A STUDY ON INADEQUACIES OF BUILDING DESIGNS AND THEIR CAUSES REFERENCE TO PRIVATELY OWNED RESIDENTIAL BUILDINGS IN MATHARE NORTH, NAIROBI AREA.

BY

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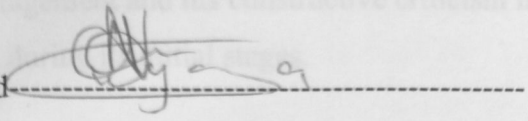
DECLARATION

I, MOTANYA. N. A., do hereby declare that, this project paper is my original work and has not been presented for a degree in any other university.

Signed  ----------

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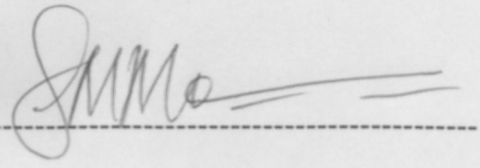
This project has been submitted for examination with my approval as a university supervisor.

Signed  ----------

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Much gratitude to my classmates, for creating a homely atmosphere during my stay.

DEDICATIONS

This work is dedicated to all those families who have suffered, and experienced losses, irrespective of the kind or nature, also to those continuing to suffer, as a result of building failures and disasters.

ABSTRACT

This is a study on the inadequacies of building designs and their causes with special reference to privately owned residential buildings in Mathare North, Nairobi area. The study examines the problems experienced in this area in reference to building designs and attempts to correlate them to the level of professional consultation.

The work has been split into four chapters. The first section comprises the introductory chapter covering the general introduction formalities of the study. Chapter one sets the premise against which the inadequacies of building design is examined. It sets the problem statement, the hypothesis, the objectives of the study, the assumptions, justifications of the study, the scope and limitations, research methodology and operational definition of terminologies.

Chapter two consists of the reviewed literature, which aids in developing an in depth understanding of obligations of various parties, and design problems, i.e. the influence of climate, e.g. sunshine, humidity, and rainfall. Moreover, it looks at the aspect of human comfort, ventilation. It further examines, building failures and their causes. Finally discusses the aesthetics and security aspects of design.

Chapter three consists of data presentation and analysis. The findings of the research,, while seeking to achieve the objectives of the study are explained. It attempts to show the degree or extent of design problems in the area of study, the level of consultation of professionals and the causes and recommendations of inadequacies of building designs from the architect's point of view.

Chapter four comprises of the findings, conclusion, recommendations and further areas of study. The researcher does not wish to conclude that the buildings in Mathare North are very poor. He has a conclusion, on each of the objectives of the study.

Inadequate abstract

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CHAPTER ONE

1.0 INTRODUCTION

This is a study on some of the building designs and their inability to meet their intended purpose i.e. that of aesthetics, functionality and structural stability. Jones J.C (1976:9) says that designers are obliged to use current information, to predict a future state, that will not come about unless their predictions are correct.

Natural lighting should be utilized whenever possible. This will be geared towards reduction of lighting costs.

Stone P.A (1975:20) states that;

"In internal room, the levels of lighting provided are much greater than is necessary for the tasks to be performed; the reason is usually to brighten the room so that the absence of natural light does not engender a feeling of gloom. Thus in one way or another the cost of lighting are increased."

Designing in response to Kenya's economic and climatic conditions, maximizing the level of professional consultancy in building contracts, is the essence of this study.

Research is therefore needed in this area, in order to boost confidence to clients, occupants and the society as a whole.

The study will dwell on residential buildings in Nairobi, a case study of Mathare North flats.

1.1 PROBLEM STATEMENT

Many of the problems experienced in buildings, can be traced not only from the architects conceptualization of the building design, but also from the implementation of this idea, that is the construction and the clients change of ideas and needs. Moreover due to problems of communication between client and designer, as indicated by Stone P.A. (1975: 17)

If therefore no adequate care is taken, the building will fail in the provision of some of its functions, such as comfort, protection e.t.c. This is a disgrace for professionals who spend, 4, 5 and 6 years studying buildings only not to meet expectations.

Some of the problems experienced as a result of poor design include:

a) Overheating of spaces (rooms): B. Givoni (1969:208) explains that: *"one of the characteristics of modern architecture is the widespread use of glazing in the building facades. This and the increasing use of light weight structures, has caused considerable changes in the relationship between interior and ambient climate, and the problem of overheating has become a major concern even in temperate and cold countries."*

(b) Poor natural lighting: This is due to the fact as indicated by Stone P.A. (1975:19) that, daylight will only penetrate at an adequate strength, comparatively short distances into a building.

(c) Circulation problems: Stone P.A (1975:19) advices that: *"The spaces for each activity should be related so as to minimize the space devoted to circulation and the time and cost of communications between the various spaces."*

(d) Collapsing of buildings[1]

Examples of these failure related buildings are in Mathare North high-rise flats. These problems and others, lower the quality and value of a building. For instance, if it was a commercial building there will be loss of clientele, lowering rental rates and thus a long pay back period.

Professionals are partly to blame, for their failure in provision of services to projects of small magnitudes. They only go for those providing millions of shillings. If available these professionals are too expensive.

1.2 HYPOTHESIS

The hypothesis to be tested in this study is that, the various parties involved in construction of buildings have contributed significantly to problems associated with building designs.

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[1] **Daily Nation,** "Narrow escape as building collapses," No.12606 (March,2001), pg 1.

1.3 OBJECTIVES OF THE STUDY

The main objective of the study is to establish whether, the various parties involved in construction of buildings have contributed to the problems associated with building designs.

The study attempts to:

a) Establish whether building professionals are consulted before buildings are designed.

b) Find out what are the effects of tropical climate on building designs.

c) Identify the causes of thermal discomfort in buildings.

d) Examine the aesthetics and security aspects of designs from the tenants' point of view.

e) Examine the floor, wall and slab ceiling failures.

1.4 ASSUMPTIONS

(I) The tastes, fashions and preferences of users are held constant

(II) The climatic conditions and patterns are not to the extreme as in temperate regions.

(III) Factors such as morphology are within the control of the designer, so that their manipulation will be geared towards meeting the people's expectations and climatic needs.

1.5 JUSTIFICATIION OF THE STUDY

The need to undertake the above study arose, because of the need to make some contribution to the existing academic knowledge, on why low-cost building flats e.g. Mathare North estate are poorly constructed, that is they do not fulfill the basic purpose of buildings i.e. that of aesthetics, structural stability and functionality.

These buildings are multi-storeyed and cannot be classified as slums like Mathare low-rise buildings which are constructed with the poorest quality building materials e.g. mud. The Daily Nation[2] newspaper has it that, Mathare North though classified as falling in the sprawling Mathare, one of Africa's expansive sordid settlement, is a middle-class

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[2] **Daily Nation,** "Mathare violence," No.13408 (June 4,2003) pg 5.

encampment of high-rise constructions, that starkly contrast with the shanties in the nearby Mathare slums.

Were its proximity to the sprawling Mathare to be taken into account, the high-rise development would fit the bill of slums. However, Mathare North is served with piped water and electricity.

Through proper designs, alterations in the future will be reduced. Stone P.A. (1975:112), noted that;

"Alterations are usually relatively expensive as compared with the equivalent amount of new construction."

If professionals are ever consulted, then they are a ready target, for scrutiny and criticism, for their role in producing building designs that fail to perform as per the expectation of every mwananchi and yet they are paid for their services.

Sang B.k (1991:36), on his study of the level of professional consultancy in rural areas, did not wish to put forward that poor housing is due to low levels of professional consultancy, but concluded that if the level of consultancy is raised, building activity in the rural areas would change for the better.

Urban areas (cities), being the places where majority of professional's firms are located. It is fallacious, that these are the same places that buildings lack professional touch. Otherwise a study is therefore necessary to establish why this is the case.

1.6 SCOPE AND LIMITATIONS OF THE STUDY

The following considerations or aspects will not be part of the objectives of the study:

a) Checking through the colleges of Architecture's curriculum to ascertain that the architects are trained to cater for the Kenyan needs.
b) Building failures on roofs
c) Detailing of the design methods to cater for disasters e.g. earthquake
d) Changing technology
e) Quality of workmanship see plate 1 and 6
f) Quality of materials
g) Structural stability function of a building

Thus the study will deal with what the design team can do to uplift the standard and quality of building designs.

Plate 1: A staircase lacking a handrail, thus posing danger to the residents.

1.7 RESEARCH METHODOLOGY

A) Research Design

This is a survey research. The study attempts to identify the problems and shortcomings being experienced in already occupied residential buildings within Nairobi, at Mathare North.

After going through the city council's list of residential buildings (Housing Development Department), the buildings were chosen randomly and the size of the sample was obtained as follows:

There are 1000 units of buildings in Mathare North. The following formula was used:

$$n = \frac{Z^2 p q}{d^2}$$

Where:

n = the desired sample size (if the target population is greater than 10,000)

Z = the standard normal deviate at the required confidence level

P = the proportion in the target population estimated to have characteristics being measured.

q = 1-p

d = the level of statistical significance set.

Since there is no estimate available of the proportion in the target population assumed to have the characteristics of interest, 50% will be used as quoted by Olive Mugenda etal (1999: 43)

The Z- statistics is 1.96 and desire accuracy at the 0.05 level, the sample size is therefore:

$$n = \frac{(1.96)^2 (0.50) (0.50)}{(0.05)^2}$$

$$= 384$$

Since the target population is less than 10,000. The final sample estimate is calculated using the formula:

$$nf = \frac{n}{1 + n, / N}$$

Where:

nf = the desired sample size (when the population is les than 10,000).

n = the desired sample size (when the population is more than 10,000).

N = the estimate of the population size.

$$nf = \frac{384}{1 + 384) /_{1000}}$$

$$= \frac{384}{1.384}$$

= 277 units.

But due to limitations of time and finances only $^1/_9$ of the units will be researched i.e.

$^1/_9$ x 277 = 30 as used by Sang B.K (1991:26)

Problems and shortcomings in the buildings will be identified, through the use of questionnaires and interviews with the occupants / tenants and the landlords.

Questionnaires will also be administered to the architects and even an interview with the same.

b) Data collection

The research will require both the primary and secondary data. The primary source will be obtained through:

I) Questionnaires: - They will consist of open and close ended questions. The reasons of using it are:

a) Getting quick or rather fast responses

b) They don't consume much time and thus the respondents will be ready to part with their limited time.

II) Photographs: - They will provide some of the pictorial illustrations of the problems of building designs.

c) Data analysis

This will be done to assist in verifying whether the various parties involved in construction of buildings have contributed significantly to problems associated with building designs.

The data will be analyzed through the use of simple statistics be it inferential or descriptive statistics.

The exercise will involve examining those problems which are most prevalent and try to identify their possible causes. The level of professional consultation by the landlords (prior to construction) will be calculated as a percentage, i.e. how many of these landlords consulted the professionals.

A comparative analysis will be done to ascertain whether there is a relationship between the level of professional consultancy and design inadequacies. This will assist in making the relevant conclusion.

d) Interpretation of the data and presentation of research findings

This will be based on the outcome of the analysis and will ascertain whether my hypothesis holds ground or not.

The results will be presented in the written text, tables, graphs, pie charts and bar charts.

1.7 OPERATIONAL DEFINATION OF TERMINOLOGIES

(i) Design

Jones J.C[3] defines designing as the initiation of change in man-made things implying that there are other objectives that must be achieved before drawings can be completed or even started. If the object that is drawn is to bring about prescribed changes in the world at large, the designers must be able to predict the ultimate effects of their proposed design as well as specifying the actions that are needed to bring these effects about.

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[3] Jones.j.c, (1970), **Design methods**, John Wiley and sons Ltd, London, p.6

The objectives of designing become less concerned with the product itself and more concerned with the changes that users and society as a whole are expected to make in order to adapt to and to make benefit from the new design.

(ii) Architect

A person trained and experienced in the design of buildings and the coordination and supervision of all aspects of the construction of building. The government has provided CAP 525 for the registration of architects and quantity surveyors. According to CAP 525 Section (3) subsection (1) provides that;

"*Subject to the provisions of this Act, no person shall practice under any name, title or style containing any of the words or phases "architect", "architectural", "quantity surveying" unless he is registered under this Act as an architect or quantity surveyor, as the case may be.*"

Provided that:

(i) Nothing in this Act shall apply to any person in the service of the government, or to any person who for the purpose of preparing any particular piece of work for the government, is exempted from the provisions of this Act.

(ii) A number of an approved professional institution who is entitled under the constitution thereof to display after his name any affix which includes the word "Architect", "Architectural", or any abbreviation thereof, may use such affix whether he is so registered or not.

Sub section 2 says that:

"Any person who contravenes the provisions of sub section (1) of this section shall be guilty of an offence and liable to a fine not exceeding five thousand shillings."

(iii) Slums

Marshall B.C[4] defines it as those portions of cities in which housing is crowded, neglected, deteriorated, and often obsolete. He advices that, a slum should be judged physically according to the general living standards of a country.

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[4] Marshal, B.C, (1966) **Slums and community development**, Collier-Macmillan ltd, London, p. 4

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CHAPTER TWO
LITERATURE REVIEW

2.1.0 INTRODUCTION

Syagga P. M[5] argues that it is not only physical deterioration of the structures that is evident in buildings; obsolescence both functional and economic is equally evident.
Besides unsound management considerations for maintenance, the buildings themselves may be inherently expensive to maintain as a result of inappropriate consideration during design and construction.

Inappropriate design detailing and specification of various building components and materials or constructional errors arising from inadequate supervision or poor workmanship arising from contracts awards, to incompetent contractors may severely or individually cause rapid physical deterioration in buildings.

He further mentions that inappropriate building designs may also cause rapid functional obsolescence. This occurs when a building is an over-improvement or under-improvement, rooms are too small, the ceiling is too high, the light inadequate or architectural plan, style and design are poor. Therefore, all those factors inherent in the structure itself, which are not deteriorating but are responsible for depreciation or decrease in value of a building, may be classified as function obsolescence.

The net result of functional obsolescence is that large sums of money may have to be spent on improvement and rehabilitation to make the building satisfactory.
He advises that designers should be aware of good or bad effects or alternative designs upon issues which are important to the users but which may not be of direct interest to the developer. He is of the view that the consultants may be from different firms, sometimes not necessarily residents or having knowledge of the area where the buildings are to be

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[5] . Syagga, P.M., (1985), "The Impact of Building Design on Maintenance Costs of Residential Housing Estates Owned by Mombassa Municipal Council", Unpublished Ph. D Thesis, University of Nairobi

constructed. The resulting design therefore, may be based on general guidelines from textbooks, about the constructional requirements for buildings in the tropical climates.

2.1.1 Building failure

Who is responsible for the failure?

Building Failure can be classified into three broad categories namely[6]:

i. Design problem
ii. Construction problem
iii. Maintenance or usage problems

i. Design Problem

When examining on this problem, one has to answer several questions before coming to a conclusion. These are: -

a). Whether the construction project was properly designed, devised, selected or specified.

b). Whether it was engineered properly.

c). Whether the contract documents were faulty.

Design problems are the responsibility of the architects and engineers. Design adequacy must be gauged by the opinions of the professionals in the same discipline. If the design is founded on deviation from accepted standards and practices of design, care and diligence for that profession, the designer could be held liable.

ii. Construction Problem

One needs to look at the following: -

a). Whether the project was built in accordance with the contract requirements.

b). Whether it was properly constructed.

c). Were the workmanship practices at fault?

d). Whether the materials and equipments were finished as specified and in with industry standards.

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[6] Arthur, F.O., (1992), **Construction Administration in Architectural Practice** , Mc Graw hill Inc, London P. 166 – 167

Construction problems are the prime responsibility of the general contractor. The actual party at fault might be an employee, a subsequent or a manufacturer of building materials and equipments.

When a contractor fails to follow the requirements of the contract document or unilaterally decides to deviate from or make substitutions, any unsuitable or defective result is the responsibility of the contractor.

iii. Maintenance/ Usage problem

One also needs to look at the following: -

a). Whether the project and all its systems have properly been cared for.

b). Whether the project has been abused or vandalized by its users.

c). Whether the project has been used properly.

Maintenance or usage problems are the owner's responsibility. Sometimes owners of a new facility are lulled into action by the newness of the materials and systems and do not commence their maintenance programmes soon enough. Some maintenance personnel are not properly trained and cause damage by improper or negligent actions. The occupants and users of buildings often abuse them by rough or inappropriate usage of vandalism. Normal wear and tear is not a construction defect.

2.1.2. Building and site development defects appear in a multitude of forms and variations including[7]

i. Inadequate strength or stiffness, structural instability, setting of foundations or distressed structural members as evidenced by cracking, movement and excessive deflection.

ii. Unsightly or dangerous cracking, crazing scaling, peeling, discolouring, swelling blisters or excessive smoothness or roughness.

iii. Weather and moisture intrusion caused by failure of roofing, exterior walls, floors or openings.

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[7] Ibid,P. 165

iv. Premature depreciation such as abnormal wear, decay, erosion, corrosion or disintegration, beyond the effects of normal wears and tear.

v. Inadequate capacity or function of electrical, mechanical, vertical transportation or environmental systems including wiring, piping, ducts, devises and equipment.

2.1.3 Activities that take place during the five design phases.

These have been discussed by Ivor H. Seeley[8] as follows: -

i. Client's brief

At this stage the Architect and the building client are busily, endeavoring to establish the client's requirements and in particular to distinguish between desires or wish and essential needs. The architect finds it very difficult to determine just how much the building client is prepared to spend and to reconcile the two major factors of cost and quality.

The quantity surveyor can render valuable service at this stage by supplying cost information based on the actual cost of the previous buildings of a similar type. This will help the client prepare himself; this is because nobody likes being told that they cannot afford what they have set their hearts on having.

ii. Investigation

The building client's requirement has now been definitely established, the site has been surveyed and the architect begins to consider the various alternative ways in which the building can be designed and constructed.

Some drawings will be produced at this stage and the quantity surveyor will be in a position to give general guidance on costs and in particular, different solutions to any design problem.

iii. Sketch Design

The major planning problems will be resolved and the outline designs will emerge. Sketch design will include sections and elevations and services and finishing will be considered in addition to these forms of structural framework

Consultants will be brought in at this stage in order that their requirement may also be investigated. The quantity surveyor checks on his approximate estimate figure and with the aid of extensive cost plan with provisional target cost figures set down for each element or major part of the building.

iv. Constructional Design

Sketch plans are now finished and some working details are prepared. These should be approved by the building client to avoid the possibility of future alterations. The quantity surveyor will be called upon to give comparative costs of different forms of construction, materials and services layouts and will include probable running and maintenance costs.

Continuous cost checks by the quantity surveyor will ensure that the development of the design remains compatible with the cost plan. This process is sometimes described as cost reconciliation.

v. Working Drawings

The final working drawings (Production drawings) will now be prepared from which the bills of quantities can be produced. Consultants, sub-contractors and suppliers will be required to supply full information at this stage, including realistic quotations.

The quantity surveyor continues his cost checks and ultimately produces the final cost plan. He will also be available to give advice to the architects on any financial or nonstructural matters associated with the project including terms and conditions of the main contractor and sub-contracts on the selection of tenders.

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[8] Ivor,H. S, (1976), **Building Economics**, McMIllan Press Ltd , London

Construction drawings are a means of communication. David Oakley[9], has it that "*If your design is to merit the description of Architecture, imagination and inventiveness are just as necessary at the stage of detailing as in the earlier stage of the creation of plan and form*".

2.1.4. Obligations of various parties

Failure by the various parties involved in construction to follow the right channels of contract could be the source of inappropriately designed buildings. According to the agreement and conditions of contract for Building Works[6], obligation of the various parties is as follows: -

1. General Obligation of the employer

The employer shall upon the execution of the agreement;

i. Clearly identify the site upon which the work will be carried out and the access thereto.

ii. Confirm that the said site is in his legal possession and that it is free from all materials encumbrances

iii. Ascertain and confirm to the contractor that the proposed works comply with all statutory requirements, local authority planning and design by laws or regulations as the case may be.

iv. Make adequate financial arrangement to ensure that all payments to the contractor under these conditions are made within the periods and the manner stipulated in the contract and shall provide such evidence to the contactor on request.

2. General Obligations of the Contractor

i. Carry out, superintendent upon and complete the works and rectify defects appearing therein in accordance with the contracts and to the reasonable satisfaction of the architect unless it is legally and physically impossible to do so.

ii. Give a written notice to the architect specifying any discrepancy, ambiguity or divergence in these conditions, the contract drawings, the contract bills or

[9] David, O., (1961), **Tropical Houses**, William Clowes and Sons Ltd, London, P. 233

specifications immediately such discrepancy or divergence is detected. The architect shall there upon issue instructions in regard thereto as is practicable.

iii. Notwithstanding any obligation of the architect and whether or not the employer appoints a clerks of works, the contractor shall remain wholly responsible for carrying out and completing the works in all respects in accordance with the contract and whether or not the Architect or the clerk of works, if appointed, at anytime goes on to the works or to any workshop or any other places where work is being prepared to inspect or approve the same or otherwise.

3. General Obligation of the Architect.

I. Issue comprehensive drawings and all necessary details and other information required by the contractor for the proper carrying out of works.

II. Expeditiously supply information, instructions and interpretations required or requested by the contractor to ensure timely carrying out of works.

III. Issue all necessary approvals and certificates and take other required action as soon as practicable.

IV. Where the Architect is required under the contract to exercise his discretion by giving his decision, opinion, consent, contractor approval or by taking any other action which may affect the rights and obligations of the employer or the contractor; he shall exercise such discretion importantly within the terms of the contract.

4. General obligation of the Quantity Surveyor.

I. Expeditiously provide the necessary advice, opinion, assessment, measurement, computations or valuations as the case may be of any matter required of him under these conditions. While giving advice, opinion, assessment, measurements, computations or valuations, he shall carry out the task impartially within the terms of the contract. [10]

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[10] The Architectural, A. K.,. etal, (1999), **Agreement and Conditions for Building Works,** Joint Building Council Nairobi, P. 8 - 9

2.2.0. THE INFLUENCE OF CLIMATE ON DESIGN

The designer must design a building in such a way as to take the advantage of the favorable and mitigate the adverse characteristics of the site and climatic features.

Maxwell F. etal[11] noted that: -

"*One of the great needs of a shelter is to keep out the weather*".

Therefore a major function is to modify and regulate out door air temperatures so that temperatures indoor can be brought within the human comfort zone.

I. SUNSHINE AND RADIATION

Human thermal comfort is the dominant problem in tropical climate. Charles Hopper[12] has dealt with the issues dealing with sunshine and radiation as follows:-

i. Radiation on opaque surfaces

The quantity of direct solar radiation received on the earth's surface is dependent upon atmospheric conditions e.g. the amount of cloud, dust and haze and the thickness of the atmosphere that the sun's rays must traverse and not directly on the prevailing air temperature.

Radiation on external surfaces of walls and roofs can raise their ambient air; a dark coloured sheet roof for instance might reach temperatures up to 30^0C above the maximum air temperature. Radiation from hot internal surfaces especially roofs rather that the resulting increase in air temperature is probably potentially the greater sources of discomfort in hot climate.

ii. Radiation on transparent surfaces

Glazed openings are largely transparent to solar radiations. The solar energy that passes through glazed openings is absorbed by sunlit internal surfaces which in turn become heat radiators.

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[11] Maxwell, F., etal, (1976), **Architecture and the Environment,** George A. and Unwin Ltd, London, P. 20

[12] Charles,H., (1975), **Design for Climates,** Housing Research and Development Unit, Nairobi, P. 12 – 20.

The heat they emit is however low temperature long-wave radiation which cannot be transmitted back to the outdoor environment through the glass, because glass is opaque to energy emitted from low temperature sources; this is commonly known as the *"green house effect"*.

iii. **Solar heat gains on different surfaces.**

Greater solar gains are experienced in West than in East, elevation as there is more cloud in Nairobi during the morning i.e. when the sun is in the East, than during the afternoon, and on South than North elevation, as there is greater cloudiness during the months when the sun is North of the equator (April to September) than during the months when the sun is North of the equator.

iv. **House forms and orientation**

House forms that minimize the areas of roofs, and East and West walls are advantageous in the tropics as they limit solar heat gains. The building forms, which is proportional to its size, receives the least solar projection, is the tall sub-like block that has its long axis running East-West.

Multi-story dwellings and flat excepting their top floors have the considerable advantage of receiving no direct solar heating from above. In hot tropical climates all major openings should be located North and South Walls. These walls are subject to the least solar heating.

v. **Surface forms**

Curved surfaces (such as vaults and domes) or uneven surfaces (such as brick wall with alternate courses recessed or corrugated sheet roofs) are an advantage in controlling the impact of solar radiation for two reasons.

a). Radiation is diluted by its being spread over a large surface area.

b). Convective heat loss to the cooler air will be greater due to the greater surface area.

vi. **Deterioration of Materials**

Isolation can affect the performance of building material by causing large changes in their temperature, leading to corresponding large thermal expansions, followed by equally large contractions during the night. Such thermal movement can lead to the cracking and disintegration of rigid walls and roofs.

Paint deteriorates more rapidly when exposed to solar radiation, since it tends to destroy polymerization and causes loss of plasticity which causes cracking and flaking. The deteriorating effect of solar radiation can be reduced by application of reflective surfaces and by solar shading

2. HUMIDITY AND RAINFALL

Charles H[13] examines the above element as here below:-

A. Humidity Levels and comfort

The level of relative humidity at times of high temperatures will determine the desirability of air movement – a factor which has a most worked experience on the shape and form of house.

i. **Mould growth and Biological decay.**

High humidities, when combined with high temperatures often result in the growth of surface mould on certain products, concrete and other cement products (cement mortar rendering, concrete tiles) are susceptible to intense blackening of exposed surfaces as a result of algae growth.

ii. **Corrosion of metals**

High humidities quicken the corrosion of metals in particular – galvanized iron sheets and retard evaporation from wet surfaces.

iii. **Moisture movement in block walls**

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[13] Ibid, P. 20 - 24

It is one of the major causes of cracking, in concrete block walls. Such cracking may not be serious from a structural stand point, it looks unsightly, and it is disconcerting to occupants and has a detrimental effect on weather resistance.

Make use of vertical control joints which are capable of taking up the small movements in block walls that are the cause of cracking.

B. Rainfall

Rates of precipitation will determine drainage requirements while wind speeds at the time of rain will influence the weather proofness necessary for the construction. The quantity and intensity of rainfall will influence the choice of roof pitch, and desirability, or not of roof overhangs, and the size of gutters.

The heavy down pours that occur over much of Kenya necessitate provisions for the drainage of surface water. Problems which result from inadequate surface drainage provisions are to be seen most dramatically in dense squatter areas.

Considerable black splash of rain off bear ground against external walls can occur during heavy rain and this needs to be planned for if unpleasant markings are to be avoided.

3. WINDS

They affect ventilation condition and human comfort, the structural damage of sweeping off of light weight roofs.[14]

[14] Charles Hopper, ibid, p. 24

2.3.0. HUMAN COMFORT.

2.3.1. Indoor Comfort

As explained by Charles Hopper[15] overheating is commonly experienced in houses particularly those with large unprotected windows and uninsulated sheet roofs, as a result of solar heat gain. While most overheating of interiors occurs during the day, the reluctance of many occupants to keep window open after dark can lead to unpleasant warm rooms at night.

Problems of overheating are particularly severe both during the day and in the evening in urban, "barrack", type of housing where whole families are living, sleeping and cooking in single "back to back" rooms.

Koenisberger, O. H.[16] has stated:

> *"The task of the designer is to create the best possible indoor climate. The Occupants of a building judge the quality of the design from a physical as well as an emotional point of view".*

It is therefore a challenge for the designer to strive towards optimum of total comfort, which may be defined as the sensation of complete physical and mental well being.

Human responses to the thermal environment do not depend on air temperature alone. It has been established that air temperature, humidity, radiation and air movement all produce thermal effect and must be considered simultaneously if human responses are to be predicted.

Effects of prolonged exposure

Prolonged exposure to discomfort conditions can produce adverse effects even if the physiological control mechanisms can maintain life (e.g. with a constant high rate of

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[15] Charles Hopper, ibid, p. 102.

[16] Koenigsberger, O.H., (1973), **Manual of Tropical Housing and building,** Longman Group Ltd, London, p 41.

sweating and permanent vaso-dilation) there is a considerable loss of efficiency in work coupled with physical strains.

Human comfort is subject to the following variables:[17]

a). Clothing
b). Acclimatization
c). Age and sex
d). Body shape
e). Subcutaneous fat
f). Food and drink
g). Skin and colour

2.3.2. Ventilation

Charles Hopper[18] explains that air movement is not a requisite for human comfort for air temperatures only rarely exceed the upper limit of comfort, physiological cooling of the body is necessary.

Air change is however necessary for the convective cooling of interiors that is often required to contract the build up of internal heat that result is often required to counteract the build up of internal heat that results from the solar heating of the building fabric, cooking, human activity e.t.c. An adequate air supply can be ensured by keeping the windows and doors open.

Functions of ventilation. [19]

I. To maintain the quality of air in houses above a certain minimum level by replacing indoor air, contaminated in the process of living with fresh out door air.
II. To cool, in hot regions, the structure of the houses during the night when indoor temperatures are higher than those outside.
III. Provide thermal comfort by increasing the heat loss from the body and preventing discomfort due to moist skin.

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[17] Ibid, p. 45
[18] Charles, H., ibid, p.20

Comfort requirements can affect all aspects of building design, such as[20]:

a. Orientation.

b. Size

c. Location of windows

d. Layout of surroundings

1. Housing Layout.

The spacing of houses is not critical climatically as air movement is not a prerequisite of comfort.

2. Orientation.

Housing layouts should preferably make it possible for all houses to be oriented with their main elevation, facing North and South so that solar heat gains can be minimized. The orientation of layouts need not be influenced by wind directions.

3. House form.

Houses should be compact so as to reduce solar heat gains and minimize nocturnal heat losses. The need for cross-ventilation has an immediate impact on house forms, since it suggests the adoption of single-banked houses, i.e houses which are only one room deep. Adequate cross-ventilation may, however also be achieved in houses that are not single banked.

4. Plan arrangement.

North facing rooms can be expected to be cooler than South facing rooms, during the hot season and marginally warmer during the cold season, as north elevations are subject to no insulations during the hottest months (December to March) but unlike South elevations receive some insulations during the coolest months (June to September).

Internal room arrangement.[21]

Windows and doors should be positioned so as to ensure that air flowing between them crosses internal spaces as fully as possible. Dead air pockets should be avoided both in plan and in section.

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[19] Ibid pg. 26.

[20] Ibid, P. 102-114

[21] Ibid p. 26.

5. Walls.

East and particularly West walls should if at all possible be constructed with heavy materials. Light weight constructions are acceptable for internal walls, which receive no solar radiation and for North and South walls which receive only limited amounts of radiation.

External surfaces.

Light and reflective external surfaces are essential for light weight walls and roofs and more desirable for medium weight walls and roofs.

6. Openings.

I. Size of opening.

A window area comprising some 20% of the elevation area of houses will be quite adequate for ventilation and day lighting[22]

II. Type of openings.

Glared openings are generally preferred by users. This is due to daylight.

It is important that openings, doors and windows can be adequately closed and that they are sufficiently close fitting to prevent bad draught.

III. Louvres and casement.

Louver windows provide directional control of incoming air, are easy to clean but are vulnerable to breakage and can cause draughts and leaks.

Casement windows are stronger steadier and more secure, though damage to fixing rods and catches is not uncommon.

IV. Location of openings.

Best located in North and South walls, but are acceptable in north-east, Southeast and east walls, as morning sun is not usually unwelcome indoors.

Openings on wells, North West and South West walls should, however be avoided as these can give rise to overheating indoors or hot afternoons.

Roof lights should never be used due to the strength of the overhead sun.

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[22] Charles Hooper, ibid, pg 113

7. Natural ventilation.

Natural ventilation of buildings results from two forces[23]:

(I). Thermal forces

(II). Wind forces.

It is possible to utilize thermal forces to ventilate a room provided that there is a difference in temperatures and hence a difference in density between the air in the room and the air outside by placing two openings at different heights.

When the indoor temperatures is higher than the outdoor temperature the warmer and less dense air within the room will rise and leave through the top opening to be replaced by cooler and denser air entering through the bottom openings. This process is referred to as the *"Stack effect"*.

Limitations.

Natural ventilation can not either ensures a specified air change or is it possible to filter the air before it enters the buildings. If the air inside is at the same temperatures as the outside and there ventilation is non existent.

Nevertheless with adequate structural controls, the task of mechanical controls is radically reduced. Moreover when conditions are such that only a degree of discomfort is in question, i.e. when the risk is light the use of mechanical controls is optional.

According to Koenisberger O. H[24];

"One of the basic needs of humans is change and variation noticeable in mechanically controlled environments such as air conditioned buildings"

What the designer should therefore aim is a range of comfort conditions.

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[23]Ibid, P. 24

8. Mechanical ventilation.

Koenigsberger O. H[25], has listed and explained the various types of mechanical ventilators as follows:

Types of fans.

(I). Propeller.

(II). Centrifugal

(III). Axial Flow Fans.

The installation can take the following forms:

a. Exhaust system.

b. A Plenum system

c. A balanced system.

The form of cooling by air, movement is the *"psychological cooling"* by directing an air stream of substantial velocity at the body surface. This is achieved by table-top ceiling mounted fans (punkahs) which do not provide air exchange but generate an air movement.

9. Air Conditioning.

Air applied to a room or building by mechanical means can be[26]; propelled, filtered, washed, humidified, cooled, dehumidified and heated or reheated.

The collective term for the machinery which carries out all these functions is *"air handling plant"* and the installation is referred to as air conditioning.

In summary there are four methods of reduction of solar heat again through windows and of which are within the control of the designer, namely[27]:

(I). Orientation.

(II). Internal blinds and curtains.

(III). Special glasses.

(IV). Shading devices which are further subdivided into:

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[24] Koenigsberger, O.H., (1973), **Manual of Tropical Housing and Building**, Longmangroup Ltd, London , p. 45

[25] Ibid, p. 94

[26] Palo, A.J.,(1987), "Ventilation as a Thermal Control Design Factor", Unpublished Thesis, university of Nairobi, p. 21

[27] Koenigsberger, ibid, 103,105,112.

a. Vertical devices consisting of louvre blades or projecting fins in a vertical position.

b. Horizontal devices-canopies horizontal louvre blades, externally applied Venetian blinds.

c. Egg-crate devices-combinations of horizontal and vertical elements.

2.3.3 Day lighting.

David. O[28] has noted that day lighting is dependent upon the use of the various spaces. All rooms require enough light to enable dirt to be seen and to permit ordinary household tasks to be done. Sunrays are a cleaning agent that can aid health and cleanliness by being permitted occasional entry.

The purpose of lighting is two fold[29]:

a. Practical-to facilitate the performance of a visual task and ensure visual comfort.

b. Artistic (for lack of a better term) - to create a certain emotional comfort.

However due to the accompanying thermal radiation, over lighting would mean over heating and overheating would cause much greater discomfort than under-lighting.

2.4.0 COMPONENTIAL ANALYSIS OF BUILDING FAILURES AND CAUSES.

These were studied and researched by Onesmus. M[30] and are as follows:

2.4.1 Walls.

Cracks may be either random, vertical, diagonal or horizontal, flaking of top coat rendering, shelling and bulging of the plaster finishing coat, general surface erosion, crumbling of mortar joints, efflorescence dampness, flaking and blistering of paint work.

Random cracks. These are mainly caused by current based finishes. When the specification of the mix is strong like 1:3 (cement: sand ratio), then the finish is bound to crack as a result of shrinkage.

Rendering prevents the rapid evaporation of water and the back ground remains wet, leading to divorcing of the rendering and the background.

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[28] David, O.A (1961), **Tropical Houses**, B.T Batsford ltd, London , p. 112

[29] Koenigsberberger, ibid,p. 138

[30] Onesmus, M.N, (1987), "A Study of the Role of Design in Building Failures with Special Reference to Government Owned Residential Buildings within Nairobi Area," Unpublished M.A Thesis, university of Nairobi, p. 45-54.

Also specification for the trowelling of smooth faced rendering is liable to induce cracking earlier than would be the case with textured rendering and make them more prone to this defect.

Flaking and Shading of the top coat of rendering.

When cement-rich mix is applied to a layer that is less rich, the top coat will shrink more than the under coat is relatively physically weak, the top will curl off bringing with it small pieces of the undercoat.

Other forms of cracks are caused by differential moisture movement between adjacent parts of the structure leading to foundation movements.

Others are due to expansion and curing of the building materials during curing and ageing.

Horizontal cracking may occur in mortar joints at about 300mm intervals or every 4^{th} course with or without dampness on the inside surface. This is mainly due to corrosion of metal tiles or reinforcement bars due to inadequate covering.

Dampness on walls.

May be due to the construction water used in setting of materials such as Portland cement and other uses. Water intruding or entering the building as a result of rainfall, either directly by absorption, through condensation, leaking pipes, tanks and cisterns or the use of excessive amounts of cleaning water can make contribution especially when it seeps underneath floor covering.

Efflorescence is the appearance of soluble salt at the walling surfaces after they have been carried there in solution and then water has evaporated.

It may also occur in painted surfaces but this should not be confused with a defect of the paint itself.

Blistering, Flaking or discolourization of paint work. This can either occur on rendered surfaces or on timber wall cladding, Blistering is due to the presence of water in the rendering in which is prevented from evaporating, by the impervious film. The paint film cracks and peels back from the cracks.

Discolourization may range from a complete change of colour to the occurrence of coloured patches. This disclourization is mainly caused by dampness and chemical action.

Crumbling/Powdering or cracking of mortar joints.

This is due to the mortar having been incorrectly proportioned, in which cases it is weak through out the joint.

Horizontal cracks are usually as a result of either sulphate attack of the cement in the mortar or shrinkage. Ages of the building, perse, may also contribute to general surface erosion, weathering, crumbling and powdering of mortar joints.

2.4.2 Floors.

Onesmus M.N[31] has reviewed literature on defects on floors and are as follows:-

Excessive deflection of screed- This may take place due to inadequate design, poor workmanship, and movement of the peripheral or intermediate support, superimposed loads higher than those which the floor was designed for, shrinkage of concrete.

Ground floor concrete Lifting and Curling-

Due to sulphate attack and use of unsuitable aggregates, this may cause the concrete to expand.

Concrete Finishing and concrete slabs disintegrating-

There has to be attack by acids, sugar, certain salt solutions regrettable and animal oils, and cooking fat.

Hollowness, Lifting and curling of the concrete screed.

Due to poor preparation and cleaning of the surfaces of the base on which the screed has to be laid, incorrect design, unsuitable mix specification, poor workmanship either due to the mix being too wet or too dry, too rapid drying of the screed leaving it weak.

Lifting or aching of Floor woodblock finishes.

This is due to increase in the moisture content of the blocks which cause them to swell and set up comprehensive forces. This increase in moisture content may either be done to absorption of water from the rising dampness on water from the users, used for cleaning.

When woodblocks are laid under very dry condition in a building where subsequently the atmospheric humidity is high.

Lifting and arching of clay tiles-due to thermal expansion and contraction and shrinking of freshly laid screeds as they dry.

Lifting of thermoplastic and pvc asbestos tiles floor finishers- It is caused by general loss of adhesion by water which has been made alkaline by its passage through concrete base on which the tiles are laid, excessive use of water.

- Gross spillage of water into the floor.

2.4.3 Slab ceilings.

Common failures include; cracks, loss of adhesion of plastics on concrete, peeling /flaking of painted finishes.

Cracks- Occur as a result of shrinkage due to deflation of the floor. This deflection occurs either because the floor was not correctly disguised or because it has been overloaded.

Loss of adhesion. - is a result of the undercoat not being strong enough to withstand any movement of the finish coat, use of wrong plaster or mix especially if the concrete surface was smooth, condensation will cause the peeling and flaking of painted finishes.

2.5.0 AESTHETICS.

David Oakley[32]; states that:

"Ugliness in manmade things is a sin to be ousted and shamed by beauty."

Beauty should be treated as real human need. Aesthetics is the responsibility of all design professionals.

Designers must make rational decisions in case where the aesthetic factors must be considered concurrently with; social, technical, economic, and ecological factors.

The important implication is that different individuals will make different value judgments of the same aesthetic features. This attitude is reflected in the cliché

"Beauty is in the eyes of the beholder"

It is normally difficult if not impossible, to trace a high incidence of anti-social behaviour

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[31] Onesmus.M.N, ibid, p. 54-60.

[32] David. O., (1961), **Tropical Houses**, B.t Batsford Ltd, London, p. 219

to generally prevalent poor architectural (or other) design. The important thing is establishing a communicative link between project designers and the community intended upon.

Bagley M.D[33] notes that:

"One can predict perhaps that an effort to make a structure pleasing to the surrounding community may carry a message that their value as people with feelings has been considered"

Bagley[34] further suggests that:

"If art and aesthetic concepts are truly a reflection of our society, then we must examine our way of life, a direction advocated by a majority of art historians--- our social structure, our methods of production and distribution, the accumulation of capital and the incidence of taxation----to decide whether it is not in these factors that we should look for an explanation of our aesthetic importance"

2.6.0 SECURITY.

For the fortunate, home is a refuge from other stresses. For those being abused in their houses or those afraid of the threat immediately outside their doors, "home" is the source of their most extreme stress. Thus the need to have safe homes.

Paul stollard[35] quips that:

"Security is only one of many factors which need to be considered when designing housing. It should not be the main aim, but it should perhaps be given greater priority than at present. Designing to deter does not necessarily detract from, no require drastic changes in, building form or site layout, provided it is considered at the design stage."

To suggest that better design and layout can offer solutions to the problems of crime and security on new and existing housing developments is to ignore a whole range of social and economic factors, which can affect the levels of crime in a particular area.

Defensive design has a role in crimes prevention, but factors such as unemployment, poverty, social stress and bad management simply cannot be designed out. Other factors

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[33] Bagley, M.D., (1973), **Aesthetics in Environmental Planning,** Environmental Research Center, Washington, p. 5.

[34] Ibid,pg 25.

[35] Paul, S.,(1991), **Crime Prevention through Housing Design,** Chapman and hall Ltd, London , p. 71.

affecting crime include, style of housing management, mix of tenancies and available social amenities.

Some design features do appear to exacerbate local crime problems although the same features in a different situation may not have the same effect.

It's advisable that Architects, planners and housing managers must work together with residents and local communities to develop an accurate pictures of what is happening and to try and identify why problems exist before they can formulate solutions.

2.6.1 The effect of design on crime.

There are three basic elements necessary for a person to commit a crime[36]:

(I). Ability.

(II). Opportunity.

(III). Motive.

The provision of building security through designs attempts to eliminate or reduce the intruder's ability and opportunity to commit a crime. This in turn should also reduce their motivation.

The factors influencing burglar choice of targets are:

a. Surveillability.

b. Occupancy.

Designs which discourage outsiders from entering the neighborhood may be counterproductive as they stem healthy flow of passers by and leave the field open to local miscreants.

Although buildings and their surroundings need to be designed with security in mind, over reliance on defensive measures can create other problems.

Blatantly defensive hardware may even be seen as a challenge to the aspiring delinquent.

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[36] Paul, S., ibid, p 7

2.6.2 Principles.

Paul. S[37]has identified key principles for architects, designers, planners and housing managers, some of them are as follows:

(i). Surveillance.

a. Natural surveillance- Opportunist crime is likely to be reduced if the potential offender feels there is or may be someone watching.

b. Dwelling Orientation- its significant in determining the amount of natural surveillance provided.

(ii). Neighbourhood –

Designing layouts which fosters a sense of neighbourhood lines or community will contribute towards making intruders feel conspicuous since residents will be more able to identify who does or does not belong there.

(iii). Comprehensive approaches.

Design and layout should be considered in conjunction with other security strategies, such as target hardening measures i.e. increasing the resistance of likely points of entry, making entries into dwellings more deficient etc.

(iv). Collaborative approaches.

These include:

a. Daily management of the completed estate.

b. Inclusion of management in the design process.

c. Rented houses require good land lords regardless of designs.

The inclusion of design oriented questions as standard in any police crime statistical survey is important.

This would enable designers to readily acquire design information. At present only details concerning the offender are recorded such as age, race and gender. In future, it should be possible to include information about the offense itself, e.g where crimes occur, what types of dwellings are attacked, or how entry was made.

2.6.3 Security of Doors and Windows.

The designer of window security grillers and bars merits careful consideration. Unless this is given, the completed house may well look like a prison.

It is important to note that the security value of any door or window is dependant on the type and construction, strength and reliability of hardware locking mechanisms, strengths and fixing of frames, the adequacy of any glazing and degree of visibility. As a safety precaution glazed panels should not be located near locks.

2.6.4 Residential streets: What to look for has been explained by Gerda et al[38] as follows:

a. Lighting.

Lighting should be sufficient to see a person approaching at a distance of say 15 feet. Moreover the lighting should be sufficient for the side walks as well as the street.

b. Lane way.

Entrances to alleys or laneways need to be well lit and clearly visible from the street.

2.6.5 Interior spaces in multi-unit housing.

Stairwells, Laundry rooms, elevators and entrances, to buildings are often cited by residents as sites of assaults.[39]

What these places have in common is isolation and poor sightlines. Security conscious design is not the complete answer to improving security in multi-story housing. Ongoing process issues, including tenant involvement in choosing and maintaining security features, housing allocation, staff (tenant relations and inter-tenant conflict resolution are security issues that need to be on the table when a safety strategy is being discussed for a building.)

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[37] Ibid, p. 21.

[38] Gerda,W.,etal, (1995), **Safe Cities,** Van Nostrand and Reinhold Ltd, London , p. 110.

[39] Ibid, pg 123.

2.6.6 Lighting

Lighting of common areas such as corridors, entrances, elevators and stairwells need to be adequate. Moreover areas of shadow can be avoided through the use of more lighting fixtures.

2.7.0 CONCLUSION.

Even though many researchers have investigated the influence of climate on building designs, aesthetics and security aspects of a building. It does not seem to be of use, to the construction of the majority of low income group's flats in Kenya.

Faceless buildings that lack the architectural appeal have been emerging. Not all the inadequacies can be studied, given the limited time available.

An investigation is needed to be done, as to why; poorly designed buildings are still being churned out by the construction industry. Who is to blame for these poor designs.

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CHAPTER THREE

3.00 DATA PRESENTATION AND ANALYSIS

3.1.0 INTRODUCTION

This chapter's main aim is to establish on whether various parties involved in construction of buildings, have contributed to the problems associated with building designs. It attempts to:

a) Find out what are the effects of tropical climate on building designs.
b) Identify the causes of thermal discomfort in buildings
c) Examine the aesthetics and security aspects of designs from the tenants view
d) Examine the floor, wall and slab ceiling failures
e) Establish whether building professionals are consulted before buildings are designed.

There are three categories of questionnaires administered. These are to:

1) Tenants
2) Landlords
3) Architects

For the tenants 30 building units were studied, and on each building three questionnaires were given. One on the ground floor, the next one on the middle storey and the final one on the top most floor or storey. This was necessitated by the fact of trying to avoid bias. Tenants on different floors hold different views, despite the fact that the building is one. The following table shows the number of distributed questionnaires in each category and the number returned answered

Table 3.0.1Total number of questionnaires distributed and those returned.

Category	Questionnaires distributed(No)	Questionnaires returned answered	Percentage (%)
Tenant	90	84	93.3
Landlords	12	8	66.7
Architects	30	22	73.3

Source: Own Field Survey

Most questionnaires were returned i.e. tenants 93.3%, landlords 66.7% and Architects 73.0% the information provided can therefore be relied upon.

The questionnaires to the landlord were reduced to 12 due to limitation of time, and the problems encountered, see section 3.1.1.

3.1.1. Problems encountered with:

Landlords

There erupted a clash between the residents and some youths sent to evict tenants for non-payment. 13 people were killed in the rent battle.[40] This happened on the researcher's case study, area.

The researcher therefore managed to get only 8 questionnaires from the landlords unlike the projected 30.

The research had therefore to be terminated prematurely. Before peace resumes in the place, the handing in of the project will be due.

Most of the landlords were skeptical about the motive of the researcher. They thought that the researcher was one of the government's agent or city council's agent for that matter, who was cross checking on those inadequately designed buildings and then report them to the authorities, so that some action can be taken against them.

Others mistook the researcher as a spy of certain stealing groups (gangs) and thought that the researcher was doing groundwork for the same.

On extending a request to interview some tenants. Some other landlords became more suspicious and had to refuse this adamantly, citing that they are not in good terms with their tenants concerning rental payments.

Even after explaining that the research had nothing to do with payment. They still could not allow the researcher to interview and hand them some questionnaires. The landlords

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[40] Daily Nation, "13 killed in rent battle" No 13408(June 4, 2003), P.1.

explained that some of the problems these tenants are undergoing through e.g. lack of electricity etc, was a way of trying to chase them away.

The researcher was suspicious about some of the reasons put forward and felt that, these landlords were trying to protect their poorly, inadequately designed buildings. They did not want these problems, to be exposed or highlighted.

Some other landlords thought that the researcher is an agent who can solve problems or conflicts they are having with their neighbouring landlords concerning the buildings constructed. They feared that some of the storeyed buildings could collapse at their own buildings at any time. They were ready to give the researcher the plot number, owner's name so that an immediate action can be taken.

Other landlords the researcher came across had inherited the property and therefore could not assist with necessary information for this research.

Despite all these doubting or suspicions the researcher had the necessary research permit and other introductory letters.

Tenants

Some tenants wanted to know or rather were curious on what will be done to assist them due to the inadequately designed buildings. They were questioning on whether the researcher was an agent from the government or the city council. The researcher had to elaborate that this is just an academic research and there is nothing the researcher can do to assist them.

Others saw the research as an opportunity to benefit them financially and were demanding "kitu kidogo" or money, in order for them to fill the questionnaire.

While taking photographs, even after prior notice to the building management agents. The researcher encountered problems when taking the snap shorts. The problems were brought about by people who happened to be near the buildings especially the youths. They thought these photographs had some sinister motive and the researcher was either a

police, a criminal investigation department (C.I.D) agent, or wanted to report them to the police. Thus the photo graphs acting as a guide for the police.

The researcher was even threatened that the camera would be snatched, if he goes further, taking the snaps.

It dawned to the researchers that most of the youths engaged in illegal deals, are either thugs, etc. hence the fear of photographs being taken.

While dishing out the questionnaire, most of the tenants could not allow the researcher inside the buildings as they held him as a suspect or an agent of a gang or thieves, doing a survey on the buildings to strike on. Those who agreed to answer the questionnaires cautioned the researcher to take care, as the area he was treading on is a dangerous zone.

Architects

As directed from the members list from Architectural Association of Kenya (A.A.K). Some of the building names, where these Architects are housed have changed names. Tracing them was problematic.

Some other Architects did not even have a sign on their doors to identify them, thus the researcher was being shifted from one room to another then back again to the same room. Other architects had shifted from buildings indicated in the membership list to other unknown destinations. The researcher had therefore to seek for other available and willing architects.

3.2.0 THE EFFECTS OF TROPICAL CLIMATE ON BUILDING DESIGNS

Most of the tenants experienced thermal discomfort, as can be depicted from the table below.

Table 3.1.1Confirmation on whether the tenants were experiencing thermal discomfort.

Response	Frequency	Percentage(%)
Yes	65	77.4
No	12	14.3
Undecided	7	8.3
Total	84	100.0

Source: Own field survey

From table 3.1.1, 77.4% of the tenants were experiencing thermal discomfort, 14.3% hand no problems and 8.3% were undecided or neutral i.e. they could not tell whether this problem is there or not.

Despite the fact that thermal discomfort can be influenced by age, type of clothing, acclimatization and housing density. The researcher was –of the view that among the above-mentioned factors, the one closely related to design was the housing density. To try finding out whether this thermal discomfort was due to the influence of climate and housing density.

The occupancy per room per household unit was as follows:

$$\text{Occupancy per room} = \frac{Number\ \ of\ \ occupants}{Number\ \ of\ \ rooms}$$

Table 3.1.2 Occupancy per room

Number of rooms	Number of occupants	Persons/room
96	354	4

Source: Own field survey

These rooms were very small as the researcher observed. Four persons per room can therefore be said to be overcrowding.

In order to test further whether climate has really affected the comfort in these buildings. Study was done on the times, when this thermal discomfort is experienced.

Table 3.1.3 Times of experiencing thermal discomfort

Time	Frequency	Percentage(%)
Morning	0	0
Noon	37	44.0
Evening	25	29.8
All the above	16	19.0
No overheating	6	7.2
Total	84	100.0

Source: Own Field Survey.

As shown on table 3.1.3, climate (weather) has caused the overheating of spaces, especially in the afternoon (44.0%). As for the discomfort experienced in the evening (29.8%). This could be attributed to overcrowding, cooking being done in the same room i.e. room being multipurpose i.e. dining, sleeping and even as kitchens.

Those experiencing overheating at any time (19.0%) the reasons are as aforesaid. Only 7.2% had no problems of overheating of spaces.

3.2.1 Type of external wall

Table 3.1.4 Type of wall

Type	Frequency	Percentage (%)
a) Masonry	84	100
b) Bricks	0	0
c) Concrete block	0	0

Source: Own field survey

All the building units (100%) had masonry as the walling materials. Thus good weather proofness against rainfall and high temperatures. Moreover less external maintenance needed.

3.2.2 External wall finishes

As for the designing of the external of the wall. It was as follows:

Table 3.1.5 External wall finishes

External wall finish	Frequency	Percentage (%)
Painted	72	85.7
Rendered	42	50.0
Pointed	18	21.4

Source: Own field survey.

Majority of these buildings were painted (85.7%). The painting was mostly done on the rendered parts of the building. These are along the external faces of beams and window lintels. The painting was done to protect the rendering against the adverse effects of weather and also add beauty to the building.

Only 50% of the building units were rendered, and 21.4% were pointed in order to add beauty.

To verify whether the painting was to assist in reflection of sunlight, or addition of beauty. The following were the different colours noted on the buildings.

Table 3.1.6 The different varieties of colour used.

Colour	Frequency	Percentage (%)
Black	0	0
White	60	71.4
Grey	11	13.1
Brown	7	8.3
Others	24	28.6

Source: Own field survey

White colour being a good reflector of sunlight as seen from the table i.e. 71.4%.

None of the building units (0%) had colour black. thus the overheating of spaces could not have been caused by absorption of solar energy, due to the colour of paint.

Grey had a percentage of 13.1 though it's not a good absorber of solar heat as compared to black, neither is it a good reflector as white.

Only 8.3% had colour brown, this also is a good radiation absorber.

As for the other colours (28.6%), these are mainly used for decoration purposes. They ranged from all sought of colours one can think of.

3.2.3 Effects of solar radiation, mould growth and biological decay

Table 3.1.7 Effects of solar radiation, mould growth and biological decay

Defects	Frequency	Percentage (%)
1) Fading of paint	57	67.9
2) Blackening of wall finish	45	53.6

Source: Own field survey

Solar radiation causes deterioration of paint in this case, fading which is 67.9%. As for the blackening of wall finish (53.6%), also see plate 2,

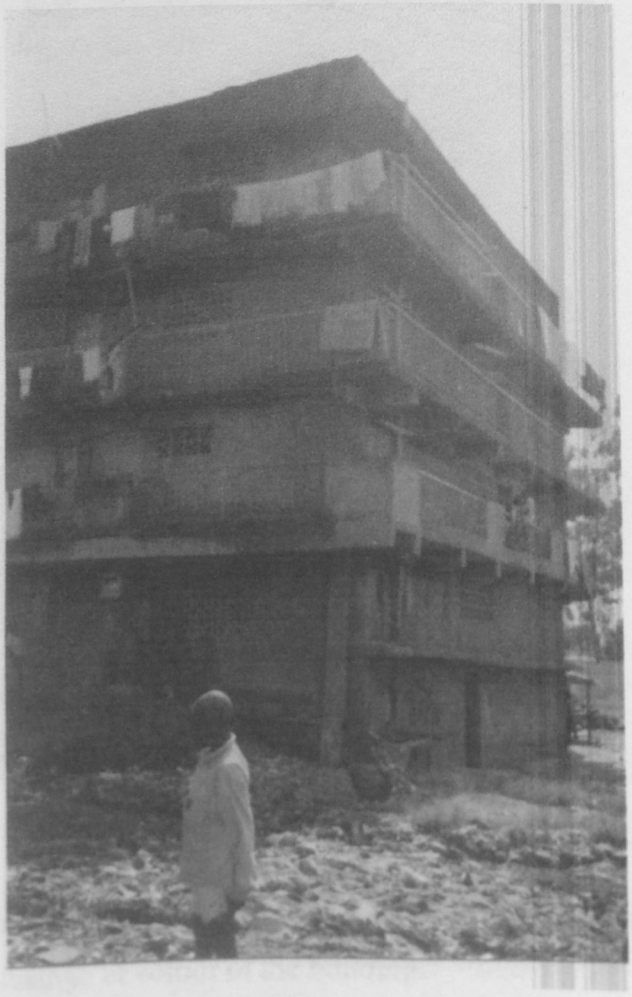


Plate2: Blackening and dirty decorations on rendering as a result of the effects of weather elements.

it is being caused by high humidities, being combined with high temperature and thus resulting to growth of surface mould or algae growth. Lack of maintenance on leaking soil pipes, can result on the same, see plate 3.

Plate3: Lack of repair or maintenance of soil pipes has led to leakages and encourage growth of mould and change of colour of the building.

To try and confirm what the landlord does to avert these defects i.e. how often he/she maintains the building, the following were the results.

Table 3.1.8 Frequency of maintenance

Maintenance	Frequency	Percentage(%)
a) After the following months		
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
b) After the following years		
1	4	4.8
2	0	0
3	0	0
4	0	0
5	0	0

Source: Own field survey.

Even though solar radiation affects the external wall finishes. The landlords are the blame for not maintaining their buildings. As seen from table 3.1.8 only 4.8% of the occupants reported external wall and finishes being maintained and this is done after one year. The remaining 95.2% reported to having never seen maintenance of which ever nature, taking place, even though they have lived for 3,4 and 5 years in those buildings.

3.2.4 Reduction of solar heat gains through windows

Table 3.1.9 Solar heat reduction means

Means	Frequency	Percentage (%)
1) Sunbrakers		
a) Yes	6	7.1
b) No	78	92.9
2) Curtains and blinds		
(a) Yes	77	91.7
(b) No	7	8.3

Source: Own field survey.

7.1% of the buildings had sunbreakers and this were in the form of canopies because all the respondents who admitted the buildings having sunbrakers, ticked the part indicating the sunbrakers being horizontal; this is in the questionnaires addressed to tenants, 92.9% had no sunbreakers.

Similarly only 8.3% of the occupants had no curtains and blinds.

Whereas the remaining 91.7% had the same.

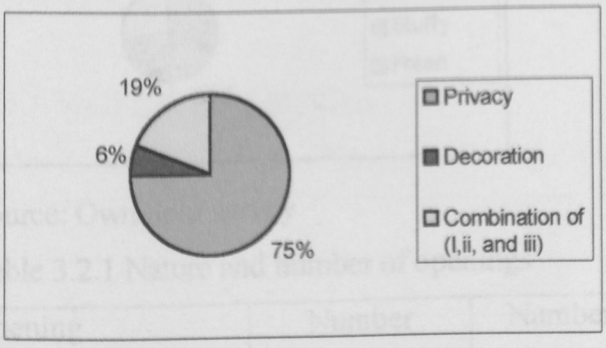
In order to confirm whether the curtains and blinds were purposely meant to sunshade the building. The findings were as follows:

Table 3.1.10 Importance of curtains and blinds

Use	Frequency	Percentage(%)
i) Privacy	63	75
ii) Sunshading	0	0
iii) Decoration	5	6
iv) Combination of (i, ii, and iii)	16	19

Source: Own field survey

Figure 1: Pie chart Importance of curtains and blind.



Sources: Own field survey

None of the tenants (0%) admitted to curtains being used as sunshading devices only. Majority of the respondents, 75% use curtain for privacy only. Though this is one of the uses, it should not solely be so, 6% of the respondents used them for decoration.

The remaining 19% who said the use of curtains and blinds to be of privacy, sunshading and decoration were the only group aware of the uses of curtains and blinds. No wonder most of the respondents had curtains that could not let the sun's rays penetrate them.

3.3.0 Ventilation

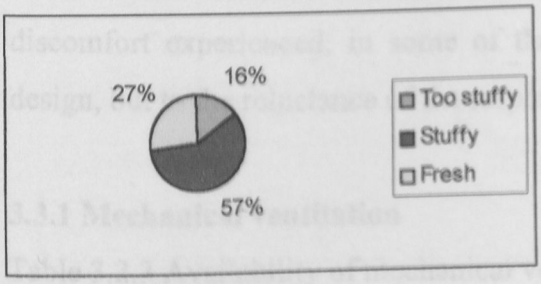
Table 3.2.0 Comments on quality of air in the room

Quality	Frequency	Percentage (%)
(i) Too stuffy	13	15.5
(ii) Stuffy	48	57.1
(iii) Fresh	23	27.4
Total	84	100.0

Source; Own field survey

57.1% found the air in these spaces to be stuffy, 27.4% to be fresh and 15.5% to be too stuffy. As to whether this stuffiness was being caused by the surrounding being filthy and cannot thus bring in fresh air or cannot allow for air changes. The nature and number of ventilation openings in the building were noted. The results were as follows:

Figure 2: Pie chart: Quality of air in the room



Source: Own field survey

Table 3.2.1 Nature and number of openings

Opening	Number	Number of rooms/spaces	Opening /room
i) Doors	96	96	1
ii) Windows	96	96	1
Iii) Vents	54	96	1

Source: Own field survey

Out of the 96 spaces surveyed every space had approximately 1 door, 1 window, and 1 vent block. The number of openings can therefore be said to be low and cannot therefore solve the problem of thermal discomfort due to high temperatures. Thus the stuffiness in this spaces.

An adequate air supply can be ensured by keeping the window open; and thus ventilating the room. To test on whether the tenants or respondents normally open the windows. The results are as shown below.

Table 3.2.2 Regularity of opening windows

Time of opening	Frequency	Percentage (%)
Daily in the morning	49	58.3
Twice in a week	0	0
Thrice in a week	0	0
Closed all the time	10	11.9
Open all the time	15	17.8
Total	84	100.0

Source: Own field survey

As seen majority of these people (58.3%) are aware of the importance of opening the windows daily. 17.7% had it that their windows are open all the time, to some extent there is a lie in this, 11.9% had no idea that windows provide ventilation and therefore the discomfort experienced, in some of these buildings cannot be entirely be blamed on design, but to the reluctance of the respondents to use the openings appropriately.

3.3.1 Mechanical ventilation

Table 3.2.3 Availability of mechanical ventilators (fans)

Response	Frequency	Percentage (%)
Yes	12	14.3
No	72	85.7
Total	84	100.0

Source: Own field survey.

Most of the rooms/ spaces (85.7%) had no fans. This explains the discomfort experienced in these rooms. Natural ventilation is not always possible, and thus the need of fans, only 14.3% had these fans.

3.4.0 Componental analysis of building failures

Where:

01 Building materials
02 Intensity of use
03 Shape of building
04 Age of building
05 Density of housing
06 User
07 Poor maintenance
08 Site condition

Table 3.3.0 Defects and possible causes

DEFECTS	FREQUENCY OF POSSIBLE CAUSES							
(A) WALLS	01	02	03	04	05	06	07	08
(I) External								
1. Random cracks on rendering	9			3				
2. General cracking	31			17				
3. Flaking of paint	8			10				
4. Blistering of paint work	12							
5. Dirty decoration						4	32	
(II) Internal								
1. Cracked plasterwork	10			8				
2. Discoloured plasterwork	9			6				
3. Decorations							58	
4. Walls looking damp							5	
(B) FLOOR/SLAB CEILING								
1. Concrete floor/slab ceiling cracking	12	3		13	20			
2. Indentation		5						

Source: Field survey

Table 3.3.1 Percentage (%) contribution of possible causes on defects

DEFECTS	FREQUENCY OF POSSIBLE CAUSES							
(A) Walls	01	02	03	04	05	06	07	08
(I) External								
1. Random cracks on rendering	10.7			3.6				
2. General cracking	36.9			20.2				
3. Flaking of paint	9.5			11.9				
4. Blistering of paint work	14.3							
5. Dirty decoration							4.8	38.1
(II) Internal								
1. Cracked plasterworks.	11.9			9.5				
2. Discoloured / Blistered	10.7			7.1				
3. Decorations							69.0	
4. Walls looking damp							6.0	
B FLOOR/SLAB/CEILING								
1. Concrete floor/Slab ceiling cracking	14.3	3.6		15.5	23.0			
2. Indentation								
Total	108.	9.6	0	67.8	23.0	4.8	113.1	0
Average	15.5	4.8	0	11.3	23.0	4.8	37.7	0

Source: Own field survey

From the field survey, an assortment of 11 defects were identified as compared to the 20 defects, theorized in section A of the questionnaire addressed to the tenants.

The percentages shown are for those respondents who noted defects in the buildings. The remaining percentages noted no defects.

As shown from Table 3.3.1

Poor maintenance is the highest ranked possible cause of defects (37.7%), but as seen, the only defects its causing is dirty decorations on internal and external walls, and walls looking damp. The dampness on walls is caused by lack of maintenance on leaking waste

pipes, which lead to other defects like: change in appearance and mould growth as shown on plate 2 & 3.

Density and intensity of housing have 23.0% and 9.6% respectively, but the only failures they are causing are cracks and indentation on floor and ceiling slabs. This is due to overcrowding as shown before.

Building materials cause the majority of defects noticed. Out of the 11 defects, 7 are due to building materials, despite its average percentage coming to 15.5%. These buildings can therefore be said to be constructed from low or poor quality materials,thus the cracking of plasterwork or rendering,see plate 4.

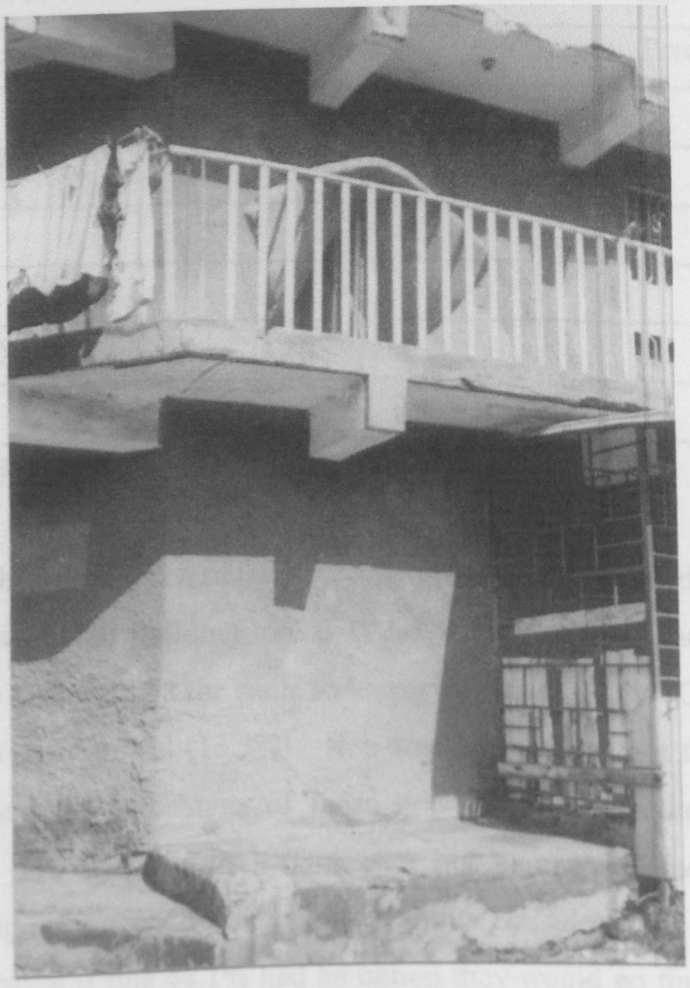


Plate4: Cracks which appears at the ground floor and the first floor as shown have been plastered, hence the non-uniformity of the rendering. As told this cracks are always plastered after every 3 months, because they keep on recurring.

Age of the building is the cause of 6 out of the 11 defects. Its average percentage is 11.3%. Therefore age contributes significantly to some of the defects noted in buildings.

Users cause the least defects, has an average percentage of 4.8%. They cause dirty decorations on external and internal walls or plasterwork of the building. This could be dirty markings, as a result of touching the walls with dirty materials or hands.

This is aggravated by the failure of building owners to maintain the buildings, and thus increases the occupant's negligence or they refuse to have a moral duty and obligation to maintain the building.

3.5.0 AESTHETICS

Table 3.4.0 Opinion or view on the beauty of the building or its overall design

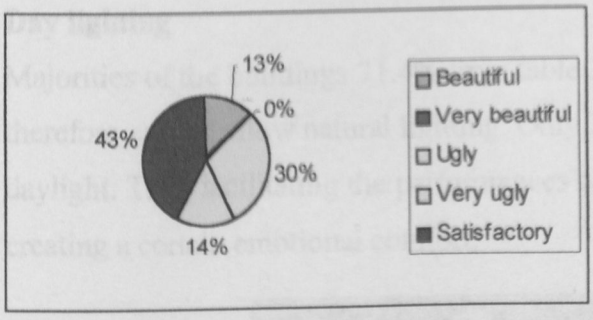
Opinion	Frequency	Percentage (%)
Beautiful	11	13.1
Very beautiful	0	0
Ugly	25	29.8
Very ugly	12	14.3
Satisfactory	36	42.8
Total	84	100.0

Source: Own field survey.

Despite the fact that beauty is subjective, majority of the respondents 42.8% were satisfied with the way their building looks. Those who considered them to be ugly are 29.8%, while those who thought the same to be very ugly are 14.3%. Others surprisingly considered them to be beautiful (13.1%). Non-was of the view that the buildings were very beautiful. The total percentage of those not satisfied with the beauty of these building are (29.8 + 14.3 = 44.1%). This is a big percentage and is the one that necessitates building designers (Architects) to take into considerations the aesthetics part of the design, otherwise if this 44.1% had an option they would go for another building, leading to loss of clientele.

Figure 3

Pie chart: Opinion of the beauty of the building



Source: Own field survey

3.6.0 SECURITY

a) Lighting

Table 3.5.0 Adequacy of lighting

Query	Response		Percentage(%)	
	Yes	No	Yes	No
(i) Whether lighting in common areas are adequate	24	60	28.6	71.4
(ii) Whether areas of shadow are avoided through the use of more lighting fixtures.	24	60	28.6	71.4
(iii) Whether natural lighting is possible	24	60	28.6	71.4
(iv) Whether lighting fixtures are maintained in a clean condition of burned out.	30	54	35.7	64.3
(v) Whether lighting are protected casual vandalism.	12	72	14.3	85.7

Survey: Own field survey

As indicated from table 3.5.0 lighting of common areas such as corridors, entrances, elevation and stairwells are not adequate (71.4%) admitted to this, while 28.6% thought otherwise.

Moreover areas of shadow have not been avoided, as agreed by 71.4% of the respondents, whereas 28.6% refuted this claim. One cannot therefore claim to be safe in such buildings.

Day lighting

Majorities of the buildings 71.4% from table 3.5.0 are poorly designed, see plate 5 and 6 therefore cannot allow natural lighting. Only 28.6% are properly designed and can allow daylight. Thus facilitating the performances of a visual task, ensuring visual comfort and creating a certain emotional comfort.

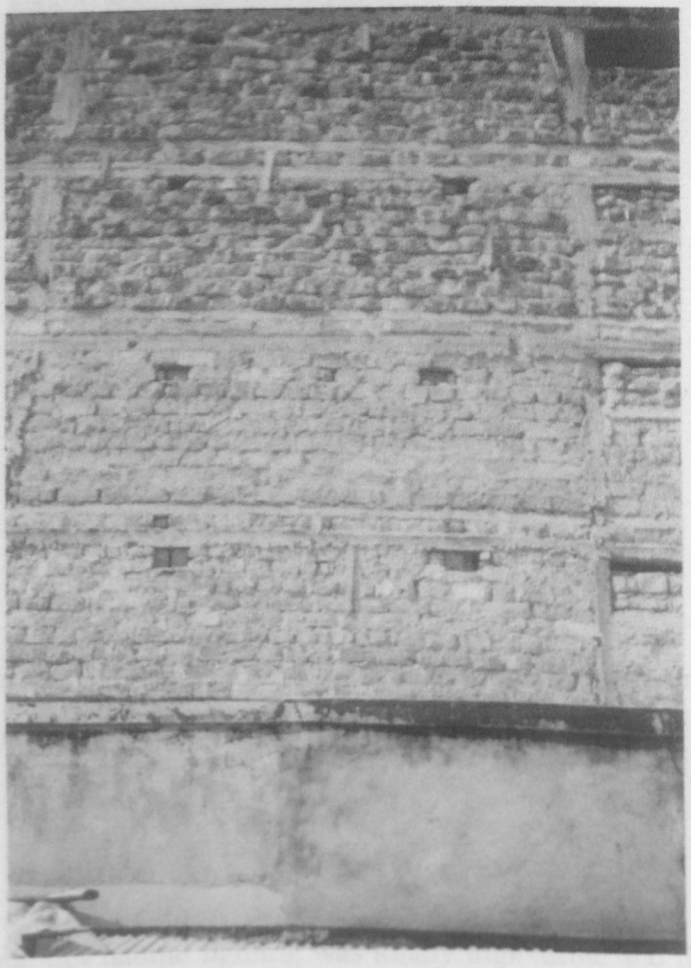


Plate5: Small, very tiny windows on each storey. The size is not adequate enough to bring in daylight. Make no mistake! They are not toilet or bathroom openings.

Plate 6: Formwork was not removed as shown on the photo. Moreover the windows are recessed and covered with paper thus poor natural lighting.

In some of the buildings natural lighting was totally impossible and the tenants, had to light their rooms from morning, till at night when they went to sleep. Mind you some of the buildings had no artificial lighting, implying that only lamps are used. 85.7% of the lightings are not protected from casual vandalism and thus the insecurity being experienced in these places, due to lack of lighting. Only 14.3% of the buildings are protected.

In addition most of the lighting fixtures (64.3%) are not maintained in a clean condition and are not promptly replaced if burnt out, thus rising the level of insecurity. 35.7% are properly maintained and replaced when burn out. This can be attributed to good management.

b) Locking devices

Table 3.5.1 Confirmation of interior door locks being 25mm dead bolt.

Response	Frequency	Percentage (%)
Yes	44	52.4
No	40	47.6
Total	84	100

Source: Own field survey

52.4% of the occupant doors had a 25mm dead bolt. Unlike the 47.6% whose rooms are vulnerable to burglary. Thugs can therefore find their way through quite easily.

c) Residential streets

i) Lighting

Table 3.5.2 Adequacy of street lighting

Query	Frequency		Percentage (%)	
	Yes	No	Yes	No
1) Whether the streets have lightings	30	54	35.7	64.3
2) If yes in (1) above, whether it is sufficient to see a person approaching at a distance.	18	66	21.4	78.6
3) Whether the lighting is sufficient for the sidewalls as well as the streets.	24	60	28.6	71.4

Source: Own field survey

64.3% admitted that the streets have no lightings, whereas only 35.7% opposed this. This implies that walking at night in these places is very dangerous and suicidal.

Lighting should be sufficient to see a person approaching at a distance say of 15 feet, but as the researcher found out. 78.6% agreed that the lightings provided in this areas are not sufficient. This implies that the lighting is only for the building i.e. the area near the building and not for the streets. Only 21.4% of the buildings have lightings purposely designed for security and they are therefore the only safe places.
Furthermore 71.4% admitted that the lighting is not sufficient for the sidewalls as well as the street, 28.6% refuted this.

It can therefore be said that failure to see a person approaching at a distance is as a result of some of the buildings not being provided with security lights.

ii) Lane ways

Table 3.5.3 Are the entrances to laneways well lit.

Response	Frequency	Percentage (%)
Yes	6	7.1
No	78	92.9
Total	84	100.0

Source: Own field survey

As shown the entrances to alleys or laneways are not well lit (92.9%) and are not clearly visible from the street. Only 7.1% said they are well lit as aforesaid.
Laneways can act as havens or dens for thugs, thieves or all kind of evil persons. Most laneways in the case study have been blocked, see plate 7.

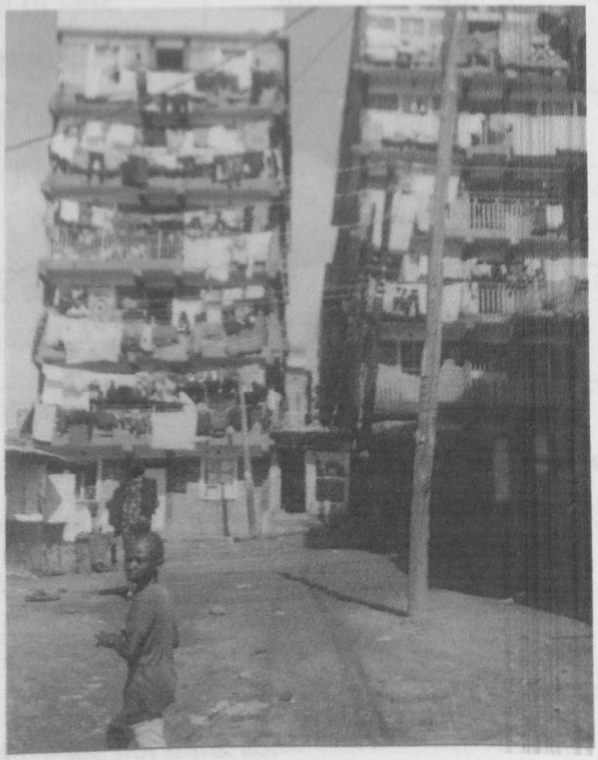


Plate6: Laneways are blocked by extensions of buildings e.g. a butchery as indicated. Thus obstructing the movement of wind, human traffic. Buildings block each other and thus the poor daylighting in some buildings.

iii) Residential pattern

Table 3.5.4. How residential streets are patterned

Query	Response		Percentage (%)	
	Yes	No	Yes	No
1. Whether the layout of new residential streets is predictable.	36	48	42.9	57.1
2. Whether the streets can be linked to an existing grind and pattern of street.	18	66	21.4	78.6
3. Whether a stranger entering a street can know how to get out.	67	17	79.8	20.2

Source: Own field survey

From table 3.5.4, the layout of new residential street is not predictable as indicated by 57.1% of the respondents and only 42.9% opposed this. Therefore no one street resembles the other. In addition 78.6% agreed that the streets cannot be linked to an existing grid and pattern of street, 21.4% refuted this.

A stranger entering a street can know how to get out as concurred by 78.6% of the respondents and 21.45% did not think so.

iv) Direction and information signs

Table 3.5.5 Availability of direction and information signs

Query	Frequency		Percentage (%)	
	Yes	No	Yes	No
1.) Whether there are signs (room number, building name).	42	42	50	50
2.) If no in 1 whether there are directional signs nearby that can help one identify where he/ she is	0	84	0	100
3.) Whether there are signs to show where to get emergency assistance if needed.	11	73	13.1	86.9
4.) Whether exit doors, identify where they exit to.	27	57	32.1	67.9

Source: field survey

Half the respondents (50%) interviewed agreed that there are signs (Room numbers, buildings name), which identifies where you are, while the remaining 50% did not have the aforesaid. Failure to provide these signs can be blamed on the landlord.

Among the 50% who admitted not having signs (room numbers, building name) they all (100%) agreed that there are no directional signs nearby that can help one identify where he/she is.

Still among the respondents only 13.1% agreed that there are signs to show where to get emergency assistance if needed.

Majority 85.71% refuted this. This could be due to lack of emergency assistance after all.

32.1% admitted that exist doors identify where they exist to but majority 67.9% opposed this. Thus it's hard to find your way out in such buildings.

Table 3.5.6 Opinion on the impression of overall signage

Opinion	Frequency	Percentage (%)
Poor	36	42.9
Very poor	24	28.6
Good	16	17.8
Very good	0	0
Satisfactory	9	10.7
Total	84	100.0

Source: Own field survey

As shown the signage in these buildings are inadequate. 42.9% agreed that the signage is poor. 28.6% are of the idea that the signage is very poor. The total amount of those discontented with the signage is about (42.9 + 28.6 = 71.5%) hence the inadequacy in signage. Those contented or find the signage to be good are 17.8% while 10.7% find them to be satisfactory. Hence there is need for the signage to be improved.

iv) Escape route

Table 3.5.7 How easy it would be for an offender to escape

Opinion	Frequency	Percentage (%)
Very easy	36	42.9
Quite easy	24	28.6
Not very easy	24	28.5
Total	84	100.0

Source: Own field survey

An offender will find it very easy to escape as confirmed by 42.9% of the respondents. This is due to the many routes available in this place. 28.6% admitted that it is quite easy while the remaining 28.5% had it that it is not very easy for the offender to escape, hence the high levels of insecurity.

Table 3.5.8 Confirmation on whether the number of exit doors is more than one.

Response	Frequency	Percentage (%)
Yes	30	35.7
No	54	64.3
Total	84	100.0

Source: Own field survey

For a building to be safe it must have more than one exit. This assists during an emergency e.g. fire eruption and thus can form an escape route.

From table 3.5.8 only 35.7% had more than one exit. These same respondents admitted that among the two exits provided, one is completely closed i.e. it has been welded in place. It is tantamount to having no exit at all. It is only 64.3% who had only one exit.

v) Overall design

Table 3.5.9 Confirmation on whether it would be easy to find your way around.

Response	Frequency	Percentage (%)
Yes	22	26.2
No	62	73.8
Total	84	100.0

Source: Own field survey

Majority of the respondents 73.8% agreed that if one was not familiar with the place, it would not be easy to find ones way around. This could be attributed to the poor signage, clustering of the buildings and closing of some of the laneways as the researcher observed.

26.2% admitted that it would be easy for one to find his way around.

3.7.0 Obligations of the building owners

The landlords said that they were obtaining their plans from the Nairobi city council. This is after being issued what they termed as "beacon certificate". After this, it is upon them to find their builders or tradesmen. They would employ tradesmen as they are calling them "foreman", who are well known to them. They know where to get them, and would negotiate on payment. Some paid on daily basis while others on a weekly basis.

No contract documents are issued or no formal contract is made. They are dependent upon mutual trust.

At the initial stages of construction, they would call the city council's inspector "engineer", as they are calling him. He/she would inspect the building at a fee. This would be done once or twice, and afterwards the works will proceed normally with no further inspection. They said that sometimes back, they were issued with notices, specifying that buildings above two storeys, would be demolished and thus their suscipicion on the motive of the researcher.

They are well aware that they have flouted some by-laws (concerning the number of storeys, their buildings should have), but are of the view that since in their neighbourhoods, the same by-laws have been flouted so should they.

Table 3.6.0 Construction time

Time (years)	Frequency	Percentage (%)
<2	1	12.5
2-5	5	62.5
5>	2	25.0
Total	8	100.0

Source: Own field survey

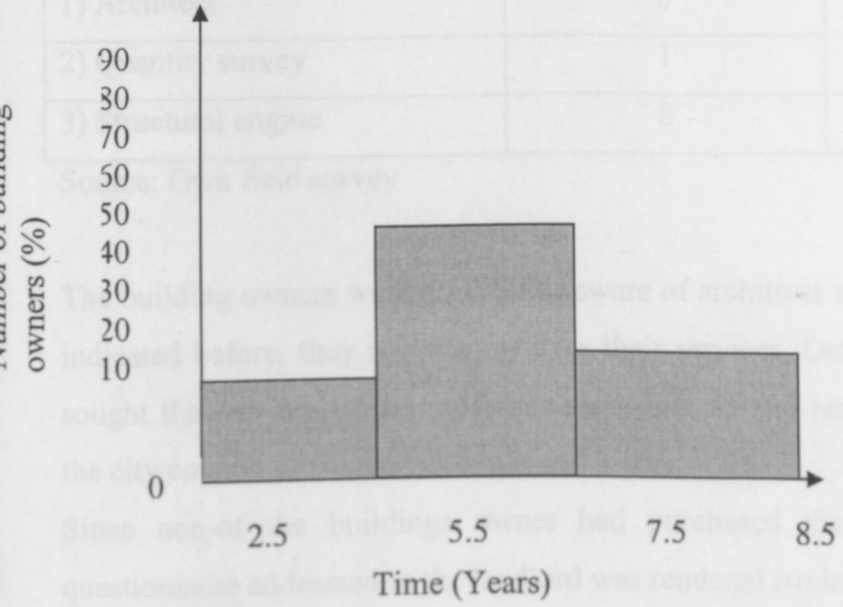
Over 60% of the building owners have construction time ranging between 1-5 years and 25.0% have the same ranging above 5 years. Whereas only 12.5% have their construction time below 2 years.

Some of the buildings took long to complete, due to inadequate finance, by the time they would get the finance, they would find building costs i.e. materials and labour has escalated.

Most of these landlords claim that their buildings are not complete and if more finance is available, they would add the number of storeys.

Figure 4

Construction time (years)



Source: Own field survey

Table 3.6.1 Cost of building

Cost (in Kshs)	Frequency	Percentage (%)
> 100,000	6	75
< 100,000	2	25
Total	8	100

Source: Own field survey

Over 75% of the buildings were costing over Kshs 100,000, this dates several years back. The researcher has not gotten an index to update this amount.

Only 25% hand their costs below Kshs 100,000. Over Kshs. 100,000 is a good amount, which can keep architectural firms in business.

The only problem the building owners experienced during the design and construction periods was lack of finance.

3.7.1 Building owners awareness on professionals

Table 3.6.2 Confirmation on whether the landlords have heard of the following professionals.

Consultants	Frequency	Percentage (%)
1) Architect	8	100
2) Quantity survey	1	12.5
3) Structural engine	8	100

Source: Own field survey

The building owners were all (100%) aware of architects and structural engineers, but as indicated before, they never sought for their services. Out of 8 landlords, only one had sought the services of the professionals, while for the rest, everything revolved around the city council of Nairobi as explained before.

Since non-of the buildings owner had purchased the property, section B of the questionnaire addressed to the landlord was rendered irrelevant.

3.8.0 Obligations of the architects

Table 3.7.0 A check on whether the consultants (Architects) are involved with the clients of low-cost buildings.

Response	Frequency	Percentage (%)
Yes	23	100
No	0	0
Total	23	100

Source: Own field survey

All the Architects (100%) admitted that they engage in consultations with clients of low-cost buildings.

It can therefore be seen that they are willing and able to provide their services, to all categories of clients. One therefore needs, only to seek their assistance.

Table 3.7.1 Request for the essential documents

Response	Frequency	Percentage (%)
Yes	5	21.7
No	14	60.9
Rarely	4	17.4
Total	23	100

Source: Own field survey

Most of the Architects (60.9%) admitted that the essential documents i.e. bills of quantities, structural engineering drawings, sectional drawings plans etc, are not requested for. They only seek for building plans and once they have them, no other documents or professionals are needed thereafter.

Even among those who admitted that the documents are demanded for (21.7%), their opinion is that these clients want the service for free. The importance of the other documents, to these low-cost builders is irrelevant. This is because they don't seek for them. 17.4% had it that the documents are rarely demanded for.

3.8.1 Payment of fees

Table 3.7.2 Confirmation on whether the clients are willing to pay the fee

Response	Frequency	Percentage (%)
Yes	4	17.4
No	19	82.6
Total	23	100.0

Source: Own field survey.

17.4% of the Architects agreed that the clients are willing to pay the fee. A big percentage (82.6%) contradicted this. They said that once the architect makes a proposal, these clients promise to come back, never to be seen again.

The Architects cautioned that they nowadays do not operate on a fixed rate basis, but they negotiate the fees with the clients.

3.8.2 How the Architects get the low-cost building clients

Table 3.7.3 Confirmation on how the Architects get the low-cost building clients.

Means	Frequency	Percentage
1. Introduction by friends	16	69.6
2. Acquaintances	12	52.2
3. Relatives and folks the Architects went to school with	10	43.5
4. Reputation of the Architect	9	39.1
5. Clients inquiring form other developers	12	52.2

Source: Own field survey

From table 3.7.3, most Architects, 69.6% were obtaining their clients through the introduction by friends. 52.2% through acquaintances and the same percentage by clients inquiring from other developers. Reputation had the least percentage (39.1%) while other Architects (43.5%) admitted that some of clients were relatives and folks that the Architect went to school with.

Level of consultation

Table 3.7.4 Confirmation of whether the consultation is increasing, decreasing or constant.

Query	Frequency	Percentage (%)
Increasing	9	39.1
Decreasing	9	39.1
Constant	5	21.8
Total	23	100

Source: Own field survey

39.1% of the Architects, agreed that consultation is decreasing this is due to the fact that these clients for low-cost buildings are now settling for draughtsmen (plan makers). Most of these draughtsmen are employees or workers of these Architects. They would just reproduce or steal the drawings from the Architects and would alter them slightly.

39.1% also admitted the consultation to be increasing, this is due to the increase in population and the rising demand for these low-cost buildings.

21.8% had it that the consultation is constant. As for how the clients respond, when they go for consultation. All the Architects admitted that they do respond well.

3.8.3 Reasons why low-cost buildings are poorly designed and constructed

The following is a summary of reasons as per responses from the Architects data collected from the field:

(i) They do not employ-qualified consultants and/or builders i.e. competent artisans. In most cases consultants are not involved.

(ii) Low enforcement of by-laws.

(iii) Developers do not follow the designs as given.

(iv) The developers interfere with fundis in order to maximize on the plot use.

(v) Ignorant/ unknowledgeable developers.

(vi) Motivation of consultants is low.

(vii) Most consultants never care to understand the socio-economic background of the client.

(viii) Low design input.

(ix) Funds are not available to make these low-cost buildings look good.

(x) Skilled labour is not available for the construction.

(xi) Finishes are not taken into consideration, as they are expensive and thus the poor designs.

(xii) As the name suggests (low-cost houses) hence the inability to have decent houses.

(xiii) Lack of appreciation to the restatement endeavors, which have succeeded in other parts of Africa.

CHAPTER FOUR

4.1 CONCLUSION

It would not be fitting for the researcher to conclude that the state of buildings in Mathare North is very poor. Nevertheless it is poor.

There were few cases of serious defects, but majority had minor defects such as cracks, dirty decorations, leaking soil pipes etc. The major causes of some of the defects were: poor maintenance, building materials, age of the building, density and intensity of housing and users.

Climate has seriously affected these buildings. The most notorious climate element being the sun. Solar radiation has raised the level of discomfort of occupants.

Maintenance levels have been on the decline, thus aggravating the problems in this place.

Enlightenment on the part of occupants concerning human comfort is low and thus the absence of mechanical ventilators such as fans.

Aesthetically buildings in Mathare North can be said to be satisfactory, according to the residents. They are contented with the appearance of these buildings.

The landlords of these buildings can be blamed for the high level of insecurity. This is through failure to provide lighting fixtures and lack of maintenance of the same. Moreover not protecting lightings against vandalism.

Design cannot assist to a great extent to reduce the level of insecurity in this area. This is because it is densely populated.

The low-cost building client does not seem to seek out for professional consultancy, but seems to be under the mercy of the Nairobi city council. As long as their buildings are approved, whether inadequately designed or not, this does not matter to them.

The architects as indicated earlier are ready to offer their services to these low-cost house builders. It therefore emerges that my hypothesis has been proved right in the case of landlords (clients) but wrong on the part of architects. The hypothesis stated that the various parties involved in construction of buildings have contributed to the problems associated with building designs.

The researcher therefore was able to achieve his objectives, i.e. he was able to find out the effects of tropical climate on building designs, the causes off thermal discomfort in buildings. Moreover, the aesthetics and security aspects of designs, from the tenants point of view. Further more, the floor, wall and slab ceiling failures. Finally the researcher was able to establish whether building professionals are consulted, before buildings are designed.

4.2 Recommendations to reduce these inadequately designed buildings

Maintenance level of these buildings e.g. painting, sealing of leaking pipes etc. should be raised. This would assist in counteracting the adverse effects of climate on buildings, reduction of mould and algae growth.

Local authority should be strict with the enforcement of building regulations. There seems to be a laxity in their part in dealing with errant developers.
Moreover the local authority should offer consultation at a subsidized rate or someone to hire consultants and pay them well to design good buildings.

The tenants should be enlightened on matters concerning human comfort for instance opening of windows daily, the type of curtain and blinds they should be using, to allow daylight into the buildings.

The landlords should always put streetlight and replace lighting fixtures when they are burnt out. This will reduce insecurity in the area.

The buildings should always be inspected by the local authority, from its initial stages to the final stage (completion), before commissioning them as fit for habitation.

The validity of the city-by-laws should be examined.

Local materials should be appreciated and this will reduce the cost of a building. Thus low-cost housing will be properly or adequately designed.

The landlords (clients) should use better-trained artisans. This will greatly reduce the inadequately designed buildings.

Planning should be done to prevent the haphazardness of these buildings. Thus creating order and identifiable pattern.

Consultants should be motivated and not necessarily cashwise. This will make them be ready to handle any kind of project irrespective of size.

Since it seems that most of the landlords (developers) are not aware of the buildings professionals. They should be enlightened on this.

If the above recommendations are taken seriously. The inadequacies in low-cost buildings would reduce tremendously. This is for the betterment of other people who are incapacitated financially. Hence they can afford to live in comfort like any other filthy rich individuals.

4.3 Areas of further research

The contribution that the local authority (city council) makes to inadequately designed buildings has not been covered in this study. Any researcher interested in studying inadequacies of building designs should therefore look into it.

Objectives being:

i) Examine the frequency of building inspection before a building can be commissioned as fit for habitation.

ii) Find out the steps or actions taken on defaulters of building by-laws.

iii) Find out the competence of the building inspectors.

iv) Find out the functions of the local authority in relation to buildings.

v) Find out whether the issuance of building plans, is part of the work of local authority.

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APPENDIX A

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

Telegrams: "EDUCATION", Nairobi
Telephone: Nairobi 334411
When replying please quote
Ref. No. MOEST 13/154/16
and date

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. Box 30040
NAIROBI

19th February, 20.03.

The Chairman
Department of Building Economics
and Management
University of Nairobi
P.O. BOX 30197
NAIROBI

Dear Sir

RE: RESEARCH AUTHORISATION

Please refer to your letter dated 7th February, 2003, on the above subject.

I am pleased to inform you that the twenty seven (27) Building Economics and Management students of your Department whose names appear on the attached list have been authorised to conduct research in all Provinces in Kenya for a period ending 30th June, 2003.

It is noted that the research is a requirement in part fulfilment for the award of B. A. in Building Economics by the Universtiy of Nairobi.

Advise the students to report to all the Provincial Commissioners and all the Provincial Directors of Education before embarking on their research project.

Yours faithfully

S. G. KAARIA
FOR: PERMANENT SECRETARY/EDUCATION

For Permanent Secretary
Ministry of Education Science
and Technology
P O Box 30040, Nairobi

CC
All the Provincial Commissioners

All the Provincial Directors of Education

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APPENDIX B

UNIVERSITY OF NAIROBI

Department of Building Economics & Management

P.O. Box 30197, 00100 Nairobi, KENYA, ***Tel: No. +254-2-2724525/9 Fax: +254-2-2718548***

E-mail: *building_econ@uonbi.ac.ke*

April 25, 2003

TO WHOM IT MAY CONCERN:

Dear Sir/Madam,

RE: MOTANYA N. A - REG. NO. 0300/1999

The above named is a student of this Department pursuing a Bachelors Degree course in Building Economics. He is currently in his final year of the course, during which he is required to write a project on ***"A Study on Inadequacies of Building Designs and Their Causes".***

The purpose of this letter therefore is to request you kindly to allow him access into any kind of material he might require from your organisation to enable him complete the project successfully. The information given will be used for research purposes only.

Yours faithfully,

CHAIRMAN
DEPT. OF BUILDING ECONOMICS
AND MANAGEMENT
UNIVERSITY OF NAIROBI

Dr. Alfred A. Talukhaba
Chairman, Dept. of Building Economics & Management

D:\Attachment lets\yr4.doc

APPENDIX C

UNIVERSITY OF NAIROBI.

DEPARTMENT OF BUILDING ECONOMICS AND MANAGEMENT

MOTANYA N.A

BO3/0300/99

TO WHOM IT MAY CONCERN:

Dear Sir/Madam,

RE: REQUEST TO FILL QUESTIONNAIRE

I am a final year student undertaking a research project on inadequacies of building designs, their causes and effects.

Your experience and opinion is a significant contribution towards the success of this research. Please fill the questionnaire with your own views. The findings here in will be used for the purpose of research and shall be kept confidential.

I shall not hesitate to share its findings with you, if requested.

Yours sincerely,

MOTANYA N.A.

APPENDIX D

UNIVERSITY OF NAIROBI.

DEPARTMENT OF BUILDING ECONOMICS AND MANAGEMENT.

QUESTIONNAIRE.

(TO BE FILLED BY TENANTS)

TITLE: **INADEQUACIES OF BUILDING DESIGNS AND THEIR CAUSES.**

A case study of Mathare North flats.

NB: (I) All information in this questionnaire shall be treated as confidential and shall be used as only for the purpose of this research.

(II) Put a tick where your answer is appropriate, in the appropriate box e.g ☑

A. Influence of Climate on design.

1. Do you experience thermal discomfort?

Yes. ☐

No. ☐

2. What is the type of wall for the building?

a. Masonry ☐

b. Bricks. ☐

c. Concrete Blocks. ☐

3. In (a) above, is it:

i. Painted. ☐

ii. Rendered. ☐

iii. Pointered. ☐

4. If painted, what colour?

i. Black. ☐

ii. White. ☐

iii. Grey. ☐

iv. Brown. ☐

If any other colour, specify _____

5. Does the painted wall show any of the following building defects?

i. Fading of paint. ☐

ii. Blackening of wall finish. ☐

6. How frequently is the building externally maintained?

a. After how many months.

1	2	3	4	5	6	7	8	9

b. After how many years:

1	2	3	4	5	6	7	8	9

7. How many rooms are there in this building?

One. ☐

Two. ☐

Three. ☐

8. What time do you mostly experience the overheating of spaces/rooms?

i. Morning. ☐ iii. Evening. ☐

ii. Noon. ☐ iv. All the above. ☐

9. How many people are living in the house?

One. ☐ Four. ☐

Two. ☐ Five. ☐

Three. ☐ Six. ☐

If more than this write down the number_____

10. On the external face of the building, are there sunbrakers?

Yes. ☐

No. ☐

If yes, are they

i. Vertical ☐

ii. Horizontal ☐

iii. Egg-shaped ☐

iv. Both (i & ii) ☐

11. Do you use curtains and blinds on the windows?

Yes. ☐

No. ☐

12. If yes, are they for any of the following?

i. Privacy. ☐

ii. Sun shading. ☐

iii. Decoration. ☐

iv. Combination of (i) (ii) & (iii)

v. If any other specify _____

B. Ventilation.

13. What is your comment on the quality of air in this space?

i. Too stuffy. ☐ ii. Stuffy. ☐ iii. Fresh. ☐

14. State the nature and number of ventilation openings in this house.

Doors.

1	2	3	4	5	6

Windows.

1	2	3	4	5	6

Vents.(Any type i.e Bricks, Concrete blocks e.t.c.)

1	2	3	4	5	6

15. How often do you normally open the window?

Daily in the morning. ☐ Closed all the time. ☐

Twice in a week. ☐ Open all the time. ☐

Thrice in a week. ☐

16. Are there fans in the rooms?

Yes. ☐

No. ☐

C. <u>Componental analysis of building failures.</u>

17. Tick the defects noted on site and indicate against it the possible cause(s) from the possible causes.

Where:

01 - Building materials.

02 - Intensity of use.

03 - Shape of building.

04 - Age of building.

05 - Density of housing.

06 - User.

07 - Poor maintenance.

08 - Site condition.

DEFECTS	POSSIBLE CAUSES							
(A). WALLS	01	02	03	04	05	06	07	08
(I) **External**								
1. Random cracks on rendering.								
2. General cracking								
3. Flaking of paint								
4. Walls looking damp								
5. Crumbling of mortar joints								
6. Blistering of paint work								
7. Dirty decorations								
8. Flaking off of rendering.								

Where:

01 - Building materials.

02 - Intensity of use.

03 - Shape of building.

04 - Age of building.

05 - Density of housing.

06 - User.

07 - Poor maintenance.

08 - Site condition.

DEFECTS	POSSIBLE CAUSES							
(A).WALLS	01	02	03	04	05	06	07	08
(I) **Internal**								
1. Cracked plasterwork.								
2. Plaster loose								
3. Discoloured/blistered								
4. Decoration								
5. Walls looking damp								
(B). FLOORS/SLAB CEILINGS								
1. Deflection of reinforced concrete floor								
2. Concrete floor cracking								
3. Lifting and curling of concrete screed								
4. Woodblocks tiles/arching								
5. Thermoplastic/p.v.c tiles lifting								
6. Indentation								
7. Hollowness of concrete screed								

D. Aesthetics

18. What is your opinion or view on the beauty of the building or its overall design?

Beautiful ☐ Ugly ☐ Satisfactory ☐

Very beautiful ☐ Very ugly ☐

E. Security.

19. **(a). Lighting**

(I). Is lighting of common areas such as corridors, entrances and stair wells adequate?

Yes. ☐

No. ☐

(II). Are areas of shadow avoided through use of more lighting fixtures?

Yes. ☐

No. ☐

(III). Is natural lighting possible?

Yes. ☐

No. ☐

(IV). Are lighting protected from casual vandalism by such means as wired glass or lantern style holder?

Yes. ☐

No. ☐

(V). Are lighting fixtures maintained in a clean condition and promptly replaced if burned out or broken?

Yes. ☐

No. ☐

(VI). Are entrances to housing units:

Hidden. ☐

Inset. ☐

20. **(b). Locking devices**

(I). Are interior door locks at least a one inch (25mm) dead bolt?

Yes. ☐

No. ☐

(II). Are glass panels near doors reinforced?

Yes. ☐

No. ☐

21. **(c) . Residential streets.**

1. **Lighting.**

(I). Do the streets have lightings?

Yes. ☐

No. ☐

(II). If yes in (I) above, is lighting sufficient to see a person approaching at a distance?

Yes. ☐

No. ☐

(III). Is the lighting sufficient for the side walls as well as the street?

Yes. ☐

No. ☐

2. Lane ways

(I). Are entrances to alleys or lane ways well lit and clearly visible from the street?

Yes. ☐

No. ☐

3. Residential pattern.

(I). Is the layout of the new residential streets predictable?

Yes. ☐

No. ☐

(II). Can the streets be linked to an existing grid and pattern of street?

Yes. ☐

No. ☐

(III). Would a stranger entering a street know how to get out?

Yes. ☐

No. ☐

4. Direction and information signs.

(I). Is there a sign (i.e. room number, building name) identifying where you are?

Yes. ☐

No. ☐

(II). If no, are there directional signs nearby that can help you identify where you are?

Yes. ☐

No. ☐

(III). Are there signs that show you where to get emergency assistance if needed?

Yes. ☐

No. ☐

(IV). Do exit doors identify where they exit to?

Yes. ☐ No. ☐

(V). What is the impression of overall signage?

Poor. ☐ Good. ☐ Very poor ☐

Very good. ☐ Satisfactory. ☐

5. <u>Escape route.</u>

(I). How easy would it be for an offender to escape?

Very easy ☐

Quite easy ☐

Not very easy ☐

(II). Is there more than one exit?

Yes. ☐

No. ☐

6. <u>Overall design.</u>

(I). If you weren't familiar with the place, would it be easy to find your way around?

Yes. ☐

No. ☐

(II). Does the place "make sense"?

Yes. ☐

No. ☐

APPENDIX E

UNIVERSITY OF NAIROBI.

DEPARTMENT OF BUILDING ECONOMICS AND MANAGEMENT.

QUESTIONNAIRE.

(TO BE FILLED BY LANDLORD/BUILDING OWNER)

TITLE: **INADEQUACIES OF BUILDING DESIGNS AND THEIR CAUSES.**

A case study of Mathare North flats

NB: (I) All information in this questionnaire shall be treated as confidential and shall be used as only for the purpose of this research.

(II) If spaces provided for in each question is inadequate any type of stationary can be used for provision of further information.

(III) There are two sections to be answered by: Owners who built – Section A

Those who purchased the property – Section B

SECTION A

1. When did you decide to build?

_____

2. Why did you find it necessary to build?

_____

3. When did the construction work start and when was it completed?

_____

4. How much did it cost to complete?

_____

5. What was the estimated cost?

_____

6. Who estimated the cost?

Name: _____

Address: _____

Tel: _____

(If available)

7. Is he a registered practitioner?

Yes ☐

No. ☐

I don't know ☐

8. How did you come into contact with the estimator?

_____

_____

9. Who designed the building?

Name: _____

Address: _____

Tel. No.: _____

(If available)

10. Is he a registered practitioner?

Yes. ☐

No. ☐

I don't know ☐

11. What other things did the designer do for you?

_____

_____

12. Who was the contractor?

Name: _____

Address: _____

Tel. No.: _____

(If available)

13. How did you choose the contractor?

14. How were you paying the contractor?

15. Does the building meet what it was built for?

16. What are the natures of the shortfalls?

17. Were there problems experienced during the design?

Yes ☐

No. ☐

Enumerate them.

18. Were there any problems experienced during the construction period?

Yes ☐

No. ☐

Enumerate them.

19. Have you heard of the following professionals?

a. Architect

Yes. ☐ No. ☐

b. Quantity Surveyor.

Yes. ☐ No. ☐

c. Structural Engineer.

Yes. ☐ No. ☐

20. If (No) in (19) above, why did you not engage the services of the professionals?

_____

_____

_____

_____

21. If you were to build again would you engage an architect, quantity surveyor and structural engineer?

Yes. ☐

No. ☐

SECTION B

(To be filled by those who purchased the property)

1. When did you decide to purchase?

_____

2. Why did you find it necessary to purchase?

_____

3. What was the cost of the building purchased?

_____

4. Who estimated the cost?

Name: _____

Address: _____

Tel No.: _____

(If applicable)

5. Is he a registered practitioner?

Yes. ☐ No. ☐

6. Does the building meet what it was purchased for?

_____

7. What are the natures of the shortfalls?

_____

_____

_____

_____

_____

_____

8. Have you heard of the following professionals?

a. Architect.

Yes. ☐ No. ☐

b. Quantity surveyor.

Yes. ☐ No. ☐

c. Structural engineer.

Yes. ☐ No. ☐

d. Valuer.

Yes. ☐ No. ☐

9. If (No) in (7) above, why did you not engage the services of the professionals?

_____

_____

_____

_____

_____

APPENDIX F

UNIVERSITY OF NAIROBI.

DEPARTMENT OF BUILDING ECONOMICS AND MANAGEMENT.

QUESTIONNAIRE.

(TO BE FILLED BY ARCHITECT)

TITLE: **INADEQUACIES OF BUILDING DESIGNS AND THEIR CAUSES.**

A case study of Mathare North flats (residential buildings).

NB: (I) All information in this questionnaire shall be treated as confidential and shall be used as only for the purpose of this research.

(II) If spaces provided for in each question is inadequate any type of stationary can be used for provision of further information.

---

1. Are you involved in any consultations with the clients of the low-cost buildings?

Yes ☐

No. ☐

2. Do they request for all the essential documents?

---

3. Are they willing to pay the fee?

---

4. Do they make complains as regards the fee they are charged?

---

5. How do you get the low-cost buildings clients?

---

6. How regular is the consultation?

---

7. Is the consultation increasing or decreasing or is it constant over the years?

8. Do the people respond well when they come for consultation?

9. As a profession why do you think low-cost houses are poorly designed and constructed?

10. What would you recommend should be done to reduce these inadequately designed buildings?