costs of work must be obtained. Projections of expenditure up to the year 2010 was calculated for each element (see table 4).

Table 4 Forecasted Maintenance Expenditure

Year	FORECASTED MAINTENANCE EXPENDITURE (IN THOUSANDS)						
	Frames /Walls	Doors/W indows	Sanitary Serv.	Elect. serv.	Finishes	Roofing/ Ceiling	External Works
1998	127	164	535	415	539	419	156
1999	130	167	548	426	553	435	159
2000	133	170	561	437	567	452	161
2001	136	173	575	449	582	468	164
2002	139	176	588	460	596	484	167
2003	142	179	601	471	610	501	169
2004	145	181	614	481	625	517	172
2005	149	184	628	493	639	534	175
2006	152	187	641	504	653	550	178
2007	155	190	654	515	667	566	180
2008	158	193	667	526	681	583	183
2009	161	196	681	537	696	599	186
2010	164	199	694	548	710	616	188

4.1.8 THE EFFECT OF INFLATION ON MARKET PRICES

The prices of building materials used in the maintenance of those buildings had not been stable. THe rise in inflation rate due to time lapse was the main reason for that instability.

The market surveys carried out and published by the Federal Office of Statistics, the Survey Department of the Central Bank of Nigeria (CBN), the Business Times Newspaper and the Quantity Surveyor Magazine show the gradual rise from which inflation rate could be calculated. Only a few common maintenance materials are considered here to picture the trends of the market prices.

To arrive the percentage inflation, the price index is calculate (as in chapter two) from the various market prices. Then, the percentage inflation rate is obtained by dividing the price index of the present year by that of the previous year and then multiplying by 100.

Table five (5) below summarises and gives the percentage inflation as calculated from a ready made price index culled from the CBN Annual Report and Statement of Accounts for the year 1993-1996.

Table 5 Percentage Inflation on Market Prices.

Year	Paints		Cements		Roofing Sheets	
	Price Index	% Inflation	Price Index	% Inflation	Price Index	% Inflation
1989	82.7	75	126.2	70	149.0	53
1990	62.7	156	88.7	111	79.6	73
1991	98.0	102	98.7	102	57.9	71
1992	99.7	111	100.5	104	41.2	95
1993	110.6	89	104.1	91	39.3	78
1994	98.4	120	95.0	98	30.8	123
1995	118.1	104	93.0	95	37.8	107
1996	122.2	0	88.5	0	40.5	0

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF RESEARCH FINDINGS

Graph number one presents summary of the expenditure for nine years maintenance period. It shows the total expenditure in each element. It can be observed that sanitary services and finishes consumed over four million Naira each, while work on the building frame and wall took less than a million Naira for its maintenance over the same period of time. This portrays the expensiveness of maintaining the former in respect to the rest of the components.

Each of the rest of the graphs shows how much was spent on each element. Most graphs indicate high maintenance costs of repairs in roofing, finishes and sanitary services. This deteriorating condition could be due to the high rate of rainfall on the rocky soil of the site which is located on the highest altitude of the plateau. As a result, rusting and sagging of roofing sheet, expansion and evacuation of blocked gutter increased rate of repairs.

Abnormal increase of expenditure was experienced in the last two years (1996 - 1997). These was due to the millions of Naira allocated by the Petroleum (Special) Trust Fund (PTF) for barracks rehabilitation. On account of that, the entire repair work was influenced by this sharp changes.

Finishes that was carried out on forty different occasions has the highest average unit cost of N105,126.00. That high value means

that whenever a high number of finishing operation is foreseen, we should expect a high spending. Whereas an equal number of repairs on doors and windows will cost only 36.4% of that of finishes. On the whole, it was established that frame and wall contributed only 5.35% to the maintenance work executed between 1989 and 1997 while sanitary services made the highest contribution of 22.65% (see Fig. 6). Proportionate projections of the cost of work for each of the elements for future operations show simultaneous increases following the trends of past spending (table 7). An establishment through a correlation test confirms a strong relationship among all the components of the building; implying that any alteration of any one of the elements will proportionately affect the rest of the items (see table 4).

It is generally known that residential buildings have more direct contact with the users. Thus, its components especially doors, finishes and services are always over burdened. Due to this fact, it can be seen on graphs numbers two and three that maintenance requirements were very much expensive in residential buildings than in non-residential buildings which were occasionally used.

5.2 CONCLUSION

The following are the conclusions drawn from the study:

1) Maintenance records, like the one collected for this study is a suitable tool for budgeting maintenance work.

2) The application of cost analysis, based on synthesized elements (like the one used by the author) is a good method of cost study of maintenance work.

3) The application of these findings are not restricted to budgeting but also important to the designer as well as the management for decision making.

4) It was discovered that for a maintenance record to be useful in planning of budget, records must be accurate, organised and up-to-date. Accuracy here, in terms of reflecting the real situation of work and information transfer

5.3 RECOMMENDATIONS

In order to facilitate efficient adaptation of the maintenance records in budgeting maintenance work of the station, certain adjustments must be made. The following are therefore suggested.

1) The corrective form of maintenance practised in the 'Base' has a great inefficiency. Complete damage of property or component were reached before remedial actions were taken. A more economical and effective method, generally recommended is the planned preventive type of maintenance. A maintenance that is

targeted at preventing the occurrence of failure in facilities. It consists of regular periodic inspection and restoration of defects.

2) The extraneous costs cropping in to distort budget can be arrested by providing enough buffer contingencies. The Sam O'Donavon's law of sound planning dictates that if things can go wrong, they will go wrong and at the most awkward time and place (Taylor and Walting, 1979). So budgets must foresee everything that can possibly go wrong and prepare contingency plan to cater for that.

3) Scheduling of job necessary for long-term preservation of building (e.g. painting) may not have a high degree of urgency like a blown off roof. The procedure in which jobs are scheduled are supposed to be outlined according to degree of urgency of attention they deserve and the financial implications involved.

4) The information as to the condition of a building after repair is very important. This information will assist in analysis and decision making. The document used for the collection of this information is the work order. To design work 'order forms',maitenance activity and description must be considered:

5) The mode of communicating the maintenance department to effect repairs by occupants is one of the loopholes. The method in use gives room for malpractices in the system. It does not differentiate or bring to notice how repairs or defects could be so as to be classified accordingly. It carries scanty

information and is at times ambiguous and misleading.

Requisition or repairs forms should contain the following essential information:

a) The identity and address of the complainant.

b) The name and address of the building where repair is needed.

c) The exact location dimension and quantity of the item needing repairs within the building.

d) Names of any person to be contacted before work is done.

e) Details of any special precautions or dangers.

f) Details of any limitation on access.

g) A full description of the fault or repair.

h) An indication of the degree of urgency

i) The name and telephone number (if any).

j) Cost code details.

When a complaint is received containing the necessary information, the maintenance officer inspecting the buildings will have to ensure that worthwhile defects are not ignored and repairs are made to the satisfaction of the occupant.

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APPENDIX (A)

Year	A	f	B	f	C	f	D	f	E	f	F	f	G	f	H	f
1989	1015	1	1800	3	3843	3	580	3	4235	2	2625	3	230	1		
1990	969	3	868	4	4281	7	558	3	1197	4	3920	10	2151	5		
1991	309	3	538	5	4670	7	1661	4	1278	4	2738	4	1249	4		
1992	152	1	12000	6	8946	3	9811	5	18076	3	10606	3	36	1		
1993	3376	2	5168	3	11986	3	10921	6	11929	2	6926	3	300	1		
1994	8142	4	1891	3	3650	6	2872	3	2850	2	6699	5	3000	2		
1995	2142	1	39936	6	543080	5	38786	7	75000	1	216374	4	16112	5		
1996	440815	9	507236	13	876373	14	425809	11	579936	7	1122511	21	1082722	10	2824	2
1997	540329	12	776340	20	2761061	25	2747218	31	3510552	15	1653340	25	176935	7	321198	6

Maintenance Cost Data and Frequency of Repairs.

KEY

A - Frames/Walls
B - Doors/Windows
C - Sanitary Services
D - Electrical Services
E - Finishes
F - Roofing and Ceilings
G - External Works
H - Miscellaneous Works
f - Frequency of Repairs

ANNEX - APPENDIX (A)

Y YEAR	FRAMES/WALLS		DOORS/WINDOWS		SANITARY SEVICES		ELECTRICAL SERVICE		FINISHES		ROOFING AND CEILINGS		EXTERNAL WORKS	
	R	N	R	N	R	N	R	N	R	N	R	N	R	N
1989	761	254	1260	540	2690	1152	294	286	1313	2922	2100	525	70	160
1990	436	533	451	417	2226	2055	441	117	597	600	2900	1020	430	1721
1991	154	155	322	216	2340	2330	913	748	601	677	1697	1041	150	1099
1992	91	61	6000	6000	6709	2237	6377	3434	3616	14460	5300	5306	10	26
1993	2363	1013	2790	2378	2636	9350	8081	2840	2147	9782	1663	2564	90	210
1994	3908	4234	680	1211	1155	2695	1723	1149	1197	1653	3818	2881	600	2400
1995	1113	1029	28753	11183	434464	108616	29865	8921	26250	48750	168771	47603	4834	11278
1996	251264	189551	405788	101448	630988	245385	217163	208646	336362	243574	841883	280628	378953	703769
1997	324197	216132	621072	155268	2346901	414160	1923052	824166!	2632914!	877638	1157338	496002	53080	123855

KEY:-

R - Residential - Building

N - Non - residential - Building

APPENDIX (B)

Year	Rainfall (mm)	Raindays (No.)	% Change over Preceding Years
1989	1211	110	
1990	1230	102	1.6
1991	934	75	24.1
1992	869	71	-7.2
1993	1070	87	23.4
1994	877	71	-18.0
1995	728	54	-17.0
1996	1331	113	82.8

Source: C.B.N. & Federal Office of Statistics.
Average Annual Rainfall and Rain Days of Plateau State.

APPENDIX (C)

Department of Building,
Faculty of Environmental Design,
Ahmadu Bello University,
Zaria.
11th March, 1998

Dear Sir,

REQUEST FOR INTERVIEW

I will be very grateful if you could answer some questions pertaining to building maintenance in the Nigerian Air Force Base, Jos. Your views on this topic can greatly contribute to providing solutions to the maintenance problems in the Base.

I wish to assure you that information that will be given will be held in a strict confidence and will be reported only in a form of statistical summaries unidentifiable for any specific use.

The attached will be the issues to be discussed during the interview session.

Yours sincerely,

Mshelgaru, I.H.E.
(Research Student)

APPENDIX (D)

(Maintenance Executives)

1. Systems of maintenance in use in this base.
2. Programmes for maintenance.
3. Complaints and documentations.
4. Response to complaints.
5. Feedbacks.
6. Use of contract and direct labour.
7. Budgeting.
8. Estimating maintenance work.
9. Past records of work.

(Tenants)

1. Requisition for maintenance work.
2. Work certification.
3. Personal spendings on maintenance.
4. The frequency to which building components demand repairs.