**TITLE**

# A STUDY INTO THE IMPACT AND SUITABILITY OF BUILDING MAINTENANCE PRACTICES OF LOCAL COUNCIL BUILDINGS ON PERFORMANCE OF FLOOR FINISHES:

CASE STUDY OF NAIROBI CITY HALL AND KISUMU TOWN HALL //


BY

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B03/0528/2001


**A PROJECT PAPER SUBMITTED IN PART FULFILMENT OF THE DEGREE OF:**

B.A BUILDING ECONOMICS, IN THE DEPARTMENT OF BUILDING ECONOMICS AND MANAGEMENT, FACULTY OF ARCHITECTURE, DESIGN AND DEVELOPMENT.UNIVERSITY OF NAIROBI.

**JUNE 2005**

>

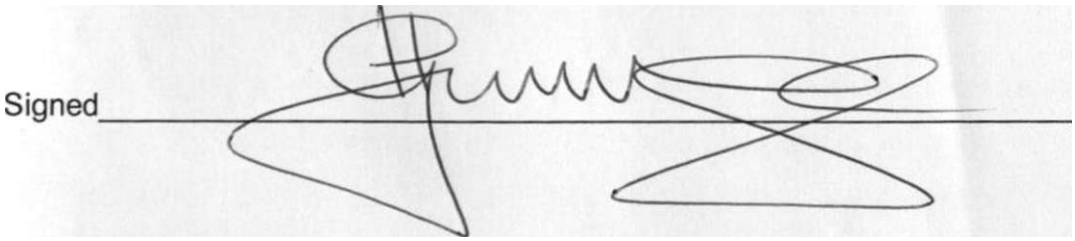
## DECLARATION

**I, ALUGA OTIENO COLLINS,** hereby declare that this project paper is my own original work and has not been submitted for the award of degree in any other university

Signed

## SUPERVISORS DECLARATION

This project has been submitted for examination with my approval as the university supervisor.




**DR.H.GICHUNGE**

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# DEDICATION

To Daddy

# ACKNOWLEDGMENT

I have received assistance from very many people both at the university and outside.

I would like to particularly thank my supervisor Dr, Gichunge, for his guidance and corrective criticism at all stages of this project. I also appreciate the members of the department of Building Economics for their help and guidance through seminars held during the period of the project .In this respect, I owe special gratitude to our project coordinators, Dr. Mugenda and Dr. Rukwaro for lectures on research methods and organizing seminars.

I would also like to pay special tribute to the officials of Nairobi city hall and kisumu town hall for taking time in providing me with the information I needed to realize this project.

I also wish to thank those who contributed in various capacities namely, Caren Ambrose, Peter, and Mary who especially helped me in typing and editing this work.

Finally I would like to thank my bible study members, quest members, koma fellow, and all the holy hustlerz who stood with me in prayers for this project.

What the world calls virtue, without Christ, is a name and a dream. The foundation of all human excellence must be laid deep in the blood of the Redeemer's cross and in the power of His resurrection. -Robertson

God bless you all.

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## ABSTRACT

This research is a study in to the impact and suitability of building maintenance practices of local council buildings or performance of floor finishes. The aim was to explore the maintenance practices adopted by the councils and their suitability to the building fabric with regard to floor finishes. Two case studies of local councils have been selected for examination. These are; Nairobi's city hall and Kisumu town hall.

The study established that, the local councils have no maintenance policy as such but practice unplanned maintenance of the emergency type on their building assets. As such, the floor finishes of the councils are in such a sorry state which continues to worsen due to other contributory factors such as; lack of sufficient funds due to bureaucratic budgetary allocation, lack of regular building inspection, indiscriminate cleaning of floor finishes with undue regard to the type of floor finishes among others. These are covered comprehensively in Chapter 4 of this research

The first part of this study comprises of the introductory chapter and includes the problem statement, the objectives and the hypothesis. This is followed by Chapter 2 which establishes the theoretical framework on maintenance generally, life cycle costing with regard to the same and the various types of floor finishes and their performance under different conditions. Chapter 3 contains the methodology employed in the study including data collection instruments, procedures and analysis of the same. Chapter 4 reports the results obtained from the field study.

The last Chapter involves discussion of the main findings based on the literature review done, conclusions and recommendations stemming from the findings of the research.

Aluga, O.C, 2005

# 1.0 CHAPTER ONE

# PROBLEM STATEMENT

## 1.1 INTRODUCTION

Maintenance is work undertaken in order to keep or restore a facility or anything used for production process to an acceptable standard (BS 3811, 1964) Building maintenance should therefore be regarded by management as part of the operating strategy that far from being a "make do and mend" service, it should be viewed as property conserving activity contributing significantly to the success and well being of the operations and occupants within it Seely (1976)

In essence therefore, the primary purpose of maintenance is to preserve a building in its initial state as far as it's practicable so that it serves its purposes, for example.

1. That it remains in a state that is neither dangerous nor injurious to the health of occupants throughout its physical life.
2. That it continues to provide utility for which it was intended throughout its functional life.
3. That it retains the value of investment as a capital asset throughout its economic life.
4. That it presents good appearance thereby preserving the character of the neighborhood and enhancing the self-esteem of both the owner and users.

Feldman (1975) in his study concludes that, floors receive an estimated 90% wear and tear more than any other part of the building and they account for 40% of the overall cost of the building operation. Seely (1976)in addition asserts that, the cost of maintenance of a building in a period of about 15-20 years will equal the actual cost (approximately) of the building therefore floors having been said to receive the most wear and tear will require special attention if cost of maintenance is to be put in check.

However, this is not the case since the floor is usually an underestimated element in building construction until it goes wrong, yet it is one part of the building which cannot be avoided; you must walk on it, you must sit on it, truck, build or support on it, store, spill, drain or contain on it, lift from it, drop or throw on it.

Cattell,D(1988) states that , if a floor is used, the chances are that the floor will also be abused and so bring nearer the time when serious maintenance is essential at which point end users must be prepared to move plant and equipment or in certain instances drastically decrease or cease production. For a public building such as city hall, shutting down operations for serious maintenance will affect the running of the city (Nairobi) generally. Therefore, a maintenance policy is important to formulate, long term maintenance strategy and preparing budgetary forecasts of the same with regard to floor finishes.

The ideology /philosophy to be adopted in formulating a maintenance policy is the concept of duty of care. Some of the factors to be considered when developing a maintenance policy are:-

1. Aims of the organization: - Nature of the end product and how its produced and the requirements in buildings and services.
2. Standards required : influenced by aims of organization , but can vary between different buildings
3. Legal liability Refers to compliance with statutory requirements
4. Method of execution : use direct labour or outside contractors with particular attention paid to the effect on production
5. Cost and method of financing: Decision supported by cost benefit analysis where appropriate criteria have been considered and optimum solutions achieved.

## 1.2 PROBLEM STATEMENT

The main function of maintenance is to ensure safety of occupants, visitors and the general public. The design team frequently neglects consideration of maintenance aspects and there is great need to decrease the gulf between design and maintenance. This is because it's at the design stage that the maintenance burden can be positively influenced in terms of future running and replacement cost. Since nothing can go maintenance free, a maintenance policy has to be developed based on the nature and use of the building.

There is insufficient maintenance of local council buildings in Kenya. The fabrics of the buildings have become unattractive and unacceptable to users. A casual look at the floor finishes used at Nairobi's city Hall depicts this problem. This raises questions with regard to

(a) The kind of maintenance policy adopted and its effectiveness

(b) The choice of floor finishes used in such buildings and their appropriateness

Nairobi city hall has a variety of floor finishes. That is-

(a) Wood block finish

(b) P.V.C.

(c) Parquet

(d) Terrazzo

(e) Marble

(f) Terrazzo files

(g) Gramo

All the above finishes show neglect from the kind of deterioration they have undergone

**Therefore the purpose of this study is to explore the maintenance practices adopted by local councils and their suitability to the building fabric with regard to floor finishes. The population (target) considered in this study will be local council buildings in Kenyan cities.**

**Nairobi - City Hall**

**Kisumu - Town Hall**

## 1.3 OBJECTIVES

1. To determine the suitability of choice of building floor finishes used with regard to various uses/functions of the building.

2. To investigate the maintenance practice adopted by local authorities on floor maintenance.

3. Propose a suitable maintenance policy to be adopted by the local authorities on maintenance of floor finishes.

## 1.4 HYPOTHESES

Daily hygiene-type cleaning of floor finishes in council buildings contributes to deterioration of floor finishes.

## 1.5 SCOPE OF THE STUDY

The study is designed to cover two of the major council buildings in Kenya, in Nairobi and kisumu. This is due to time and financial constraints.

Nairobi - City hall

Kisumu- Town hall

## 1.6 SIGNIFICANCE OF THE STUDY

Public (council) buildings are an important asset to the nation as a whole. They perform key functions of the local authorities such as; licensing of businesses, certifying building plans and projects etc. The number of people who visit them for one of the various reasons is so great. It has also established from Feldman (1975) that floors receive 90% wear and tear more than any other part of the building and this accounts for about 40% of the overall cost of building operation. Therefore, there is a strong need to develop a suitable maintenance practice or policy for such buildings to ensure no interruptions of their functions due to maintenance of floors.

## 1.7 LIMITATIONS

***Bureaucracy-:*** In addition to the research permit issued by the permanent secretary in the ministry of education, the council required the researcher to obtain a research authorization from City Engineers Department. This delayed the commencement of the research. The same was the case with Kisumu Town hall.

***Data collection***-: Obtaining supporting photographs on the state of floor finishes in both councils was treated with a lot of suspicion and the councils had to be convinced that the research was purely for academic purposes. This was attributed to the bad picture painted by the media on the state of facilities in public buildings of which City Hall was a major target.

## 1.8 DEFINITION OF TERMS

**Maintenance practice**-methods adopted in the identification and replacement of worn-out finishes including methods of preventing deterioration of finishes.

**Suitability of choice-** Appropriateness and application of particular flooring materials for a given function.

**Hygiene-type cleaning-** This means general cleaning of floors; washing down; vacuuming; polishing; shampooing etc save for those activities relating to preservation, protection or to improve the appearance of the asset. For *example*

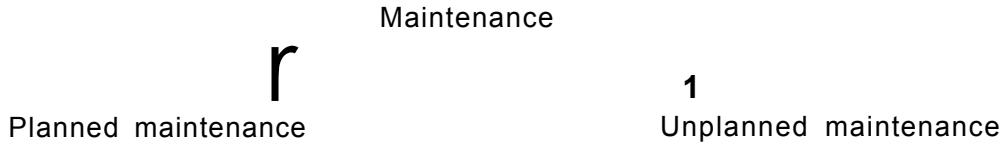
• Removal of algae from paths where it presents a slip hazard.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### MAINTENANCE TYPES

Maintenance is divided as shown below.




Preventive maintenance

Scheduled maintenance CBM Corrective Corrective

Condition based Maintenance

Source: Seely, I (1996) pg 1-3

**Corrective Maintenance** - maintenance performed, because of failure, to restore an item or asset to its original condition, as far as practicable;

**Preventive Maintenance** - maintenance performed to retain an item or asset in its original condition, as far as practicable, by providing systematic inspection, detection and prevention of incipient failure. (Examples include servicing of plant and equipment, cleaning of gutters, grass cutting, testing and maintenance of fire evacuation systems and fume cupboards);

**Unplanned Maintenance**-maintenance carried out to no predetermined plan, Seely (1983)

**Emergency Maintenance**-maintenance that is necessary to put in hand immediately to avoid serious consequences, Seely (1983)

**Backlog Maintenance** - maintenance that is necessary to prevent the deterioration of the asset or its function but which has not been carried out. accordingly, backlog maintenance has a higher priority than deferred maintenance. The deferred and backlog lists will be reviewed annually; and

**Deferred Maintenance** - maintenance that is due to be carried out in the current financial year but which intentionally will not be carried out because of a shortage of funds or unavailability of parts. Such maintenance should be added to the Backlog Maintenance program awaiting attention. (Examples include painting, floor coverings, gutters and roof coverings and building fagade maintenance).

**Maintenance**

Maintenance can therefore be said to be work on existing building asset that is undertaken:

- to prevent deterioration and failure;
- to restore to correct operation within specified parameters;
- to restore physical condition to a specified standard;
- to recover from structural and services failure;
- to obtain accurate and objective knowledge of physical and operating condition including risk and financial impact for the purpose of maintenance; and
- partial equivalent replacement of components of the asset.

Work excluded from maintenance includes:

• Improvements and upgrading to meet new service capacity or function;
• Refurbishment to new condition to extend the capacity or useful life of the asset;
• Capital replacement of major components to extend the capacity or useful life of the asset;
• Upgrading to meet new Statutory requirements;
• Operational tasks to enable occupancy and use (e.g. cleaning, security, waste removal);
• Supply of utilities (energy, water and telecommunications);
• Construction of new assets; and

• Major restoration as a result of natural and other disasters.

**Defered maintenance**

Deferred Maintenance is defined as essential maintenance work that has not been carried out within a reporting period and which is deemed necessary to bring the condition of the asset up to a standard or acceptable level of risk that will enable the required operating capacity of the asset to continue.

Deferred Maintenance excludes:

• Newly identified maintenance work which can be deferred without affecting function and level of risk;
• Maintenance work scheduled from previous years which can be rescheduled without affecting function and level of risk; and
• Non-maintenance work.

Deferred maintenance should be re-evaluated at least annually in terms of priority and considered for inclusion in Maintenance Work Programs as part of the Maintenance Planning process

**Maintenance cleaning**

Maintenance cleaning is considered to be part of building maintenance if it relates to those activities required to preserve, protect or to improve the appearance of the asset. *Examples include:*

• High pressure water blasting and washing down of building exteriors; and
• removal of algae from paths where it presents a slip hazard.

Otherwise day-to-day hygiene-type cleaning is not considered to be part of building maintenance. Hygiene-type cleaning includes general cleaning of walls and floors; washing down; vacuuming; polishing; shampooing.

Seely, I (1976).asserts that cleaning is said to be the most important and expensive single item in any building after rents and rates have been paid. That in a period of 30 years or less the cost of cleaning would have risen above the original cost of the building Therefore buildings should be constructed with a view of reducing cleaning cost.

The frequency of cleaning for various building elements varies from one element to the other. For this case, floors are generally swept daily.

White areas such as toilets will require cleaning daily and therefore surface should specify for easy cleaning.

Public entrance halls and common staircases should be surfaced with durable and easily cleansed materials.

## 1. Building maintenance policy

### Purpose of a building maintenance policy

A maintenance policy should affirm the responsibilities assigned for the strategic and operational management of maintenance within the organization and form part of the organization's asset management policies and priorities.

This will ensure that the building maintenance policy is used for internal management and planning purposes and that maintenance service delivery arrangement comply with the policy and support organization's outcomes.

### Structure and content of a building maintenance policy

The building maintenance policy should be structured to include:

- a statement of intent and purpose;
- the scope of the policy;
- the details of the policy;
- the responsibilities associated with the policy; and
- the continuous improvement arrangements for the policy such as policy review procedures

### Statement of intent and purpose

The statement of intent and purpose should provide a succinct statement that conveys how the maintenance of assets will support organizations service delivery objectives. It should establish the importance of asset maintenance in achieving organiztion's service delivery outcomes. There should also be an over-arching statement regarding the requirement by Government to comply with the acts and codes (Local government Act Cap 265 and the Building Code)

In developing the statement, consideration needs to be given to the physical and functional requirements relevant to the organization's assets and how these relate to sen/ice provision, including the need to maximise the benefits of capital investment in building assets.

**The scope of the policy**

This section of the policy should provide a clear statement of the assets that the policy applies to and who will be affected by the policy.

**The details of the policy**

This section of the policy should detail the requirements that will support the statement of intent and purpose. It should include both organizations' specific needs, and how the policy links to organization's asset management policies and other related processes including capital works and disposal programs.

It should address each of the Maintenance Management Framework (MMF) elements to identify how maintenance is to be managed and delivered to ensure compliance with the MMF. Similarly, any organization-specific compliance requirements should be addressed in the same way. This may include statements related to compliance with statutory, legislative and other requirements such as:

- Heritage and environmental legislation;
- Health and safety;
- Security;
- Risk management;
- Asset management, e.g. Strategic Asset Management (SAM), guidelines; and
- Compliance with other related Government policy.

The details of the policy would cover organization policy requirements in relation to the following.

**Maintenance management** -This should include the primary roles associated with responsibility for maintenance management including any organization specific compliance requirements such as delegation authorities;

**Maintenance standards** -The definition of maintenance standards in relation to any asset items is fundamental to the whole maintenance management process. The defined datum sets the standards of care appropriate for the assets concerned in relation to the business operations they are supporting. The defined standards of care then establish the asset maintenance demand and justification for resources This should include how and by whom the standards are to be established and implemented, which may require reference to other related organization documentation or policies;

**Maintenance strategies** -This should include how and by whom the strategies are to be established and implemented, which may require reference to other related organization documentation or policies;

**Strategic Maintenance Plan (SMP)** -This should include responsibilities and processes for the development of a SMP and the inclusion of maintenance considerations in the development of a Capital Investment Strategic Plan (CISP);

**Condition assessment programs, maintenance plans and maintenance programs** -This should include responsibilities and delegations as well as timeframes for accomplishment of specific milestones in developing, approving and managing these programs and plans;

**Maintenance budgets** -This should include delegations and responsibilities for compliance with Government or organizations accounting policy in developing, approving and managing maintenance budgets;

**Maintenance procurement** -This should indicate specific responsibility and outcome requirements to comply with Government and organization procurement policies including procurement strategies e.g. performance based contracts;

**Maintenance information and reporting** -This should address the control, management and use of maintenance information and any specific reporting requirements;

**Maintenance performance** -This should indicate responsibilities associated with performance monitoring, including the development of performance measures and their integration with other asset management performance measures;

**The responsibilities associated with the policy**

This section details the roles and responsibilities assigned for developing and managing the policy. Specific details of responsibility associated with the policy such as policy ownership and policy implementation should be included as well as reference to related areas within organization that contribute to or are stakeholders in the policy.

The responsibilities assigned for the management of maintenance within the agency at all levels should be included in this part of the policy. These would align with and reflect, the responsibilities assigned for the management of the portfolio and the individual facilities or buildings.

**Continuous improvement arrangements for the policy**

This section of the policy should indicate policy review arrangements such as policy review intervals including the application period for the policy and reporting and feedback arrangements for suggested improvements to the policy are to be addressed in this section.

## 2. Building maintenance strategy

### Purpose of a building maintenance strategy

The purpose of a building maintenance strategy is to adopt the best approach to undertake maintenance activities, so that maintenance objectives are achieved.

The strategy should reflect the organization's approach to maintenance and support the Strategic Maintenance Plan and maintenance policy established by the organization.

### Development of a maintenance strategy

### Responsibilities and competencies

The responsibility for the development of a maintenance strategy requires an understanding and thorough knowledge of the organization's service delivery strategy and the role that building assets have in the delivery of services.

The responsibility for the development of a maintenance strategy should preferably be at a senior level and involve a team consisting of:

- the asset manager;
- facility managers;
- the maintenance service provider; and
- asset user representatives, where appropriate.

Relevant stakeholders that have an interest in maintenance outcomes should also be consulted when developing the maintenance strategy.

The development of the appropriate maintenance strategy to be adopted requires skills in:

- Building portfolio management;
- Maintenance management;
- Financial management;
- Risk management; and
- Procurement and contract management.

**Key elements of a maintenance strategy**

The maintenance strategy that is developed should ensure that resources and risks are managed effectively and that the maintenance of assets aligns with organization's business objectives. The primary driver for the maintenance strategy is the organization's service delivery strategy.

The service delivery strategy determines how the organization intends to use assets for service delivery and any future changes in direction. This will determine the maintenance strategy that will best meet organization maintenance objectives.

A Maintenance Strategy should include the following.

**Risk management strategy** -This would determine how the organization intends to manage its risks in relation to statutory, technical and operational requirements. This will help to identify the risks associated with the physical, functional and operational attributes of assets. The risk management strategy will determine the priorities in undertaking maintenance activities.

**Financial management strategy**-This would determine the approach to funding arrangements for maintenance and achieving value for money in maintenance expenditure. The financial management strategy will influence the type, cost and planning of maintenance activities.

**Procurement strategy** -This would determine the procurement methods to be used within the organization and decisions on using in-house or external labour.

It should reflect any government policy relating to the use procurement procedures and the use of pre-qualified contractors.

**Management strategy** -This would determine the management arrangements for maintenance across the organization such as the organisational structure to support the management of maintenance at head office, district and facility levels.

**Technical strategy** -This would determine the maintenance activities which would be undertaken on the portfolio of assets. The MMF specifies an appropriate combination of condition-based, preventative and zero-based strategies to be used, taking into consideration the organization's service delivery strategy and other related strategies as outlined above.

A condition-based maintenance strategy is suited to most building components and is driven by a pro-active, systematic, inspection process. Maintenance actions are undertaken based on the condition of the asset as determined by the inspection process or on demand. The information that is collected through the inspection process will enable efficient and effective use of maintenance resources and improve planning and budgeting.

A preventative maintenance strategy is where maintenance is undertaken at predetermined intervals for technical, statutory or reliability considerations.

A zero-based maintenance strategy is one in which no maintenance is undertaken other than statutory or breakdown maintenance. This strategy may be appropriate for assets that are to be replaced, refurbished or disposed.

**Review**

It is important that the maintenance strategy should be reviewed regularly to ensure that the strategy is effective and achieves value for money. The review may be undertaken by the team that developed the strategy or independently.

**Risks**

The development and implementation of a maintenance strategy needs to be carried out carefully and objectively. The selection of an inappropriate strategy can be significant in terms of the impact on asset value, the maintenance budget and the operations of the business. The risks associated with establishing an inappropriate maintenance strategy include:

- Building assets being over-maintained resulting in higher maintenance costs;
- Building assets being ineffectively maintained resulting in waste of maintenance resources;
- Building assets being under-maintained resulting in an increased frequency of failures and the possibility of litigation problems and productivity losses; and
- Building assets not supporting the organization's service delivery.

**Implementation**

The maintenance strategy should be fully documented and endorsed by senior management and the appropriate aspects included in service arrangements. The maintenance strategy should also be incorporated in an organization's internal management system such as Corporate Policy, Asset Management Manuals and other related organization documents.

Maintenance service providers, facility managers and other relevant personnel should have a thorough understanding of the maintenance strategy. It should also be conveyed to building users so that they are made aware of the maintenance strategy in place and are able to contribute to implementation and review of the strategy.

## 3. Strategic Maintenance Planning

### Purpose of strategic maintenance planning

Strategic maintenance planning determines the future maintenance needs and strategies for a building portfolio by reviewing the state of the existing portfolio and the potential for future growth/depletion of building assets based on business strategies. The SMP developed will be supported by a sound financial strategy, ensuring that the building portfolio is adequately maintained in the longer term. An SMP forms the basis on which annual maintenance budgets, plans and programs are developed.

Strategic maintenance planning may also indicate that pro-active building rationalisation and more innovative building acquisition and use is required, to avoid compromising future maintenance.

Inspections:

Inspection cycles are a vital aspect of only maintenance system. The fabric of a building should be inspected at regular intervals, preferably related to the endurance period of a significant compound or material (Seely 1989) pg 347.

The main challenge here is achieving the right balance between the cost of check inspections and the resultant benefits

### Responsibilities and competencies

Senior management has a responsibility for strategic maintenance planning which should be undertaken at portfolio, regional/district, facility and building levels. Responsibility for the development of an SMP rests with the portfolio manager, assisted by:

• Facility managers
• Finance managers, and
• Planners and capital works managers.

Strategic maintenance planning requires knowledge and skills in the areas of:

• Building portfolio management;
• Maintenance management;
• Life cycle planning and analysis;
• Asset performance management;
• Financial management; and
• Risk management.

**Strategic Maintenance Planning**

Strategic maintenance planning is a structured process to ascertain the future maintenance requirements and directions for an organization's building portfolio. The planning horizon usually covers a time period of 5^10 years.

The process involves a review and analysis of organization corporate and service delivery objectives and the building maintenance environment. The future maintenance requirements to support the organization's service delivery outcomes are then determined and documented in an SMP.

The process of review and analysis should be sufficient to ensure that financial projections are soundly based. The SMP developed should be incorporated into the organization's Asset Strategic Plan.

**Formulating a Strategic Maintenance Plan**

The formulation of an effective SMP involves a process of reviewing, analysing and developing a critical view of the building portfolio based on:

•The status and trends of existing building assets including age, condition, performance and their effects on achieving service delivery outcomes;
•The CAP, for the potential growth of the building asset base and building assets likely to be upgraded or disposed;
• Maintenance expenditure trends and associated performance measures;
•deferred maintenance trends and associated performance measures;
• Impending major repairs including any depreciation implications;
• Life cycle profiles of building assets to assist in the planning process;
• Policies and service standards established for core services and their implications on maintenance; and
• Financial, social, environmental, heritage and other emerging issues that have an impact on maintenance.

The results of the analysis can be further used to:

• Review the organization's maintenance policies, strategies and practices, standards and performance measures, ensuring that they continue to be relevant and useful in the future; and
• Influence capital investment planning outcomes.

Key **elements of a Strategic Maintenance Plan**

The SMP should contain the following key elements.

**(a)The status and trends of the organization's existing building portfolio -**

This includes a detailed analysis of the building portfolio to identify any issues where the key attributes of the building portfolio are impacting on organization service delivery.

Issues and trends that relate to maintenance should be clearly identified and supported by appropriate information drawn from analysis of data to enable any immediate and potential problems to be addressed and rectified.

**(b)The maintenance environment** -This includes an overview of the outcomes of the review of maintenance expenditure and deferred maintenance trends and how these correlate to the condition and performance of the existing building portfolio.

Potential changes to the building portfolio and business directions that impact on maintenance should also be presented and discussed. These include:

• new building assets, assets to be upgraded and disposed, and their impact on maintenance management, resources, implementation and outcomes;
• major repairs and the accompanying depreciation expenses that will need to be factored into financial projections; and
• heritage, environmental, legislative and other technical factors that may contribute to higher maintenance demand should be identified and supported by appropriate data including financial projections.

(c**)Financial implications, strategies and projections** -These include a review of current and likely future funding scenarios based on the organization's corporate direction, the budgetary environment, building portfolio and maintenance analysis. Additional funding to meet increasing demands should also be articulated, including any strategies for meeting these funding requirements. The risks associated with funding shortfalls should be substantiated with reliable data.

The funding projections should be incorporated within the CAP and Operating Statement financial summary for Cabinet Budget Review Committee (CBRC) consideration.

**(d)Maintenance management** -This includes a review of the existing policies, strategies and standards to ensure that they continue to achieve efficient and effective maintenance. They should continue to support achievement of the agency's service delivery objectives and align with the Government's Maintenance Management Framework.

Any changes required to meet the projected strategic business and portfolio directions and improve the efficiency and effectiveness of maintenance should be identified and described.

**Summary action plan** -As a summary, an action plan drawn from all of the above should be established, with clearly articulated key actions, responsibilities and implementation time frames. This will provide the basis for any review of the SMP and allow for refinement or adjustments.

**Implementation**

The organization should ensure that the SMP is:

- Fully documented and endorsed by senior management;
- Included in the CISP and referenced in maintenance procurement arrangements; and
- Made available to relevant personnel through internal management systems such as corporate policy or asset management manuals.

**Review**

It is important that the SMP be reviewed regularly to ensure that maintenance continues to support agency service delivery objectives and the plan provides the basis for informed strategic asset planning and management decision-making. The review should align with the annual budget and corporate planning cycle.

**Risks**

The risks associated with inadequate strategic maintenance planning include:

- Inefficient and ineffective asset management;
- Future maintenance liabilities that cannot be met effectively and in a timely manner;
- Deterioration of the building portfolio, loss of building asset value, functionality and service potential;
- Maintenance policies and strategies that fail to align with best practice and business directions; and
- Inefficient and ineffective use of maintenance resources.

## 4. Building Maintenance Budget

**Objectives of a maintenance budgeting model**

The aims of a Maintenance Budgeting Model is to:

- establish a process for the development of a maintenance budget in the context of the overall budget process of government;
- establish a review process to ensure that the maintenance budget developed meets policy requirements and established guidelines; and
- ensure key benchmarks are available to enable a reasonable assessment of the appropriateness of the maintenance budget.

A yearly budget prevents adequate forward planning. Ideally budget period should extend over a number of years possibly matching the maintenance programme. This would provide a framework for an efficient maintenance system based on detailed cyclic inspections, accurate estimates and a firm long term budget which would enable work to be properly planned and executed. . Ashworth, A (1999)

**Process for the development of a maintenance budget**

The development of a maintenance budget should be based on:

- The Maintenance Management Framework (MMF);
- Capital Investment Strategic Planning (CISP) guidelines;
- Organization CISP and strategic maintenance plans; and
- Organization maintenance plans (1-3 years).

Based on this information and other maintenance information, a Strategic Maintenance Plan (SMP) should be developed. The SMP articulates how the organization plans to maintain its asset portfolio in the longer term in accordance with the MMF and its funding strategy for the current budget cycle and in future years.

Maintenance plans are developed on the basis of the SMP and information from:

- Condition assessments;
- Technical assessments of preventative maintenance needs;
- Any deferred maintenance backlog;
- Historical maintenance expenditure; and
- Major replacement works programs.

Maintenance plans are developed for individual buildings and facilities and aggregated into a maintenance plan for the asset portfolio. Plans should include the assets earmarked for disposal and new assets coming on-line. Based on the plan, cost estimates are developed to form an organization portfolio maintenance budget.

The maintenance budget is matched against potential funding sources based on the funding strategy and any mismatch results in a review of the maintenance plans and/or funding strategy. The maintenance budget is then factored into the organizations overall service delivery costs and subjected to the budget process in accordance with organization and Government budget policies.

The maintenance budget should address:

- Organization maintenance management costs (staffing, office facilities, vehicles);
- Maintenance service provider management and overhead costs;
- Maintenance management services (maintenance planning, contract management, computerized maintenance management system, call centre operation, technical information);
- Condition assessment costs;
- Planned works program costs (condition-based);
- Planned preventative maintenance work program costs;
- Unplanned reactive maintenance work costs (forecast based on historical trends);
- Major plant and equipment replacement costs (except those that are capitalized); and
- Any other maintenance-related costs (special projects, consultancies).

**Other cost factors to be considered**

- **Overheads**

This covers general administration supervisions, Inspections, tools and equipment (running cost and depreciation charges). There is no standardized way in which to allocate these various overhead items. Some firms do it on job by job basis, others on annual basis and others again will not explicitly separate out all the overheads associated with the particular maintenance work but include those in the general cost and running the maintenance team. Harrison (1978)

- **Life of the Component**

Quantitative data to determine effective life span of any particular component is very rare, partly because few really meaningful industrial comparisons have been established but mainly because the environmental conditions to which various components are exposed vary so widely from one site or building to the other.

- **Total Cost of Maintenance**

From the foregoing it can be seen that there are complex interactions between the different elements that go into making up cost of maintenance of a component.

**Review**

The review process should be undertaken as part of the budget cycle at a macro level and would involve a review of:

- the CISP and SMP;
- maintenance plans;
- asset portfolio performance indicators; and
- maintenance performance indicators and benchmarks.

**Benchmarks**

Benchmarks need to be established based on selected performance indicators to enable an assessment of the appropriateness of the maintenance budget. These benchmarks may be compared:

• Internally (historical to the organization concerned); or
• Externally (with similar portfolios elsewhere).

Some of these benchmarks may include:

• Cost per meter squared;
• As a percentage of the asset value;
• Ratio of planned/unplanned maintenance;
• Deferred maintenance index; and

• Facility condition index.

## 5. Building Maintenance Planning

**The purpose of maintenance planning**

Maintenance planning aims to:

• Confirm asset service delivery, condition and functional performance requirements;
• Determine the maintenance activities to be undertaken for each asset for the appropriate planning period to achieve the agency's objectives;
• Establish priorities; and

• Estimate resource requirements and prepare budget bids.

Maintenance planning enables agencies to:

• Secure budget allocations and other resources;
• Review budget allocations and resources;
• Program work according to available resources; and
• Implement maintenance to meet objectives.

**Planning and Management of Maintenance Work**

A maintenance plan should be formulated within the context of a maintenance policy which itself should be comprehensive covering all types of work and all property under maintenance.

Planning has been subdivided into four stages by NFHA (1989)

(a) Identify needs
(b) Establishing priorities
(c) Developing the plan possibly encompassing a 5 year period on a rolling programme
(d) Monitoring results with feed back on the ongoing plan.

Seely (1989) describes suitable arrangements for planning and management of maintenance work giving full records of each property including the following:-

Geographical location
Age
Condition
Construction details by elements
Details of sen/ices
Floor area cubic content
Accommodation provided
Current use

Any proposals for the area by the local authority that may affect the property (All based on a stock condition survey)

**Roles, responsibilities and competencies**

In accordance with the MMF, organizations are responsible for ensuring that strategic and operational maintenance plans are prepared.

The development and documentation of maintenance requirements requires an understanding and thorough knowledge of the organization's corporate plans, service delivery strategies and the contribution of building assets to service delivery outcomes.

Responsibilities and specific personnel responsible for maintenance planning should be clearly defined at the appropriate levels within the agency and maintenance service provider.

In general, those involved in the maintenance planning process would include:

- The portfolio asset manager; facility managers;
- The maintenance service provider; and
- Asset user representatives.

Competencies and skills to undertake maintenance planning are required in:

- Maintenance management;
- Building portfolio management;
- Technical skills in architecture, building construction, repair and maintenance;
- Risk management; and
- Costing and estimating.

**Maintenance planning**

Maintenance planning is a structured process to achieve the efficient and effective delivery of maintenance. It consists of management activities focused

on meeting the organization's corporate objectives and achieving service delivery outcomes through an effective maintenance plan.

Maintenance planning involves the collection and analysis of all relevant data and strategy documents and applying a process to develop a plan for the short, medium and long-term maintenance of building assets.

Maintenance planning should start from a review of the organization's corporate and service delivery plans to develop an understanding of the role and contribution of assets to service delivery. This can be done at the portfolio; facility and building levels to ensure maintenance priorities and strategies are relevant and align with business directions.

Specific areas of review should include:

- The assets to be maintained and the standards to be achieved;
- The operating requirements, asset performance requirements and criticality of the assets to service delivery;
- The long term plans for capital investment, refurbishment and disposal;
- The current maintenance program for the assets and any work outstanding; and
- The current condition and functional performance of the assets.

**Reviewing maintenance information**

This area of planning relates to the process of collecting and reviewing asset data and any other relevant information for the purpose of developing maintenance plans, and ensuring that new assets are included, while disposed assets are excluded accordingly.

Information that should be reviewed includes:

- Maintenance plans of any new assets (if delivered as part of the capital works process);

- Current and historical maintenance costs;
- Engineering and other technical information;

laws and other statutory requirements (for any amendments);

- Results of previous condition assessment inspections;
- Maintenance records and other relevant information;
- Deferred maintenance information;
- Replacement information based on life-cycle projections; and
- Current asset maintenance plans.

**Maintenance Feedback**

This is important for any maintenance administration. 11 can be injected in the system in the following ways:

(a) Directly to the design team with regard to information on design faults, poor workmanship and materials failures

(b) By general discussion within the maintenance team, when solutions to problems should be documented and passed on to all appropriate personnel.

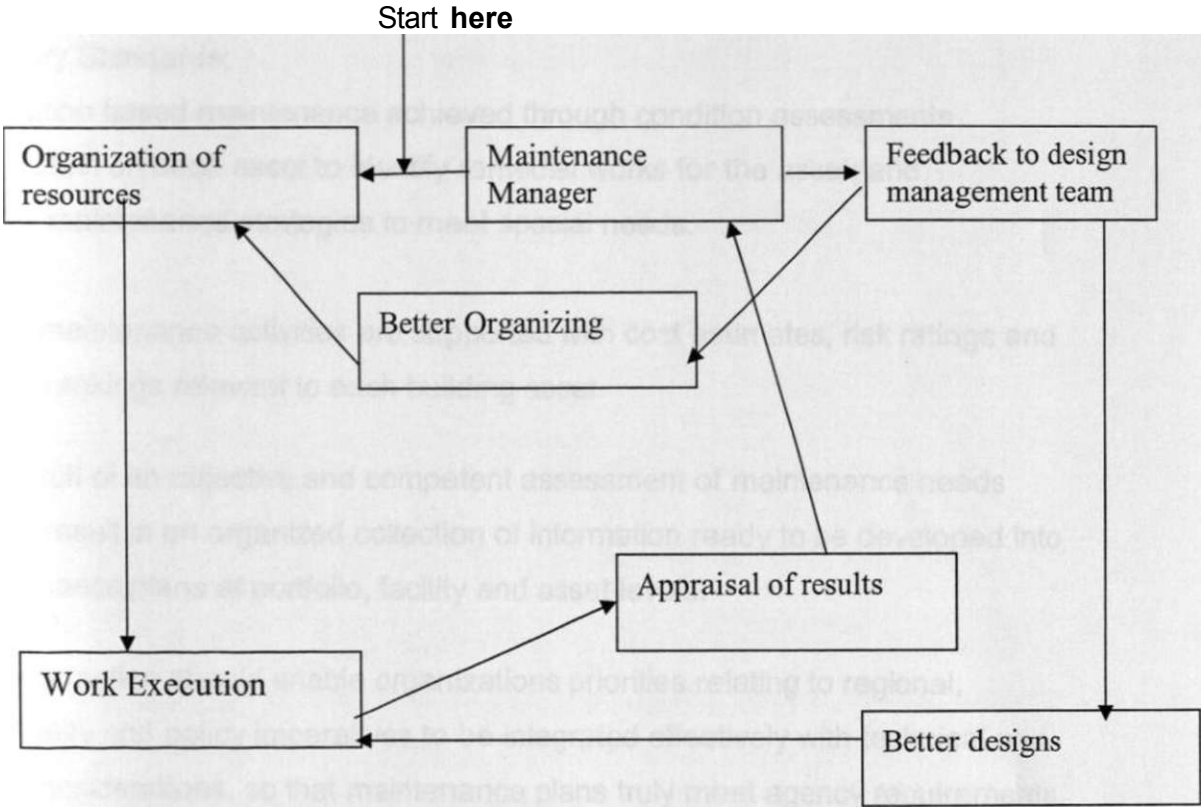
To assist in the feedback of information such defects are suitably recorded showing the symptoms, diagnosis, prognosis and the agreed remedy (Seely, 1987). Pg 358-360

Therefore feedback is the process whereby useful knowledge gained during the lifecycle of buildings and works is collected, analyzed and fed back to those engaged in design, construction and maintenance, so as to eliminate repetitive errors, optimize solutions and improve overall efficiency in the total building process. Harrison (1978) .It involves;

(a) Information concerning failures in components, systems and installations revealed during construction, commission, testing, operation and maintenance; defects or shortcomings in design or specification; abnormally high operating cost etc.

**(b)** Here the objective is to identify defects which are repetitive or likely to recur in the future, or are in some other way significant and to determine what has some wrong and what to do about it.

*Maintenance feedback (source; Seeley 1987)*




**Assessing maintenance needs**

The maintenance information assembled on the current status of maintenance should be evaluated against the maintenance objectives and asset plans, performance standards and programs etc to guide the assessment of maintenance needs.

The objective of assessing maintenance needs is to develop an effective regime of maintenance consisting of:

• Preventative maintenance achieved through a technical assessment of preventative maintenance needs from inspection datasheets, maintenance manuals, manufacturer's specifications, construction drawings and Statutory Standards;
•Condition based maintenance achieved through condition assessments undertaken on each asset to identify remedial works for the asset; and
• Other maintenance strategies to meet special needs.

These maintenance activities are supported with cost estimates, risk ratings and priority rankings relevant to each building asset.

The result of an objective and competent assessment of maintenance needs should result in an organized collection of information ready to be developed into maintenance plans at portfolio, facility and asset levels.

The information should enable organizations priorities relating to regional, community and policy imperatives to be integrated effectively with technical and other considerations, so that maintenance plans truly meet agency requirements.

**Formulating maintenance plans**

Maintenance plans are formulated at a number of levels: building, facility and portfolio. Plans can also be formulated for different timeframes from 1 to 3 years for short term plans.

Formulating a maintenance plan involves:

• Organizing maintenance information from the planning process into a maintenance plan at the building level;

• Reviewing the information to ensure maintenance activities, costs, priorities and timing are appropriate;

•Aggregating the information up to facility and portfolio levels along regional/district or other service delivery boundaries;

• Documenting the plans with appropriate accompanying information to enable evaluation against budgets and business directions;

• Presenting the maintenance plan with an implementation program or schedule; and

• Ongoing consultation with all stakeholders throughout the process to ensure plans are within the parameters of organizations requirements.

The final step in maintenance planning involves the allocation of maintenance budgets and the formulation of a confirmed maintenance program to be implemented over the planning horizon targeted.

**Outcomes of maintenance planning**

The outcomes of maintenance planning include: budget bids for maintenance that are supported by sound business cases; efficient and effective maintenance programs once budgets are approved; and achievement of organizations asset management plans to support service delivery.

***Cleaning***

Cleaning services are generally performed on weekday evenings in office buildings. Because of the high cost of funding, hiring, training, and managing cleaners, these cleaning services are usually contracted out to specialized firms. These people clean the garbage, empty ashtrays, and dust desks and office equipment. While staff will turn off lights when done, they are instructed **NOT** to turn off any computer equipment.

**Maintenance Plans**

Written maintenance plans shall include at least the following:

1. A general description of the building and its function including

- Work activity,
- Number of employees and visitors,
- Hours of operation,
- Weekend use, and
- A written maintenance program for the maintenance of building systems which shall be preventive in scope and reflect manufacturers' recommendations and recommended-good-practice. At a minimum, the maintenance program shall describe the equipment to be maintained, and establish maintenance procedures and frequency of performance;
- A checklist for the visual inspection of building systems.
- A list of known contaminants that are regularly at the site (e.g., cleaning chemicals, other odor producing substances).

2. A description of the facility building systems;

3. Construction documents which locate major building system equipment and the areas that they serve;

4. Information for the daily operation and maintenance of the building systems, which shall include at least:

- Manuals or other written documentation that describes normal operating procedures, and;
- Special procedures such as start-ups and shutdowns, and
- A list of operating performance criteria such as;

  -Maintenance and cleaning schedules to include an approved list of substances and materials acceptable for use in state buildings.

2. Any other information that is important such as;

- As built construction documents with current changes;

## LIFE CYCLE COSTING

The term "Life-Cycle Costing" is quite broad and encompasses all those techniques* that take into account both initial costs and future costs and benefits (savings) of an investment over some period Dale(1993) defines life cycle costing as," a mathematical method used to form or support a decision and is usually employed when deliberating on a selection of options. That it is an auditable financial ranking system for mutually exclusive alternatives, which can be used to promote the desirable and eliminate the undesirable in a financial environment.

## Product life cycle

The idea of a product life cycle acknowledges the fact that designing and selling a product is only part of the story. In fact, every product goes through a series of steps between the time it is first conceived and the time the manufactured product is retired or discarded. Figure 1 shows one view of the various phases of a produce lifecycle

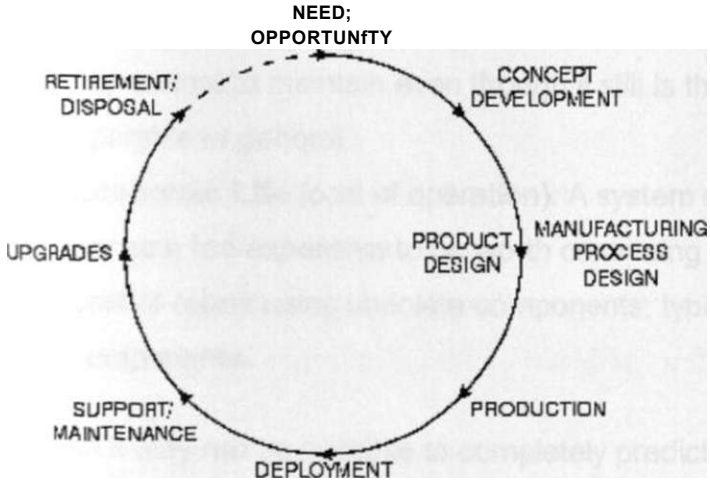



Figure 1. The phases of a product life cycle.

The product starts with a need or opportunity in the marketplace. Once a need or opportunity is defined, a concept for a product is created. This stage involves defining the product, and also addressing the business model of how the company will make money from the product, how users will employ the product, how the manufacturer and/or user will benefit from any potential upgrades, and how the product will be retired, disposed of, or refurbished.

After concept development, both the product and manufacturing process are designed. Once this is completed, the equipment is produced and deployed. After which it must be supported and maintained. Finally, all embedded systems are eventually retired, discarded, or replaced.

**Life Cvcle Cost**

Kirk & Dell'Isola(1995) provides a comprehensive look at life cycle costing from the perspective of operating a commercial building, such as an office building.

The life of a product is the shortest of three different aspects of system life:

- **Useful Life** (utility). This is the obvious notion of equipment lifetime, in which eventually equipment wears out to the point it is beyond reasonable repair.
- **Technological Life** (obsolescence). A system may become expensive or impractical to maintain even though it still is theoretically repairable or operable in general.
- **Economic Life** (cost of operation). A system may still be functional, but become too expensive to be worth continuing to use. For example high cost of repair using obsolete components, typical problem with long-lived components.

Although it may not be possible to completely predict the lifetime of a system in advance, it is estimated taking these three factors into account. Then, the direct costs of ownership are considered, including:

- **Initial purchase cost.** Clearly, purchase cost is part of total cost. The usual issue is optimizing whether one should pay a higher up-front purchase cost in hopes of reaping lower operating costs.
- **Energy costs.** Operating equipment usually requires energy, and can be a significant portion of total
- **Maintenance/Repair/Custodial costs.** A low initial purchase cost may be indicative of a system which will need frequent maintenance, repairs, or upkeep. Presumably a higher purchase cost indicates a system that contains more durable components.
- **Alteration/replacement costs.** In a long-lived system that will be upgraded, it is important to take into account eventually removing or upgrading the equipment. As an example, a component or housing may be glued into place to save on installation costs, but be very difficult to remove, whereas a bolted-in system is more expensive to install, but cheaper to replace

Additionally, there are many indirect costs that must be taken into account in a complete financial model. These indirect costs of ownership include:

- **Interest** (debt service). In some cases the most important indirect cost is the cost of borrowing money to pay the initial purchase cost in order to reduce later operating costs (or, alternately, the opportunity cost of not investing the purchase cost in some other way). Thus, any life cycle savings must be higher than extra initial cost savings to take into account the fact that extra money may need to be borrowed early in the system life cycle, but the savings are reaped later in the life cycle.
- **Administrative costs.** These can vary considerably, but might include such factors as periodic safety inspections, the cost of arranging for and administering service agreements, the cost of tracking capital equipment via property tags, and the like.
- **Opportunity cost of down time.** A system that is frequently unavailable for service may not be as cost-effective as a more dependable system

because of reduced productivity, the cost of stockpiling against potential service outages, or the cost of paying operators while their equipment is broken. Minimizing down time is extremely important most embedded system industries, including manufacturing and transportation

**Total Life Cycle Costing**

TLCC is a method of evaluating alternative building investment projects based on initial. Operating and maintenance costs over the economic life of the project, as illustrated below.

## Time

- Acquisition costs are those incurred between the decision to proceed with the procurement and the entry of the goods or services to operational use
- Operational costs are those incurred during the operational life of the asset or service and include maintenance.
- End life costs are those associated with the disposal, termination or replacement of the asset or service. In the case of assets, disposal cost can be negative because the asset has a resale value.

For new buildings the TLCC technique is used to evaluate (or rank) the options concerning design, sites, and materials on the basis of total life-cycle costs. Its application to existing buildings involves:

1. Comparison of total life-cycle costs and savings of rehabilitating the existing building vis-avis redeveloping it, i.e., tearing it down and rebuilding it;

2. determining how much of any given retrofitting measure or a combination of various retrofitting measures should be used in order to achieve maximum savings, given certain constraints of budget, level of amenity, etc.; and

3. Determining which method of retrofitting or rehabilitating a building be used to achieve maximum savings from a given level of investment costs.

The basic costing equation for TLCC is expressed as follows:

Total LCC = First costs plus all future costs (operating, maintenance, repair and replacement costs and functional-use costs) minus salvage value (i.e., value of an asset at the end of economic life or study period).

First costs are made up of all investment costs directly related to the project, including land costs and those associated with design, installation of services and construction, including future costs. They can be divided into two categories:

1. Energy costs. Which include operating costs to cool, heat, and light the building, and
2. Non-energy costs comprising maintenance repair, and replacement costs.

As life-cycle costs are spread over many years, they must be converted to a common value (present or annual value) in order to make them comparable over a period. In converting future values to present values, "discounting" is performed by applying interest (discount) formulae to the estimated costs or benefits of a given investment project. The main idea behind discounting is that it should reflect the fact that today's money is worth more than tomorrow's, i.e., it can earn interest. This interest rate must be specified before LCC analysis is carried out. Assumptions must also be specified regarding the economic life of building

components, inflation rate, future energy, and non-energy cost escalation rates. Before discounting, values of future flows of costs and savings should be converted to constant dollars to remove the effect of inflation and to make their comparison meaningful over a period of time.

To be able to decide which project is the most cost effective, one must assemble the information required to determine and evaluate the options. These are determined by specifying

(a) The objectives, e.g., desired level of thermal comfort;

(b) The constraints, which may include safety, aesthetics, or efficiency of users of facilities; and

(c) The assumptions, and then calculating and comparing the total life-cycle costs of various alternatives.

Depending on the objectives and the type of investment projects, other LCC-related measures such as internal rate of return (the interest rate for which the total discounted benefits from an investment equal its total discounted costs) and payback period (the period required for an investment to recover the investment cost, taking into account changes in the value of money resulting from "inflation" and changes in "time") can also be used to determine the most efficient level of investment.

Investment would be economical if the internal rate of return were greater than that minimally accepted by the investor; under the discounted payback period analysis, it would be economical if the time required to recover an investment were lower than the expected life of a building project.

Before finally selecting an investment project, it is sometimes desirable to test its economic feasibility based on alternative values of key parameters uncertain in the future, e.g., life of the building, energy price escalation rate, and discount

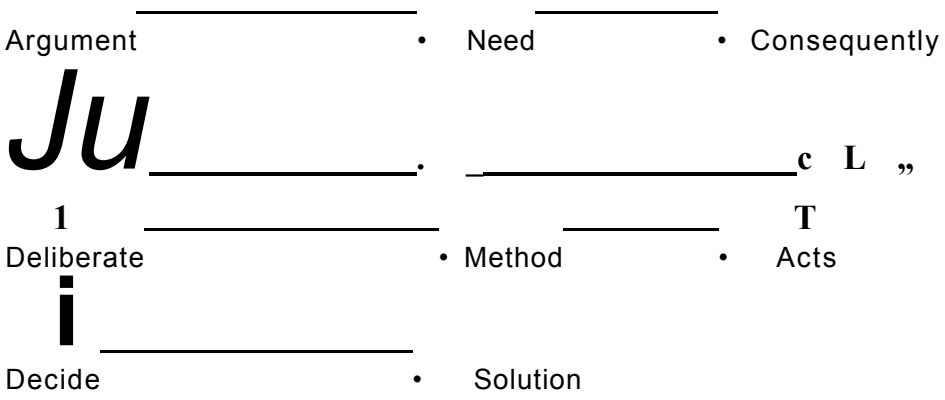
rate. It is also important to know the value or range of values of parameters that affect the LCC analysis. This can be done by recomputing the LCC measure for minimum and maximum values of the parameters in question, using a technique called "sensitivity analysis." This informs the decision-maker of the consequences associated with uncertainties in the data.

In brief, an LCC analysis requires the following steps:

1. Specify the objectives and constraints of the analysis.
2. Identify options to achieve the objectives.
3. Specify various assumptions regarding discount rate, inflation rate, economic life, etc.
4. Identify and estimate relevant costs.
5. Convert all costs into constant dollars and to a common base.
6. Compare the total life-cycle costs for each option and select the one with the minimum total costs.
7. Analyze the results for sensitivity to the initial assumptions.

**Application of LCC**

LCC is a fundamental part of decision mainly process as illustrated in figure 1.0. It can be explained as an argument, which establishes a proposition, from which one deliberates upon alternatives, in order to decide upon a course of action. The argument will define certain needs; the proportion will establish goals from which methods are developed to achieve them. Eventually a decision is made and a solution reached. Bull, W.J (1993)




*The Decision Process*

Fig 0.5

**Public Sector**

This sector is one area where LCC has significant relevance. The need to quantify and justify expenditure from the public purse makes LCC particularly relevant. In deciding the discount factor use a treasury bond rate or index linked gilts which would a ppear sensible. Once a government forecast for inflation is added, the net of inflation discount factor will be calculated and a full LCC analysis will be worthwhile. Bull, W.J (1993) pp 7,8,9

The goals for public sectors building promoters are

(a) Building functionability

(b) An auditable decision making process

(c) Cost effectiveness

**(a) At the Design Stage**

LCC can be used to weigh the various options in the design in order to assess their economic impact throughout the projects life. It's unrealistic however to assess all items concerned as the cost of undertaking such as exercise may rule out any possible overall cost savings. As a result it's more sensible to target those areas where financial benefits can be more easily achieved. LCC is most effective at this stage because changes are able to be made more easily, and where the resistance to such changes is less likely than when a design is nearing completion. In selecting a design component from a possible choice of options,

the choice with the lowest LCC will usually be the first choice provided that the other performance measures or criteria have been net. Dale,S.J

**(b) At the construction stage**

With regard to contractor's method of construction which unless prescribed by the designer, is left to the contractor to determine.

**(c) During the project's use and occupation**

LCC has an important part to play in physical asset maintenance management. The cost attributably to maintenance do not remain uniform or static throughout a project's life and therefore need to be reviewed at frequent intervals to assess their implications within the management of cost in use, for example

Changes in taxation rates and allowances will have an impact upon maintenance policies being used.

Grants may also become available for building repairs or to address specific issues e.g. energy uses

Changes in the way the project is used and the hours of occupancy

All the above need to be motivated to maintain on economic LCC as the project evolves to meet new demands placed upon it.

However, when a project nears the end of its useful economic life, careful judgment needy to be exercised before further expenditure is apportioned. A component should only be replaced when there is rising running cost as against lower running cost for replacement.

**d) <u>Procurement</u>**

Under present contractual and procurement arrangements, both manufacturers and suppliers are encouraged to supply goods materials and components which ensure their lowest initial cost irrespective of their future cost in use. So as to operate a life cycle programme in procurement of capital works projects, greater emphasis should be placed upon the economic performance in the long term, in

order to reduce future maintenance and associated costs. The inconvenience that often arises during maintenance and other associated replacement costs, which may be out of proportion to the cost of the part that has failed also need to be examined.

**e) In energy conservation**

**f) At inspection**

**Set Backs**

Ashworth, A(1988)

While the principles of LCC and the associated evaluative methods can be easily demonstrated in theory, there are difficulties in using the techniques in practice. These relate to a lack of knowledge and understanding on the part of both practitioners and clients and to a number of uncertainties particularly in respect in historic data, the long term future time horizon and the policy issues of asset management. There is also a feeling of vogue about the use of the technique and that tomorrow it must not be relinquished in favour of a more novel form of analysis.

**Difficulties in utilization of LCC**

(a) Life expectancy

Traditionally most commentators on LCC have based their calculations on a 60 year life span of buildings. This originated from a development surveyors perspective, associated with rentals and yields, and from the technological view regarding construction longevity and obsolescence. However, it's not possible to forecast cost for 60 years ahead and even then, calculating in a rapidly changing world may be wide off the mark. It's now generally accepted that the life cycle time horizon should be increasingly related to current use expectations associated with the building structure's own cycle, or related to the cyclical effect of population movements associated with the project.

(b) Data Difficulties

Data on maintenance cost have in the past been collected mainly for accounting purposes and satisfying reconciliation of budgets and this is not reliable or relevant as will be seen later. They are unsuitable for use in L.C.C applications. It is important that the inherent characteristics of such data be known to the users for example insight into the causes of component failure or deterioration otherwise such published databank of maintenance or historical data on maintenance will be of limited real use to the user. Therefore information with regard to why repairs or maintenance was done e.g. due to failure of other items of work, vandalism, misuse or simply normal wear and tear should be given. Another reason for difficulties in using such historical data is their contradictor nature. This way illustrated by Holmes and Droop (1982) in their analysis of large amount of maintenance data from local authority projects on schools and housing that revealed considerable deviations in their standard deviations though, their mean values of the data offered some consistently.

(c) Technological change

The construction industry, its process and its product are under purposeful change and evolution (Ashworth 1999). There is constant need to develop excellence in both design and manufacture and to introduce new materials having the desired characteristics of quality and reliability in use. This can have a major impact on the life cycle cost forecasts and in the pursuit of whole life construction economy. However the changes in technology can often be sudden and unexpected and therefore difficult to forecast with any degree of accuracy the possible changes over the next decade.

(d) Fashion Changes

Life cycle cost analysis must attempt to anticipate future trends and their future effect on the overall economic solution. However, fashion changes are more unpredictable as compared to technological changes and therefore also subject to a degree of speculation.

(e) Cost and Values Changes

The pattern of inflation is quite unpredictable and volatile for example, an examination of building tender prices, throughout the 1960s and 1970s indicated a general upward trend in the values of this data a state that had existed since the end of depression in 1930s. However in the early 1980s tender price levels showed a down turn, when at the time it was unusual and unexpected phenomenon since the preceding years had already been financially difficult times for building and construction (Ashworth 1990). Inflation and interest rates are influenced by such factors as booms ad slumps which are also not very predictable. Cost and values also do not more in tender; neither do the respective indices for the different materials, products or components follow similar patterns due to wide variations in fluctuation. Hence it is difficult to forecast future cost or values of different components.

(f) Policy and Decision Making Changes

This is a factor that is generally absent from the sparse historical data sources available. It is now widely recognized that maintenance work is not needs oriented but budget -led and as such once the budget allocated has been expended then there is no further available funds until the following year's budgetary allocations has been determined. Therefore, there may be only limited value in comparing the whole life costs of say, wall tiling with those of repainting in the absence of such a policy. The tiling may be shown to be the economic choice but if the owner due to shortage of available funds does not repaint the walls at intervals stipulates in L.C.C plan, then the economic comparison may prove to have been at best optimistic or even a false assumption.

The way in which owners / occupiers use and care for their buildings are different from one building to the other as maintenance is influenced by the cost and inconvenience involved. Hence different owners will have different priorities that cannot be assumed on historical precedents of apportionment of other buildings unless it's certain that the uses and priorities are compatible.

(g) Accuracy

One of the main criteria in any estimate is its reliability and accuracy. However an estimate will never be spot - on. Lifecycle costing being relatively new with limited experiences in practice and subjective quality of data offers less reliability of results as there are much longer variations and possible errors in their estimation. Therefore the key criteria for lifecycle costing are the accuracy of the comparability of design options, in allowing the current economic solution to be made. This must be made in the knowledge of large possible estimating inaccuracies.

The primary aim of maintenance of building is to retain the value of investment; to maintain the building in a condition in which it continues to satisfactorily fulfill its function and to present a good appearance to the public.

**Concluding Remarks**

LCC is a valuable method of tracing the cost consequences of various alternative investment projects with long life spans. It is now used in both the public and private sectors as a tool to select the best investment option for new construction and to determine the feasibility of alternative systems in building retrofits. But because the application of LCC requires prior specification of several parameters and a considerable amount of prediction about them, the limitations of the

MAINTENANCE TEAM

Where a number of properties or one large property is concerned, there will be a direct labour force and consideration will have been given to the minimum trades required i.e. corporate, electrical, fitter/plumber etc Harrison (1978). For repairs by contractors, two points need to be emphasized.

- Response rate: - it is useless to have access to a large and skilled resource held by a large contractor, if a week's notice is needed. It is also unreasonable to expect several contractors to prepare and estimate for doing work of which the context can't accurately be predicted.

- Period contracts i.e. for one year minimum based on time and material in which hourly rates are quoted for labours and percentage on cost for material are acceptable, and indeed for specialist services e.g. lifts, fire alarm systems, they may be the only acceptable arrangement.

**Cost comparison**

The maintenance manager or property owner or the company's upper management may seek cost comparisons for various components to be maintained. Such information is available through building maintenance cost information services (BMCIS) which aims to encourage better standards of management and more effective control of expenditure in thefield of property ownership and administration. It prepares and publishes information in various forms including cost analysis, design/performance data sheets, publication digests, case studies and an important new series of cost indices. BMCIS was established in 1970 and is sponsored by the department of environment and the royal institute of chartered surveyors. Harrison (1978)

**Direct Labour vs. Contractors**

A direct labour system permits full control of operatives but entails provision of supporting facilities e.g.

work-shops
stores
transport
high standard of supervision and control

method must be clearly understood. Efforts should be made to improve its value by developing a data bank on the various components of the total life-cycle costs.

## PUBLIC MAINTENANCE AND DIRECT LABOUR

Brech, E.F.L(1971)

Direct labour organizations (DLOs) are normal features of local government. The central government carries out a considerable amount of repair work in this way. Most DLOs come into existence because emergency repairs were needed on a fairly large and predictable scale in defined locality. Parts of the works are plannable in detail and the councils have found it possible to devise programmes of preventive maintenance, which anticipate at least emergence calls and reduce the work to routine. DLOs vary between organizations of 50 -100 men engaged upon work requiring painting etc. This type of workforce deals with 15% of the load on the industry. If all workers engage on new works and work which might be let out were to live public employment, there would still an amount of maintenance and minor improvement works which could only be done economically by a resident force.

## MAINTENANCE OF PUBLIC BUILDING

Having been done by direct labour in most cases, it has been possible to develop expertise in the methods of maintenance and also knowledge about how the work might be done most economically. It should be possible to specify the standard to be achieved, so that the cost can be controlled to suit the life of the structure. The concept of life cycle costing which include capital, loan service charges, taxation, maintenance etc , has arise where they were DLOs capable of feeding back cost data to the designer. Brech, E.F.L (1971)

**Budget.** Ashworth.A (1999)

Some of the large central and local government offices, while having maintenance policies, recognize that this are budget oriented rather than needs driven. Such budgets are generally insufficient to meet anything like total need that is, the work carried out occurs where the needs for maintenance and the adequacy in the provision of funding co-exist.

## FACTORS TO BE CONSIDERED IN SELECTION OF FLOORING MATERIALS

Contract flooring association: Flooring compendium (1980) pg 15

1. Sub-floor type and suitability to receive various floor finishing
2. Resistance to wear depending upon incidences of traffic
3. Resistance to point loads, dynamic loading and recovery from indentation.
4. Maintenance ability to stay clean in relation to the environment
5. Impervious surface finish -hospitals and laboratories use sheet vinyl or linoleum with welded seams
6. Resistance to surface-applied water; use of abundant and constant water maintenance. Use of sheet vinyl with welded seams including welding to skirting.
7. Grease and oil resistance
8. Resistance to the transmission of impact sound.

General **properties of floors finishes** . Handysyde, c.c. (1953)

1. Resistance to wear and tear
2. Slipperiness
3. Cleaning
4. Ease of replacement
5. Movements and cracking
6. Floor finishes and noise
7. Fire risk
8. Resistance to chemicals, fats etc
9. General appearance
10. Comfort

### 1) Resistance to wear and tear

For extremely heavy wear very hard surface e.g. hard tiles, special concrete or even steel plating is good. A good deal of abrasion that does occur result from the dragging of fine particles of grit across the floor and if the floor surface is

resilient the grit will be embedded in it and tend to scratch the shoe or whatever is causing the wear, rather than to embed itself in the shoe and scratch the floor.

**2) Slipperiness**

In public buildings safety is very important and therefore non-slip finishes should be used to avert the dangers associated with slippery floors. However, the is often c onflict between the requirements for a non-slip finish and a surface which does not hold dirt and which is easy to keep clean hence the requirement carrying most weight should always be considered.

Quality of "grip" can be obtained either by a slight all-over texture or by a series of fairly closely spaced joints amounting to a large scale of texture.

NOTE: polish may be "walked off' from one type of floor to another and then cause unexpected degree of slipperiness e.g. Polish carried over to terrazzo from linoleum.

**3) Cleaning**

This is done by washing or polishing however in either case some type of finishes raise special problems that need to be taken into consideration.

For example;

- Ordinary concrete tend to wear sufficiently rapidly to make the floor dusty therefore undesirable for some uses.
- For polished finishes, it is the polish rather than the material under it that is worn away and then replaced by fresh polish hence no direct wear on the finish.
- Uneven wearing could occur where two dissimilar materials are used in one floor e.g. two different marbles or tiles. Or if the base they are laid upon is not even.
- Finishes of cement compositions e.g. concrete and granolithic can be improved in their resistance to abrasion by the application of a surface hardener (based on sodium silicate).

- For timber floors, resistance to wear depends on the type of wood and type of grain which is exposed. Quarter sawn timber wears better than slash sown. Wood types e.g. Douglas fir has grain that splinters and wears badly for all wood floors; resistance to wear is greatly improved by regular polishing.
- For entrances where there is a combination of grit from outside and dampness, special consideration should be given.
- Floor finishes can also be damaged by heavy loads in the following ways:-
    a) Denting -Caused by small point loads
    b) Rutting - Caused by wheeled traffic
    c) Fracture -Caused by sudden should loads.

***For polishing***

Porous materials will absorb a great deal of polish. Asphalt would be softened by ordinary polish and therefore needs special type of polish.

***For washing***

Take care in choosing cleaning agents. Abrasive powders damage some surfaces or cause chemical action (strong soda).

It's therefore wise to enquire whether special care is required in the cleaning and any floor finish that's not familiar.

**4) Ease of Replacement**

In areas of heavy traffic and especially in places where traffic is concentrated over one part of a floor, it is often very useful if small areas can be replaced without relaying an entire floor. Floors of small units e.g. tiles are most convenient in this respect.

**5) Movements and Cracking**

Movement in floor finish is harmful as it leads to cracking, swelling and buckling, or to the general loosening of the bond by which the finish is held to the base.

Cracking occurs particularly for in-situ components that shrink on drying or setting e. g granolithic and terrazzo.

For timber, there is a possibility of high reversal movement with changes in moisture content and therefore timber should be kiln dried and subsequently kept dry. It should be installed when the building is dry and a provision should be made for expansion at the edges.

Structural movement of floor could also lead to cracking of floor finishes a nd therefore a defined joint should be provided for joint less floors at positions where such cracks are anticipated.

**6) Fire Risk**

In very few cases will the finish itself have any appreciable effect on the fire risk except w here h ollow f loor c onstruction o f t he j oist a nd b oard o r j oist a nd s lab tyres are used.

**7) Floor finishing and Noise**

a) ***Reduction of noise in the room where the floor is situated.***

Resilient finish reduces noise at its source better than any other finish and should therefore be used for such purpose.

***b) Reduction and noise transmission through the floor***

This is more complicated and depends on construction of main floor than the type of finish. Soft finishes are useful in reducing high frequency noise but low frequency "bumbs" are not greatly affected in this way.

**8) Resistance to chemicals for oils**

***a) Fats and oils***

Pitch mastic may be satisfactory in the absence of much heat and severe abrasion. Clay tiles, in cement are also good and are not affected.

***b) Mineral oils and Petrol***

Avoid rubber, asphalt and bituminous jointing to the other materials.

Portland cement compositions or clay tiles in cement will usually be satisfactory.

c) ***Food Processed***

Fats, brine, water etc should be prevented from penetrating to reinforcement. It's advisable to use continuous damp resisting membrane e.g. asphalt and cover with a finish that is unaffected by fats.

***d) Weak Acids***

Portland cement is attacked but aluminous cement compositions are fairly resistant. Rubber, linoleum, cork are all right if they meet other requirements.

***e) Sugar***

Sugar in form of hot solutions rapidly attacks Portland cement mixes. Aluminous cement is much more resistance. Clay tiles with aluminous cement jointing are great.

**9) Comfort**

Depends on three types, hardness, warmth and colour

***a) Hardness and warmth***

Hard, non-resilient floors are likely to be cold, but coldness can also come from soft colours.

Some materials e.g. Linoleum feels cold to the touch but do not feel cold if contact is maintained. However tiles or concrete feel cold when touched and appear to get worse after a period of standing on them.

It is commonly supposed that hard floors are uncomfortable because of their hardness and lack of resilience, quite apart form objections because they are cold. However there are cases of hard floors being claimed to be quite comfortable if they are warmed.

**b) Colour**

This is considered from the point of view of its decorating effect and need for cleaning. However attention has been given to the improvement in vision which can be obtained by avoiding high contrast in the field of view as seen from normal working positions.

For good vision, absence of very highly polished surface is important.

Moderately light colored floor finishes are very desirable but not always easy to maintain and or obtain.

**10)General appearance**

Important things affecting appearance are colour, scale and ease of cleaning plus texture, hardness or warmth and which gives a material an appearance of friendliness, richness or some less easily recognized quality.

Colour has been discussed above as affecting vision, but in this case choice will primarily depend on general decorative requirement modified however by the question of cleaning.

A plain colour will show dust, dirt and also evidence of wear and tear much more quickly than pattern.

Choice of scale of unit in relation to its surrounding also affects general appearance. A floor finish of tile or block tile can be used with considerable effect if carefully chosen with this in mind.

**SPECIFICATIONS**

Main points to be covered in specifying finishes are:

- Quality of material
- Preparation of base
- Thickness and material and the number of coats if finish is of an in-situ composition type
- Good workmanship
- Protection after laying

(a) Quality of material -This can be covered by reference to British standards

(b) Preparation of the base -especially in regard to cleanliness and dryness through in some cases evenness of the base may also be quite important

(c) Thickness of material and the number of coats if the finish is of an in-situ composition type. Requirements for thickness may depend upon to degree of wear and tear expected the thickness require for resilience , the minimum thickness required to enable the floor finish to be laid as an independent material floating upon the base floor.

(d) Good workmanship -This is vital to successful application of most types of materials. Useful guidance can be obtained from a number of codes of practice, but ultimately the essential thing is to choose a firm with a reputation for good work and to avoid the temptation to accept a low price on the ground that a small sample piece of material appears to be satisfactory.

(e) Protection after laying : Since floor finishing are laid towards the end of a building process, however there are other trades working on finishing such as painting of walls that floor finishes have to be protected from.

## FLOOR FINISHES

### 1) Aluminium

***Advantages***

- Durable

***Major use***

- Utility stairs and platforms

### 2) Asphalt

Consist of thoroughly bonded composition of thermoplastic binder, asbestos and other fibres, inert filler materials and inert colour pigments, formed under pressure while hot and cut to size.

They are durable and fire resistant but comparatively brittle and hard

It is manufactured to meet rigid requirements of impact, deflection, indentation **and curl.**

***Advantages***

- Easily installed
- Fairly large colour collection
- Relatively hard

***Demerits***

- Will show any defects in the surface of the materials on which it is applied
- It will indent where legs of furniture come into contact with it.
- Colours are not brilliant
- Cannot be used where moisture is present.

***Major use***

- General utility flooring

**3) Brick**

Hard burned brick is a clay product fired at high temperatures to near vitrification which produces low absorption, high compressive strength and vice versa for soft burned brick. They are of two type; those made of clay and those of cementitious materials that harden by chemical action. The surface may have, smooth, scored, combed, or roughened finish.

***Merits***

- Durable
- Water proof
- Fire proof

***Demerits***

- Hard
- Rough
- Uneven due to joints
- Difficult to clean

***Major use***

- Decorative purposes

**4) Clay tiles**

Are made from clay or a mixture of clay and other ceramic materials and fired according to various processes. They differ in terms of composition surface finish

{glazed or unglazed} process of manufacture, degree of vitrification or fusion of tile body after firing.

Those made of compounded bodies contain three principle constituents, which is the plastic, the filler and the flux or solvent.

They are of various types

***Glazed interior tiles;*** they are non-vitreous products and are graded into standard grades and seconds. Most are made with rounded facial age while some are made with variations in type and surface shape.

***Ceramic mosaic tiles;*** they are less than 6sq inch in facial area; prepondently unglazed having fully vitrified or dense bodies. They are of two type's i.e the porcelain and natural clay or shell. The former having vitreous impervious body resistant to thawing and to abrasive wear of food traffic. They are also available in wide range of colours. The latter is restricted in colour due to limitations of raw clay in the tile body though certain effects can be achieved by adding mineral oxides and stains.

To facilitate installation, ceramic mosaic tiles are usually mounted at the factory on sheets of paper about 2sq ft in area.

***Glazed weather proof tiles;*** they are durable and have semi-vitreous or vitreous body strong and dense enough to stand severe freezing. They are suitable for interior and external walls, and on floors except those subjected to heavy wear.

5) ***Quarry tiles,*** it is unglazed and made from natural clay or shale. They are durable impervious to moisture, free from dirt and stains, while resistant to abrasion freezing and thawing.

6) ***Pavers*** they are standard size unglazed tiles, similar to ceramic mosaic tiles in composition and physical characteristics but has facial area of 6sq inch or more and are laid out individually. They can be vitreous or semi-

vitreous depending on the manufacturing process adopted. They are weatherproof and suitable for heavy floor service.

7) ***Faience tiles,*** they are generally surfaced with a highly colored opaque glaze and are made from natural clays and are shaped by either hand in mold or by cutting the desired sizes from a ribbon of plastic clay as it is forced from the die of an auger or extrusion machine. The body may be non-vitreous or semi-vitreous with the degree of vitrification depending on whether the tiles are to be employed externally or internally.

***Merits***

- Durable
- Water proof
- Wide variety of colours
- Easily cleaned

***Demerits***

- Hard

***Major use***

- Areas where moisture is present
- Areas where heavy wear is expected

**8) *Concrete***

***Merits***

- Durable
- Can be painted or treated

***Demerits***

- Hard
- Gives off dust when untreated
- Difficult to clean

***Major use***

Utility floor

**9) Cork**

This is characterized by buoyancy, elasticity, a low thermal conductivity a nd a high coefficient of friction. It is chemically inert and has relativity of imperviousness. It can be highly compressed vertically without horizontal spread. It is very light with a specific gravity of 0.15 to 0.25

***Merits***

- Resilient
- Durable
- Non-slip
- Has insulation and acoustic properties
- Easily cleaned

***Demerits***

Available in limited colours

Stains

***Major use***

- Used in areas where resilience and non-slip qualities are vital

**10)Linoleum**

This is a resilient water proof covering consisting of a backing covered with a relatively thick layer of wearing surface.

***Merits***

- Durable
- Resilient
- Available in wide variety of colours and patterns
- Easily cleaned

***Demerits***

- Dents where legs of furniture into contact with it
- Can be attacked by acids petroleum and acetate solvents.
- Softened to exposure to high humidity's

***Major use***

- Areas where resilience is important

**11)Plastic (vinyl)**

They are divided into three types

Solid vinyl

Vinyl and asbestos combined

Thin vinyl layer applied to other types of resilient flooring materials.

They are available it both sheet and tile forms. For solid vinyl sheet and tile it is advisable to install an underlay before applying the flooring material so as to increase the resilience, level of the surface and stop penetration of dampness in conditions of floors below grade.

***Merits***

- Durable
- Resilient
- Available in wide variety of colours and patterns
- Easily cleaned

***Demerits***

- Except for thick types, it shows any defects on surface of the material on which it is applied.

***Major use***

- General utility flooring

### 12) Plastic floor coverings

***Merits***

- Durable
- Easily cleaned
- Water proof

***Demerits***

- Requires carefully controlled mixing and application
- Limited in colours

***Major use***

- Finished flooring surface on concrete

### 13)Rubber

***Merits***

- Durable
- Resilient
- Available in wide variety of colours and patterns
- Easily cleaned

***Demerits***

- Slippery when wet

***Major use***

- General utility floor

**14) Steel**

***Merits***

- Durable

***Demerits***

- Requires painting

***Major use***

Utility stairs and platforms

Mezzanine floors in mechanical in industrial equipment materials

**15) Stone**

***Merits***

- Durable

Easily cleaned

***Demerits***

Hard

Stains

Available in limited colours

**16)Terrazzo**

It's a dense hard floor or wall material made by laying a mixture of colored marble granules, Portland cement {white or grey} and water on top of an under bed of concrete feel on which metal or plastic dividing strips have been affixed to eliminate cracking and also to form patterns. They are available in precast form and cast in situ or made in place form with either a smoothly polished or non-slip surface.

***Merits***

Durable

Easily cleaned

***Demerits***

- Hard
- Stains
- Available in limited colours

***Major use***

Areas where heavy wear is expected

**17)Wood**

***Merits***

- Durable
- Relatively easily cleaned

***Demerits***

- Limited colours
- Stains

***Major use***

- Residential construction
- Multiple dwelling buildings

**18)Granolithic concrete**

It is suitable for use as a wearing surface and is made with aggregates specially selected to provide

# CHAPTER THREE

# 3.0 METHODOLOGY

## 3.1 Description of Study Area and Population:

**NAIROBI CITY HALL**

**Nairobi city Hall was constructed in stages. It was built and completed in 1934 at an estimated cost of £ 30,000 and opened at the same time as the law court apposite during the silver jubilee cerebrations in May 1935.**

**With the sustained growth of the city, it was decided that the council needed more spacious and permanent accommodation hence construction of a new complex commenced in 1950 and was completed in 1957 when it was officially open. See the picture below.**

Fig 0.6Nairobi city hall

Source http://www.nairobicity.org/3445

Fig 0.7Extension of the City Hall Offices opened in 1957

Source http://www.nairobicity.org/3445

**However, the need for further expansion continued to be felt both for office and accommodation and services to the residents. In 1981, the council completed a further 13 storey city hall annex to meet this needs. See picture below.**
**It was latter extended up to 16 storeys.**

Fig 0.9 City Hall Annex

Source http://www.nairobicity.org/3445

**The council has integrated its activities into various departments namely.**

1. **Town Clerk- The town clerk, who is also the secretary to the council, is the chief executive of the city council and heads the town clerk's department**
2. **City Treasury- the finance department plays a major role in day to day operations of the council. The treasurer is the head of the finance department and the chief financial advisor of the council.**
3. **Water and sewerage. This department has been moved since the water was privatized and hence a very small establishment remains.**

4. Education department- This department is responsible for all matters pertaining to education both in lower classes and high schools for schools belonging to the council.
5. Public Health- The public health department is responsible for all matters pertaining to health of the residents of the city and is headed by the medical officer of health and his deputy.
6. City Engineers Department
7. City inspectorate Department (Formed in 1935).
8. City Planning And Architecture Department^ Also formed in 1935)
9. Housing Development Department-

The main building contains the mayor's parlour with a few departments like the :-

- City Treasury
- Town Clerk
- Public Health and Environmental
- City Planning and Architecture

The annex on the other hand contains all the other departments not included above with the exception of city planning and architecture department. It has also leased out some spaces to, private consultancy firms such as:-

- Ndichu and Associates.
- Rumba Kinuthia and Company Advocates.
- Millennium Insurance Brokers.

The current floor finishes at the time of research are the initial floor finishes from the original construction. They have only been maintained but not replaced

**KISUMU TOWN HALL**

Kisumu town hall is a one storey building constructed way back in 1950's by the colonial government at the time for administrative purposes in the lake region. Unlike the Nairobi city hall, it has few departments, namely-

1 - Town Clerk's department

2. Public Health department

3. Education department

4. Town Engineers department

It **also has the same floor finishes from original construction. However they are in a relatively better condition as compared to Nairobi's city hall. See picture below.**

**Fig 0.11 Kisumu Town Hall**

## 3.2POPULATION

**The target population consists of local authority administrative buildings in the country. However due to the nature of out study and the fact that all local authorities fall under the management of the local government, case studies were selected.**

## 3.3CRITERIAL FOR CASE SELECTION

**The research being a fact finding mission, the case study of two local authorities were selected purposive selection of cases was employed in choosing the case study for in-depth study (Patton 1990). In addition, also for the purpose of carrying out a comparative study between them. As such Nairobi city hall and Kisumu town hall were selected for this research.**

## • 4DATA COLLECTION INSTRUMENT

The data collection instrument for the study includes the following:-

**(a)** Questionnaires

Lb) Observational forms

**(c)** Physical traces.

a) questionnaires (See Appendix 1 )

The q uestionnaire w ere d eveloped from the literature review in chapter two to help achieve objectives of the research

(b) Observational forms ( See appendix 2 and 3)

This are design to help report the current state of the finished from direct observations. However, there are two types; one to be completed by the researcher (appendix 2) and the other one to be completed with consultation with care takers of the respective buildings,

**(c)** Physical traces (See plates in appendix 4)

This involves reporting the current state of the finishes by use of photographs of the common areas considered.

## 3.5DATA COLLECTION PROCEDURES

(A) Questionnaire Administration

The questionnaires were administered to the respective building superintendents by the researcher in an interview kind of setting. Note taking was also done for new facts that came on board during the administration of the questionnaires that had not been taken into account in the research.

(b) Direct observation

This is to be done with the aid of the observational forms (see appendix 2 and 3) directly by the researcher. However the second observational form requires some information on the form of cleaning that could only be obtained from the

retakers of the buildings and so it is to be completed in consultation with the iretakers of the respective buildings.

') Photographs

'hotographs of the floor finishes are to be taken on permission from the building iuperintendents. The photographs only covers the common areas considers that s the entrance, corridors and stairs.

## 3.6DATA ANALYSIS

The research being a fact-finding mission involves two case studies. The data collected from the instrument employed will be used for in-depth analysis and comparison of the two cases. The comparison will be done at two levels i.e.

- Between the two case studies
- Between both case studies as against the ideal situation already covered under a literature review

Likewise similarity arising from the two case studies will also be noted. From the comparison and similarities drawn from the data collected, the researcher (based on the background established in the literature review) will make inferences about the maintenance practices adopted by the local authorities in this regard. Appropriate recommendations and conclusion will also be drawn from the findings of the research in chapter five.

## 3.7DATA PRESENTATION

The data obtained from the instrument employed will be presented in tables for comparison purposes. However some questions in the questionnaire that give rise to qualitative data will be analyzed in the form of discussion.

## 3.8HYPOTHESIS TESTING

The hypothesis **'daily hygiene cleaning contributes to deterioration of floor finishes in counsel building'** will be tested suing Chi-square test.

# 4.0 CHAPTER FOUR
# RESULTS

## 4.1 NAIROBI CITY HALL

**Introduction**

Nairobi city hall houses several departments as mentioned in the previous chapter. It consists of the main building and the annex which extends sixteen storeys high .It was noted that the annex does not only house the council's departments, but has some /rooms rented or leased out to private firms. Nevertheless it is the annex that houses most of the council's departments. The main building on the other hand contains the mayor's parlor, town clerks offices a court and a few departments e.g. the public health department.

**Type and level of maintenance**

The Nairobi city hall carries out unplanned maintenance of the emergency kind. In addition it also carries out backlog maintenance and deferred maintenance when funds are inadequate.

The building is required to be maintained at good operational condition.

**Corporate vision and image to the society**

The Nairobi city council strives to provide quality service to satisfaction of residents of Nairobi as well as its visitors while spurring business and socio-economic activities through a professional, faithful and well motivated workforce and sound management practices while ensuring justice for all. The management's perception in their rule of property assets maintenance was rated 6 on a scale of 1-10 with 10 being the best or utmost concern for property assets maintenance

## Labour employed

The council employs both direct and contracted labour on maintenance of floor finishes. Normal maintenance works whose scope is small such as replacement of a parquet tile or woodblock are carried out using direct labour. However for specialized maintenance work such as terrazzo works {recarpeting} of which must be extensive in scope are contracted out to contractors. Also maintenance works that are of emergency nature are hired out to contractors to perform.

The maintenance section under building works is well established in the sense that it has the following

1. Qualified supervisors and employees
2. A workshop

However the number of employees employed under maintenance is inadequate thus a major setback as will be depicted in the challenges facing the use of direct labour for maintenance.

**Challenges faced by the maintenance section in using wither direct or contracted labour**

***Direct labour***

Most of the workers in the lower cadres are unskilled for example cleaners. City hall having a variety of floor finishes requiring various levels of care during cleaning. Yet the cleaners do their cleaning indiscriminately on all types of floor finishes. Maintenance works also sometimes get delayed since some workers

⇨ **frequent** sick-offs while some go on leave hence not available when quired. Therefore the works get delayed and even become worse with time due to **unavailability** of labor.

[1e] number of employees has reduced to 177 (figure obtained from building s-Jperintendent) from 489 due to retrenchment and even death of workers without replacement

## Contracted labour

There is lack of information exchange between the design team i.e. the architects and engineers as well as the maintenance team hence some problems keep recurring over and over again. Also the process of procuring contractors services sometimes gets caught up in bureaucracy adding up to delay of urgent maintenance works.

### Type of tendering procedure used

The council uses open competitive tendering when there are maintenance works requiring contractors to be placed on site. This takes about two months on average i .e. 2 8 days after advertisement followed by 21 days to allow for any appeals among contractors. This process sometimes gets dragged in meetings with contractors as well, contributing to the delay even further.

### Building inspection

The council has no building inspection cycle i.e. regular interval at which the building is inspected for maintenance and rectification purposes. Similarly it does not have a checklist for visual inspection of building components. The council also lacks a maintenance manual with regard to floor finishes. It only has a manual for specialized items such as pumps and other facilities.

**ii»t d o w n periods**

^ council has procedures to shut down operations where maintenance works eeds to be done but when it's necessary until such works are completed. This oes interfere with the various operations concerned with that particular area or pace and it is handled by shifting operations to other rooms. For corridors, the ame happens with the activities/operations on rooms opening up to the corridors £ing shifted to other places.

**Information to support maintenance planning**

The council has past records on the following

- Labour employed-through labour sheets
- Contractors' services
- Components replacement
- Components failures
- Cleaning programmes etc

The council also has assumed minimum accepted conditions of performance of floor finishes. And this is above good operational conditions. However the council does not have a list of acceptable substances or materials for use in maintenance and cleaning of its floor finishes.

**Budgetary allocation**

Budgetary allocation on floor maintenance is carried out annually at departmental levels. The maintenance section being a service department to all the departments in the city hall determines the value of work and resources needed for them. This is then included in the departments budget and forwarded for approval by the minister of local government according to Local Government Act Cap 265 section 213 (3)

a ' W population in the building

iaddition to the personnel workers of the city hall, it is visited by approximately 0,000 people.

**laily operation hours and weekend use**

[he building is used from 8am to 5pm on normal working days. However it also has weekend use especially the conference hall and the charter hall (which has now been burnt down in suspected arson attacks)

The private advocate firms on the annex also use the building over the weekends.

**Locational application of floor finishes**

***Entrances***

At city hall main building, it has two entrances of white coloured terrazzo that is still in good condition though it has gotten worn out evenly

The annex has the floor finished with marble tiles 0.45$m^2$ in size. It is however in a deplorable state, characterized by large pittings here and there; it has also lost its glossy finish. This has been caused by the heavy traffic that causes wear and tear on the finish as well as lack of polishing the surface when necessary. Poor workmanship and water could also be a probable cause of deterioration.

***Stairs***

The stairs at the main city hall building are finished with white terrazzo. However, it is worn out and at some places one can seethe cements screed. Also the terrazzo in some instances can be observed to have been broken at the nosings of the staircases. Nonetheless they are still in relatively good physical condition and could last longer if the necessary repairs are done at the various areas that have defects. Similarly at the Annex, the stairs are finished in terrazzo with similar defects except for the stairs leading to the mezzanine which has a landing made of marble tiles that has undergone serious pitting. The stairs at the fire

cape are made ofgranno and have no problem probably because they are used.

***orridors***

**lain building**

*Woodblocks*- these have been widely used along the corridors of the main building however they have broken off extensively at some areas exposing the underlying bitumen. They also show lack of polish for quite a long time save for the mayor's parlour where the polish is still on and the woodblocks are in a good state.

*Terrazzo tile*- these are still in a good condition though they have lost their polish and in very few instances have discolorations at the edges (or border)

*Parquet tiles-Xhese* has not been used widely as woodblocks. However, they are characterized with lack of polish over a long period of time and a majority of the tiles have broken off from the base exposing the underlying bitumen.

**Annex**

The annex extends up to sixteen storeys high and the floor finishes along the corridors are majorly repetitive on each floor. This consists of

***Terrazzo-*** this has been used in the corridors and is in the same state as the one in the main building.

*Parquet tiles*- here parquet has been extensively used along the corridors and lift lobbies. They are in a deplorable state with a large portion chipping off. The few remaining reveal lack of polish for quite some period of time.
This could have been caused by indiscriminate washing by cleaners, heavy traffic, and lack of timely repairs, where the need has been noted and also lack of consistent or regular application of polish

*PVC tiles*- this has also been used though not extensively as parquet. They have also worn out and this is evident by the torn patches at certain places.

*Screed*- this has also been used. However, it seemed like it was supposed to receive another floor finish, but this has not been done. Hence the screed is characterized by small hair cracks here and there, probably because of water and poor workmanship during the laying of the screed at the construction stage.

## 4.2 KISUMU TOWN HALL

### Introduction

Kisumu town hall is far much smaller both in establishment and in terms of size as compared to Nairobi's city hall. It is a one storey building and has few departments.

It serves the whole municipality and its environs.

### Type and level of maintenance

Just like Nairobi city hall, Kisumu town hall carries out unplanned maintenance as well of the emergency type. However, an interview with the town engineer revealed that there is planned maintenance of the planned-schedule maintenance type. This nonetheless is not usually followed owing to insufficient

funds to be allocated for such hence unplanned emergency maintenance is the one that is often employed.

Subsequent to the legislation and codes prescribed with regard to maintenance, the level of care to be applied should be above the defined minimum that is good operational conditions.

**Corporate vision and image to the society**

The council strives to provide the best services to the local residents of the city. Even so, the management's level of concern on property assets maintenance was rated 5 on a scale of 1-10 whence 10 is the utmost concern to assets maintenance. This reveals inadequate level of concern considering issues of maintenance in the building.

**Labour employed**

This is similar to Nairobi city hall as the council also employs both direct and contracted labour centering on maintenance.

**Challenges encountered by the maintenance department in use of direct and contracted labour.**

***Direct labour***

An interview with the town engineer revealed that notwithstanding the fact that the labour employed is inadequate, the employment criteria is based on political connections to councilors and all figures of authority in the council. Consequently this has fermented into indiscipline amidst the employees especially on supervision from their superiors. This has made it difficult to implement certain

maintenance works on time. Similarly the council is plagued with insufficient to execute its maintenance works on schedule and every so often practices differed maintenance.

The number of employees under maintenance section is about 20.

***Contracted labour***

The procedure of procuring a contractor's services for maintenance works is cumbersome due to the bureaucracy that the process is subjected to. This leads to delays extending up to possibly 3 months before the contractor commences on the maintenance works.

**Type of tendering procedures used**

This had a semblance to the Nairobi city hall procedure of open tendering system.

## Building inspection

Regrettably, like the Nairobi city hall, it lacks a building inspection cycle as well as a maintenance manual that shows how various building components should be operated and maintained.

**Shut down periods**

The council has no official shutdown periods upon which maintenance works can be done. Though, when it is necessary for instance emergency maintenance, operations in the affected areas are usually shifted to other offices to pave way for maintenance to be done.

**Information to support maintenance plan**

**Unlike** Nairobi city hall the council has past records on the following information **only**

- Labour employed
- Contractors' services
- Cleaning schedules and programmes

Even so, it has insufficient information on the following

- Equipment and component failures
- Components replacement

**Budgetary allocation**

Budget allocation for maintenance is done annually and has to be approved by the minister of the local government. This is where the maintenance department can plan and forecast their maintenance needs for the coming financial year and submit the budget along with the other departments for approval by the minister of local government.

**Daily population in the building**

It was approximated that in addition to the permanent staff employed, the council receives an average of about 500 to 1000 visitors daily.

**Daily operation hours and weekend use**

The building is used from 8am to 5pm on normal working days. It is also used on Saturdays and selected Sundays. Hence extensive maintenance works can be scheduled to be done during the weekends.

**Locational application of the floor finishes**

**Entrances**

***PVC-*** the entrance and the lobby is finished with PVC tiles as seen in plate 1 of Kisumu town pictures. It has a mixture of various colours namely, black, white, and grey.

However it is worn out in certain areas as shown in plate 9and 10. This kind of wear is occasioned by heavy traffic and foot wear along with subsequent neglect to those requiring immediate maintenance thereby extending the damage to other tiles.

The average size of the tiles is 0.04 $m^2$.

**Stairs**

***Screed-*** all stairs save for the one that leads to the mayor's parlour are finished with screed that has been painted with red-oxide. The paint is coming off owing to traffic and foot wear on the treads and landings. It is also broken at the nosing probably due to sharp impact from foot wear or other items being carried along them. Frequent cleaning and mopping is also a potential cause of the wearing out of paint and the screed itself. See plate 6.

***Granno-*** the stairs leading to the mayor's parlour are still in perfect condition as shown in plate 5.



i

**Corridors**

*Screed*- the screed has been painted by red-oxide which has faded due to wear and tear of the floor as shown in plate 5 and 6. it also has air cracks probably due to poor workmanship and mix during the construction. There is also pitting in some areas caused by sharp impact loads being dragged along the corridors. See plate 3,11 and 12.

PVC-this has also been used along the corridors. It is stained here and there by substances like gum and oil as shown in plate 6. it has also torn out at certain sections revealing the screed underneath. This may have been caused by delay in replacement of broken tiles thereby leading to the breakage of the others around it owing to traffic from foot movement. The average size of these tiles is $0.04m^2$. See plate 7 and 8.

*Terrazzo tiles*- these have been used along the corridors leading to the mayor's parlour. They are in perfect condition as shown in plate 1,2 and 4. The average size of the tiles is $0.2m^2$ each.

**Mode of cleaning**

The floor finishes are all cleaned by mopping using soapy water daily. Most of the common contaminants are dust and mud and cleaning of the floors is not very labour intensive

## 4.3HYPOTHESIS TESTING.

The study hypothesized that," **daily hygiene type cleaning contributed to the deterioration of buildings in council buildings."**

The field study revealed that the council employees clean the floors daily. However this is done indiscriminately without due regard of the variety of floor

finishes used and their special cleaning requirements. This in addition to use of harsh detergents has led to the wearing-off of the polish thereby exposing the floor finishes to deteriorating agents like foot traffic and water. Given the above case coupled with poor irregular (unplanned) maintenance practices the hypothesis was found to be true and therefore accepted.

## 4 4DATA PRESENTATION AND DISCUSSION

### ENTRANCES

| FINISH | KISUMU TOWN HALL | CITY HALL NAIROBI | |
|---|---|---|---|
| | | MAIN BUILDING | ANNEX |
| PVC Tiles | 100% | 0% | 0% |
| Terrazzo | 0% | 100% | 0% |
| Marble Tiles | 0% | 0% | 100% |

Table 0.1 Entrances

### STAIRS

| FINISH | KISUMU TOWN HALL | CITY HALL NAIROBI | |
|---|---|---|---|
| | | MAIN BUILDING | ANNEX |
| Screed | 75% | 0% | 0% |
| Terrazzo | 0% | 100% | 12.5% |
| Granno | 25% | 0% | 87.5% |

Table 0.2 Stairs

From the tables above it can be seen that kisumu town hall has P.V.C finish at the entrance while city hall has terrazzo, in the main building but marble tiles at the annex .P.V.C and terrazzo were in a fairly good state save for marble tiles of the annex, which were in a more deplorable state. As for the stairs, it can be seen that kisumu used both Granno and screed .Granno was used in small percentage just for stairs leading to the mayor's parlour while screed was used for the rest of the stairs .In Nairobi city hall, terrazzo was extensively used in the main building while at the annex ,Granno was used in grater percentage as compared to terrazzo. Both terrazzo and granno were in a fair state.

**KISUMU (Corridors)**

| FLOOR | SCREED | PVC TILES | TERRAZO TILES |
|---|---|---|---|
| **Basement** | 75% | 25% | 0% |
| **G.Floor** | 75% | *25%* | 0% |
| **1st Floor** | 33.30% | *33.30%* | 33.30% |
| **Total %** | 183% | 83% | 33% |
| **Averaae %** | **61%** | **28%** | **11%** |

Table 0.3 KISUMU Corridors)

**KISUMU TOWN HALL(Corridors)**

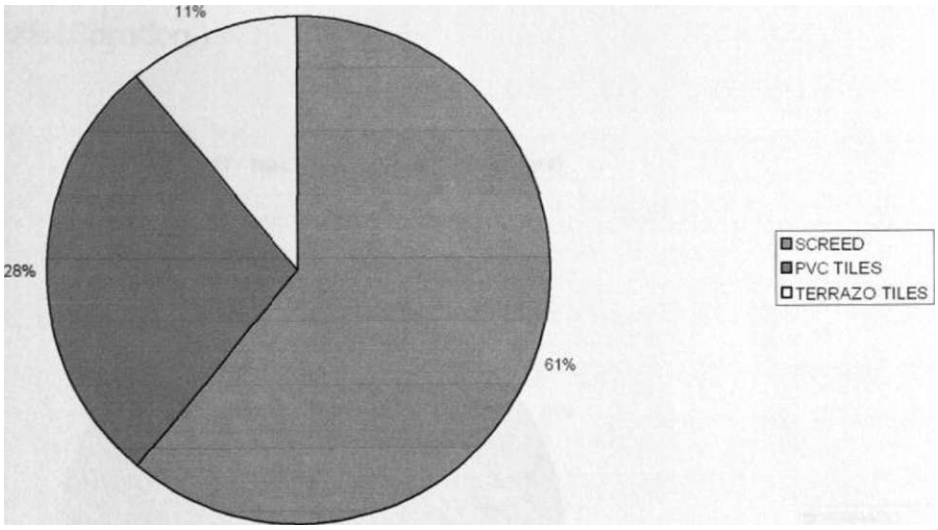



Chart 0.1

A greater percentage of the floor finish in kisumu town hall is left in screed finish (red oxide) From observation ,the screed had worn out revealing hair cracks and it had even lost its colour (red oxide)due to heavy foot traffic. Therefore screed is not a good finish for use in areas of major foot traffic like corridors. The P.V.C

and terrazzo tiles were in good conditions except at corners where P.V.C had worn out probably due to the turning effect of foot traffic.

**CITY HALL MAIN BUILDING (Corridors)**

| FLOORS | TERRAZO | WOODBLOCK | PVC TILES |
|---|---|---|---|
| **1st Floor** | 75% | 25% | 0% |
| **2nd Floor** | 50% | 50% | 0% |
| **3rd Floor** | 25% | 75% | 0% |
| **4th Floor** | 20% | 80% | 0% |
| **5th Floor** | 0% | 25% | 75% |
| **Total %** | 170% | 255% | 75% |
| **Average %** | **34%** | **51%** | **15%** |

Table 0.4 CHMB (Corridors)

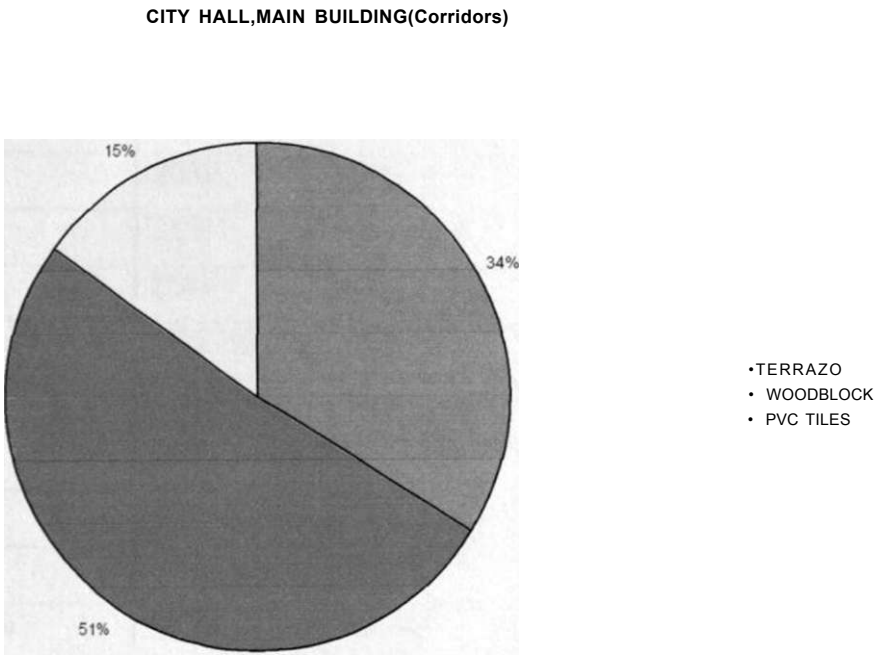



Chart 0.2

The proceeding chart reveals that a greater percentage (51%) of city hall corridors (main building) is covered with wood block. The structural performance of woodblocks is generally good except for the intersections between the landings and the corridors where it could be observed that the woodblocks had come of the floor surface thereby revealing the bitumen underneath. As for PVC and terrazzo, they were in fair condition probably because they were used in areas of low traffic as compared to wood blocks.

**CITY HALL ANNEX (Corridors)**

| FLOOR | MARBLE | TERRAZO | PARQUET | PVC TILES | SCREED |
|---|---|---|---|---|---|
| **G,Floor** | 75% | 25% | 0% | 0% | 0% |
| **Mezzanine** | 0% | 75% | 25% | 0% | 0% |
| **1st Floor** | 0% | 33.30% | 0% | 33.30% | 33.30% |
| **2nd "** | 0% | 25% | 50% | 25% | 0% |
| **3rd "** | 0% | 16.67% | 50% | 16.67% | 16.67% |
| **4th "** | 0% | 25% | 50% | 25% | 0% |
| **5th "** | 0% | 25% | 50% | 25% | 0% |
| **6th "** | 0% | 25% | 50% | 25% | 0% |
| **7th "** | 0% | 16.67% | 50% | 16.67% | 16.67% |
| **8th "** | 0% | 25% | 50% | 25% | 0% |
| **9th "** | 0% | 25% | 50% | 25% | 0% |
| **10th "** | 0% | 25% | 50% | 25% | 0% |
| **11th "** | 0% | 25% | 50% | 25% | 0% |
| **12th "** | 0% | 16.67% | 50% | 16.67% | 16.67% |
| **13th "** | 0% | 16.67% | 50% | 16.67% | 16.67% |
| **14th "** | 0% | 25% | 50% | 25% | 0% |
| **15th "** | 0% | 25% | 50% | 25% | 0% |
| **16th "** | 0% | 16.67% | 50% | 16.67% | 16.67% |
| **Total %** | 75% | 467% | 775% | 367% | 117% |
| **Averaqe %** | **4%** | **26%** | **43%** | **20%** | **6%** |

Table 0.5 CHA (Corridors)

CITY HALL ANNEX(Corridors)

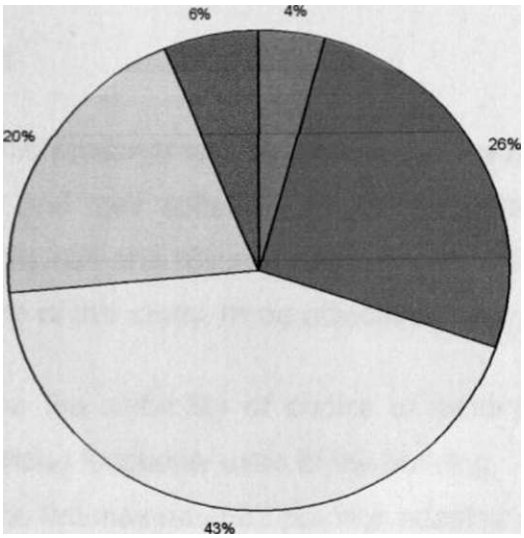



Chart 0.3

The annex has a myriad of floor finishes along the corridors. However it can be seen that a greater percentage is under parquet tiles followed by the rest in various percentages as shown in the chart above. Field observation revealed that parquet tiles had chipped off the surface with some floors actually losing all the tiles. Parquet tiles are very strong and their poor performance at the annex could be attributed to the following reasons.

1 Poor workmanship during installation.

2 Lack of regular polishing and timely replacement of loose tiles.

3 Poor cleaning habits and use of poor detergents.

The rest of the finishes were in a less deplorable state but also showed lack of general maintenance.

# CHAPTER FIVE

## 5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

### 5.1 SUMMARY

The purpose of this research was to explore the maintenance practice adopting by local councils and their suitability to maintenance of floor finishes. A case study of Nairobi city hall and Kisumu city hall were selected for investigation .To realize the purpose of this study, three objectives were put foreword as follows:

1. To determine the suitability of choice of building floor finishes used with regard to various functions/ uses of the building
2. To investigate the maintenance practice adopted on floor maintenance
3. To propose a suitable maintenance policy to be adopted by the council on floor finishes.

To meet the above objectives various research tools were employed, that is questionnaires, and observational checklist and note taking of any facts found out but not covered in the questionnaires. Based on the literature review done, it was also hypothesized that daily hygiene type cleaning of floors contributes to their deterioration.

The raw data obtained from the field study was presented in the form of tables showing the extent to which various flooring finishes were used in the building. Pie charts were also employed in the same.

As for qualitative data, these were reported in the same way in the same way, with comparison being made between the two cases. Photographic plates were as well employed to produce physical evidence of the state of the floor finishes as shown in the appendixes. The major causes of the deterioration that could be generalized for both buildings were;

1. Wear and tear due to heavy traffic from foot work
2. Lack of timely repair of floor finishes where there is needed.

The causes of these were attributed to poor and indiscriminate cleaning of floor finishes. Lack of funds was also sited as encumbering timely maintenance and repair works

## 5.2 DISSCUSION OF MAIN FINDINGS

1) ***Type and level of maintenance.*** The research revealed that, Nairobi city hall carries out unplanned maintenance of the emergency kind likewise, Kisumu. However it was noted that Kisumu town hall also practices planned schedule maintenance, but this is not followed due to lack of funds to be allocated for future maintenance needs. This has led to serious sustained deterioration of floor finishes in both councils. Furthermore, this kind of maintenance practice does not provide mechanism for identification of faults that are in need of repair and rectification. This was evidenced by lack of building inspection cycle in both councils. Without a building inspection cycle, timely identification of faults on floor finishes cannot be done. As a result, the fault goes unnoticed by those incharge of maintenance and in turn spreads to the other unaffected parts thereby worsening the situation .for example, when a parquet tile becomes loose along the corridor and goes unnoticed with time it comes of thus leaving a point of weakness of the whole parquet floor finish. Consequently the rest of the tiles within its proximity will succumb to the traffic due to foot wear and constant knocking, hence coming of. Therefore lack of timely response to repairs of such floors leads to the deterioration of the whole floor with time. It is said that a stitch in time saves nine, well in this case, the council will have to contend with high maintenance cost in doing repairs of the whole floor sections affected. Other costs to be incurred are cost of re-allocation of operation from the affected areas during maintenance.

2) ***Drivers and Maintenance*** To investigate this, the researcher set to find out the corporate strategy of the councils and image they wish to portray to the society. This is because the overall mission statement or goal of the councils could influence the weight given to maintenance of its assets. However the corporate strategy of the councils covered their areas of jurisdiction and their inhabitants but did not cover their own facilities. The management's perception towards assets maintenance was also rated average for both councils. Charity begins at home, so it is said , it therefore have much to be desired on how the council can effectively seek to provide quality services, to residents of their areas and jurisdiction when they cannot maintain their own assets to acceptable standards.

The council therefore do not actually have a maintenance policy as such. However, they do have a building works section under the city engineer department that is charged with maintenance needs. For Kisumu, maintenance duty falls on the town Engineers department.

3) ***Labor used for maintenance*** The council employs both direct and contracted labor for various maintenance works. Direct labor is used for minor maintenance works while Contracted labour is used for specialized work as terrazzo repairs and when maintenance work is extremely urgent. The councils have competent staff save for cleaners to carry out maintenance work. However, their number is in sufficient. This is particularly felt when there is more to be done yet the employees charged with that responsibility are on leave or sick-off, thereby delaying maintenance work. Kisumu has especial problem which regard to supervision of workers. This was attributed to some workers having political links to some of the councilors hence indiscipline to authority above them. The council also has not been replacing their staff when they do retire and this has also contributed to insufficient numbers of wormers.

4) ***Information Flow*** The field study revealed that the councils had adequate past records on maintenance work that can be used to plan for future

maintenance needs. In as much as this information is available, it was revealed that it is not made use of as a feedback on performance of floor finishes to the sections in charge of making decisions on materials to be used for finishes

-[n]erefore problem of a particular floor finish are sustained in future designs since there are no mechanism necessitating a feedback cycle on floor performance for vanous finishes

Cleaners were found to clean all types of floor finishes indiscriminately by napping with soapy water without giving due regard to various, floor finishes. This is because of lack of proper awareness, among the cleaners on requirements and procedures for each type of floor finish.

5) ***Budgeting Allocation*** Building works maintenance section in Nairobi city hall is regarded as a service department to the other departments. It estimates on yearly basis maintenance requirements for each department including floors with the exception of electrical and mechanical works. The budget is then handed over to the respective department who in turn forward them alongside other budgets to the minister of local government for approval. This system has been found to be bureaucratic as it leads to long process to channel funds to maintenance sections from other departments accounts whenever maintenance works is required. Furthermore, the budget recommended for maintenance works is usually slashed to some extent hence unavailability of adequate funds for maintenance.

6) **Daily population in the building**

The number of visitors to city hall Nairobi and Kisumu town hall was found to be very great, for Nairobi it was approximated over 20,000 people while for Kisumu t ranges between 1,000-5,000 daily. This number is great and leaves no doubt

as to one of the major causes of floor deterioration being attributed to heavy foot traffic

**7) Location Suitability of floor Finishes**

Some of the floor finishes were found to be in quite a deplorable state raising concern with regard to their suitability to the areas in which they are used. For example parquet has been extensively used in city hall i.e. 43% it has been used on the lift lobbies and corridors. These are areas of major foot traffic and the tiles revealed lack of polish. They are also chipped of the floor surface revealing the bitumen underlay.

## 5.3 IMPLICATIONS AND RECOMMENDATIONS

**Maintenance Policy**

The local council needs to come up with a maintenance policy that is grounded on planned preventive maintenance. The councils have adequate information from past records regarding maintenance that can be used to forecast future maintenance requirements. The instruction also include components cost, replacement and failures, labour sheets .cleaning programmes and schedules e t c. Planned preventive maintenance will spare the councils from costs incurred in performing extensive maintenance woks since the defect or fault will be arrested in its early stages.

**Building inspection cycle**

For planned preventive maintenance to be successful, inspection, detection and prevention of incipient failures has to be put in place in building inspection cycle done at regular intervals is therefore important in this case. This will help arrest defects before they spread to other areas and ensure timely response to maintenance needs.

**Information Flow and Feedback**

The building work and maintenance section is charged with the responsibility of carrying out maintenance and therefore have an insight into the programme of the various floor finishes. A feedback mechanism should be set in place to facilitate feedback in formation on the same to the city engineers department that is mcharge of making decision on the type of floor finishes to be used and in what areas.

**Wear and tear**

The major cause of wear and tear of various floor finishes was established as heavy foot traffic that is prevalent in council buildings. To minimize this it recommended that the floor finishers be polished regularly at appropriate intervals. This will ensure that it is the polish that wears off and not the flooring material itself. Polish will also make them impervious to water and thereby avoiding damage caused by the same. Regular polishing using wax should be done for floor finishes such as wood blocks and parquet.

**Investment in Information technology Supporting Maintenance**

Information regarding maintenance works or local council is very bulky in size and therefore requires a form of management. This is so as the information collected can be stored and analyzed with appropriate decision regarding maintenance work being taken. Currently, there are firms that have developed maintenance management programmes and soft wares; they also provide these services on line via the internet. Some of the benefits to be reaped from the use of such programmes are;

1. Simplification of maintenance administration
2. Reduction of cost and risks

3. Online access and regular schedule audits
4. Improved contract management
5. Provide strategy that aligns with the councils needs.

**Workshop and Labor Employed**

The councils need to upgrade their workshops to improve their competency in carrying out various maintenance works such as repair of terrazzo floors. The councils needed to acquire tools and machines used for maintenance. It also needs to employ more trained staff to handle floor repairs. The research revealed there is need for more staff to be employed especially those of lower cadre so that maintenance works are not delayed due to leave off and sick off of some workers. As for cleaners, training needs to be done so that they appreciate the various needs of different flooring finishes so that they don't clean all the floors indiscriminately as has been the case.

**Appropriate allocation of floor finishes**

Among the various finishes used in city hall, the floor parquet was found to be in a more deplorable state from the rest followed by woodblocks. This raised questions with regard to its suitability in the areas that they are used given the functions of the same areas . About 51% of floor areas of city hall main building is covered with wood block. However with the exception of corridors, the stair landings where wood blocks had been applied were in worst state as all the wood blocks had come off the surface.

Even though this was attributed to lack of timely replacement of defective blocks it can also be due to the turning effect produced by foot traffic. Therefore it was recommended from this study that, wood blocks are not suitable for use around

the landings and instead terrazzo should be used since it has no major jointing as wood blocks.

Similarly, parquet was also used extensively in the annex; about 43% of the areas considered were covered in parquet. This was majorly the lift lobbies. They were in a more deplorable state than the wood blocks at the main building and this could also be attributed to heavy foot traffic since these are waiting areas. This study therefore recommends that parquet should also not be used in areas with constant heavy foot traffic such as the lobbies and instead terrazzo should be used for similar reasons as above.

## 5.4 FUTHER AREAS OF RESEARCH

This particular research has dwelt on maintenance and practices adopted by local authorities with regard to floor finishes. It can also be noted that most of the causes given for floor finishes deterioration were actually inferred from observations and interaction with the maintenance staff. This therefore leaves much to be done with regard to performance of various floor finishes in local councils, causes of their deterioration and probably criteria to be used and followed in making an appropriate choice of floor finishes for such buildings.

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16)http://www.basingstroke.gov.uk/planning/historic repairs.asp#dx

17)http://www.vermont.gov/egovernment/govindex.html

18) http://EzineArticles.com/ Ron Neal "Green" Area Rugs and Flooring (title of article)

## APPENDIX 01: PLATES

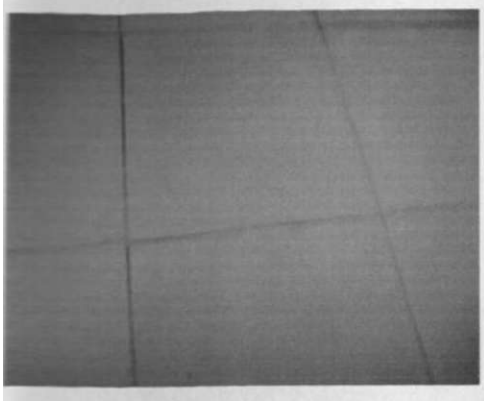


PLATE 1

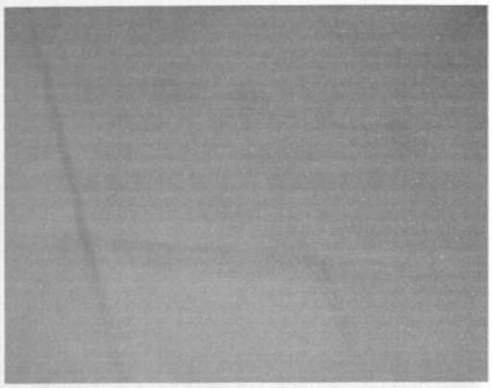


PLATE 2

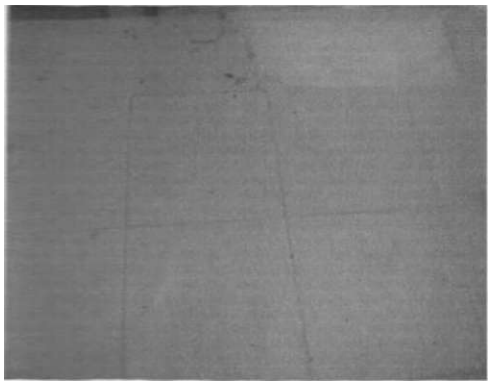


**PLATE 3**

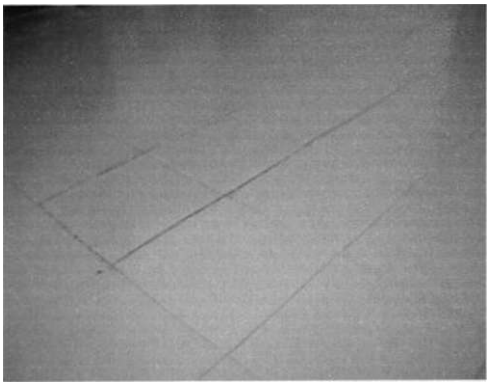


PLATE 4

**PLATE 5**

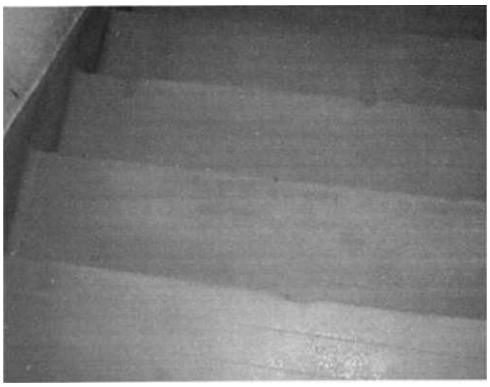
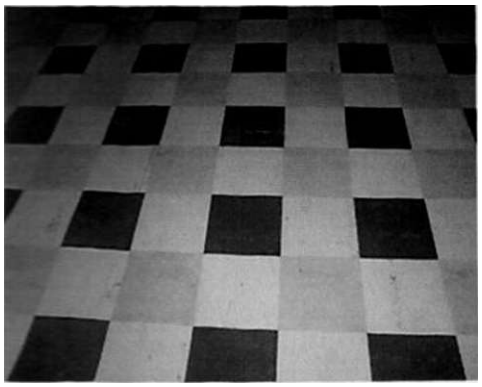


**PLATE 6**

**PLATE 8**



**PLATE**

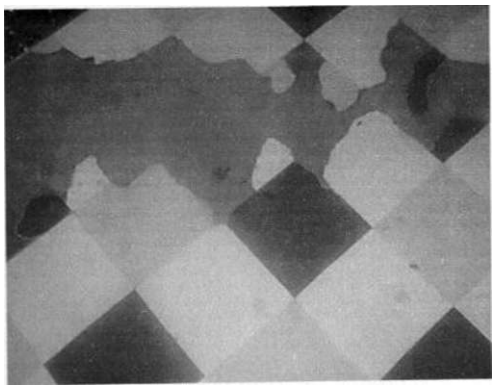


**PLATE 10**

PLATE 11

PLATE

## RESEARCH PROJECT

Cover Letter

am a final year student at the University of Nairobi, Department of Building Economics and Management. I am carrying out a study in to **the impact and suitability of building maintenance practices of local council buildings on performance of floor finishes: case study of Nairobi (city hall) and Kisumu (Town hall)**

The major objective of my study is to investigate the maintenance practices adopted by the local authorities with regard to floor finishes, I would be very grateful if you would help me complete this questionnaire, which has been formulated with the purpose of collecting as much information as possible to permit an objective assessment of the situation.

In seeking your assistance, I appreciate the considerable effort that may be involved in providing some of the answers. I also appreciate the very important part that your contribution will play in the realization of this research and indeed in the determination of the conclusions of the study .For both effort and contribution I remain immensely grateful.

I would like to assure you that any information that may be given in confidence will be treated strictly as such

Therefore, kindly assist me to complete the following questionnaire.

Thank you for your cooperation.

Yours sincerely,

Collins Aluga.

* Which type of maintenance works do you carry out? (Can be more than one)

a) Planned preventive maintenance. ●
●

i.) Planned scheduled maintenance.

ii.) Condition based maintenance

b) Planned corrective maintenance ^—j

c) Unplanned maintenance q

i.) Emergency maintenance

ii.) Negligence or avoidable maintenance

d) Backlog maintenance O

e) Deferred maintenance EH

2 From the nature of operations the building is supporting, what would you say is the implied or required level of care above the minimum prescribed by legislation and codes?

a) Minimum condition

b) Reasonable condition D

c) Good operational condition •

d) Best possible condition ├─┤

3 With regard to actions derived from corporate strategy of the local authority, comment on the following.

a) Is there a corporate vision and image, the authority wishes to portray to the public

**"TesTNO"**

b) If "YES", briefly state it?

c) On a scale of 1-10, give a rate to the management's perception in their role of property assets maintenance.

4 What kind of labor force do you employ for your maintenance works with reference to floor finishes?

i.) Direct labor |__|

ii.)Contracted labor

iii.)Both the above |—|

a) If "BOTH", what kind of works are done by

i.) Direct labor

ii.) Contract labor.

For direct labor;

| | | YES/NO |
|---|---|---|
| iii.) | Do you have qualified supervision? | • • |
| iv.) | Do you have a workshop? | ● ● ● ● |
| v.) | Do you have a well-established | |

**maintenance department?**

**YES/NO**

**vi.) In your opinion, is the number of employees employed for maintenance adequate?** **Q |___|**

**vii.) Are the employees qualified?**

**In your opinion, what are some of the challenges you face in using direct labor for execution of maintenance works?**

**b) How do you carry out maintenance works involving specialist trades such as terrazzo repairs?(77c/r *where appropriate)***

**i.) Using out-sourced contractors, or**

**ii.) In-house/direct labor.**

**c) For out-sourced jobs, what are some of the challenges faced in employing contractors to do maintenance works?**

**d) What is the procedure for procuring contractors services with regard to floor maintenance?**

e) What kind of tendering procedures do you use to procure contractors services ?(77c/c *where appropriate)*

i.) Open competitive tendering. I____I

ii.) Restrictive/Selective tendering. i 1

iii.) Negotiated tendering [

iv.) Serial tendering. r

f) What is the average response rate (time between the expression of the need for maintenance and placing the contractor on the site)? *{State in months)*

Do you have a building inspection cycle? YES/NO

If "YES ", briefly state the period/interval.

a) Do you have a checklist for visual inspection of building components, covering and including floor finishes?

YES/NO

b) Do you have a maintenance manual?

YES/NO

If 'YES , what is the recommended cleaning cycle with regard to floor finishes?

: **Do you have shutdown periods upon which maintenance works on floors can be done if need be? YES/NO**

● ●

**If "YES ",**

**i.) When?**

**ii.) In your opinion, is/are these period(s) adequate for minor maintenance work?**

**7 During maintenance works involving replacement, cleaning etc,does this process interfere with the operations of the spaces concerned**

**YES/NO**

• •

**If "YES", how do, you handle the disturbance created by the maintenance works.**

8 Are there past records for the following with regard to maintenance costs of floor finishes?

| | YES | NO |
|---|---|---|
| Labor employed | | |
| Contractor services | | |
| Replacement | | |
| Cleaning | | |
| Component failure | | |
| Others | | |
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9 Do you have information for the daily operation and maintenance of the building components from the following? (Tick where appropriate)

a) Manuals or other written documentation that describes normal operating procedures. YES / NO

b) Special procedures such as, start-ups and shutdowns YES I NO

c) Conditions of operating performance criteria, in terms of;-

i) Minimum accepted conditions on floor finishes? YES/NO

ii.) Maintenance and cleaning schedules including an approved list of substance and materials acceptable for use in such a building YES I NO

**10 .How is budget allocation done with regard to floor finishes maintenance. Is it;-**

***(Tick where appropriate)***

**i. Given yearly, or** **Q**

**ii. Extended over a number of years (probably matching the maintenance programme).** **i—. I—I**

**11 With regard to your budget estimate, does it have to be approved by the minister of local government (according to Local Government Act Cap 265, section 213(3)?**

**YES/NO**

**• •**

**12 What would you say is the major work activity in this building (for example administrative functions, industrial processes etc)**

**a) Approximately, what is the number of your employees?**

**b) Approximately, what is the number of your visitors on daily basis?**

**c) What are your daily normal hours of operation?**

**d) Does the building have a weekend use? YES/NO**

**● ●**

| AREA/FUNCTION | | TYPE OF FINISH | FORM OF WEAR AND TEAR | CAUSES | SLIPERINES | CAUSES | EASE OF REPLACEMENT | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Average unit size | Rating |
| 1 | Entrances | | | | | | | |
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| AREA/FUNCTION | | TYPE OF FINISH | FORM OF WEAR AND TEAR | CAUSES | SLIPERINES | CAUSES | EASE OF REPLACEMENT | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Average unit size | Rating |
| 1 | Stairs | | | | | | | |
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| AREA/FUNCTION | | TYPE OF FINISH | FORM OF WEAR AND TEAR | CAUSES | SEIPERINHS | CAUSES | EASE OF REPLACEMENT | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Average unit size | Rating |
| 1 | Corridors | | | | | | | |
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OBSERVATION CHECKLIST TO BE FILLED IN CONSULTATION WITH THE WORKERS/CLEANERS

| AREA/FUNCTION | | TYPE OF FINISH | CLEANING | | | LABOR INTENSITY | | | COMMON CONTAMINANTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Form of cleaning | | description | Intensive | Intermediate intensity | Not intensive | |
| | | | Washing | Polishing | | | | | |
| 1 | Entrances | | | | | | | | |
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| AREA/FUNCTION | | TYPE OF FINISH | CLEANING | | | LABOR INTENSITY | | | COMMON CONTAMINANTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Form of cleaning | | description | Intensive | Intermediate intensity | Not intensive | |
| | | | Washing | Polishing | | | | | |
| 1 | Corridors | | | | | | | | |
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| AREA/FUNCI'ION | | TYPE OF FINISH | CLEANING | | | LABOR INTENSITY | | | COMMON CONTAMINANTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Form of cleaning | | description | Intensive | Intermediate intensity | Not intensive | |
| | | | Washing | Polishing | | | | | |
| 1 | Stairs | | | | | | | | |
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