BUILDING MAINTENANCE POLICY FORMULATION:

A Market Oriented Approach

by

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DECLARATION

I hereby declare that this thesis has been prepared by me and that it is a record of my own research work. It has not been presented in any application for a higher degree.

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

JAMES OLABODE BAMIDELE ROTIMI

23rd SEPT. '96
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CERTIFICATION

This thesis entitled Building Maintenance Policy Formulation: A Market Oriented Approach by James Olabode Bamidele ROTIMI, meets the regulations governing the award of the degree of Master of Science in Construction Management of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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It is no gain saying that to undertake a research of this kind successfully, one really needs the assistance and cooperation of some knowledgeable persons.

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ABSTRACT

Building Maintenance has been a neglected area in its technological, managerial and above all economic aspects until recently in Nigeria. The turn towards it has been largely due to the worsening economic situation, resulting in high cost of new construction. The emphasis in this study is to present the need for well managed programmes to extend the lives of built space and at the same time ensure continuous and satisfactory returns for the owner. In the conditions of the market, the returns should not be less than those obtainable from other investment opportunities.

It behoves Real estate owners therefore, to put in place Building Maintenance Policy consistent with these philosophy, thus the value of the asset should be preserved as long as possible.

In an attempt to present this view, the economic significance of building maintenance is discussed, and it is agreed that an optimum balance of maintenance action need to be sought since over-maintenance and under-maintenance are not economical.

The need for the implementation of the right Building Maintenance Policy, important considerations for its formulation and the procedure involved, within the context of the market economics, is the object of the study. It is in this light that the author sees the defination of Building Maintenance as the sequence of action (policy) of preserving the usability of buildings to continually give Building Owners a benefit in the property market within the buildings' life cycle.

A field survey of existing practices in Maintenance departments is undertaken, to enable an acquaintance of the level of appreciation of the market approach to building maintenance. The research discovered some anomalies, and they form the basis of the re-orientation of property owners and their administrators towards the market approach to building maintenance.

DEDICATION

TO

FUNMILAYO EBUN ROTIMI (MY PRECIOUS WIFE)

ODUNAYO OMOLOLA ROTIMI (DAUGHTER)

OLUFEMI DAMILOLA ROTIMI (DAUGHTER)

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GLOSSARY

For the purpose of this thesis the following words, abbreviations, phrases, expressions and vocabulary are construed to have the following meanings as used here.

1. B.S - British Standard
2. Built Space - This refers to the building,its components and its direct environment i.e adjoining facilities e.g. parking lot.
3. Building Owner - An individual, or group, corporate body, who must have committed/invested money in the design and construction of a building.
4. Contingency System - A system of maintenance service which is initiated by the occupants of the building. Also referred to in the text as "Occupant based system".
5. Property Market - A special market where people buy and sell built space. The principal actors in the market are the buyers, sellers and vendors.
6. Market Rent - The periodic payment realised by the owner from the use of built spaces.
7. Building Market Value - The Value of buildings created by the demand for the facilities it provides in the property market.
8. Building Maintenance - Is the sequence of action or policy of preserving the usability of buildings to continually give the owner a benefit in the property market.
9. Building Maintenance Standards - This is the measure of the degree to which maintenance enhances the usability and value of a building. The standards should fall within a boundary of upper and lower limits.

CHAPTER ONE

INTRODUCTION

1.0 Background

Within the 70s, during the oil boom era, the construction industry was relatively busy. During these period the economic implications of embarking on most capital projects were given less thought because money was in good supply.

Lately when the economy suffered a severe setback and new buildings are rare, dilapidated and derelict buildings have become common sights in the country. Owners have had to embark on the development of a Maintenance culture that will ensure the preservation of the existing buildings. This "backward integration" as it is often referred to, increased public and private sector awareness on the maintenance of the existing building stock as opposed to the erection of new ones.

As an essence of market economy, the rule of economic gain should be appreciated by owners of built space, thus ensuring that maximum output is sought from available resources. Buildings are generally investment goods and are capital intensive. The approach towards the management of such assets should be improved to ensure satisfactory profits.

Therefore in market terms, Building Maintenance is perceived as an incessant activity aimed at increasing the use life of buildings and their components. In other words maintenance should strive to increase the utility and this way the market value of existing built space, by continually adjusting/improving built space to meet current demands.

As for now, the Nigerian reality (customs and habits) is contrary to the notions highlighted. Property professionals (often self-styled) whose responsibility is to plan and control all maintenance tasks on behalf of building owners, and to ensure profitability of money invested into buildings, have disregarded the economic implications of the maintenance actions. Thus organisational objectives and policies do not conform with that of the capital owners whose aim is to economise money (in the public sector) or to make a profit (in the private sector).

From the foregoing, it would seem necessary to stress the importance of building maintenance policy and the need for its formulation to ensure that its objectives are streamlined to conform with the rules of market economy.

This market approach becomes useful in whatever type of ownership. Today therefore the success of any Property and Maintenance department depends on the first time and on nothing else but a market oriented maintenance policy formulated and implemented consequently.

BS 3811: 1964 defines, Building maintenance policy as "the strategy within which decisions on maintenance are taken". This may alternatively be defined as the ground rule for the allocation of all resources between the alternative type of actions that are available to building maintenance management.

The study aims to present market oriented building maintenance policy. The author is of the opinion that such an approach will ensure

continuous and satisfactory returns for building owners and satisfactory standards for the users.

1.1 Aim and Objectives

Aim: to articulate the need for the formulation of Building Maintenance Policies; the procedures involved; and important considerations for a Building Maintenance Policy that will cope with its market value.

Objectives: the objectives of the study include the following;

(a) On the ground of literature review, to articulate the fundamentals of building maintenance philosophy and building maintenance policy from the market oriented economics point of view.

(b) In the light of (a) to analyse and critically appraise existing building maintenance management practices.

(c) To recommend an approach, if not a model, to the formulation of building maintenance policy that will give the right orientation to owners and administrators of buildings.

1.2 Scope and Limitations

Building Maintenance is wide both in scope and diversity for sure, and this is why only a study of building maintenance policy and its formulation is undertaken in this thesis. Therefore apart from the aspects of Property management, aspects of the economic nature of building maintenance works are also presented in line with some technological facets to meet the objectives of the study.

In chapters two and three, attempt would be made to present the fundamentals of building maintenance philosophy and its management, then

in chapter four, the concepts of building maintenance policy would be discussed. In chapter five, a study of building maintenance policy formulation in existence is undertaken. This time the goal is to determine the level of appreciation or otherwise of the market oriented approach proposed in the preceding chapters.

The thesis in its research part would visit the various branch and area offices of some finance organisations in Kaduna and Kano which are the source of data considered.

1.3 Methodology

To be able to propose a market approach to the maintenance of built assets, it was necessary to review relevant literature. The basic notions of building maintenance were identified and defined as well as a philosophy of maintenance of built space. In addition aspects of maintenance Policy formulation were considered.

Without loosing the fact that the author is dealing with management problems requiring extensive use of management techniques, the presentations have included figures (diagrams and flow charts) to facilitate easy understanding and to be able to meet the standards required of a scientific and technical write-up.

Furthermore, existing building maintenance practices would be appraised in the institution under review. The appraisals were made through questionnaires, structured and administered to the heads of the maintenance departments; interviews were also arranged with the respondents on ambiguous issues arising from the questionnaires.

A descriptive analysis of their responses coupled with tables (see chapter five) were made to facilitate easier understanding of the result of the study.

Finally, conclusions and specific recommendations would be made for the adoption of the market approach here proposed.

CHAPTER TWO

BUILDING MAINTENANCE PRELIMINARIES

2.0 Building Maintenance Defined

In general terms Maintenance have been defined in the Chamber's Dictionary [20th edition] as the act of keeping in existence or in any state and preserving from deterioration.

BS 3811 also defines Building maintenance as "Work undertaken in order to keep, restore or improve every facility i.e. every part of a building, its services and surrounding to a currently acceptable standard to sustain its utility and this way its value". Through the maintenance activity the built space becomes again and again a competitive good in the market. This is the fundamental statement as the goal and purposes of maintenance policy are concerned.

The key words in the BS 3811 definition are further broken down and explained according to Afolabi [1992 pp.5-6] thus;

work undertaken: incessant and progressive maintenance work which is connected with skilled operation by skilled tradesmen and guided by a hierarchy of management levels.

to keep: to ensure that there is no depreciation of the original situation (in case of built space usability); maintaining the status quo (as usability and market value is concerned) through regular maintenance.

to restore: where a reduction in the original level of utility is noticed, to get back to that original position through repairs, replacement, rehabilitation etc.

to improve: the built space can be expanded for example, its function(s) can be improved/ adapted to a prevailing market demand, the quality of service can be upgraded (e.g building services appliances) to meet current tastes, health requirements, fashion and available building technology.

every facility: the building and its components, functions and styles, fittings and services, aesthetics and the amenities.

currently acceptable standard: in the light of available standards demanded in the market, previous condition may be outdated and command less acceptability and consequently a lower rent. Maintenance will therefore assist in upgrading the built space to current market demands.

to sustain: actions taken to ensure that a status quo is maintained incorporating services which are possible in newer developments. This will ensure the retention of present occupants and without a compromise of the needs of future users or foreseeable new technologies.

utility: the maximum use for which the building can be put based on maintenance standards that will ensure optimum utilisation of the built space (building, its components and direct environment)

value: the level of rent for owner, it is a measure of the ability of a building to satisfy prospective users desires and needs. It is determined from the demand for the services the buildings offer with other factors serving usability within a conceivable period.

From the BS 3811 definition and its subsequent breakdown, it would seem necessary to propose a definition that will serve the aim of this study, thus the definition of Building maintenance for use in this thesis will be taken as: "the sequence of action (policy) of preserving

the usability (utility) of a building to continually give the owner an anticipated rent in the property market".

Maintenance of buildings is an incessant action and involves day to day cleaning to periodic and aperiodic maintenance to combat the progressive deterioration (obsolescence) of such buildings, its components and direct environment. At this juncture it is worthwhile to look at the factors which cause the need for maintenance of buildings. These are discussed beneath.

2.1 Maintenance Generators

Maintenance tasks are generated by a whole range of factors including, lack of immediate counter-action in case of need, poor upkeep (i.e. erratic maintenance), improper and irrelevant usage and progressive deterioration due to age and usage.

According to Lee [1976 p.12], the extent to which some of these factors cause deterioration and thus create a need for remedial treatment depend on the following:

(a) Adequacy of the design and suitability of the materials specified.

(b) Standards of workmanship employed in the construction and subsequent maintenance of the structure.

(c) The extent to which the designer anticipated future needs.

To the last point, it is expected that at the design stage, provisions should be made for maintainability and adaptability of the building and its components to accommodate future user requirements.

Generally, maintenance generators in built spaces can be traced to four sources outlined by Olateju [1992 pp.4-6] as follows:

2.1.1. Environmental/Climatic factors.

Buildings are subjected to a number of environmental and climatic factors which affect their durability under certain conditions of exposure. The combined effect of environmental elements such as wind pressure, sunshine, driving rain, air pressure and humidity changes etc accelerate the rate at which building structures deteriorate.

The effect of wind and rain depend on the orientation of the building on site, and the exposed surface area. Sunshine affects materials such as bitumen, paint, plastics etc. Humidity changes may cause corrosion of metal, decay of timber and in moist conditions, may favour insect attacks.

2.1.2. Design and Construction factors.

Design and construction factors may result from inadequacies of the initial design and construction. They may include, improper site investigations, design oversights, use of poor quality materials and workmanship etc. An important factor in design, given less consideration is the accessibility to areas that require maintenance. It is not uncommon to find minor technical problems posing difficulties because of inaccessibility. It has been recommended as a feature of good initial design for consideration of access to elements requiring maintenance at the design stages.

The use of poor quality materials and workmanship are common problems in the Nigerian construction scene. In a bid to maximise the profit margin, Nigerian Building Contractors resort to a reduction of the quality of finished products. This factor results in early remedial work than otherwise required by the initial design.

Appropriate steps have to be taken to avoid payment of work-in-progress if physical progress and quality do not conform with specifications.

2.1.3. User Activities.

This refer to both human and mechanical wear resulting from usage. Even in instances where the two factors earlier mentioned are controlled, lack of Owner's care and control after taking possession of the building may also cause a need for maintenance. Examples of mechanical wear are, worn out door and window hinges, lack of shine in floor finishes etc. Maintenance work necessitated by wear should be carried out at the earliest time to avoid further damages. Another important factor that may be considered under user activities in Nigeria is the menace of vandals.

Generally user activities can be controlled by the owner whose right and duty in this respect are stipulated in the conditions of tenancy.

Change in User activities may also necessitate a need for maintenance for instance in a change of tenancy, the demands of the new tenant may differ and minor rectifications and improvement may be required to meet the requirements of the new tenant.

2.1.4. Social Values.

This involves changing taste and standards resulting in an increase in the rate of physical and functional, and this way economical obsolescence of the building.

This factor demands that maintenance work should be carried more frequently than functionally necessary, so that the diminishing value of the asset is upgraded through maintenance work. The economic points of intervention for all maintenance operations will be subject of later considerations.

2.2 Maintenance Operations

Having considered the factors that erode the initial standards of buildings, it is worthwhile to consider what works constitute building maintenance . According to Seeley [1976 pp.8-9], Building maintenance comprises three separate components viz. builder's work in the field of,

- Servicing,
- Rectification and
- Replacement.

These terms are briefly explained in the following sub-headings;

2.2.1. Servicing.

This essentially is a cleaning and up-keeping operation undertaken at regular intervals of varying frequencies.

Complicated service schedules become necessary where sophisticated equipments are introduced. Examples of servicing operations include maintenance of roofs prior to rainy season, air conditioners before the

start of dry season etc. Typical frequencies include Day-to-Day cleaning of floors, Weekly polishing of floors and carpeting, External painting say every 5 years, Internal painting every 3 years, Replacement of P.V.C. flooring every 10 years etc.

2.2.2. Rectification.

According to Seeley [1976 p.9], rectification usually occurs fairly early in the life of buildings, They result from avoidable mistakes like shortcomings in the designs, improper installation of components and poor specifications. Rectification works can be reduced by the development and use/adherence to performance specifications and codes of installation.

2.2.3. Replacement.

This is an inevitable maintenance operation because service operations (utility) cause decay of components at different rates. The varying expected life span of different building components call for a replacement of parts, to make them still functional. Examples include the replacement of louvre carriers, electrical wiring and fittings, defective plumbing appliances etc.

Maintenance works may also include some element of improvement and refurbishing, which involve operations that would further enhance the marketability of the built space and its components through refurbishment and improvements to meet current standards of demand. "The effects through time of changing legal, social, technical and economic estate framework are liable to render a policy of maintaining a building in its original condition without some form of improvement and refurbishing worthless". Ratcliffe [1978 p.300].

Maintenance objectives therefore, geared towards the retention of market value of the asset by presenting a good physical and functional state must include some elements of improvement of such buildings.

2.3 Maintenance Standards

The standards of care or maintenance standards are the base of maintenance policy.

The identification of appropriate standards is a key factor in determining the maintenance workload. To this concept, acceptable standard may be difficult to determine because there is no absolute standard that would be satisfactory in all cases. It may be convenient to determine a boundary of upper and lower ranges of criteria. An upper boundary/limit which might be equated to a desired level of performance and a lower boundary or limit, below which the building or component should not fall.

Figure 2.1 is a model which relates maintenance requirements to standards over a period of time. The principle behind the construction of this model is the upper and lower limits of use. It is assumed that over the long life of a building, Users will tend to demand higher standards and therefore repairs and renewals will inevitably contain some element of improvement.

It can also be inferred from this Figure, that with the progressive age of buildings a period will be reached where normal or routine maintenance works will not be able to meet current demands expressed in the market, thus improvement schemes would become inevitable.

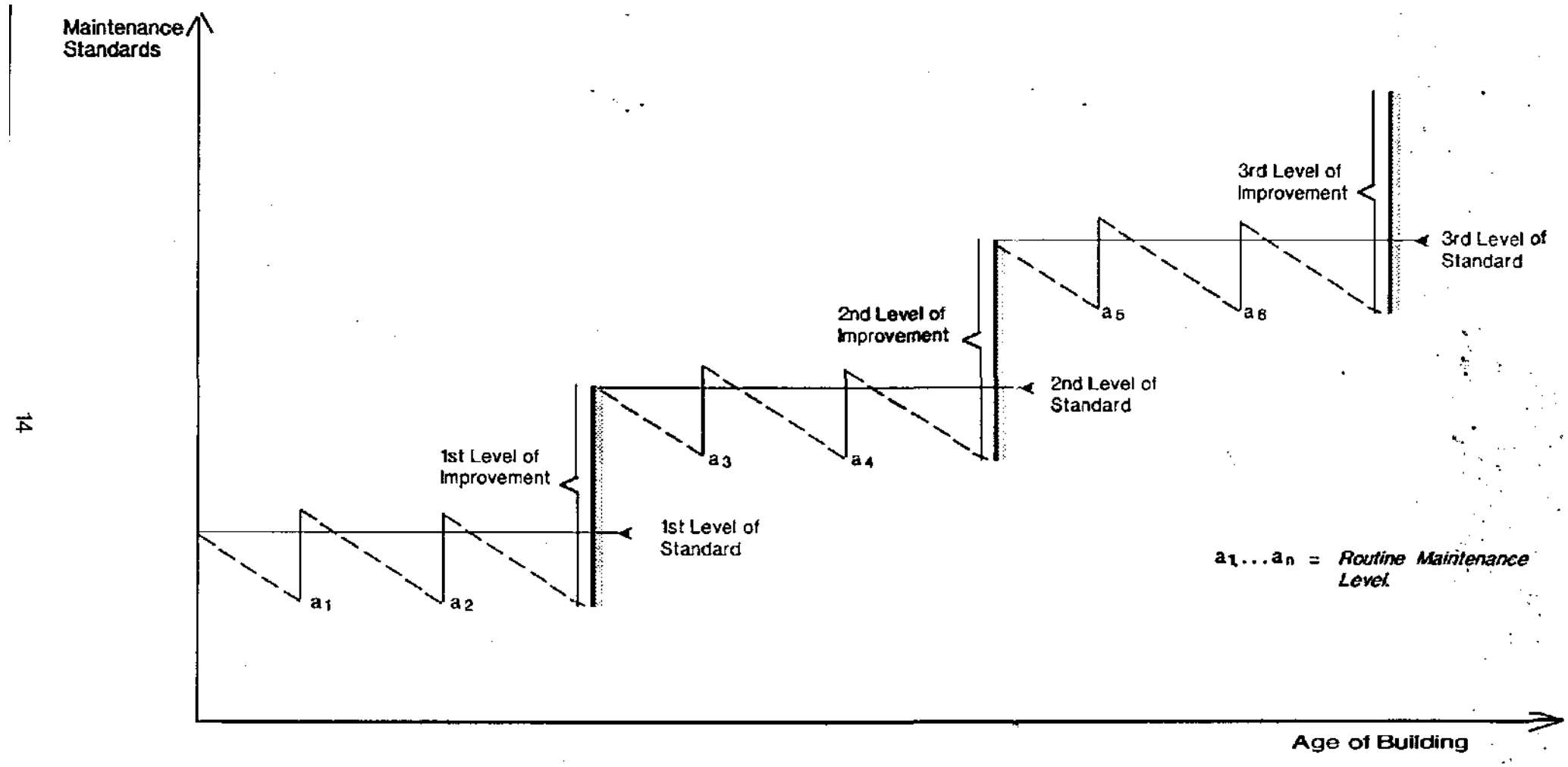


FIG. 2.1 : BUILDING MAINTENANCE REQUIREMENTS RELATED TO MAINTENANCE STANDARDS OVER A PERIOD OF TIME

SOURCE: Rotimi and Mttallib [1995 P. 7]

Robertson [1969 pp.5-7] proffered the categorisation of acceptable standards into;

(a) functional performance of quality and reliability, which relate to users' needs.

(b) structural and other safety aspects which must conform to local authority regulations.

(c) the preservation of the asset and its components, for which the owner has a primary interest.

Within each of the categories aforementioned, Robertson set out various possible levels of excellence which are given in Table 2.1. Every facility would then be allotted a level code, the "normal" in the Table 2.1 being **BMY** i.e. the performance level of the buildings must not be less than 85%, it must be fully safe and the standards of maintenance and preservation should be as specified by the Maintenance Policy of the organisation. Any combination might be needed
according to the particular circumstances, but for convenience, the "normal level" might be chosen and variants from this normal standards can be clearly specified and suitable criteria derived in each such case. Simply though, it may be convenient to establish lower limits of criteria that will conform with local authority regulations (These will be in the form of structural and safety requirements.)

Having decided and specified the particular requirements for each element of the building, the standards of care can then be expressed in the following ways:

TABLE 2.1: PROBABLE STANDARDS FOR ALLOTMENT OF TECHNICAL CRITERIA

Level	Functional performance quality and reliability	Safety of persons and property in all aspects	Preservation of the asset and the amenities
Minimum	A. Nil (not applicable)	K. All legal requirements to be met	W. All legal requirements to be met
Preservation	A. Nil (not applicable)	L. Fully safe in all respects for reintroduction or regular working at 7 days' notice	X. Prevention of deterioration of asset and amenities
Normal	B. Availability factor at full specified performance: not less than 0-85	M. Fully safe in all respects for regular working	Y. Specified condition of facilities and amenities
Operationally vital	C. Availability factor at full specified performance: not less than 0-98	N. Fully safe in all respects for regular working under specified overload and abnormal conditions	Y. Specified condition of facilities and amenities
Prestige	C. Availability factor at full specified performance: not less than 0-98	N. Fully safe in all respects for regular working under specified overload and abnormal conditions	Z. Every facility to be in first class order and impeccable condition

(a) PHYSICAL TERMS. The expression of maintenance standards in physical terms relate to the conditions required of the element; specifying the magnitude of the defects which will call for remedial action; and to their levels of performance.

The principle is based on a system known as Condition controlled maintenance and it presupposes that there will be inspections at regular intervals to determine by visual means or other measures whether or not the condition of the elements or their performance have deteriorated below the standards set.

(b) TIMING OF OPERATIONS. The maintenance standards should also express the periodicity or cycle of repairs/replacement; and the inspection cycle, if a system of planned maintenance is adopted. This will require knowledge of the rate of deterioration of the elements and the point when either functional failure or appearance will become unacceptable or fall short of the standards.

A proper balance must be achieved between the frequency of repairs and replacement and the risk and consequences of failure.

(c) FINANCIAL TERMS OR CRITERIA. The standards should state the economical amounts that should be committed to the maintenance of the built space, its components and direct environment. The economics of maintenance work will be discussed more in detail in Chapter Three.

The three components of maintenance standards are shown in chart form in Figure 2.2. In most cases, according to Lee [1976 p.32], all three components discussed may be present in the Maintenance Standards

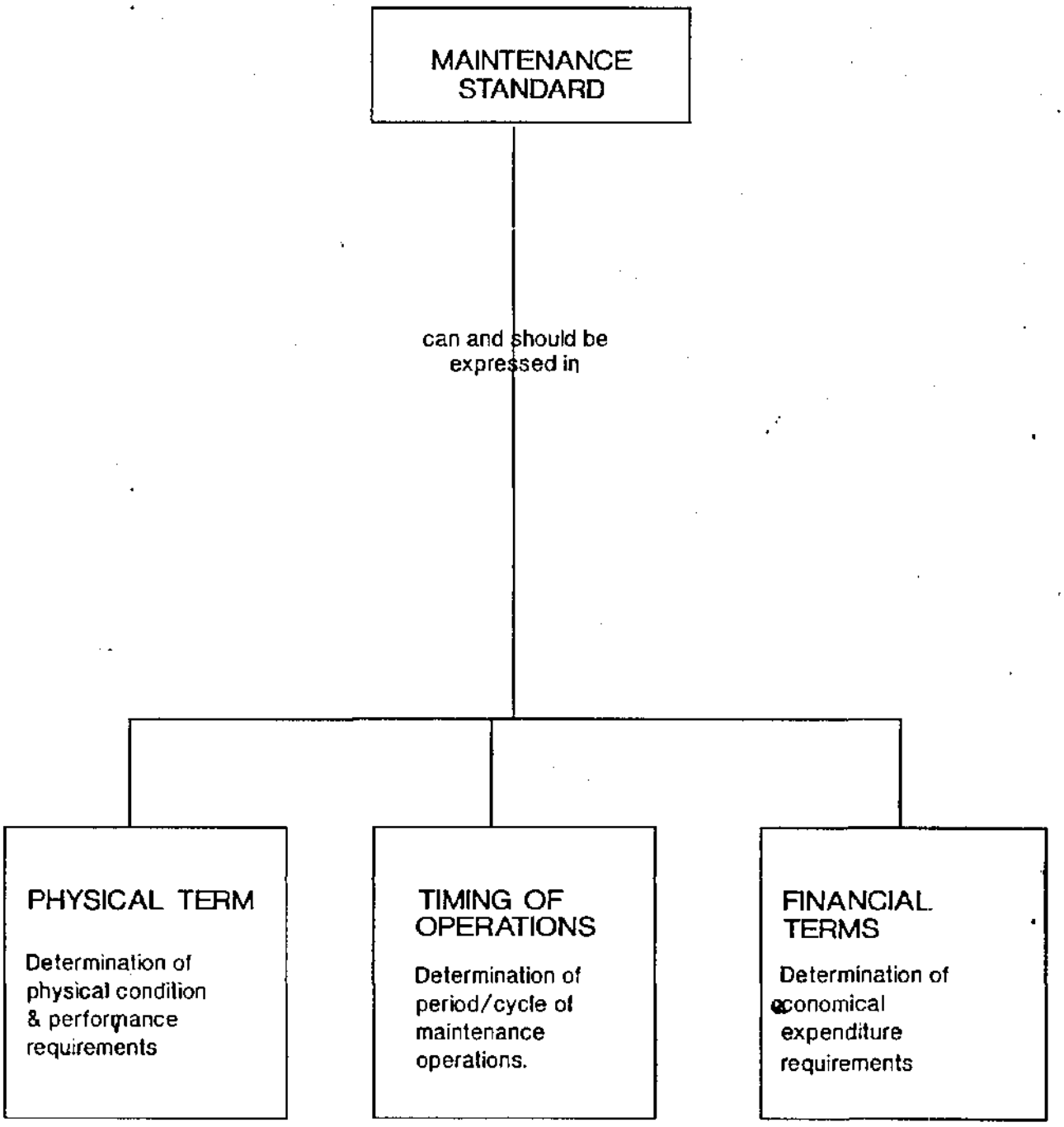


FIG. 2.2 : COMPONENTS OF BUILDING MAINTENANCE STANDARDS

outlined, but there is no doubt that financial expediency often takes precedence over the physical needs of the building. This is especially true when maintenance is viewed from the stand point of the owner. The objective of setting the standards will be in this case, the achievement of long-term trouble free investment with the minimum of expenditure.

In Nigeria the setting of maintenance standards that will emphasise the economic considerations is an attractive option for Owners of built space especially in this era of inflationary economy. Maintenance will then be geared towards achieving the least possible expenditure.

Economic decisions may also affect the timing of operations by fixing longer periods between certain maintenance operations. As long as the utility of the built space is not impaired and a demand still exists, maintenance works can be differed.

2.4 Classification of Maintenance

Further to BS 3811, Building Maintenance is classified into "Planned" and "Unplanned". The former is further subdivided into Preventive and Corrective maintenance action. Figure 2.3 shows diagrammatically the relationship between the various classes of maintenance action and their sub-components presented in BS 3811.

For clarity the diagram is put against a hierarchy of building maintenance levels according to Halpin *et al* [1992 p.8].

At this point it may be worthwhile to elaborate the terms contained therein.

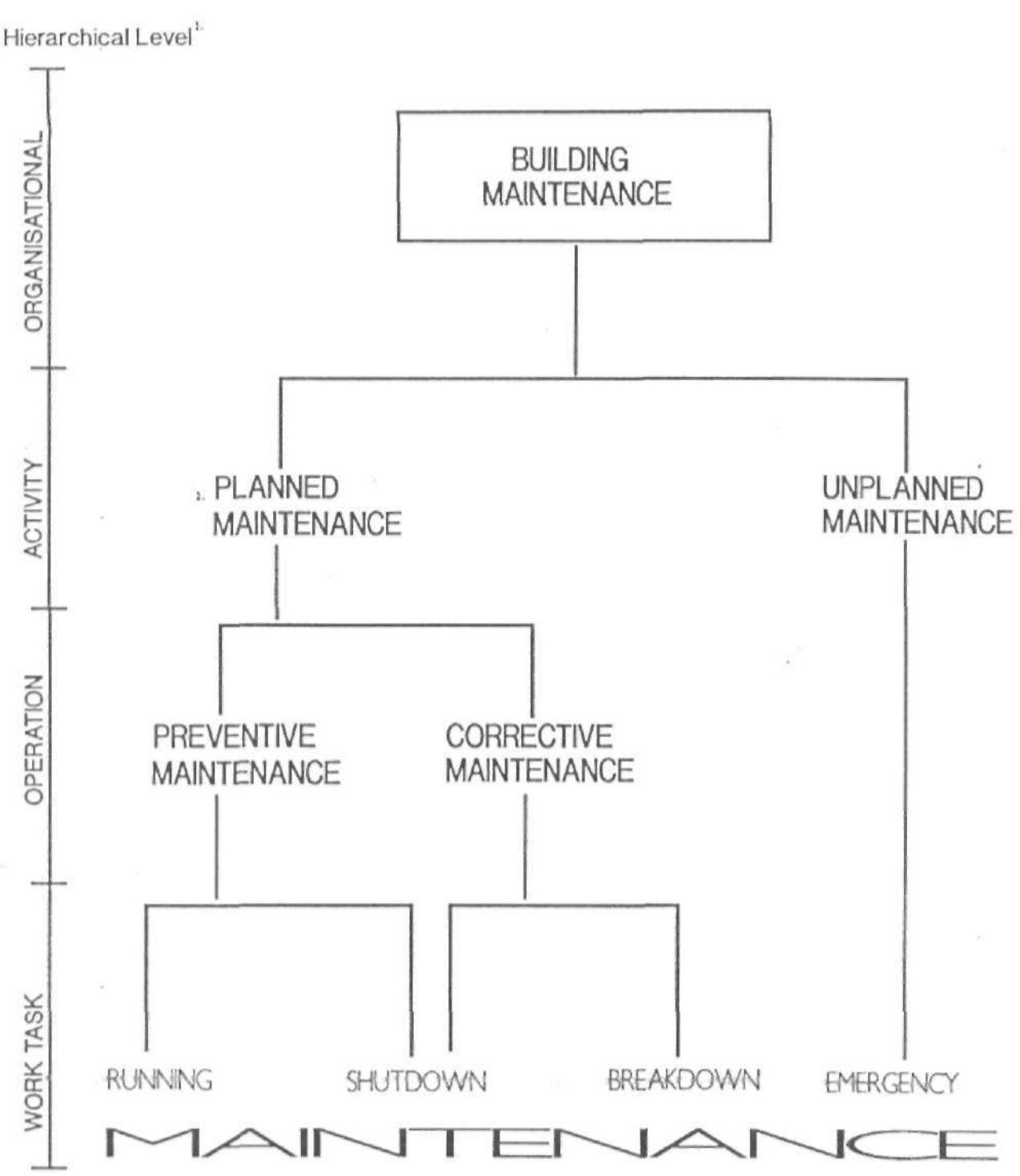


FIG. 2.3 : TYPES OF BUILDING MAINTENANCE ACTION AND THEIR RELATIONSHIP PUT AGAINST AN HIERARCHICAL LEVEL.

* *Author's diagram reflecting the BS 3811 stipulaton put against an hierarchy of Building Maintenance levels. See Halpin and Riggs [1992 p.3]*

2.4.1. Planned Maintenance

Planned Maintenance according to BS 3811 refers to a situation where maintenance work is organised and carried out with forethought, control and records.

Planned Maintenance may be enhanced through a plan of work possibly in the form of a frequency chart, which will indicate when works are to be carried out. From the records therefrom, activities can be easily controlled, thus ensuring that the maintenance objectives are met in time. A system of planned maintenance accordingly comprise two mutually balanced components; the Preventive and Corrective maintenance operations (see Figure 2.3).

Planned preventive maintenance operations are carried out at pre-determined intervals or corresponding to a prescribed criteria set by the maintenance standards. It is intended to reduce the probability of failure within the expected life span of the building, its components and the direct environment.

Planned corrective maintenance operations on the other hand are performed to restore a facility to operation or to an acceptable standard after an anticipated failure. The organisation of corrective maintenance according to Robertson [1969 p.11] is a matter of making advanced provision for foreseeable breakdown or damage. These are determined through regular inspection of the facilities. The nature and extent of the provisions will depend on the contingencies for which it is decided to provide and upon the stipulated reaction time.

Planned maintenance is further subdivided into Running, Shutdown and Breakdown maintenance works or tasks, depending on the condition and state of the built space, whether in service; out of service; or whether the asset has completely failed respectively.

Whatever the type of Planned maintenance, it requires forethought through inspections, testing and checking the condition of the building, its components and the direct environment, and advance provisions made for foreseeable breakdown or damage within the defined Maintenance Policy of the estate's owner.

Planned maintenance connotes proper organisation (work planning in particular) to ensure its success. Maintenance management must therefore move from the present waiting game practice (contingency system: whereby faults are allowed to develop until maintenance is effected) to planned operations as a matter of policy.

Maintenance management personnel must be able to plan effectively by producing systematic data/information on the following items:

- the frequency and probability of occurrence of the various types of maintenance tasks,
- inspection cycles,
- the merits and consequences of the various system of planned maintenance, and
- the merits of several methods of organising and controlling the activities of maintenance teams.

These much are absent in most Maintenance departments in Nigeria. This noticeable lapses further necessitated the importance of this study

2.4.2. Unplanned Maintenance

Much as it is desired to prevent sudden failures, breakdowns and damage, through advance planning, major breakdowns still occur. Unplanned maintenance has been defined in BS 3811 as "Work resulting from unforeseen breakdown or damage due to external causes". The sudden breakdown of underground service pipes due to crossing traffic; the blowing away of roofs due to heavy storm etc are typical examples. Unplanned maintenance therefore usually call for immediate action to stem further deterioration of the remaining parts of the building.

The chapter has endeavoured to present the basic notions and philosophy of maintenance in use in this thesis. From the text so far it would be noted that considerations of maintenance will be made from the standpoint of the Owners of built space.

It was determined that the main objective of embarking on maintenance from this standpoint is to have a building that would be as marketable in the Property Industry as newer buildings with the minimum of maintenance. As long as the functionality and utility of the buildings are not impaired, the Owners of built space are not committed to embark on maintenance. Deferring maintenance will reduce running cost and thus an increase in benefits.

The author also discussed the factors creating maintenance work and the broad operations that constitute maintenance. It was shown that maintenance work must include some elements of improvement in the later lives of built space, as demands of users would have increased over time.

The author also emphasised the need to express the required standards of care (maintenance standards) that will ensure the retention of buildings' market value and meet the stated purposes of the owners' of built space.

The constituents of maintenance standards were highlighted and it was stressed that Maintenance Standards are essential components of good Maintenance Policies.

Finally maintenance work was classified according to its managerial functions.

In subsequent chapters the notions presented above would be knitted together in order to meet the aim of the study (the importance for the owners and explanation and articulation of Building Maintenance Policy in conditions of market oriented economics).

CHAPTER THREE

BUILDING MAINTENANCE MANAGEMENT SYSTEMS AND ECONOMICS

3.0 Introduction

"Neither the policy of doing nothing nor simply doing what we did before is adequate or responsible, what is needed is a fundamental re-appraisal born of imaginative fresh thinking at the highest level".
Robertson [1969 p.2]

The quotation is expected to stimulate interest in the realm of Building Maintenance Management, hence the Owner - through the services of his Property or Maintenance Manager - is expected to develop new awareness for the formulation of the right policies and strategies for tackling building maintenance tasks.

Building Maintenance Management have been defined by the BS 3811 as the "organisation of maintenance within an agreed policy". This suggest a rational approach to the solution of maintenance problems. Building Maintenance Management should seek suitable means and procedure of maintaining built space in a state of use that assures the Owner of at least the highest value of the money invested.

Buildings are generally investment goods (assets), such that the benefits derivable from the asset less all costs should yield a profit, comparable to other alternative investments in the market. Here is a trivial formula (equation) representing that obvious rule:

$$X = Y - Z$$

where X = Profit; Y = Benefits; Z = Costs.

and $X > P$

where P = Profit on any alternative investment.

The definition of Building Maintenance Management therefore underscore the need to (foremost) formulate Maintenance Policy as a guiding principle to the organisation of all maintenance work.

The cost of asset replacement have become inflated in recent years because of the dwindling national economy, therefore, well managed Building maintenance programme to extend the lives of existing assets at the same time ensuring satisfactory returns should be built space owners maintenance policy.

This Chapter will review literature relevant to Building Maintenance Management, in relation to the basic notions and categories useful for achieving the aim of the study through its objectives.

The place and role of building maintenance in the overall building life cycle and the stages at which Maintenance Policy and Policy objectives should be set, will be considered too.

Also Building Maintenance Management sub-systems under the principles of economic nature of maintenance actions will be under review.

The considerations beneath are a follow up of notions presented in earlier chapters and run under the following headings.

3.1 Building Maintenance as an Integral part of Building Life Cycle

Raftery [1991 p.69] says that "The life cycles of buildings are diverse; between the two crucial points of Construction and Demolition lies a varied pattern of existence when buildings are subject to periods of occupancy, vacancy, modification, extension until their final removal by demolition".

Buildings can be likened to mortals; the beginning of mortality being marked by birth, passing through stages of infanthood, adolescence, adulthood and finally terminated by death. Similarly buildings from the brief/inception stage pass through construction, use and subsequent maintenance stages, until eventual demolition that marks the end of their lives. Figure 3.1 illustrates the stages mentioned. It depicts three cycles, one showing the financial commitment by the owner (inner, C cycle), the next depicts Administrative stages (center, B cycle) and the last shows the Building process stages (outer, A cycle).

The inner cycle shows the period when the building owner invests capital corresponding to the Brief, Design and Construction stages in the center cycle; and the period when the asset becomes a competitive good in the property market commencing from the day of occupation of the building as shown on the center cycle.

The outer cycle considers the stages according to the Builder's output/work from the Construction through several repetitive sequence of maintenance action like alteration, modification, rehabilitation etc. up till the final decision to demolish the structure.

FIG. 3.1 STAGES IN THE LIFE CYCLE OF BUILT SPACE
Source : Sikora [1993]

The role played by maintenance in the overall building process is further displayed in Figure 3.2. It shows that Maintenance aspects have to be considered at all the stages of the building process, especially maintenance policy and its objectives have to be set at inception and kept in view throughout the life of the building.

According to Lee [1976 p.6], the extent to which maintenance is considered at the design stages will depend on whether the Owner will be the subsequent user. Where the Owner is a developer (whose intention is to sell or lease out the property for a long period), consideration of maintenance at the initial stages that have the effect of jerking up construction cost may be played down. For the purpose of this thesis, it is assumed that the owners are the subsequent users of the facility. They exercise control over the briefing and design stage, its construction and use, and subsequently maintain the constructed facility; hence there is a need to set out maintenance policy from the initial stages.

From Figure 3.2 it will be observed that at the inception stages the Owner must decide in addition to the building requirements, the amount of money he can afford to spend, so at this stage decisions taken will affect future maintenance expenditure. There is the tendency to adopt the lowest alternative which may not necessarily be economical on the long run, since the use of cheaper materials may mean shorter life span and more frequent maintenance works. It is a common experience that low construction costs are directly related to high future maintenance costs. To build cheaply and maintain costly is obviously false economy

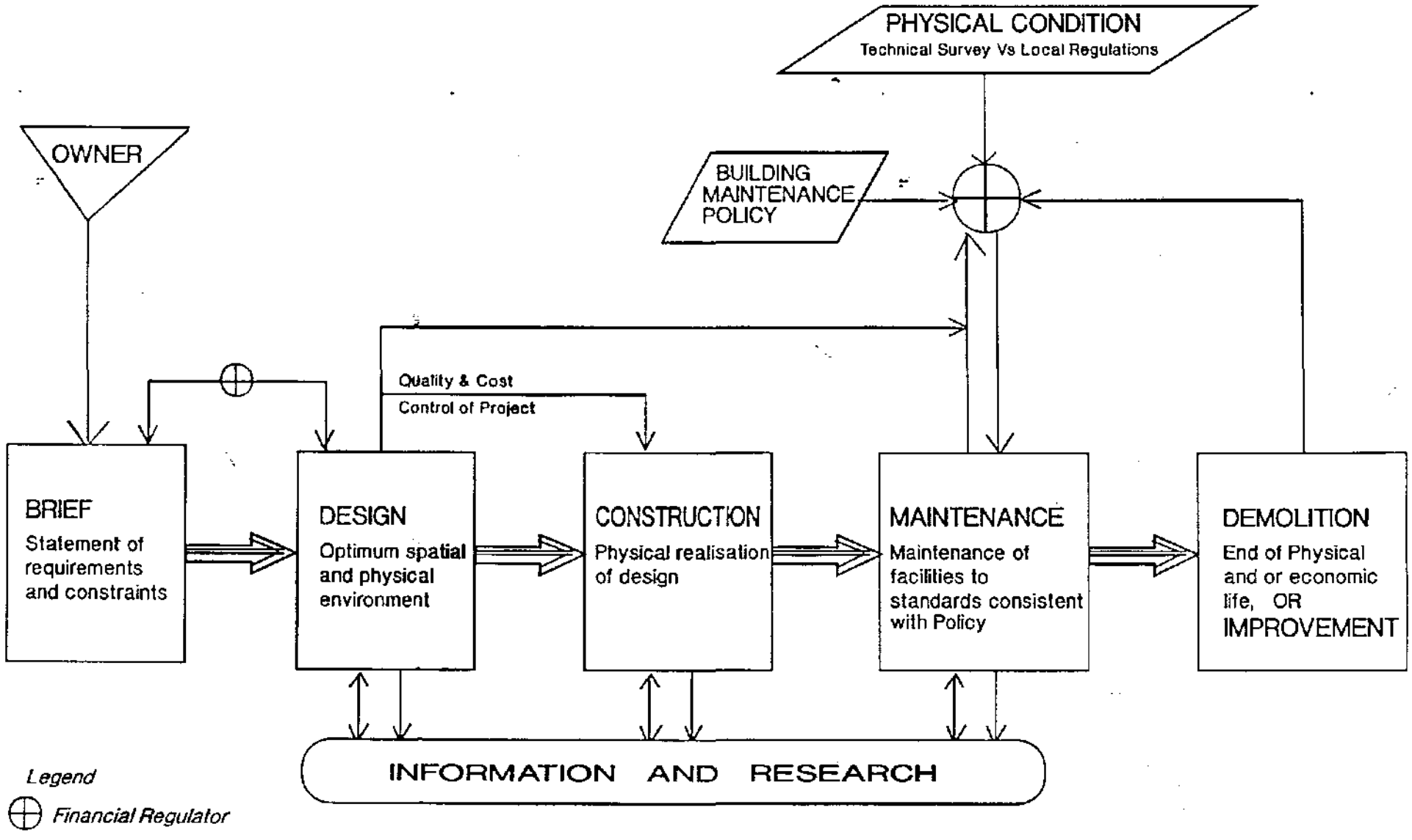


FIG. 3.2 : TOTAL BUILDING PROCESS SHOWING THE ROLE OF MAINTENANCE
Adapted from Lee [1976 P.6]

and ideally the design team should aim at producing buildings that are attractive, functionally efficient and constructionally sound with a minimum of future maintenance expenditures i.e. they are economical objects.

There is no gain mentioning the role of maintenance at the post construction stage. Maintenance work must be consistent with overall maintenance policy and would involve Servicing, Rectification, Replacement and where necessary Improvement of the building, its components and the direct environment to acceptable standards to ensure built space utility and thus an enhancement of its market value (the rent gainable).

The Figure 3.2 also shows that eventually a decision will have to be made as to whether to demolish the building and replace it with a new one or to improve or adapt the existing one to make it more suitable for either its present use or a subsequent one.

In summary maintenance have to be given due considerations from the outset and throughout the life of the buildings. Hence the implications of embarking on or differing maintenance should constantly be in the minds of Building owners.

Cases of over maintenance or under maintenance are not economical, the former will cause high unnecessary maintenance costs, while the latter will definately affect the utility and value of the buildings. A balance need to be struck therefore between the two, preferably an optimum level of maintenance need to be sought at all times.

This assertion will be discussed further under the economic nature of maintenance.

Clear maintenance policies and policy objectives have to be set and implemented by the maintenance departments so that the intentions of the department vis-a-vis the requirements of the owners are communicated, where these have not been the practice, efforts should be made to make same available.

3.2 Economic Nature of Building Maintenance Works

It should be repeated that buildings start to deteriorate from the time they are completed, if not earlier as is the case with elongated periods of design, award and construction, and from that time begin to need maintenance in order to keep up the anticipated standard of usability and prospective rent. Buildings and their components are bound to deteriorate due to the manner of their usage and their time of existence (age). Their life cycles have been shown in Figure 3.1, to include varied pattern of existence. Processes of improvement at the post-construction stage would have the effect of extending the physical life of the built assets.

Raftery [1991 p.75] asserts this view when he said "the life of buildings can be indefinitely extended through maintenance work". Though conscientious maintenance work can extend the physical life of buildings, it is the economic life that should be of greater importance to building owners.

The economic life of a building has been defined by Ratcliffe [1978 p.303] as "that period terminable when the land value exceeds that of the existing built space".

This important statement explains the rationalising effect of the value of a site on life of built spaces, and is referred to as 'Site Obsolescence'. Other types of obsolescence which combine to erode the value of buildings are:

(a) Functional Obsolescence: When the building becomes unsuitable for use and unable to accommodate the process for which it was constructed.

(b) Physical Obsolescence: Where the state of deterioration reached is such that the built space is beyond economic repair.

(c) Economical Obsolescence: When capital and recurrent expenditure is not balanced by sufficient monetary returns and/or benefits from the built space.

From the above considerations, the following aspects should be considered in the study of economics of maintenance viz.

(a) The concepts of value, costs and quality of built spaces as they relate to maintenance.

(b) The onset of physical, functional and some other forms of obsolescence germane to the building itself.

(c) Changes in the value of land, and the depreciation of the leasehold interest in the property.

(d) The techniques available for the determination of economic levels of maintenance.

In Nigeria obsolescence has reached alarming proportions. Buildings are generally under-maintained. This is evident from the state of existing buildings in many urban areas, as public buildings as well as private (mainly) residential buildings. A substantial part of built space is in danger of deteriorating beyond economic repairs.

More alarming, apart from poor maintenance culture, is the lack of building economics considerations in the realm of Maintenance Management. Existing maintenance practices do not involve economic considerations, worse still there is no knowledge that existing buildings can be maintained at minimal costs in such a manner as to provide equivalent benefits to newer ones. The old stock of building has an obvious impact on the Maintenance policy.

The main purpose of embarking on maintenance to a Owner/Investor is to retain the value of the investment, and this value is determined by the demand for the services which the building offers in combination with other factors serving usability within a conceivable period.

The value of buildings then can be equated to market value and maintenance referred to as demand-creating. Thus in the absence of demand, buildings will have no value to be maintained and neither the initial capital outlay nor the standards of maintenance will have any economic significance.

It is essential that an equilibrium point between maintenance standard and value be maintained. Beyond this point normal routine maintenance will not sustain the present value of the building. At that juncture, it may become necessary to carry out major improvements works

in order to raise the quality and value of the building. The graphical illustration of this concept is shown in Figure 3.3. Value is highly subjective and may not be easily quantifiable, but the model is useful in determining the points of intervention of major improvement schemes in order to enhance the value of the buildings. The graph in Figure 3.3 shows a shift in building value from V_1-V_1 to V_3-V_3 with age, due to the effects of major improvements.

Neither over-maintenance nor under-maintenance is economically tenable. Emphasis therefore must be placed on achieving optimality between maintenance costs, quality and the resultant market value (rent).

A number of techniques for determining economical maintenance levels are in existence and will be discussed under the next heading.

3.3 Techniques for determining Economical Maintenance Levels

Six techniques for determining economical levels are hereby proposed and illustrated with examples.

The use and adoption of the techniques require a careful consideration of the variables in maintenance problems and an analysis of the value/cost ratio. The techniques are:

- Discounted Cash Flow Analysis
- Cost-in-Use Analysis
- Cost-Benefit Analysis
- Cost-effectiveness Analysis
- Optimisation and
- Time Profile

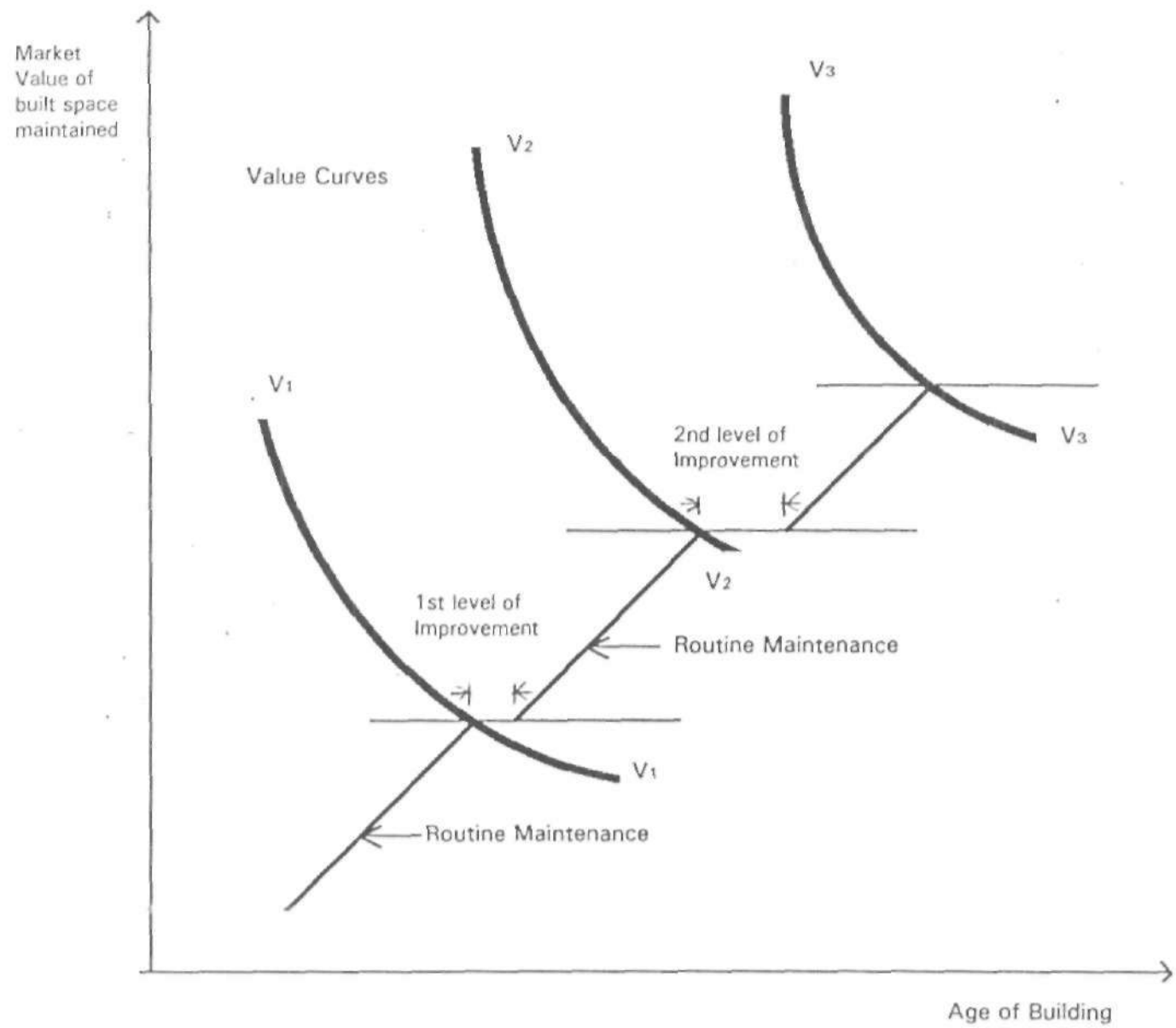


FIG. 3.3 : BUILDING MAINTENANCE Vs BUILT SPACE MARKET VALUE
Source: Rotimi and Mttallib [1995 p.6]

The nature and character of each of the techniques are highlighted below.

3.3.1. Discounted Cash Flow Analysis

This is a technique for measuring the return on capital employed on an investment. The technique allows in the form of compound interest for the time lag between disbursements and the subsequent receipts. It derives its bases from the principle underlying investment appraisal decisions, viz:

(a) **Recovery of the Investment**. Whatever is the initial yield, the ultimate realisation of the investment is essential.

(b) **Adequacy of Yield**. Considering an owner's total business situation. This subsumes such aspects as the cost of finance to the owner and the risk he is willing to take.

(c) **Time Value of Money**. Based on the fact that money owned today is not the same value as money owned tomorrow.

Buildings are Investment goods and the approach to maintenance should be treated as such. The building owner must realise the capital employed, coupled with minimal operating and running expenses, the income accruing must be adequate compared with other alternative investment, taking cognisance of the time value of money.

The technique can be used in selecting the most economic course of maintenance action, for example in Repair-Replace decisions, cost of future repair/maintenance can be discounted back to their present values and comparisons made with the cost of replacement.

Example 1: To ascertain the economic means of maintaining the windows of a building through either complete replacement of the existing windows (life span of 20yrs) costing N5,000 or the regular repair of the existing window at a five yearly interval with a cost of N1,250 each time. Assuming an interest rate of 10% and a predicted building life span of 20yrs.

Solution:

Cost of Replacement = =N=5,000

Cost of Repairs = =N=1,250

Years	Present Value
0	1.000
5	0.621
10	0.385
15	0.239
20	0.149

Σ	2.394

Present Value of Maintenance work = 2.394 x 1,250 = 2,990.50

From the table, it would seem more economic to embark on repairs on a five yearly interval. This is not a general case however. Other calculations may find it worthwhile to embark on complete replacement as against regular repairs.

Using the same principle, the economic amounts to be spent on the maintenance of an item with respect to their anticipated Repair and Replace life can be determined using the Annual equivalent tables for the analysis.

Example 2: If the Repair life of an asset is 5yrs and a Replacement will last 10yrs, using the Annual Equivalent method, it would not be economic

to spend more than 57% of the cost of replacement on repairs, assuming an interest rate of 6%. Thus,

Assume =N= P = Cost of Repair

=N= Q = Cost of Replacement

Annual Equivalent of Repairs = P / 4.212*

Annual Equivalent of Replacement = Q / 7.360*

* - present value of =N=1 per annum at 6% interest rate

Equating P and Q

$$P / 4.212 = Q / 7.360$$

$$Q = 0.572\ P$$

therefore it is uneconomical if P, the cost of repair exceeds 57% of the cost of replacement.

3.3.2. Cost-in-Use Analysis

As a development of the Discounted Cash Flow technique, the cost-in-use analysis appraises the total costs associated with buildings. The term cost-in-use is the sum of the present values of the capital, maintenance and running costs, and the residual value of a building.

Expected payback periods of investments can be determined by discounting annual revenues less the expenditures and equating them with the initial costs.

Mathematically:

$$\sum \frac{R_i}{(1 + r)^i} - E = 0$$

where; E - initial capital outlay
R_i - benefits at the ith period
T - expected building life
r - rate of return to be determined

The value of 'r' rate of return is determined from the equation. The rates of return of alternative maintenance works can be rendered comparable using this technique.

The major drawback of the technique is that it requires enormous current and accurate data on capital and user costs on various materials and components. The fact that such costs are incurred at different points in time resulting in 'varying values' makes detail comparisons difficult.

The absence of reliable data necessary for this calculation limits its application in Nigeria.

3.3.3. Cost-Benefit Analysis

The technique is similar to the techniques aforementioned, in the comparison of flows of expenditure and revenue. The major difference being its use in situations where flows of expenditure and revenue can not be directly measured.

The technique is widely used in the appraisal of public sector building projects. The value of the buildings to the would be occupants and the society at large are considered rather than the immediate cost and returns analysis of other techniques discussed.

3.3.4. Cost-effectiveness Analysis

This is an evaluation technique whereby an end result is maximised in terms of performance within predetermined financial limits, therefore comparison can be made between the different physical means of achieving the same financial end. The methods of estimating and comparisons are similar to the cost-benefit analysis.

3.3.5. Optimisation

The concept of optimisation may also be employed to determine optimum maintenance levels. The use of the optimisation technique depends on the careful analysis and determination of the response(s) (dependent variables) and independent variables associated with maintenance, hence to a certain degree of accuracy the optimum maintenance level can be determined.

There are two basic steps to the solution of optimisation problems, these are:

(a) Determination of the stationary point.

(b) Determination of the nature of the stationary point.

If the value 'V' of a building is a function of the maintenance level 'M' then it is a single variable problem with a single response 'V' and a single independent variable 'M'. The stationary point can be established by evaluating,

$V'(M) = 0$ i.e $dV/DM = 0$

and solving for the value of M at which $dV/dM = 0$ is the stationary point.

The nature of the stationary point can be determined by evaluating,

$V''(M) = 0$ i.e $d^2V/dM^2 = 0$

Decision criteria for Optimisation:

A positive value indicates that maintenance level 'M' will give a maximum value of 'V', therefore the value of the building is less than the cost of maintenance. A negative value indicates that maintenance level 'M' will give a minimum value of 'V', therefore the value of the

building is higher than the maintenance costs. A zero value will indicate a balance between the maintenance level 'M' and the value 'V'.

If on the other hand we consider the cost of maintenance Mc to be dependent on a number of factors such as level of technology, cost of materials etc. represented by x_1, x_2, ...x_n then we now have a multi-variable optimisation problem.

The stationary point is established by evaluating,

$M'c\ (x_1, x_2, ...x_n) = 0$

and solving for x_1, x_2,...x_n, through partial differentiation techniques.

The nature of the stationary point is established by evaluating,

$M''c\ (x_1, x_2, ...x_n) = 0$

Using the same decision criteria, the equation is solved.

3.3.6 Time Profile Technique

For purposes similar to the techniques presented Raftery [1991 p.52], proposed a model (see Figure 3.4) that would be equally useful in appreciating the economic points of intervention of maintenance in the lives of buildings. The model is a Time Profile showing Input and Output curves for a typical building. The Input profile represents construction costs and subsequent maintenance and replacement expenditures, while the Output profile displays a graph of the benefits accruing from the investment over the life of the building. At a point 'A' on the graph, the Input and Output profile intercept, this marks the break-even point from which the building owner begins to gain net benefits from the investment.

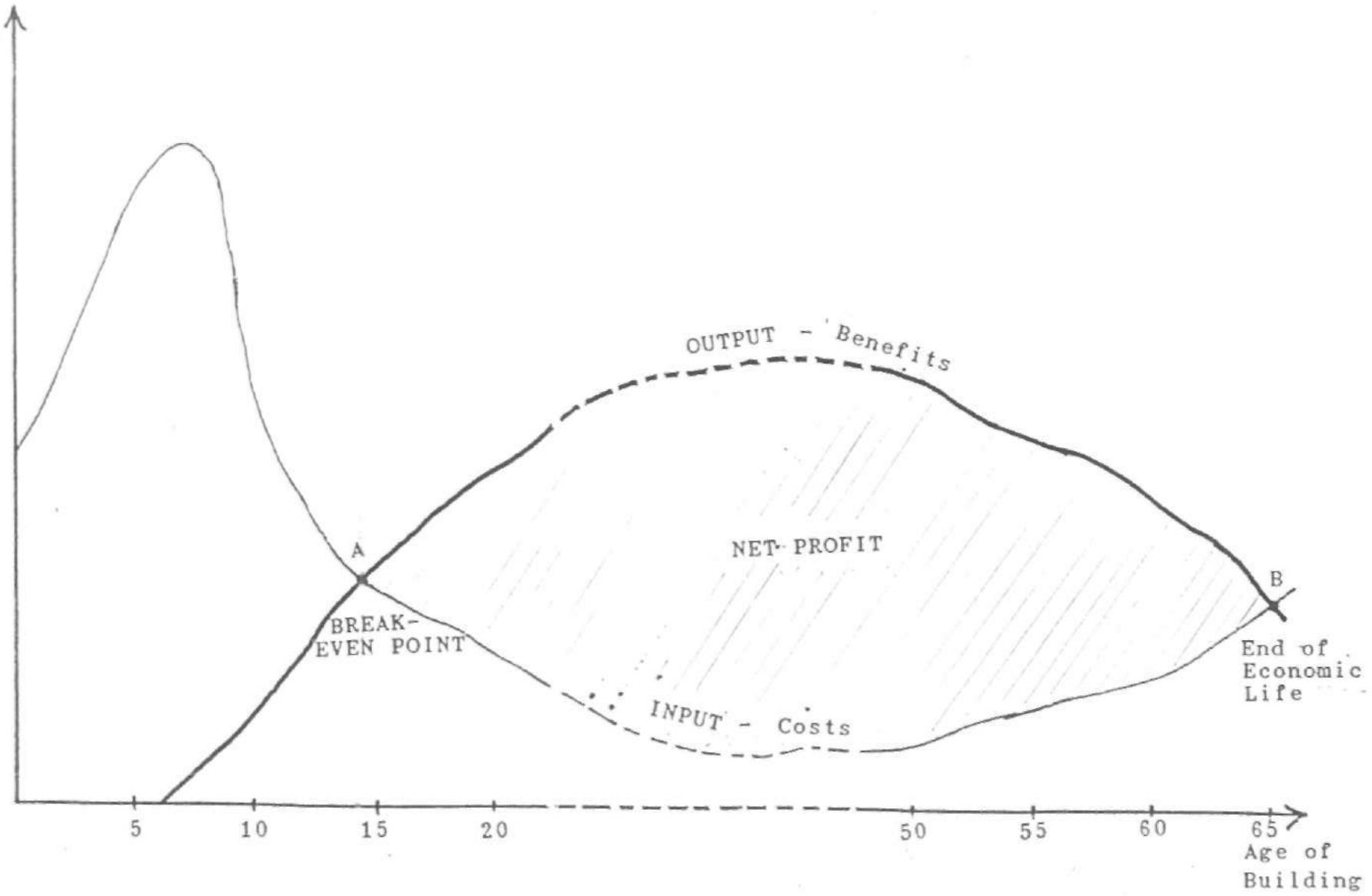


FIG. 3.4 : CONSTRUCTION OF INPUT - OUTPUT PROFILE FOR TYPICAL BUILT SPACES

Adapted from Raftery [1991 p. 52]

Effective Building Maintenance Management seek to ensure that all maintenance expenditure beyond the break-even point is kept at a minimum in order to maximise the benefits accruing to the Owner. At the same time maintenance works would be managed so as to extend the useful (economic) life of the building. The shaded portion on the graph shows the Net profit realisable from the investment (calculated by deducting all costs from respective benefits at every point on the scale).

At the point 'B' the Input and Output profile once again intercept, with rising maintenance costs and depleting economic benefits, this way the point marks the end of economic life of the building.

It can be deduced from the diagram that Maintenance work will only be considered economical, when carried out between the points 'A' and 'B' in the life of the building. Before point 'A' i.e. between the Inception/Brief stage and end of Construction work, Maintenance works will increase the initial capital outlay and thus differ the expected payback period of the investment. Of course, additional initial costs due to maintenance consideration at this stage may be beneficial if it will bring down future maintenance expenditure after construction.

Maintenance work within the defined period must be given due considerations, as it will be uneconomical to embark on maintenance if the cost of providing the benefits or the cost of adapting the building to provide the benefits is greater than the net benefit of allowing the building to be used for its present purpose. This connotes rational decision making on the part of Maintenance Management.

From the foregoing, it is observed that every maintenance action must be the subject of a feasibility study and application of any of the techniques of economical maintenance highlighted. This will enable a determination of the economical amount to be committed to maintenance works, and when such works could be safely carried out without a reduction in the benefits.

Maintenance expenditure should be kept at the barest level so as not to exceed predetermined optimum amounts. The appropriate points of intervention of building maintenance works must also be determined. Maintenance actions must not be too soon if it can be differed, and as well as, not too late such that the usability of the building is affected. The approach at all times is to ensure that the market value of the building is maintained.

Finally, in the words of Ratcliffe [1978 p.301],

> "the overriding objectives of the Property Manager in charge of maintenance is to strike an acceptable balance between the minimising of costs so as to enhance the profitability of the use to which the building is put, and the maximising of the degree of care the building receives in order to promote the economically gainful life of the built space".

3.4 Building Maintenance Management Sub-System

In a study of housing maintenance systems, Thurley [1979 pp.68-70] proposed four (4) main types of Maintenance Management sub-systems arising from the different expectations and priorities of maintenance work initiators. In his proposal, the overall level of maintenance service provided varied both in priorities (eg. Structural repairs vs Decorations); and the importance placed on the speed of response to job

requests. The four (4) systems presented in his study are outlined below:

(a) Work-force based system. This system is based on the available level of manpower. Maintenance [illegible]ions are selected based on the skills found in the labour force.

(b) Occupant based system. The system relies on job requests made up by the occupents. Attempt is made to meet the needs of the occupants based on their requests. A feature of this system is that maintenance tend to concentrate on the aesthetics and finishings rather than functional considerations.

(c) Insurance based system. This is a preventative maintenance approach relying on the predictability of key maintenance decisions. The system is more entrenched in the developed world where buildings have to be Insured against damage and failure. These are guided by local authority regulations. Emphasis in this system is on structural stability and the avoidance of breakdown through replacements and servicing at regular intervals.

(d) Owner based system. It is a maintenance system which views maintenance from the stand point of the building owner. This is the system in view in this thesis, therefore the detail nature and characteristics of this system will be presented separately in Section 3.4.1.

Two analytical distinctions can be made between the maintenance sub-systems aforementioned;

(a) Conflicts of maintenance objectives from the "supply side" (owner) and "demand side" (occupant/user).

(b) The extent to which priorities reflect technical or economic criteria on one side and human and social criteria on the other.

Figure 3.5 show these two distinctions and the relationship between the four (4) systems.

The system adopted will have an effect on the resultant building maintenance policy adopted for particular buildings because of these differing interests. For the purpose of this thesis the last system mentioned i.e Owner based system requires greater emphasis. The market approach to maintenance is no doubt in conformity with the interest of the Owners, on the property. However the real system adopted should have varying inputs from all other systems mentioned, because of the peculiar nature of building maintenance works.

The rationale behind the choice is made clearer by considering the nature and character of this sub-system.

3.4.1. Owner based System

The following are the features of the Owner based system;

(a) Maintenance operations are geared strictly towards retaining the value of the investment and the ease with which parts of the building can be let. It follows that demand-creating maintenance works are the emphasis.

(b) Planning of maintenance work will concentrate more on the functionality of the building and every step is taken so that the performance of the building is not impaired. The system allows for a re-assessment of the built space at regular intervals to ensure that standards of care are maintained.

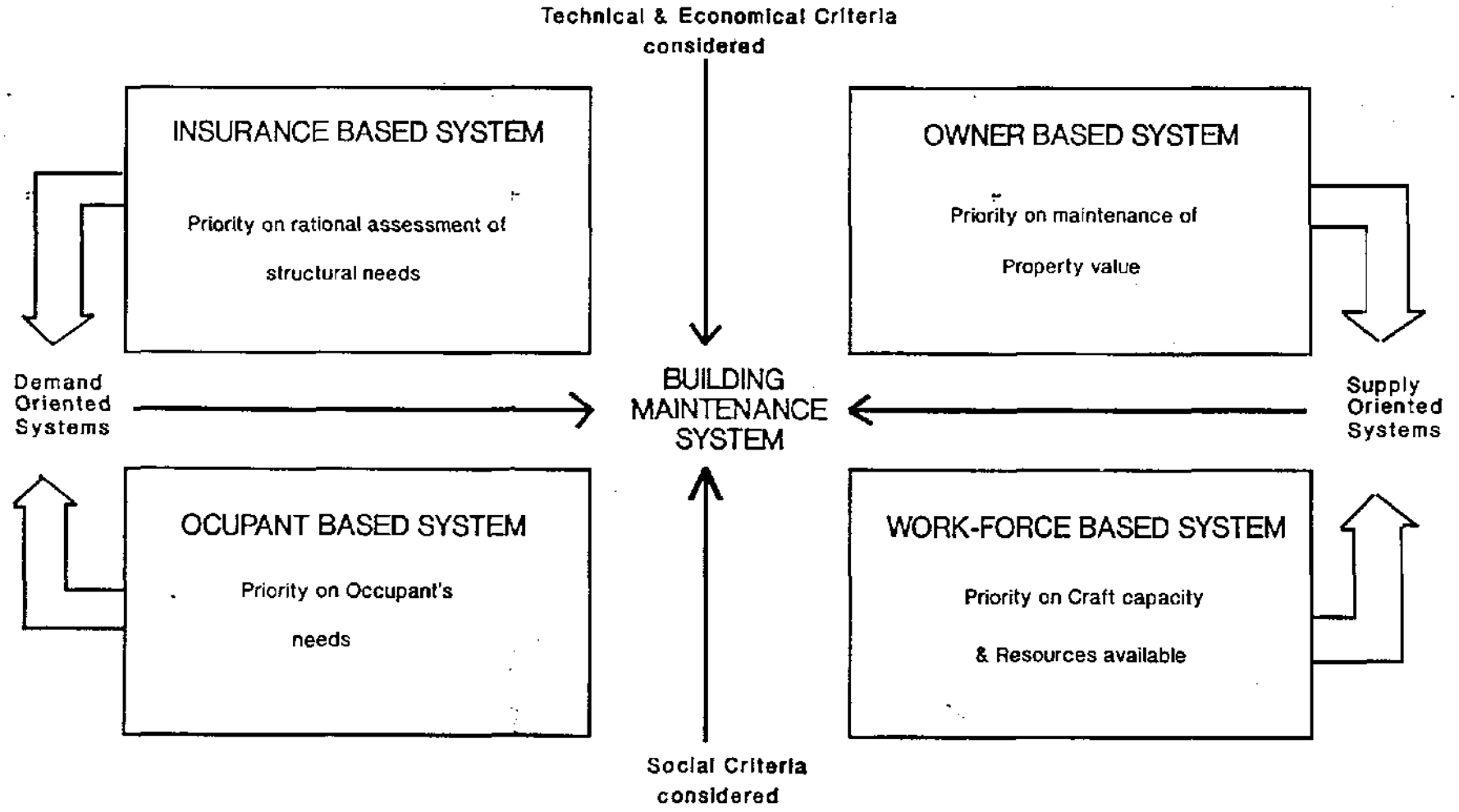


FIG. 3.5 : BUILDING MAINTENANCE SUB-SYSTEM INTER-RELATIONSHIPS
Adapted from Thurley [1979 p. 70]

(c) Supervision of works are centered on minimum costs, keeping buildings unoccupied for minimum periods and restricting the quality of workmanship to the minimum acceptable levels.

(d) Strict control is maintained on running costs at all times.

Summarising thus far, it would be seen that the emphasis in good maintenance policies is the retention of the market value of the investment and at the same time keeping all costs to the barest minimum. The value of the asset is thus preserved to ensure a long-term trouble free investment capable of providing continuous benefits and satisfactory returns.

The returns should be no less than that obtained from alternative investment opportunities and in the absence of current or future benefits the Owner will have no economic incentive to do more than is necessary to maintain the asset.

Clearly the policy adopted by the estate must be related to the fundamental aim and objective of the parent organisation's that own the buildings (i.e. the type of ownership).

Every maintenance action is thus recommended to be approached from an Owner's perspective, hence the choice for an adoption of the character of the Owner based system mentioned earlier.

CHAPTER FOUR

BUILDING MAINTENANCE POLICY AND ITS FORMULATION

4.0 Problem Presentation

The study has thus far shown the approach recommended for adoption by Owners through their respective Property and Maintenance representatives.

The market approach to the Management of building maintenance shows clearly that the emphasis is for a retention or possibly an enhancement of the marketability of built spaces in the property market. This should be the policy at all times.

This chapter will further elaborate on the definition of Building Maintenance Policy, its objectives and formulation. The factors influencing Building Maintenance Policy are discussed under the heading Building Maintenance Policy Formulation. Keeping these in view, further attempt is made to articulate the nature and character of Policy in the conditions of the market oriented approach.

4.1 Policy Defined

A Policy is a statement of aims and ideals, it is a plan of action expressed to guide a wise and sensible conduct. Schellenberger *et al* [1978 pp.28-29] defines policy as "broad guidelines to actions in the pursuit of objectives". These objectives are usually the fulfilling objectives designed to fulfill or accomplish a higher order basic objective of an organisation.

All work is expected to be performed within some boundary or framework within which both Management and Operatives must work to accomplish their ends.

Hodgetts *et al* [1990 p.6] also describes Policy as;

> the definition of a common purpose for organisation components or the organisation as a whole, where in the interest of achieving both component and organisation objectives, it is desirable that those responsible for implementation exercise discretion and good judgement in appraising and deciding among alternative courses of action.

Simply put, Policy is a guiding principle of intent that ensures that Management at various levels of authority know and pursue organisational goals accordingly.

Policy is a base for motivation which is an important stage in any cycle of organised action. It is through laid down policies that the tasks of Coordinating and Controlling the activities of organisation members becomes clearer and easier. Actual performance can be co-ordinated and controlled to fall within the boundaries or framework set by the policies.

Policy is usually a list of tasks in order of priorities stemming from Economic, Technological and Managerial considerations that enable the achievement of organisation objective(s).

4.2 Building Maintenance Policy Defined

Let us repeat that BS 3811 defines Maintenance Policy as "the strategy within which decisions on maintenance are taken". Alternatively it may be defined as the ground rules, practices, guidelines and

standard operating procedures for the allocation of maintenance resources (in time and space of course) between the alternative types of maintenance action available to management. The allocation of resources involves the establishment of priorities for operations competing for the resource allocation.

The onus in Building Maintenance Management is to determine the most suitable way of maintaining the asset (building, its component and direct environment) at an intended economical level while using available building technologies.

Speight [1980 p.131], goes a bit further saying: "The objective of Maintenance Policy may be stated as keeping buildings in appropriate conditions by the most economic means".

Policies therefore should express what is the appropriate means and how best this can be achieved economically.

It will also entail the laying down of maintenance standards required to be achieved through maintenance works. The identification of appropriate standards is one of the factors determining the maintenance workload.

4.3 Formulating Building Maintenance Policy

Building Maintenance Policy formulation involves laying down operational standards and cost objectives for Maintenance Management, by the determination and identification of all the notions presented in previous chapters. These notions include:

(a) The identification of maintenance tasks i.e. the building works

that constitute pieces of maintenance works.

(b) The determination of the maintenance management sub-system in use (see Figure 3.5).

(c) The determination of appropriate conditions of usage i.e. the building maintenance standards to be achieved.

(d) The determination of the economical levels of maintenance expenditure and the economical points of intervention of maintenance of built spaces.

The objectives of Building Maintenance have been described as the keeping of buildings in appropriate conditions of use by the most economic means and for a suitable period; through the Building Maintenance Policy, Maintenance Management is able to formulate long term Maintenance Strategy and prepare realistic budgetary forecast.

Policy laid down must be functional, complete and should leave no doubts as to the intention of the Owner with regard to the maintenance of his building, its components and the direct environment.

4.3.1 Factors influencing Building Maintenance Policy

The following five (5) factors suggested by Seeley [1976 p.273] should be subject of considerations when formulating Maintenance Policy;

(a) The aim of the Parent Organisation: The aim of the parent organisation as reflected by the requirements of the Owners should be determined. This knowledge will help to determine the priorities attached to maintenance work; and the level of such maintenance services required.

In the closing remarks in chapter three, it was pointed out clearly

that policy adopted must be in consonance with the fundamental aim and objectives of the parent organisation.

(b) The Standards of Care: This is Maintenance standard required for the buildings, it is also related to the aim of the parent organisation i.e. it stems from (a). The general standards required of built spaces should be determined and specific requirements or standards can also be set for particular set of buildings, as conditions may vary from building to building. The periodicity of maintenance operations and inspection cycles, if a system of planned maintenance is adopted, are important considerations. Also important is the determination of the points at which routine maintenance will not be able to sustain the utility and value of the building, therefore major improvement schemes will be necessary. These aspects have been covered in previous chapters.

(c) Legal Liability or Requirements: As have been subject of earlier discussions, Statutory/Insurance requirements may assist in fixing lower limits of maintenance standards. In Nigeria, unfortunately, there are no current building regulations for maintenance works. However, from a owners point of view, conditions should not be allowed to degenerate up to a point where the quality and value of the building is reduced.

(d) Method of Building work execution: The method of administering maintenance works refer to the means by which maintenance operations should be carried out, such as by direct labour or contract work. The choice between any of the two will be discussed in detail later in this Chapter.

(e) Cost and Method of Financing: For the purpose of this study, maintenance is geared towards a retention of the market value of the investment. The cost and method of financing building maintenance works (i.e. maintenance expenditure decisions) must be supported by a Feasibility Study approach using any of the techniques discussed in chapter three.

Other technical factors given by Speight [1980 pp.131-135] that would influence the Building Maintenance Policy and contribute to managements' stand and decision on maintenance operations and activities are highlighted below.

(a) Use of premises and their availability for Maintenance work. Both the use for which a building is designed and acquired are clearly a prime factor that determines the requisite maintenance standards. Obviously standards required for buildings, housing dirty Industrial processes will differ greatly from those of an hospital building for example, While the former may not insist on aesthetics, the latter will gain much from a pleasant, clean and healthy environment for proper health care delivery.
There will be a need to determine the criteria of use and consider complex user requirements, this will then be translated into terms of maintenance operations and their timing. According to Speight [1980 p.131], "the relevancy of criteria of use is clear together with the importance of initial design best suited to occupancy needs and the minimisation of maintenance to meet these requirements". Maintenance as a design factor has been dealt with in Chapter three; and it was shown clearly that the extent to which

maintenance is considered at the brief/inception stages will greatly affect the type, frequency and amount of maintenance work needed to sustain the utility and value of the property.

Generally, designers could contribute greatly to a reduction in maintenance costs if they ask themselves four (4) questions, when designing each component or part of a building, these are:

i) How can it be reached

ii) How can it be cleaned

iii) How long will it last

iv) How can it be replaced

Availability of the buildings for maintenance work is another factor. Limitation of availability for maintenance oper[illegible]y dictate the need for more durable finishings and most importantly the timing of operations. Maintenance operations may have to be differed/delayed to closing hours so as not to affect normal business hours in banking institutions; or to vacation periods in educational institutions for instance.

(b) Accessibility: Access to the building and its component for repairs is a design factor undermining the quality of final products from the Building Industry. It is a factor which should be considered in deciding on maintenance policies because ready or difficult access to parts requiring maintenance will affect the cost of maintenance and will also determine the life span of fitted components. In some situations difficult access may prompt extensive alterations in the original design. In the interest of economics; it may be decided for instance, because of maintenance costs (due to expensive

breakages) to change buried rain water down pipes to surface installations.

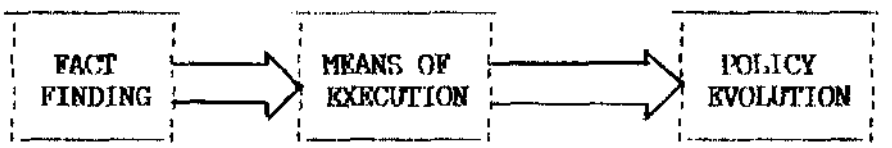
(c) Life of buildings and their services: This factor determines the periodicity and cycle of maintenance operations which should be a feature of good maintenance policy. Design lives of various components vary, e.g. structures may be designed for 50-60 yrs, major building services for 10-20 yrs, finishings and fittings 3-10 yrs and internal transport installations up to 10 yrs etc. There have been calls for a correlation of the expected life span of many of these components and building elements but unfortunately where attempts have been made, it only results to even higher maintenance expenditure and shorter life span of other components.
Maintenance Policy should allow for adequate and timely maintenance action at predetermined periods to cope with the continuous deterioration of building components. It may be convenient to adopt a five yearly repainting cycle for external walls or general servicing of mechanical installations every two years.

(d) Prevention of Defects: Whereas all buildings deteriorate from the time of completion (if not earlier as explained in Chapter three), the rate of deterioration depends on a number of factors. One factor that readily comes to mind, is the suitability of the original design and the standard of construction necessary to contain exposure and use conditions. Ideally, Maintenance Policy should originate from the design stage when a pattern would have been set for better or for worse, the prevention of defects in building. Thus the prevention of defect influences decisions on

Maintenance Policy even at the early stages of Inception and Design.

4.3.2. Steps in the Formulation of Building Maintenance Policy

The formulation of Maintenance Policy for specific Property requires a number of steps. Their sequence are taken up and grouped within three steps or procedure suggested by Speight [1972 pp.477-480]. The steps include:



The steps are summarised under the following headings.

STEP ONE : FACT FINDING

This step primarily is a fact finding and information seeking step which involve broad appraisals of the conditions prevailing within the organisation as a whole and its maintenance department (unit).

Aspects of the Maintenance Unit that should be considered include:

(a) Aim of the parent organisation

(b) Objectives of the Maintenance department

(c) The type and level of maintenance service anticipated or provided.

(d) The manpower (strength and skills) available to tackle maintenance tasks.

(e) The type and level of supervision and control available.

Other considerations are the technical factors influencing decisions on maintenance listed earlier. These are grouped under the heading technology of maintenance for convenience in Table 4.1. From these, necessary details like the attitude of the organisation towards maintenance, budget provisions, administrative controls, and the strength and weaknesses of the parent organisation will be catered for.

Another important consideration is the maintenance management system in use. For the basis of this study, the system adopted must emphasise the Owner based system discussed earlier in Chapter three.

External analysis of Basic user requirements follows; it is aimed at determining the complex requirements of the Occupants of the built space. In this case, it is assumed that the Owners are the Occupants, and so requirements should highly reflect economic criteria.

Local authority regulations are also important inputs that would determine the levels below which conditions and performance of the built space are not expected to fall.

Every decision taken at this Fact finding stage must be the subject of economic considerations; to ensure that the Owners' interest are reflected in the final Building Maintenance Policy formulated. The interconnections between this stage and other stages with economic considerations have been indicated with a returning arrow (feedback relation) in Figure 4.1.

A check list of all the factors requiring consideration is given in Table 4.1.

TABLE 4.1 - CHECK LIST OF FACTORS TO BE CONSIDERED IN THE FACT-FINDING STEP FOR POLICY FORMULATION

INTERNAL APPRAISALS	EXTERNAL ANALYSIS
1. Maintenance Unit Considerations - Aim of Parent Organisation - Objectives of the unit - Scope and Limits of service anticipated. - Manpower available - Type and level of maintenance supervision and control available 2. Technology of Maintenance Work - Prevention of Defects - Accessibility for maintenance works - Use and availability of the buildings - Anticipated life span - Standards of care required - Primacy of Maintenance 3. Maintenance Management Sub-system in use	1. Basic User Requirements 2. Local Authority Regulations

STEP TWO : METHODS OF MAINTENANCE WORK EXECUTION

Having appraised the internal environment and an analysis of the externalities, the decisions reached in Step One will assist in the determination of the appropriate means by which maintenance operations will be administered by the maintenance department.

Building maintenance works, whether major repairs or restoration, periodic or aperiodic, routine or day to day cleaning operations, can be undertaken through the following methods:

(a) Directly employed Building Labour (Direct Labour) Works

(b) Building Contract Works

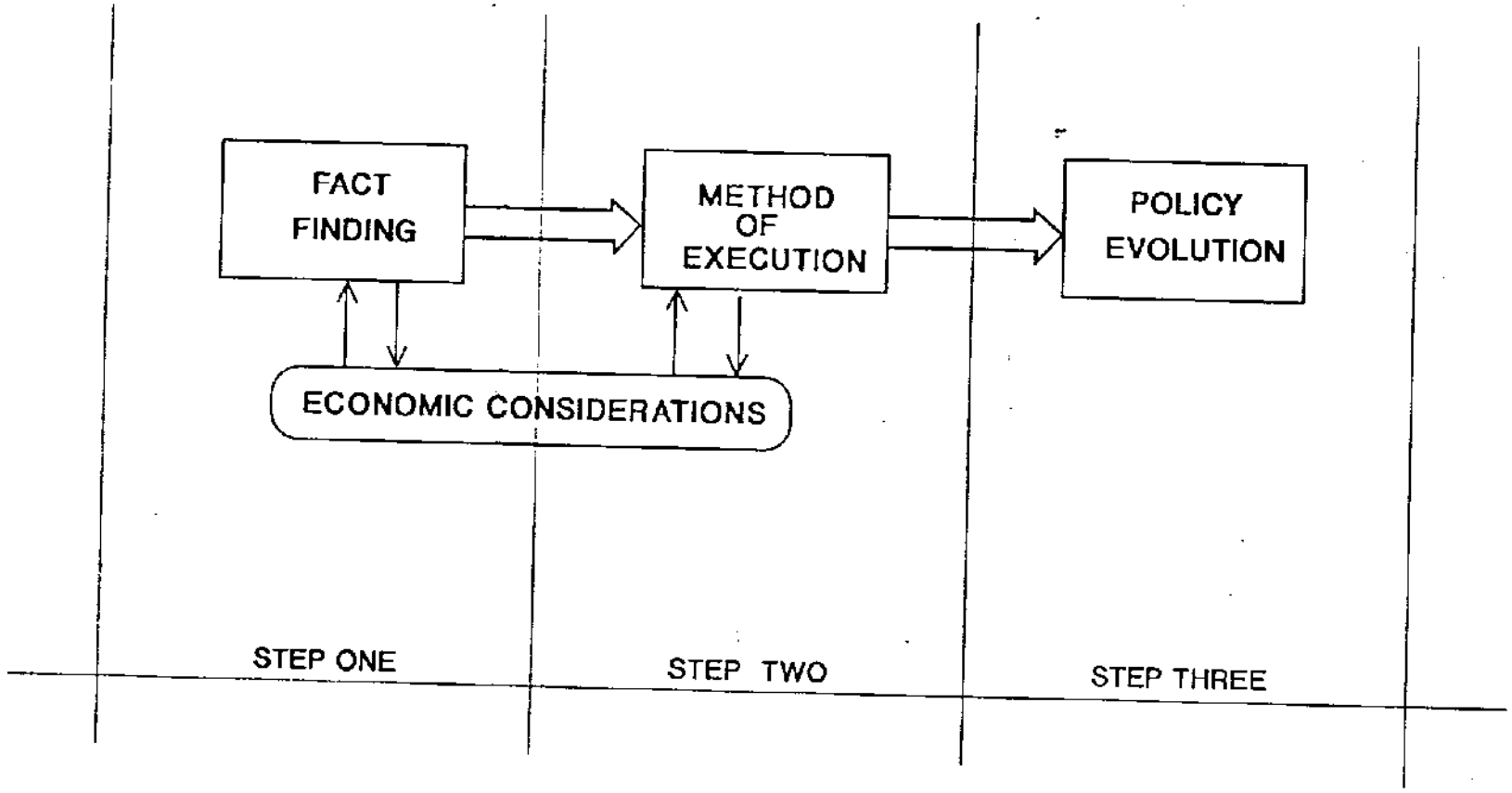


FIG. 4.1 : INTER CONNECTIONS BETWEEN BUILDING MAINTENANCE POLICY FORMULATION STEPS AND ECONOMIC CONSIDERATIONS

The merits of each method for typical maintenance work need to be considered, because optimum use of the resources available to tasks in a given situation is an important element of the building maintenance policy. It may be necessary to look at the structure and organisation of management as to their preference for any of the methods before formulating a policy.

A number of factors would guide maintenance management in deciding on the use of either of the methods in executing maintenance works. They include the following;

(a) Nature of Maintenance works.

(b) Volume of work involved.

(c) Response or Reaction time required by owner or users.

(d) Level of internal supervision available.

(e) Location of the works.

(f) Quality of finished products required.

(g) Accessibility to the works.

(h) Availability of building for maintenance operations.

(i) Built space or Labour market conditions.

(j) Security implications.

(k) Cash flow and Financial strength of the Owner/Administrator.

(l) Total maintenance cost for given building etc.

No doubt because of the obvious peculiarity of different maintenance operations, the use of any of the methods will vary.

The determination of suitable means of maintaining assets need to be the subject of economic and financial considerations also; these is

indicated with another feedback relation on the Figure 4.1.

STEP THREE : POLICY EVOLUTION

The appraisal of the conditions prevailing within the organisation and the [illegible] the means by which maintenance operations are administered, having been completed, The Building Maintenance Policy can then be formulated. The prime elements in the Policy being:

(a) the scope and limits of maintenance service set by Maintenance objectives.

(b) standards of care and use criteria set by the Maintenance standards.

(c) means of executing maintenance works set by the Maintenance work administration methods.

(d) finance and cost considerations outlined in the Maintenance cost objectives.

Figure 4.2 summarises the components or elements of Building Maintenance Policy discussed.

Constantly at the back of the minds of Maintenance Management is the economics of every maintenance decision.

Buildings are largely investment goods and from the point of view of the Owner, every expenditure must be the subject of an Economical analysis. It will not be surprising therefore that finance and cost considerations should be given a higher pride of place among the components dis[illegible].

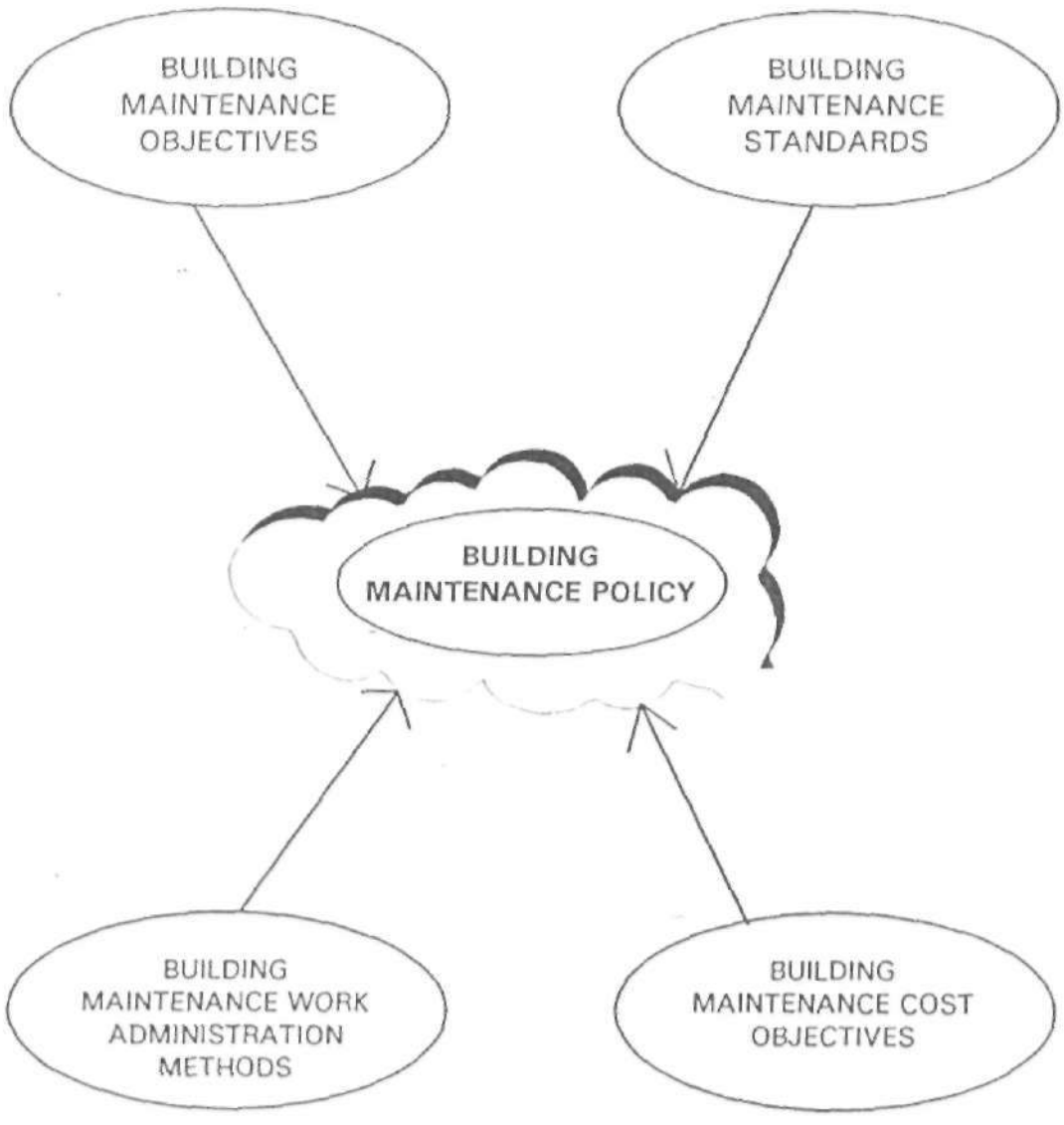


FIG. 4.2 : COMPONENTS OF BUILDING MAINTENANCE POLICY

It may be worthy to mention that good Maintenance Policies must be amenable to change to ensure that its objectives are achievable. They should incorporate a system of continuous review and periodic re-assessment at regular intervals of the market value of the built asset, hence a continuous review process should start off the entire process.

The framework set by the policy should allow for communication and interaction between all the actors (Managers involved in the decision situation and who will be ultimately responsible for its implementation) so that decisions reached are not uncoordinated and piecemeal.

Finally, the need to formulate a Building Maintenance Policy from a market oriented view cannot be overlooked, Buildings are capital assets and capital intensive, it therefore seems necessary to propose the adoption of a systematic approach (with emphasis on economic considerations) to the overall management of these assets.

Having said all these the next chapter would be devoted to the analysis of data collected during the field investigation by questionnaire (see Appendix 1) aimed at appraising the level of adoption/appreciation of the market approach discussed in this study by the Property/Maintenance Services departments.

CHAPTER FIVE

ANALYSIS OF FIELD INVESTIGATION (QUESTIONNAIRE)

5.0 Approach Presentation

This chapter analyses the result of a data set collected with the aid of questionnaire (Appendix 1) and verbal discussion with the respondents on the building maintenance policy of some finance organisations (commercial banks) within Kaduna and Kano from a market oriented approach presented in previous chapters.

A total of 15 questionnaires were sent out to the finance organisations, but only 10, corresponding to 67%, responded positively by answering the questions.

The questionnaires (see Appendix 1) with a covering letter were distributed to Heads of Property/Premises/ Maintenance services departments. The characteristics of the respondents are presented in Table 5.1.

TABLE 5.1 - CHARACTERISTICS OF RESPONDENTS

Institution	Position	Qualifications		
		Degree Bld/Civ.	Bnkg.	Others
A	Asst. Manager	X	-	-
B	Manager	X	-	-
C	"	X	-	-
D	Asst. Manager	-	X	-
E	Officer (Prem)	X	-	-
F	" (Prop)	X	-	-
G	" (Estate)	X	-	-
H	Manager	X	-	-
I	Supervisor	-	-	X
J	Officer (Prem)	X	-	-

Also respondents generally have working experience in their various departments of between 5-18 years.

In the same vein the character of the organisations to which questionnaires were distributed is presented.

TABLE 5.2 - CHARACTERISTICS OF RESPONDING ORGANISATIONS

Institution	Building Types					
	Administrative		Residential		Recreational	
	Qty	Age	Qty	Age	Qty	Age
A	5	10-20	84	10-20	2	10
B	70	10	30	10	4	10
C	30	20-25	35	2-24	-	-
D	1	5	1	10	-	-
E	25	15	50	15	4	15
F	30	20-70	20	20-70	-	-
G	2	10	15	5-10	-	-
H	35	20-30	36	20-30	-	-
I	1	26	30	10	-	-
J	28	10-25	50	10-25	5	5-10

These result show a good capability profile of the level of operations of the Maintenance departments visited.

The questionnaire (see Appendix 1) contains 14 questions. The following (from 5.1 to 5.8) are the headings to group of answers to the 14 questions put forward. The questions cover seven (7) main problems (A,B,...G) which are subject of investigation in particular as basis for the research.

5.1 Problem A: Aim and Objectives of Maintenance Departments

There are two questions in this part and the aim is to get the view of the respondents on what they consider to be

(a) The aim and objectives of setting up their maintenance departments;

(b) The reasons for which maintenance of buildings is necessary.

Question (b) is to cross check if there is a correlation between the general aim and objectives of the maintenance department and that of building maintenance in particular.

60% of the Respondents consider the aim and objective of setting up the Maintenance departments as Economic i.e. in order to coordinate and control maintenance expenditure to fall within predetermined maintenance budgets.

30% believe that it is to help achieve the designed life span of the buildings in their control. The designed life is assumed to be from 60 years and above.

20% of the respondents consider the aim to be the assurance of constant and effective maintenance work to meet the exigencies of every situation.

Other aims put forward by the respondents include:

- the minimisation of time spent in effecting maintenance operations.
- the improvement of the image of the organisation thus giving value to customers savings.

On reasons for embarking on maintenance of their buildings, Respondents were required to rank their answers with numbers 1,2,3... in the order of priority. The responses are summarised in Table 5.3:

TABLE 5.3 REASONS FOR EMBARKING ON MAINTENANCE OF BUILDINGS

S/n	Reasons	1 %	2 %	3 %	4 %	5 %
a)	To retain the market value of the investment.	10	-	-	30	60
b)	To maintain an acceptable quality standard of the premises	40	10	30	10	-
c)	To prolong the useful life of the buildings	30	20	40	10	-
d)	To present pleasant and conducive working environment	40	30	10	-	-
e)	To meet the standards of premises set by competing organisations	-	30	-	30	40

COMMENT ON TABLE 5.3: It would seem that most of the respondents are aware of the economics of maintenance works, although the coordination and control of maintenance expenditure to fall within their budgets presupposes that a number of considerations albeit economic would have been considered during budget preparations. And if this is so, it means that some form of policy would have guided originally their decision making in this respect.

A relatively new objective introduced in their response is the minimisation of the time taken to effect maintenance operations by the maintenance departments. It permits a bonafide deduction that some form of work planning is involved in their activities.

The reasons for embarking on maintenance of buildings sort of played down the economic aspects of maintenance, since 60% ranked the retention of the market value the least of their reasons for maintaining buildings. (This is almost contrary to the market approach presented in this study).

Their reason for adopting this stand is that their buildings are not put for commercial use i.e. rented out, hence there is no real need to maintain buildings with a view to improving its marketable rent/value.

The Author of this thesis believes that at all times, building maintenance should aim at giving value to the money spent on maintenance, and by so doing the owners stand to gain maximum benefits from the investment.

5.2 **Problem B: Building Maintenance Policy**

There are three questions covering this heading.The aim of the questions is to ascertain whether the organisations have written down maintenance policies or not and where not available, what forms the basis of their maintenance decisions.

As to the existence of a written down building maintenance policy document, 80% of the respondents do not have it.

The remaining 20% who allege that it exists, say it is in the form of a Redecoration or Replacement policy. A typical example of this policy is the following set of guidelines:

(a) Replacement of Carpeting every 5 years

(b) Replacement of Air Conditioners every 10 years

(c) " of Household furniture every 5 years

(d) Repainting cycle for residences every 3 years etc.

Unfortunately none of these respondents was able to provide the author a copy of this document.

The 80% who declared absence of this document have the following response to a question on what forms the basis of their building maintenance decisions. Their response is presented in Table 5.4.

TABLE 5.4 BASIS OF BUILDING MAINTENANCE DECISIONS

S/n	Decisions	Usually %	Rarely %	Never %
a)	Personal judgement	50	20	10
b)	Administrative/Management control	30	40	10
c)	Local authority regulations	10	40	10
d)	Marketable value of the buildings	10	20	20
e)	Conditions of the buildings	70	10	-
f)	Requests from users	80	-	

COMMENT ON TABLE 5.4: The important constituents of good building maintenance policies have been presented in Chapter four (see Figure 4.2 for a summary of the components of Building Maintenance Policy).

It would be observed that elements mentioned are clearly absent from the policies existing in the responding organisations. Of these elements, cycles of renewal or replacement are put down, which is only a part constituent of maintenance standards.

It is observed also that their maintenance decisions are mainly based on the requests from users. This is an Occupant based maintenance system (Contingency system) in use and experience has shown that in such a system, there is tendency to concentrate on aesthetics and finishing works rather than functional considerations. This is coupled with the fact that users' requests are made with little regard for their cost implications. It is for this reason that the study emphasises the character of the Owner based system. The system has been presented in chapter three of this thesis.

5.3 Problem C: Criteria for determining Building Maintenance Work Priorities.

To further understand the level of appreciation of the economics of maintenance works, it is needed to know what criteria are used in determining priority of maintenance operations. The respondents were required to rank their answer with numbers 1,2,3... in the order of priority. The Table 5.5 summarises the answers received.

TABLE 5.5 - CRITERIA FOR BUILDING MAINTENANCE WORK PRIORITY

S/n	Criteria	1 %	2 %	3 %
a)	Economic Criteria	60	30	10
b)	Technological Criteria	40	30	30
c)	Social Criteria	-	30	60

COMMENT ON TABLE 5.5: Economic criteria is here ranked highest by 60% of the respondents as the determinant for prioritising building maintenance works. This is followed by technological considerations with only 40%. Social criteria though rarely considered, are used while trying to present good premises for customer impressions.

The 30% who ranked economic criteria second are of the opinion that, for certain maintenance works technological considerations may override economic considerations.

The result seem to be in consonance with the technical and economic criteria proposed for organised maintenance management sub-system in the chapter three (see Figure 3.5)

5.4 Problem D: Contractual Arrangements for Building Maintenance Works.

As an element of the Building Maintenance Policy, the way and manner by which the performance of building maintenance works are administered is an important factor. The allocation of the works is the right and duty of the owner or his administrator, this may be achieved through contract works, by direct labour or a mixture of both.

It may be the policy of the organisation that all works must go to the direct works department; to specialist contractors to complement direct works; or may be that financial limits be imposed so that all works above a certain value goes out to tender. These and many more should be reflected in the policy formulated.

The questions in this part of the questionnaire, wanted to know which of the administrative arrangements are employed in executing maintenance works; and which is prefered by this particular group of respondents.

The response is presented in the following Table 5.6

TABLE 5.6 BUILDING MAINTENANCE WORK ADMINISTRATION

S/n	Contract Type	Preference 1	2
a)	Direct Labour works	70%	30%

It can be observed that direct labour works are more prefered by the responding organisations. The reason for their preference is not far fetched. All the responding organisation who prefer the use of direct labour have enough technical staff to attend to day to day routine

maintenance works. It is the general believe that maintenance works performed by direct labour can be more closely supervised and a good control of the quality of work is ensured. Also direct labour works almost always result in cost savings.
Maintenance works are only let out by them when the magnitude of the works are above the capability of the directly employed staff.

The 30% who opted for contract works gave the following reasons (verbally) as guiding their choice;

(a) The standards of care required for the maintenance of their buildings can only be met by specialist contractors.

(b) It is a matter of policy to let out all maintenance works hence the absence of any technical staff within their department.

5.5 Problem E: Economics of Building Maintenance Works

The author needed to know the type of economic consideration undertaken by the respondents before and after maintenance works are executed. There are three questions in this part, the data received through the questionnaire in answer to them are summarised in Table 5.7.

TABLE 5.7 - ECONOMIC CONSIDERATIONS UNDERTAKEN BEFORE COMMENCEMENT OF MAINTENANCE WORKS

S/n	Economic Considerations	Usually %	Rarely %	Never %
a)	Feasibility study of the works	80	10	10
b)	Cost benefit appraisal of the work	90	10	-
c)	Determination of optimum levels of maintenance expenditure	80	20	-
d)	Reference to budgetary forecasts	100	-	-

Other economic consideration carried out before maintenance works, is the sourcing of cheaper building materials (market survey of materials required).

On whether respondents carry out any economic appraisal after maintenance works must have been completed to control the chances in the market (to gain a good rent) and consider future maintenance expenditure, all the respondents do not carry out this exercise.

COMMENT ON TABLE 5.7: From the above responses it can be seen that most of the economic considerations highlighted are mostly carried out.

Though further investigations reveal that the preparation of approximate estimates before commencement of the works represent the only form of economic planning carried out by the responding organisations. This obviously does not satisfy the aim of a market approach to building maintenance. The rent achievable through maintenance of the buildings should be constantly monitored both before and after maintenance works.

5.6 Problem F: Determination of Market Value of Buildings

The two questions in this part sought to know if there were steps taken by the organisations to determine the market value of their built spaces particularly buildings, for example at the end of every fiscal year.

50% of the respondents do and 50% do not. The former category determine the market value of their properties for the following purposes:

(a) Insurance valuation purposes

(b) General Revaluation exercise of property worth.

The valuation of the properties are not carried out on regular basis, they are only done when situations warrant.

Valuation of property worth, if any, are usually carried out by either in-house valuers or by the use of professional estate valuers.

COMMENT: The valuation of property worth is an important aspect in every market economy. The evaluation of the investment at regular intervals will help owners to know their financial position as the buildings are concerned. This knowledge will help determine how the money spent on maintenance of buildings has affected its market value whether positively or otherwise.

It is even more important to institutions (banks), it is expected that this knowledge of the value of their assets (buildings are a part of their capital) should determine in all likelihood their credibility in the financial market.

A common error made by this group of owners is to apply a common percentage for the depreciation of their physical assets. Hence the values of their property reduces every fiscal year. Where this may be applicable to machinery, electronics, etc care need to be taken in the case of buildings to assume the same depreciation value.

It is common knowledge that in an inflationary economy like in Nigeria now, the value of buildings are likely to appreciate, though this largely depends on the level of business in the property market and

on the standard of care on such buildings. Owners would therefore benefit more from regular valuation of their buildings.

5.7 Problem G: Maintenance Budget Preparations

Realistic budgets can only be achieved if correct steps are taken in its preparation. The important factors influencing its preparation are the Maintenance objectives and Policy. These components are discussed in Chapter six.

The question wanted to know what factors are considered in the preparation of maintenance budgets. The table below summarises their response.

TABLE 5.8 FACTORS CONSIDERED IN BUDGET PREPARATIONS

S/n	Factors	Usually	Rarely	Never
a)	Maintenance requirements of each building	100	-	-
b)	Depreciation value of the buildings	20	30	50
c)	Past budgetary record/provisions	90	10	-
d)	Expected Capital expenditure sums	60	10	30

COMMENT ON TABLE 5.8: It would be observed that the most factor considered in budget preparations is the requirements of each buildings and reference to past budgetary records on expenditure and provisions. This is considered good practice as they form a convenient basis for forecasting maintenance expenditure.

5.8 Merits of Building Maintenance Policy (Market Oriented)

Finally respondents were requested to comment on the viability of the formulation of Building Maintenance Policy from the market oriented approach proposed in the study, i.e. Maintenance works that will ensure

an improvement of marketable rent/value of the buildings.

Generally the respondents regarded the approach plausible, believing that it will give the needed orientation towards a good maintenance culture. The following advantages were given by the respondents as derivable, from putting in place a well articulated building maintenance policy.

(a) The policy will assist in achieving investment objectives. Owners will be better placed to maximise their income as they are informed of the rent realisable on their properties in the property market.

(b) The policy will ensure that more attention is placed on the utility of the building i.e provision of conducive environment for business and an increase in the productivity of bank workers.

(c) The policy will improve the standards of care for buildings through well coordinated and controlled maintenance operations.

(d) The economic lives of the buildings are likely to be increased thus ensuring prolonged continuous and satisfactory returns to the owners.

(e) The policy may ensure optimum maintenance at the least cost.

(f) The policy can assist in the preparation of realistic budgets. Maintenance planners are thus encouraged to consider all issues capable of enhancing the market value before other considerations that funds can accommodate would be included in the budget during its preparation.

CHAPTER SIX

GENERAL SUMMARY AND PROPOSALS

6.1 General Summary

The summary of the entire study appears to be more or less a comparison of the contents of Chapters two, three and four covering the literature review with Chapter five covering the results of the field study. An attempt to highlight the problem areas discovered within the field study, will help achieve the aim of the study and its final objective as assumed in Chapter one.

This final objective is to recommend an approach to the formulation of Building Maintenance Policy i.e. the sequence of steps that will give the right orientation to building owners and administrators on how to maintain the value of their property.

The field studies revealed a number of shortcomings in the policy formulation for buildings, if any, in the institutions.

They are here summarised;

(a) A character of Maintenance service similar to an Occupancy based system or Contingency system is adopted by most of the maintenance departments visited.

(b) The relevant economic considerations that are needed in deciding among alternative courses of maintenance actions are absent.

(c) There is no knowledge of the prevailing building property market situation and prices of building materials and works which should assist in the formulation of the right policies towards enhancing the market value of maintained property (buildings).

(d) Building Maintenance Policies are not in line with the requirements of owners; those policies are not clearly expressed and formulated at the same time.

(e) The absence of appropriate policies make the preparation of realistic budgets not feasible.

To improve on these shortcomings, the relevant items which should be the fundamental of Building Maintenance Policy, will be discussed in line with considerations and deductions made within the review of literature in Chapters two, three and four. Obviously it would be done with regards to market oriented economics as pointed out in this thesis title. They are presented under the following sub-headings.

6.1.1. Building Maintenance Management System

From the literature review, it was determined that the maintenance system adopted (see section 3.4) will have an effect on the resultant Building Maintenance Policy adopted for particular buildings. It was agreed that in the market economics nothing else but the market approach to maintenance of buildings is in conformity with the interest of owners. Thus the Owner based system was assumed as a pattern.

The character of this system was presented in Chapter three and the following deductions are made now:

(a) The Owner based system will ensure a strict control of maintenance expenditure. Buildings are generally investments, and from the point of view of the owners it must yield an income comparable to other investment opportunities. Maintenance cost should therefore be kept to the barest minimum so long as the utility of the

6.1.4 [illegible]s

Building Maintenance budgets are plans for financing the maintenance work to be carried out over a period of time, to meet the stated objectives of the parent organisation.

Ideally the budget should be determined from the requirements of the building and not a mere adjustment of the previous years budget. Past budget provisions and expenditure requirements serve as reference and guide to the preparation of current budget only.

The formulation of maintenance budget should consider basically the Maintenance Objectives and Maintenance Policy. Forecasting of the likely works to be required in the short and long term is also the subject of important consideration.

Summarily the extent of the works having being determined from the Maintenance objectives and Policy, together with the costs involvement will form the value of the maintenance budget.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.0. Conclusion

The formulation of Building Maintenance Policies from the market oriented approach has a wide applicability. In as much as buildings are generally investment goods, they should offer a chance to yield an income, whatever the type of ownership.

The merits of the implementation of this approach have been presented in Chapter five. Basically they combine to ensure an improved maintenance service to the organisation at low cost.

In order to create the right orientation towards the approach represented, this study started by presenting the fundamentals of Building Maintenance philosophy. This was followed by Costs, Value and Quality concepts of Building Maintenance Management. These background considerations provided a base for discussion on Building Maintenance Policy and the steps of procedure necessary for its formulation for existing organisations.

A field study of existing practices discovered some shortcomings and negligence, those common were exposed in this thesis. At the same time it assisted the author in making some specific and general recommendations for an improved building maintenance service.

In conclusion the common approach towards Building Maintenance need to be corrected. The basic rule is to look at the building from the owners point of view. Then it would not be difficult to appreciate the

necessity for a framework of this needed improvement. This way also the overall objective of the study, namely a creation of the right orientation for the formulation of Building Maintenance Policies is being met.

7.1 Recommendations

The following recommendations stem from all the study. They are made with the best of intentions for the satisfactory management of Building Maintenance departments and units. They may almost be meaningless if they could not be implemented with the spirit with which they have been made.

The following specific recommendations are guidelines directed to Management and Policy makers at all levels of the hierarchy within the Maintenance departments and units to assist in formulating the right Building Maintenance Policy.

(a) Maintenance Departments are advised to make necessary steps to formulate Building Maintenance Policies. So, the Building Maintenance Policies should be complete and leave no doubts regarding the action plans of the department vis-a-vis the requirements of the owners. The following should be kept in mind.

(i) The Policy formulated will be a management tool for the coordination of maintenance operations and a motivator of the maintenance work-force.

(ii) The Policy should state categorically the following:

- Maintenance Objectives
- Maintenance Standards

- Maintenance Administration methods and
- Maintenance Cost objectives.

(b) For Owners having different types of buildings it is recommended that specific Policy be prepared for each of the building types apart from the general Building Maintenance Policy.

(c) It is recommended that the Building Maintenance Policy must ensure that maintenance works are subject of economic and financial evaluations before and after any implementation of the works. These pieces of information ex-ante will help in determining maintenance work priorities; and ex-post as a tool for future maintenance expenditure planning.

(d) The Policy should highly reflect economic and technical criteria as against social criteria of use. Therefore Maintenance Management is advised to view building maintenance from an owners perspective, to ensure that the buildings (which are largely investment goods) contribute positively to the level of income of the owners. This way good standards of usability could be preserved for the nation.

(e) Attempt should be made by Maintenance departments and units to be aware of the prevailing market value of their assets (built space) on a regular basis. This will provide information for the appraisal of the effect of maintenance works on the building value for any financial and accounting purpose.

(f) Realistic Maintenance Budgets should be sought at all times and this can be achieved through implementation of well articulated Building Maintenance Policies known and accepted by the Owners.

Finally, the study is recommending further research towards a critical look into the possibility of formulating an economic model(s) or formulae that will help in the determination of optimal Maintenance Expenditure for particular building types within a given period. It would require a common effort of builders' experienced in the area of Building Economics as well as those of Construction Technology.

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APPENDIX

Department of Building
Fac. of Env. Design
Ahmadu Bello University
Zaria.
November 1995

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BUILDING MAINTENANCE POLICY FORMULATION:
A MARKET ORIENTED APPROACH

The purpose of this questionnaire is to enable the student complete his study of existing building maintenance management policy of the buildings owned by your organisation.

The bearer is a student of Construction Management from the above University and would be required to submit the thesis as a partial fulfillment for the award of M.Sc. degree.

Sir, your cooperation will be highly appreciated if you could answer all the questions in this questionnaire and supply any other additional information based on your experience, that could lead to the success of this research.

All information provided shall be treated with strict confidence.

Please note that I may need to have verbal discussions with you on questions and answers that are unclear.

Thank you for your cooperation.

Yours faithfully,

James Olabode B. Rotimi

QUESTIONNAIRE ON

BUILDING MAINTENANCE POLICY FORMULATION:

A MARKET ORIENTED APPROACH

1. Please, indicate the building types managed by your Maintenance department.

	Number	Period of Use
a) Administrative buildings	[ ]	[ ]
b) Residential "	[ ]	[ ]
c) Recreational "	[ ]	[ ]

d) Others, please specify:.....

2. What do you consider to be the aims and objectives of setting up your Maintenance Departments?.....

.....

.....

3. Could the following be the reason(s) for embarking on building maintenance by your department?

Please rank with numbers 1,2,3... in order of priority.

a) To retain the market value of the investment [ ]

b) To maintain an acceptable quality standard of the premises [ ]

c) To prolong the useful life of the buildings [ ]

d) To present pleasant and conducive working environment [ ]

e) To meet the standard of premises set by organisations competing with yours [ ]

f) Others, please specify and rank with numbers: .....

.....

8. Which of the following administrative arrangements are used in executing building maintenance works?

   Please rank with numbers in order of preference.

   a) Direct Labour works [ ]

   b) Building Contract works [ ]

   c) Others, please specify and rank with numbers:.....

   .....

9. Please, state briefly the reasons for your preference and order, in response to Qs 8 above.....

   .....

   .....

10. Do you undertake any of the following economic considerations BEFORE embarking on maintenance work?

	Usually	Rarely	Never
a) Feasibility study of the work	[ ]	[ ]	[ ]
b) Cost-benefit appraisal of work	[ ]	[ ]	[ ]
c) Determination of optimum levels of maintenance expenditure	[ ]	[ ]	[ ]
d) Reference to budgetary forecasts	[ ]	[ ]	[ ]

   e) Other economic appraisals, please specify:.....

   .....

   .....

11. Are there other economic appraisals carried out to control future maintenance expenditure vis a vis the value of the building AFTER maintenance work must have been completed?

    Response: (A) Yes (B) No

12. If Yes, please specify these types of economic appraisal?

.....

.....

13. Are steps taken to determine the market value of your buildings at the end of a fiscal year?

Response: (A) Yes (B) No

14. If Yes, please specify these steps taken to determine the market value?.....

.....

15. In the preparation of Maintenance Budgets, Are your decisions based on the following factors?

	Usually	Rarely	Never
a) Maintenance requirements of each building	[ ]	[ ]	[ ]
a) Depreciation value of the buildings	[ ]	[ ]	[ ]
b) Past budgetary records/provisions	[ ]	[ ]	[ ]
c) Expected Capital expenditure sums	[ ]	[ ]	[ ]

d) Other factors, please specify:.....

.....

.....

16. Personal Details:

Rank: .....

Qualification:.....

Years of service with the department:.....

Name and Address of Establishment:.....

.....

17. Please, Comment freely on the viability of the formulation of a Building Maintenance Policy that is based on the resultant market value obtainable from maintenance work.

THANK YOU FOR THE USE OF YOUR VALUABLE TIME

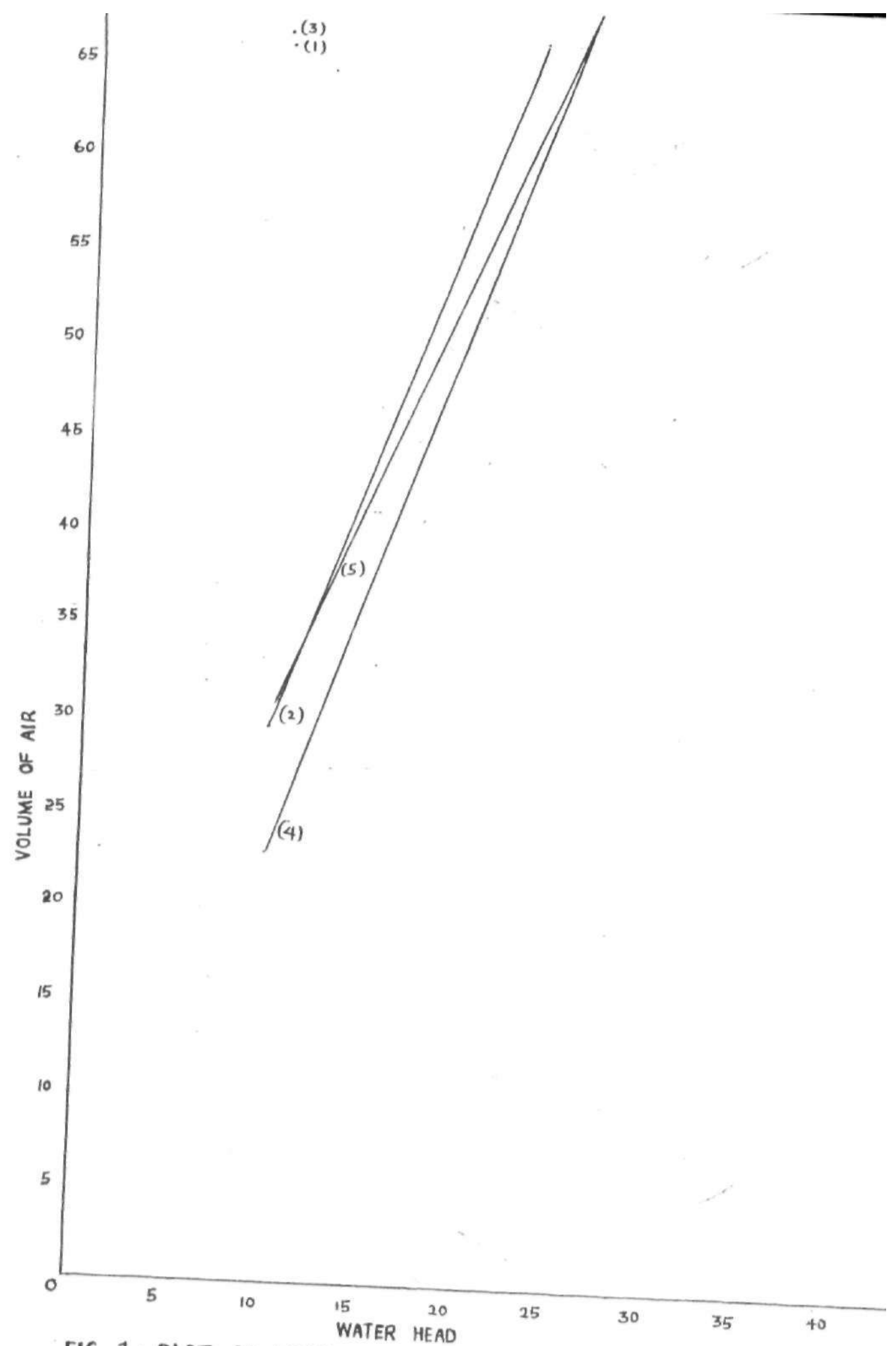

FIG. 1: PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

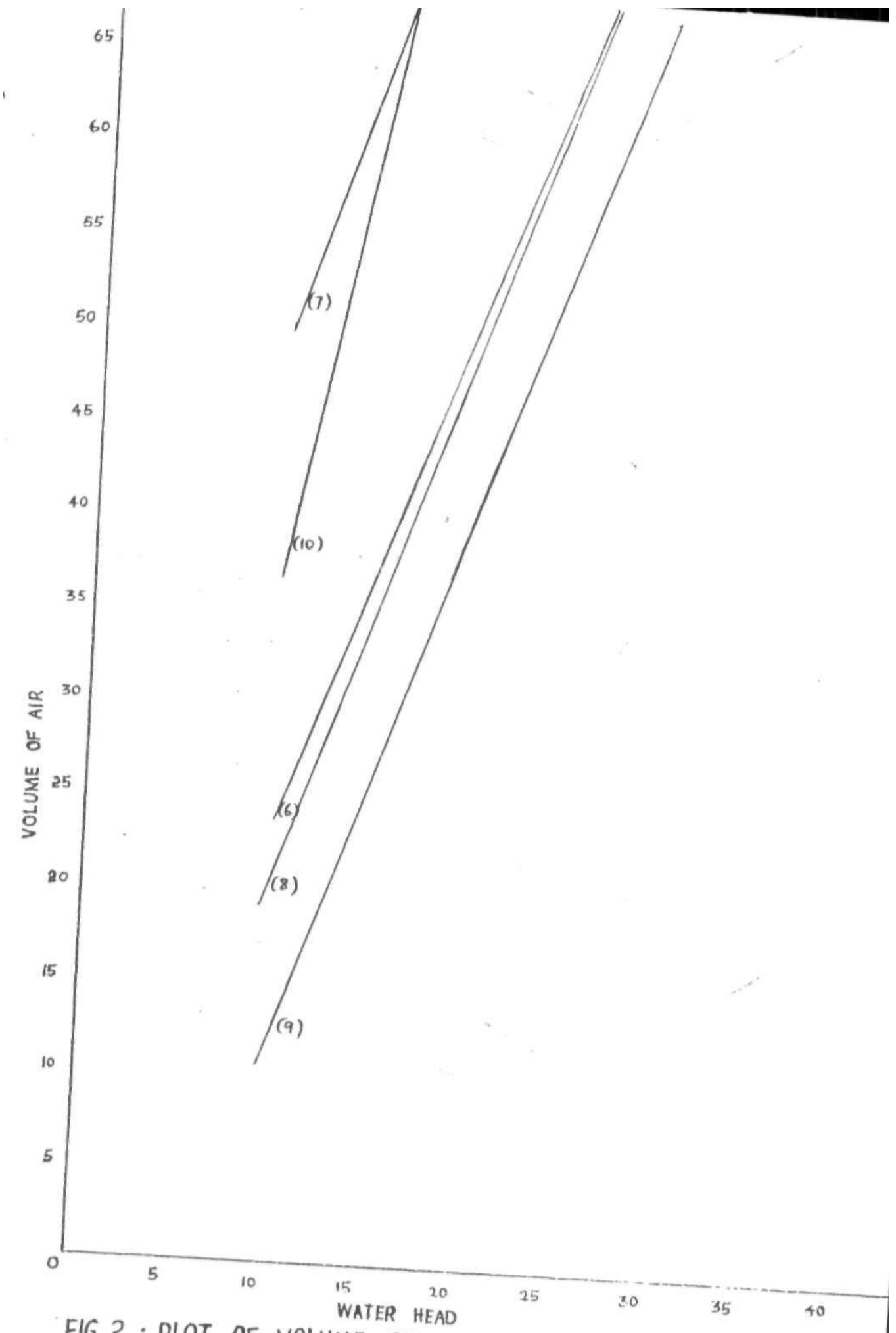

FIG.2 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

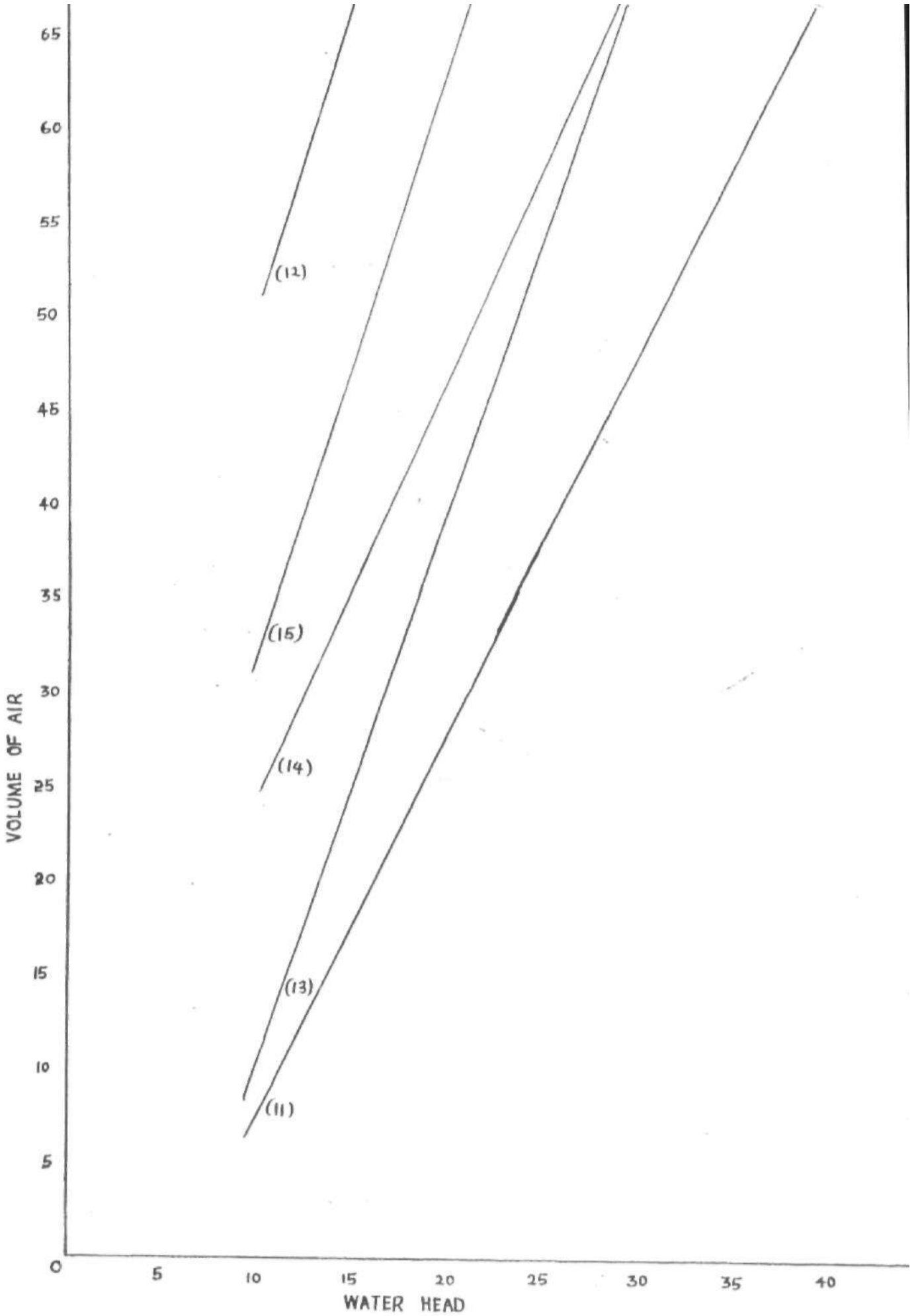

FIG. 3 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

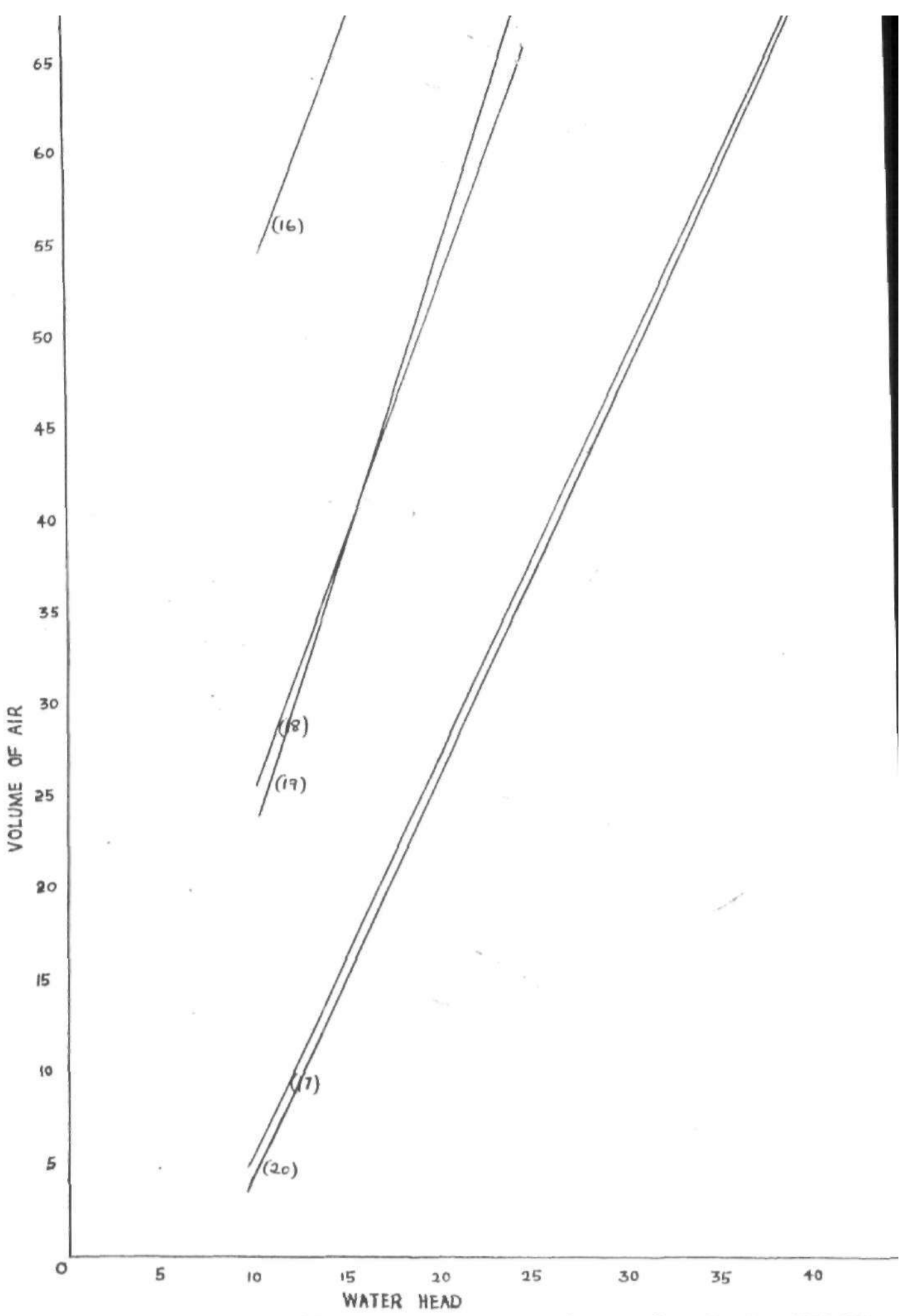

FIG. 4 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

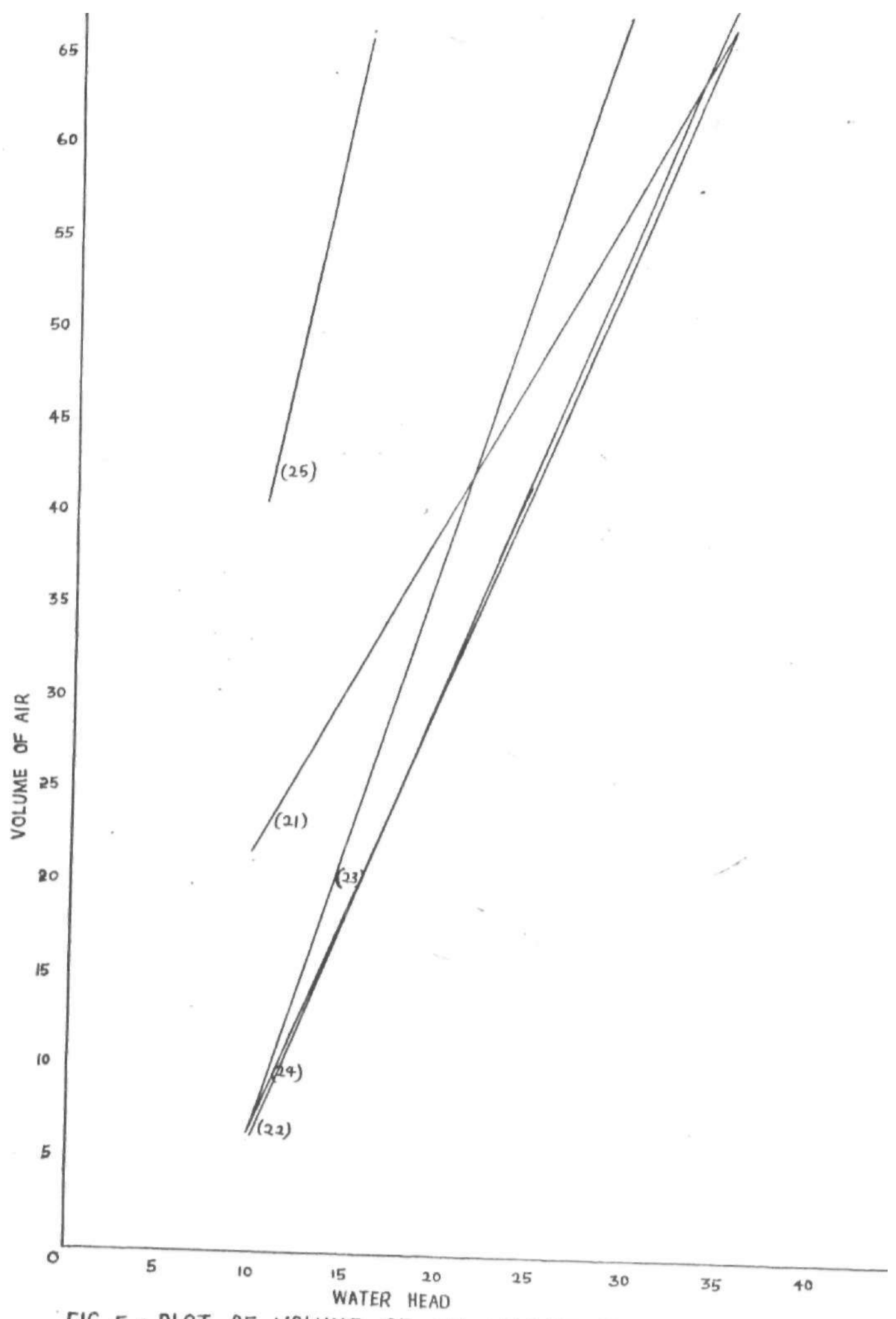

FIG.5 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

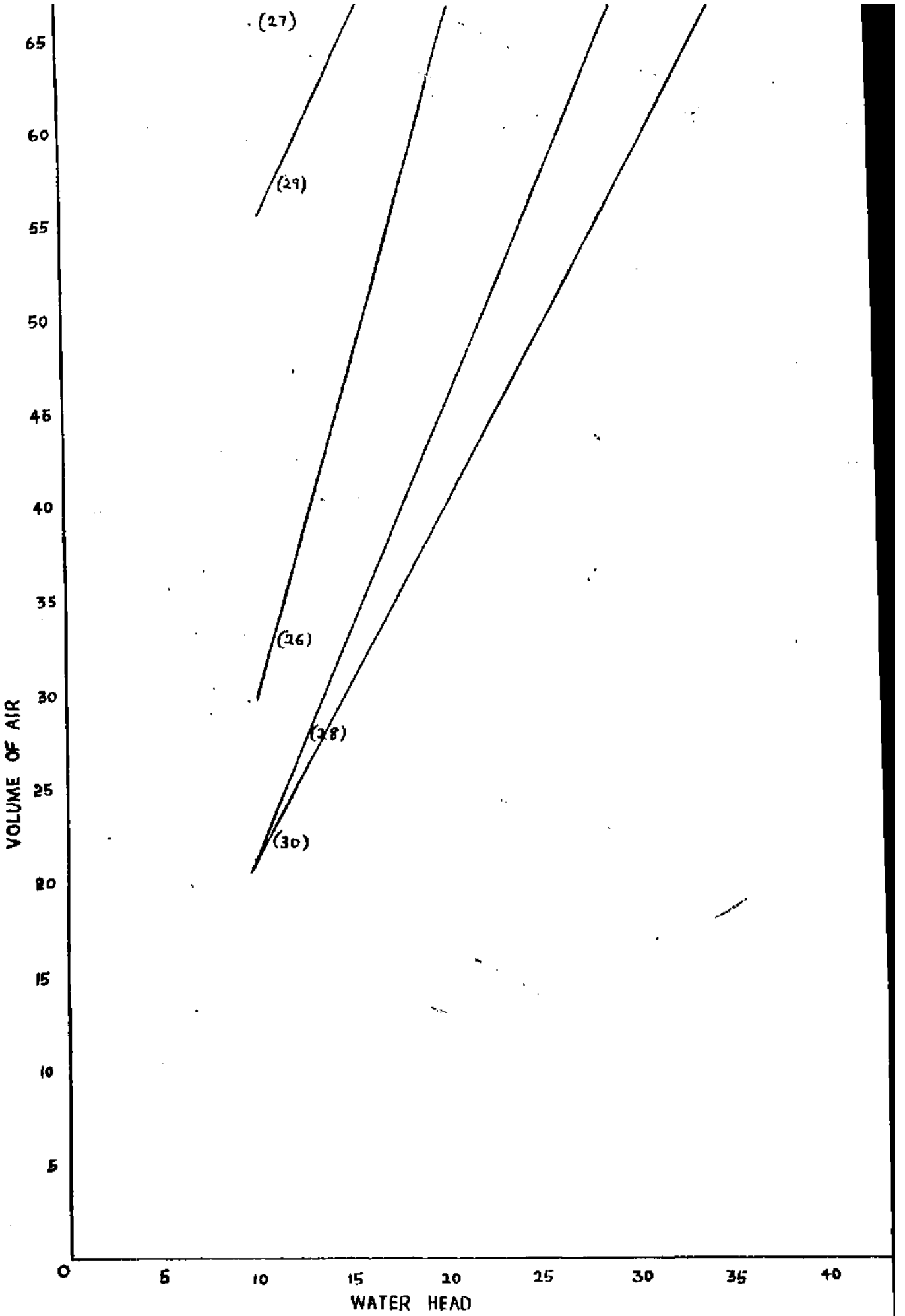

FIG 6 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

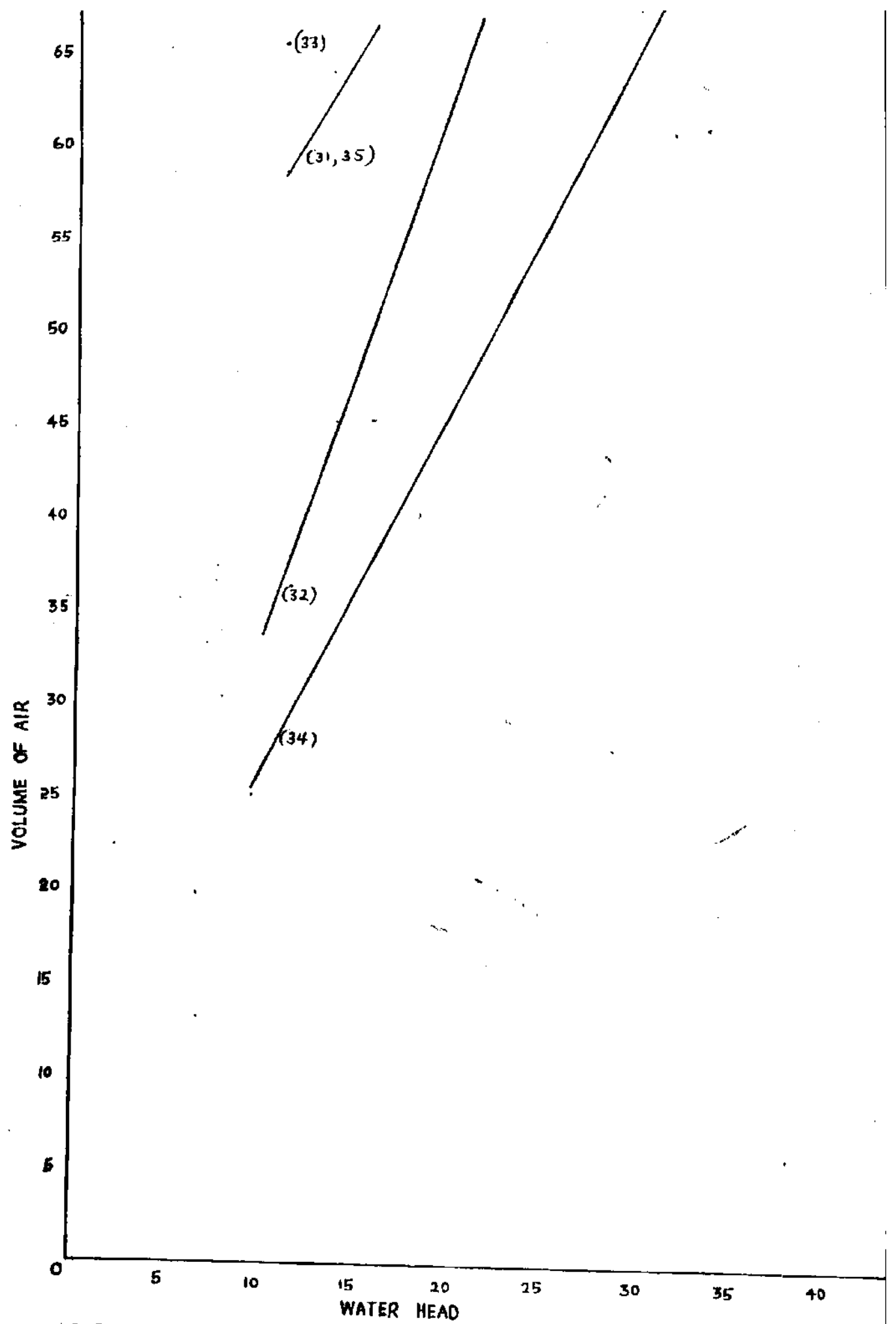

FIG. 7 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

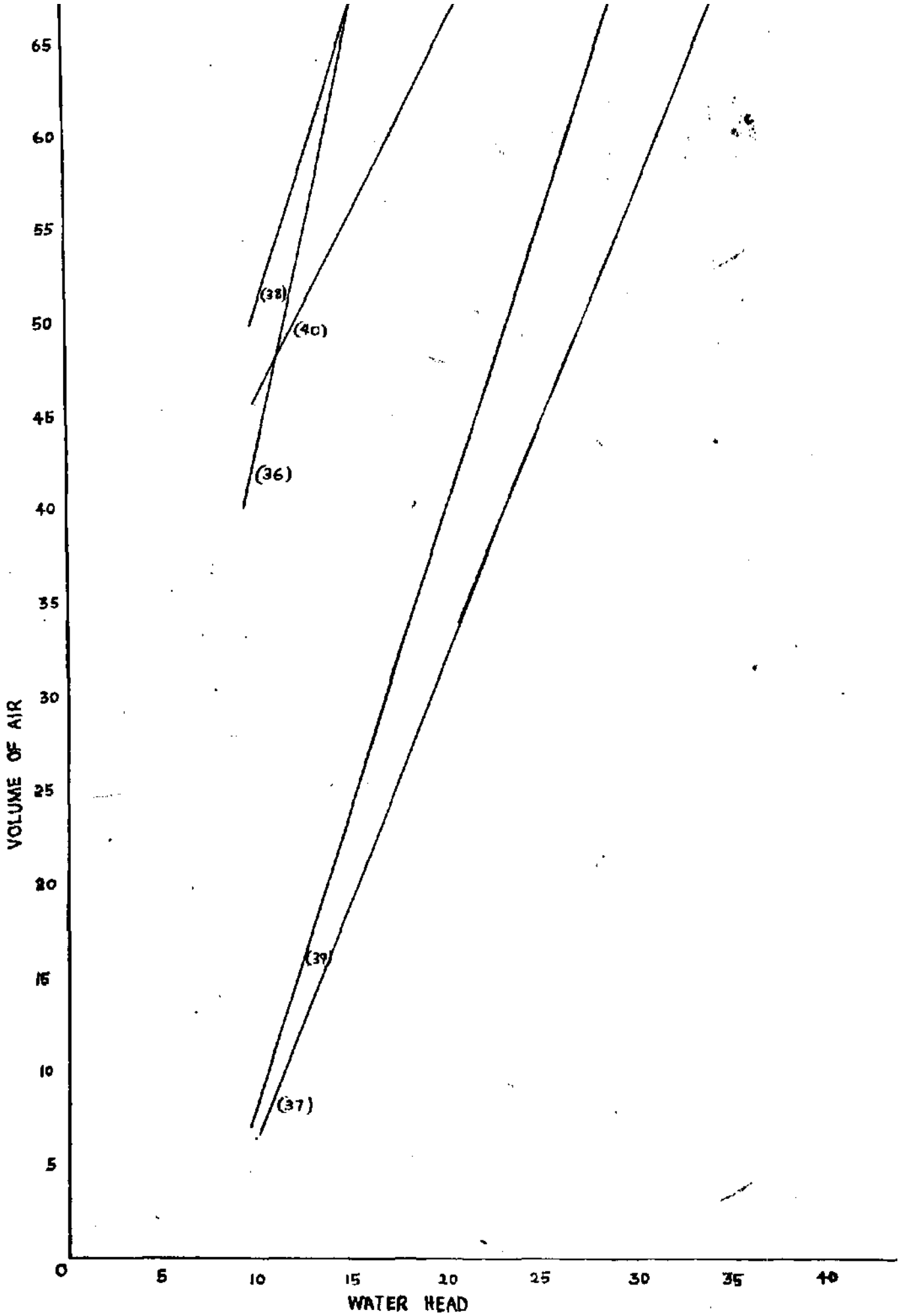

FIG. 8 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

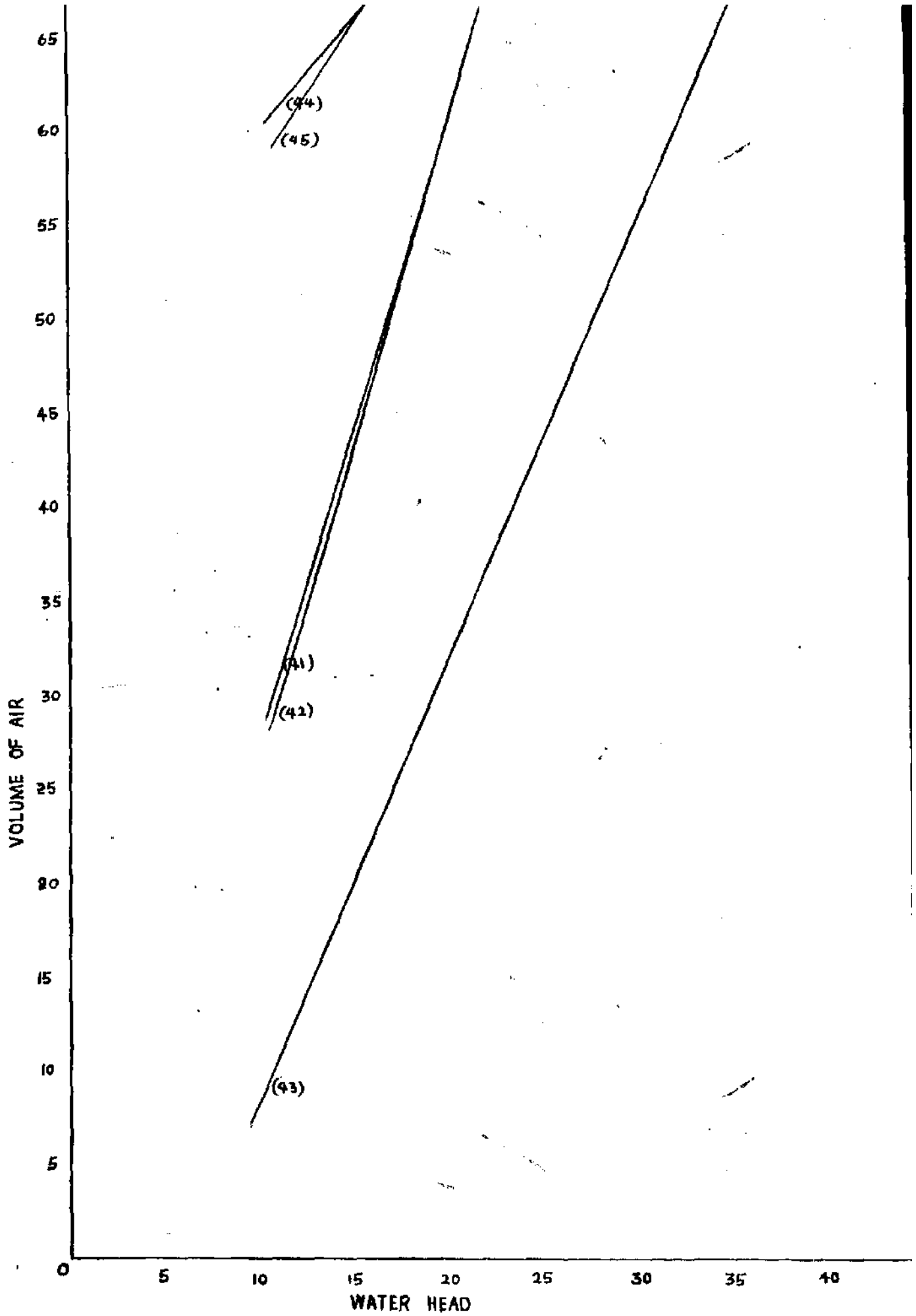

FIG. 9 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

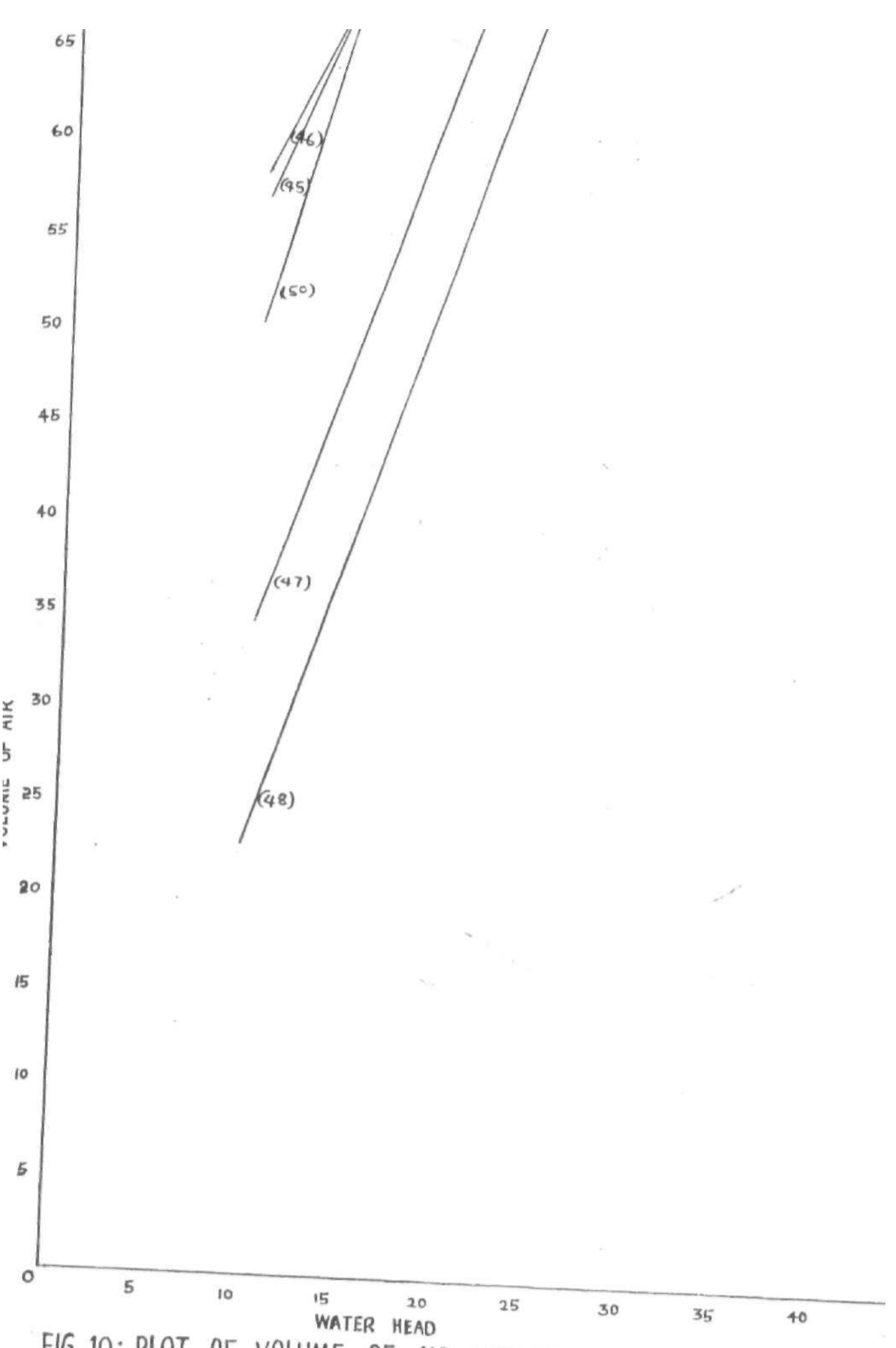

FIG.10: PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

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(see 8.1).

fabric is uppermost in such a position that the center of the spray pattern coincides with the center of the hoop. In the case of twills, garbardines,

against a so[illegible]ject, with the [illegible] facing the object, then rotated [illegible] and tapped once more on the [illegible] previously held.

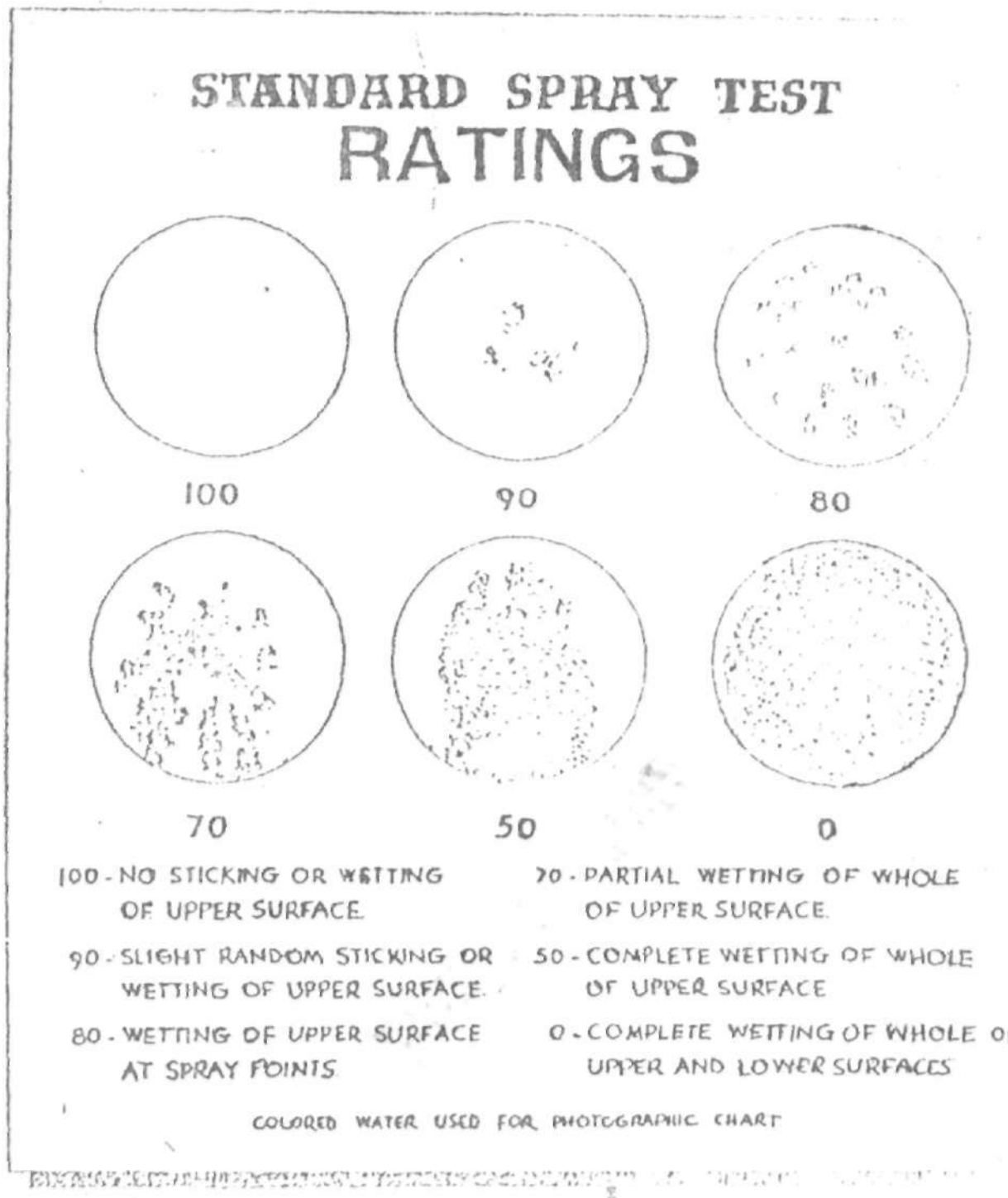

Fig. 1—Spray Test Rating Chart.