INVESTIGATING IMPLEMENTATION STRATEGIES TOWARDS ELIMINATION OF STRUCTURAL FAILURE OF BUILDINGS IN UGANDA: A CASE STUDY OF KAMPALA CITY

BY

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CERTIFICATION

We, the undersigned, certify that we have read and hereby recommend for acceptance by Kyambogo University a dissertation titled *"Investigating implementation strategies towards elimination of structural failure of buildings in Uganda: A case study of Kampala City"* in fulfillment of the requirements for the award of a degree of Master of Science in Construction Technology and Management of Kyambogo University.

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DECLARATION

I, Asingwire Myers, registration number 17/U/14353/GMET/PE declare that, this work has been done by myself and that it has never been submitted elsewhere for similar awards and is now ready for submission to the board of examiners of Kyambogo University.

Name: Asingwire Myers

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Date……..

DEDICATION

This dissertation is dedicated to my late father Mzee Andrew Kanakubona who passed on, on 14 March 2005 for his dedication and commitment to education at all levels.

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Praise be to the Almighty and wonderful God, the author and the finisher of my faith, the owner of my life and to whom i belong for leading me to this path of self-discovery and experience.

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LIST OF ABBREVIATIONS

ASTM	:	American Society for Testing and Materials
KCCA	:	Kampala Capital City Authority
LC	:	Local Council
MDAs	:	Ministries, Departments and Agencies
MLHUD	:	Ministry of Lands, Housing and Urban Development
SPSS	:	Statistical Package for Social Sciences
CVI	:	Content Validity Index
MoWT	:	Ministry of Works and Transport
ERB	:	Engineering Registration Board
UIPE	:	Uganda Institute of Professional Engineers
EIA	:	Environment Impact Assessment

ABSTRACT

In Kampala City, the failure of buildings has occurred frequently leading to increase in the spate of building collapse that have claimed many lives of people. In the past three years, Kampala has recorded quite a number of cases of building failures in areas like Buziga, Najjera, Nansana, Makindye and Makerere where buildings have collapsed killing many people on the spot. Although different strategies to eliminate structural failure of buildings have been devised by Kampala Capital City Authority, the challenge continues to affect different parts of the city, causes of which this study is examining. The study used both quantitative and qualitative research designs. Quantitative data collection was aided by use of questionnaires with closed ended questions administered to 96 respondents and then qualitative data, by use of an interview guide. The study findings indicate that the major cause of structural failure of buildings was buildings without approved drawings which was ranked first, use of unqualified and non-registered engineers during construction ranked second while poor workmanship was the least ranked factor. The major impacts created by failure of structural buildings were; failure to pay borrowed resources from financial institutions ranked first, followed by loss of resources by the developer and unemployment was ranked last. Similarly, findings on the existing strategies to eliminate structural building failure revealed that planning was ranked 1st, followed by effective communication among all the parties involved in the construction process. In conclusion, the high spate of collapse of buildings in Kampala city was found to be mainly man-made in nature. The developed framework of the study promises to establish the building committee that is made up of Division Physical Planners, UIPE representatives and EBR members. The framework also advocates the establishment of line ministries responsible of training, monitoring and offer advisory services to construction companies and KCCA. The study recommends the need for enhancement of coordination among the MDAs charged with planning and development of Kampala City, the need to involve taskforces at division level that integrate the LC1 chairpersons on the board, increased outreach and sensitization of the population about failure to report suspected cases of buildings in progress that seem to be deviating from the basic construction norms among others.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In the 21st century, the world's population has increasingly become urban (Aliyu and Amadu, 2017). Further, the global urban population is estimated to increase; by 2030, 60% of the population will live in the cities. Almost all of this growth is forecasted to happen in the lower income regions of Africa and Asia because of the faster rate at which they are urbanizing. One compelling indicator of the above claim is the fact that while at the beginning of the 20th century, just 16 cities in the world (mostly in developing nations) contained a million people or more, while today more than 400 cities have a population of a million or more, about 70% of them are found in developing countries (Aliyu and Amadu, 2017).

In the wake of this increasing population, the demand for basic needs and services to an average urban household will be enormous. One of these needs is shelter. Shelter or housing is the first thing humans need for living in this world even before food (Amadi et al., 2012; Hamma-Adama and Kouider, 2017). The construction sector is the provider of physical infrastructure essential for human sustenance and economic development. In the urban environments where prices of land are very dear owing to the competing uses and the shear shortage of space, municipal and city authorities urge developers of plots to choose multi-storey buildings over ordinary houses (Hamma-Adama and Kouider, 2017).

The provision of shelter has contributed to improvement of the lives of urban dwellers (Oloyede et. al., 2010), although, negative effects have also become a

common problem in the form of structural failures (Aliyu and Amadu, 2018; Hamma-Adama and Kouider, 2017). Against this backdrop, this chapter provides background information on causes of structural failures in buildings citing global, continental and regional case examples. It also gives a highlight of some of the major structural failures that have occurred in Kampala City over the last decade, the problem statement, main objectives of the study, specific objectives, research questions, justification, significance, scope and conceptual framework.

Since time immemorial, buildings have been factored as determinants of might of a city. According to Amadi et. al., (2012), a building is a structure that serves as shelter for man and his activities. It can also denote a roofed and walled structure built for permanent use for man's living, working and storage. Through the centuries, buildings have been integral to the socio-economic development of mankind (Windapo and Rotimi, 2012). A building, once properly constructed is expected to be in use for a very long time (Oloyede et. al., 2010).

To provide the desired satisfaction, comfort and safety while providing for the said roles, every building whether temporary, permanent or monumental structures needs to be properly designed, well planned, constructed and maintained. This is very critical for prevention of any form of failure (Asante and Sasu, 2018; Amadu et al., 2012; Windapo and Rotimi, 2012). Failure occurs in the form of partial or total collapse of the structure during and after completion of the construction process (Amadu et al., 2012). Globally, the structural failure of buildings has become a major concern and more so in cities and towns (Fu, 2009, 2010; Izzuddin et. al., 2008; Kwasniewski, 2010). The rate at which buildings are collapsing and the

magnitude of the losses being recorded in terms of lives and property is a great loss to nations (Clark, 2015). Carnage and mega losses resulting from the devastating consequences of building collapses have become a silent feature of present-day cities worldwide. The occurrence of these sudden accidents has led to loss of lives, permanent and temporary injuries. In addition, it has caused loss of investments, jobs, and income (Ibrahim, 2013; Ede, 2013).

The toll of the said challenges in the aftermath of building failures have affected most cities and towns in developing countries (Babatunde, 2013; Fagbenle and Oluwunmi, 2010; Fernandez, 2014) compared to the developed world (Asante and Sasu, 2018). Evidence to this claim has been provided by the recent building collapses in the cities of Naples (in July 2017; Sharman, 2017), Mumbai (in August 2017; Raj and Ramzy, 2017), Accra (in November 2012; BBC, 2012); and Dhaka (in April 2013; Manik,Yardley and Dhaka, 2013), which claimed tens of thousands of lives. This provides a small representation of the very many tragic events that have not been even covered in the international media houses. Faced with this wave of failures, scholars are compelled to find answers to the begging question: What are the underlying factors that lead to frequent cases of collapse of buildings in cities?

Although World Bank (2015) reports that in many locations around the world, building have collapsed due to terrorist attacks, gas leak explosions, earthquakes, and global environment changes, in Africa and in many developing countries, the causes are: weak foundations, substandard constructional materials, poor material mixing by construction workers, excessive load on strength of buildings, and poor testing of building strength (Fernandez, 2014; “Five Reasons Why,” 2016). African countries

have also witnessed building collapse although largely documented in media reports (Asante and Sasu, 2018). In Cameroun, Tchamba and Bikoko (2016) reported a number of building collapses between the period 2010 and 2014, which were caused by inadequate preliminary works, adoption of wrong foundations, low-quality sandcrete blocks, poor concrete mix ratio, and neglect of design and building approval procedures, among others (Asante and Sasu, 2018). These findings show that the underlying factors of building collapse in African countries are similar in many respects.

In East Africa, Muhumuza (2013) remarked that collapsed buildings are a growing problem in East Africa, where many buildings in the region's major cities are under construction or renovation. For example, in Kenya, Wachira (2015) remarked that construction teams often violate construction regulation resulting into collapse. Still in Kenya, Kuta and Nyaanga (2014) revealed that most collapsed buildings were constructed with low-quality building materials by incompetent craftsmen due to lack of political will to enforce existing building codes (Kuta and Nyaanga, 2014). In Uganda, the problem of structural failures has become a major blow to the planners and policy makers in the line ministries as well as to the technical teams managing the affected areas. Kampala City has experienced more cases because of the high competition for space calling for the erection of high-rise buildings, given its strategic location and grading as the only city in Uganda (Matama, 2018).

However, none of the studies has endeavored to come up with a framework for eliminating the problem of building failures in Kampala city. Against this backdrop,

this research study has been carried out with the overarching aim of producing a framework capable of filling the existing gaps.

1.2 Problem Statement

Kampala City has experienced a big number of building accidents in the last two decades (Anguyo, 2013; Manishimwe, 2017; Masaba et al., 2016, Ngwomoya, 2020) in Buziga, Makerere hill, Makindye and Kampala Central Business District [CBD] among others. This has posed a very serious challenge to those in the building industry, the government and the individuals who have invested in property development in the country. Several factors have been associated with this, some of which are negligence, deficient foundations, inadequate or faulty steel reinforcement, hasty construction, greed, failure to carry out soil tests, poor supervision and non-adherence to the building codes (Ngwomoya, 2020; Masaba et. al., 2016). Although the Government of Uganda through the Ministry of Lands, Housing and Urban Development (MLHUD) and KCCA has enacted guidelines for the construction industry, numerous buildings have still continued to succumb to failure, implying that the strategies to eliminate the structural failure of buildings as established by Government exist but are not being followed or enforced. Therefore, it is against this background that this study has investigated the deficiencies in the implementation of the strategies towards elimination of structural failure of buildings in Uganda so that a framework is designed to help in filling the void.

1.3 Objectives of the Study

1.3.1 Main Research Objective

The main objective of the study was to investigate the implementation of strategies towards the elimination of structural failure of buildings in Uganda.

1.3.2 Specific Objectives

The specific objectives of carrying out this study were:

i. To assess the causes of collapse of buildings in Kampala City;
ii. To establish the impact of building failure to stakeholders in Kampala City;
iii. To assess the performance of the strategies designed by KCCA to mitigate the occurrence of structural failure of buildings in Kampala City;
iv. To develop a framework for mitigating and eliminating structural failure of buildings in Kampala City;

1.4 Research questions

The following research questions were formulated to further guide in the achievement of the study objectives:

i. What are the main causes of buildings failures in Kampala City?
ii. What is the impact of building failure in Kampala City?
iii. How effective are the strategies formulated by KCCA to address the causes of structural failure in buildings in Kampala City?
iv. How can structural failure of buildings in Kampala City be eliminated?

1.5 Justification of study

As seen in the previous sections, a series of buildings in Uganda have collapsed. This has been attributed to lack of enough construction supervision by professional engineers, use of unqualified engineers, using poor quality construction materials that are just not strong enough to withhold the load used as well as non-complaint by the contractors on the agreed structural plans with the authorities. In Kampala, Uganda, a study by Alinaitwe and Ekolu, (2011) indicated 54 buildings that collapsed causing numerous death and 122 injuries between 2004 and 2008. The structural failure of buildings in Uganda has had effects on society for instance six (6) people were killed when a building collapsed at Kyesara in Makerere and people lost their lives, unemployment, businesses destroyed as well as increased losses to financial institutions as many clients fail to pay back their loans. The study will be important to the engineers in Kampala City, Construction companies as well as the Planning Authority of the City, since they will use the study findings to reduce on the structural building failures through applying the developed framework by the study.

1.6 Significance of the study

The study findings provide in-depth information to KCCA, Minister for Kampala City and MLHUD on the institutional weaknesses existing in the current strategies implemented to eliminate the problem of collapsing buildings and other structural failures. This provides them with the necessary information that will inform their decisions when revising or amending the control guidelines. The findings will also provide key information to policy makers and planners on the likely benefits of involving grass root-based authorities such as Local Council 1 about the potential of serving as a conduit through which the possible defects that are feared to happen to a

construction site in a given area can be reported and addressed before it develops into a major structural failure.

To future researchers and scholars, this study provides documented evidence of the problem of structural failures in Kampala City with an intervention in the form of a framework, which framework will provide baseline information concerning structural failures and collapse of buildings in Uganda.

The accomplishment of the study equipped the researcher with an assortment of research skills (such as literature reviewing, conducting field-based surveys and data analysis) that will enable the researcher to execute research related projects with ease out of the prowess gained.

1.7 Scope of the study

1.7.1 Content Scope

This study investigated the implementation strategies towards elimination of structural failure of buildings in Uganda, specifically the study looked at the reasons why many storied buildings have failed in Kampala City overtime, the impact of building failures and applicable management strategies that can be adopted in urban areas of developing economies to eliminate structural buildings failure.

1.7.2 Geographical Scope

The study was conducted in five Divisions of Kampala City, this is because most of the buildings that have collapsed are located in this area with relatively high construction activities. The divisions are: Nakawa, Lubaga, Central, Kawempe and

Makindye.

1.73 Time Scope

The study covered a period between 2008 and 2020. This is because it is the period where frequent cases of collapse of buildings and structural failures have been reported in the same period. Equally, different strategic undertakings in form of policy guidelines have also been enacted in the same period.

1.8 Conceptual framework

A conceptual framework is a structure, which the researcher believes can best explain the natural progression of the phenomenon to be studied (Camp, 2001). It helps to link the concepts, empirical research and important theories used in promoting and systemizing the knowledge espoused by the researcher (Peshkin, 1993).

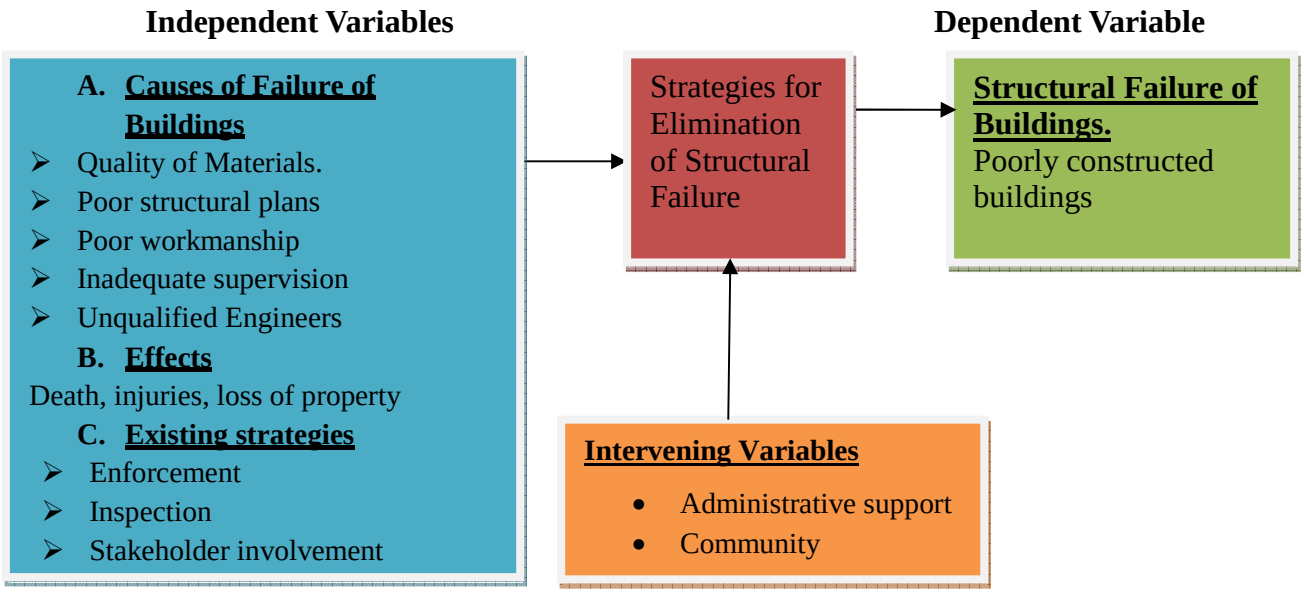

Figure 1.1 Conceptual framework

In figure 1.1, the independent variables are causes of failures of buildings, the associated effects and any existing strategies for mitigating the problem. The

dependent variable, structural failure is assessed in terms of enhancement of the building construction sector in KCCA that will give rise to well-constructed and long-lasting buildings. The conceptual framework hypothesizes that this can only be possible when the existing gaps in the implementation of the formulated strategies are addressed, which is made possible through the framework that will be designed by this study. The intervening variables (administrative good will and community participation) are introduced in the study because they have a great role to play in influencing the success or failure of any strategy designed by KCCA and the government to streamline the building constructions in Kampala City.

1.9 Chapter Summary

This chapter presented the background of the study, problem statement, objectives of the study including the main objective and specific objectives, research questions, justification and significance of the study and project scope, which includes content scope, geography, time taken to prepare, and finally the conceptual framework. The next chapter is about the review of the related literature on the strategies towards elimination of structural failure of buildings in Uganda.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter presents review of literature related to structural failures of buildings in cities. Specifically, literature is reviewed under themes developed from the specific objectives. The methodological, subject and contextual gaps left by the studies reviewed are identified and attempts to fill them by this study reflected. The review of literature is preceded by a theoretical framework, which presents underpinning information that provides a basis for the thematic review of the study concepts.

2.2 Theoretical review

2.2.1 Traditional Business Model

This study invoked the Traditional Business Model. The model is a key output of a research by Angelides (1999) on investigating the ineffective ways by which organizations operate within the public sector. This model basically outlines the three unhealthy orientations through which a business is run can harm the success of the business or organization. He discussed three orientations: Production orientation, Fragmented Control and the Sequential approach (Angelides, 1999). The Production orientation involves concentrating on the resources of the business with a sole focus on production. As part of this business orientation, very little attention is paid to other aspects of the business, which may be necessary to its growth. The fragmented control deals with the problem of excessive delegation, which makes it difficult to regulate the affairs of the business. The Sequential approach comprises the existence

of varied systems within the business organization through which work is done. According to this model, having such a variety of systems in place limits the standards of getting work done; especially the limitation of identifying possible constraints that affect the effective running of the business organization (Angelides, 1999).

2.3 Conceptual review

Failure in buildings is the inability of the building components to adequately perform what are normally expected or required of those components (Fagbenle and Oluwunmi, 2010). In instances when part or whole structure has failed and suddenly given way in a way that as a result of this failure, the building cannot meet the purpose for which it was intended, the building collapses. Collapse refers to an instant of a structure falling down or giving away because of being weak. In architecture and construction, collapse can be considered as mechanical failure of building (Hamma-Adama and Kouider, 2017). Failures in building can occur during different stages of construction process itself, as well as after (Fagbenle and Oluwunmi, 2010). Globally, building collapse is caused by one of the two major factors: the natural or man-made factors (Hamma-Adama and Kouider, 2017). The natural factors include but not limited to: landslide, earthquakes, floods and erosion, mud-flows, thunder-storms and hurricanes (Hamma-Kouider, 2017).

2.4 Main causes of structural failure of buildings

Structural failure is instigated when the materials in a building are stressed to its strength limit, thus causing fracture or excessive deformations which result into failure and collapse of buildings (Deskin and Pasternak 2018). The immediate and remote factors for structural failure of buildings are mainly categorized into two:

natural and man-made (Amadi et al., 2012; Asante and Sasu, 2018; Oloyede et al., 2010).

2.4.1 Nature-generated causes of structural failure in building constructions

Natural factors that give rise to building collapse are subdivided into two groups: Geological phenomenon that causes building failures and geo-materials that lead to the collapse of building (Amadi et al., 2012; Arayela and Adam, 2001).

a) Geological Phenomenon

The possible geological phenomenon that causes building collapse is as follows: subsidence, erosion and flooding, earthquake, landslide, mud-flow and debris-flow, hurricane, typhoon and tsunami, faulting, rain-storm, thunder-storm and lightening.

b) Subsidence

Subsidence is the sinking/settling down of land resulting from natural shifts frequently causing structural damage to buildings. Subsidence is most common in areas that have weak soils.

c) Erosion and Flooding

Erosion is the scraping, scratching, grinding, and pulverizing of the earth's surface rock. Various agents of erosion which carve and shape the earth's natural surface rock includes running water, groundwater, gravity, moving ice, wind action, waves and current. Erosion can be of the following types: stream, wind, marine and glacial erosion (Amadi et. al., 2012). Flooding is a natural process of busting of river banks or simply overflow beyond the river's bank. Most river flooding is a function of the amount and distribution of precipitation in the drainage basin, the rate at which

precipitation are infiltrated into the soil. However, some floods result from rapid melting of ice, snow and dam failure. Urbanization without adequate provision for flood channels increases both the magnitude and frequency of flooding. Factors that determine the catastrophic nature (magnitude) of floods are: land-use on the floodplain, duration of flooding and sediment load. Whenever municipal and city authorities fail to draw a sound strategy for abating the occurrence of both erosion and flood and most especially in in the design of construction sites, such buildings are prone to collapsing.

d) Earthquake

Earthquakes are series of shock vibration generated at the focus, within the earth crust or mantle. When earthquakes occur, they generate three main types of waves: L-waves, S-waves and P-waves. Earth quakes are caused by sudden movement within the earth crust or release of build-up stress and strain within the earth crust. It is interesting to note that earthquake does not occur everywhere, neither do they occur with equal intensity, rather its occurrence is concentrated along the long narrow load belt characterized by zones of crustal weakness and major fracture. Earthquakes constitute one of the natural factors leading to an increase in the spate of structural failures.

For example, Yepez and Yepez (2017) established that on April 2016, more than 7000 buildings were severely damaged or destroyed in northwest Ecuador leaving 670 people dead, 6300 injured and almost 30,000 lost housing after an Mw 7.8 earthquake hit the region. The study further established that much as the damaged and collapsed buildings showed usual seismic failure patterns of non-ductile

structures (i.e., soft stories, flat slab shear failures, plastic hinges in columns and joints, shear failures in short columns), the quality of the materials and construction seem to be key factors that contribute to the overall poor seismic performance. To substantiate the study findings regarding the quality of raw materials used, Yepez and Yepez (2017) took many samples from collapsed buildings. ASTM C1152/C1152 M-04 Standard Test for Acid-Soluble Chloride in mortar and concrete was applied in order to obtain chloride content, which was confirmed using a scanning electron microscopy SEM analysis. Finally, ASTM C642-13 Standard Test for Density, Absorption, Voids in Hardened Concrete was applied in order to obtain concrete physical parameters for characterization. It was established that chloride content exceeded the ACI limit by a factor of 30, which led to high corrosion level of steel bars. Therefore, even if there are buildings with lower or negligible seismic damage, their integrity is not guaranteed and could suffer damage and collapse in future seismic events with even lower intensity. The experiments also included assessing the quality of the sand used in the construction. After collecting regional information, it was concluded that use of sea sand in concrete production was common, even for projects supervised by professionals.

Regarding fine aggregate materials, common practice in the region considered a mix of sea sand and mining sand (Yepez and Yepez, 2017). It was established that the fineness modulus of fine aggregate samples obtained were very low, increasing water demand and water/cement ratios dramatically. Consequently, this increased porosity and decreased the strength of buildings providing antecedents for their failure. In conclusion therefore, granulometric distribution, organic and chloride content of sea

sand create problems in concrete strength, durability and also create a highly corrosive environment for steel reinforcement.

According to Lalkovski and Starossek (2016), multi-story buildings in the city of Kampalaare opted for to effectively utilize the limited space or land available, one of the worst collapse types in terms of structural damage and loss of life is the pancake-type collapse, where some or all floors end up lying on top of each other like the layers of a pancake, with the floor contents crushed between them. Mostly observed after strong earthquakes, such collapses are triggered by loss of some or all vertical load bearing elements in some story; often the ground story (Lalkovski and Starossek, 2016; Yepez and Yepez, 2016). Once this occurs, the building part above the lost vertical elements (still intact) starts gaining downward velocity until it meets resistance from below. The ensuing impact forces often lead to collapse progression consequently graduating to total collapse.

Africa is very stable with little or no occurrence of earthquake unlike other continents. While this could not be ranked as one of the major predisposing factors to the occurrence of the numerous building collapses in Uganda, Kampala City in particular, it is reviewed by this study as areas outside Africa such as Indonesia, Turkey and Croatia have experienced losses of life and property occurring due to building collapses or failures that have been precipitated by earthquakes.

e) Landslide

Landslides constitute a serious natural hazard in many parts of the world, particularly in urban areas. Landslide refers to a rapid down-slope movement of soils as a coherent mass. Landslides and other ground failure are natural phenomena but

are generally enhanced by human activity. Landslides on naturally sensitive slopes are sometimes averted by means of stabilizing structures or techniques thereby reducing the substantial damages (houses) and loss of life. It is the complex combination of sliding and flowage. Factors such as type of earth material, slope angle, climate, vegetation, water and time determines the magnitude of landslide in an area.

f) Hurricane, Typhoons and Tsunami

Hurricanes are tropical cyclones characterized by circulating winds of 100 km/hr or greater generated over an area of about 160 km in diameter. It is known as typhoon in the ocean. Tsunamis are seismic sea waves generated by submarine volcanic activity. It is characterized by very long wave length and moves rapidly in the open sea where it is known as tidal waves. Hurricane, Typhoons and Tsunami activities are catastrophic in nature and whenever it occurs, buildings and human lives are not spared. Globally they are among the causes of building collapse.

g) Rain-Storm, Thunder-Storm and Lightening

This has the potential of causing building failures. These natural disasters are accepted as " Acts of God". Although, nobody has the power over nature, most natural disasters can be avoided (minimised) through the use of technology (disaster monitoring equipment) and environmental impact assessment (EIA).

h) Geologically Derived Materials

There are some geologically derived materials that could lead to building failures, they include: Soluble rocks (limestone, chalk, gypsum etc.), clay (shrinking and swelling ability), Groundwater (shallow water table), Soil geochemistry (pH,

sulphate and chloride), Peat and Unconsolidated recent deposits (Oloyedde et al., 2010; Amadi et. al., 2012; Arayela and Adam, 2001)

i) Soluble Rocks (Limestone, Chalk and Gypsum)

Sedimentary rocks like limestone, chalk and gypsum are weak, soluble and of very low bearing capacity. Erecting Building on this soluble soil are dangerous (liable to collapse) due to its low bearing capacity and high compressibility. Such weak soils should be excavated and backfilled with soil of higher bearing capacity.

j) Clay (Shrinking and Swelling Ability)

Clays are fine-textured; sedimentary that is composed of hydrated allumino-silicates. Based on grain-size, clay is any fine-grained sediment that is less than 4 microns. Clay has wide range of application, but due to its swelling ability when wet and shrinking nature when dry which has the potential of causing cracks on wall of building and tarred roads. The plasticity and low bearing capacity of clay soil makes it unfit for their use as constructional materials. The clay minerals (montmorillonite, illite and chlorite) are responsible for the swelling and shrinking properties in clay soils should be excavated and replaced with a much stronger soil. This a major challenge in building/construction in southern Nigeria where the soil dominantly clay and water-logged. This is necessary in order to avert failures of engineering structures like roads and buildings.

k) Ground water

Groundwater is the water occupying the void spaces in rocks. It is the water stored in the zone of saturation. It may be of magma (Juvenile source), trapped within sediment (Connate Source) and from rainfall (Meteoric Source). Areas where the

groundwater table is very close to the ground surface (shallow water-table), there is a tendency of the groundwater reacting with the cement portion of the foundation and this situation can weaken the entire foundation thereby causing building failures. The problem of ground water was cited by Amadi et. al.,(2012) as one of the causes of collapse of buildings in the Nigerian major towns like Lagos, Port-Harcourt and Warri arising from shallow water table and seawater intrusion.

l) Soil Geochemistry (pH, Sulphate and Chloride)

PH is a measure of the acidity or alkalinity of a medium. It is simply defined as the hydrogen ion concentration and is determined with the aid of a pH meter. pH values between (0-6) indicate acidity, 7 is neutral while (8-14) shows alkalinity. Most biological and physicochemical processes taking place in the soil are to a large extent controlled by the soil pH. The acidity of the soil has the potential of dissolving the cement component of the foundation thereby weakening the foundation. The acidity content of the soil can be reduced by the application of lime. Similarly, excessive sulphate content in the soil has aggressive effect on the cement used in constructing the foundation of buildings. Also, much chloride content in the soil can lead to rusting (corrosion) of the metallic component of the foundation (Arriba-Rodriguez et. al., 2018; Jonsta et al., 2011; Oke and Amadi, 2008).

m) Peat

Geologically, peat is the name given to the layer of dead vegetation in varying degrees of alteration, resulting from the accumulation of the remains of marsh vegetation in swampy hollows in cold and temperate regions. Peats are regarded as the youngest member of the series of coal of different ranks. Increase in temperature

changes peat to lignite, sub-bituminous, bituminous, anthracite and graphite. Their caloric value increases with temperature. In terms of building construction, peat soils are very weak and should be excavated and back-filled with a more stable soil. Construction works whose foundation rests on peat usually collapse because it cannot withstand the load from the foundation due to its low bearing capacity.

n) Unconsolidated Recent Deposits

These are non-cemented, highly friable materials that are newly deposited. Such materials are loose and cannot withstand the load from foundations. Building construction on this type of soil is deceptive and should be discouraged. The recent sediments are not good constructional material due to friability. Niger Delta area of Nigeria has this problem and is part of the causes of building failures in the region (Amadi et. al., 2012). In addition, a study by (Shamim et. al., 2019) revealed that Kampala Capital City Authority collected significantly more waste than private collectors for all study years. Waste is disposed of in different parts of Kampala despite of the existence of the gazette collection centers and the future projection showed that future projections showed that by 2030, annual waste would increase by approximately 60% for Kampala. These deposits have made the soil loose causing failure of structural buildings. According to an architect with Infrastructure Design Forum, one of the biggest mistakes people make while building house foundations is by building on grounds that are not firm. He explains that people nowadays get soil and dump it into a valley or a swamp and they start to construct on that soil yet it’s not strong enough to support a building. This has caused failure of most buildings in Kampala (Pamela, and Sarah, 2010).

o) Man-made factors

Man-made factors are human errors that occur before, during and after the construction of a building (Akinyemi et al., 2016; Alinaitwe and Ekolu, 2014; Amadi et. al., 2012). They include: poor design and construction, use of sub-standard and untested local materials, greedy and poor maintenance culture, foundation failure, and absence of site investigation and engagement of unqualified people.

p) Poor Design and Construction

Most collapsed buildings have also been linked to poor design and wrong construction methods. Architects and Structural Engineers that find themselves at the design stages should be careful to see that necessary variables are considered at this stage such as the nature of the soil, type and sizes of materials specified. Failure of most contractors to build according to specifications and plans often results to structural anomalies in buildings.

q) Use of Sub-standard and Untested Local Materials

The use of sub-standard (inferior) material in building construction is one of the major causes of structural failure of buildings. A Study by Wright (2015) asserted that the use of substandard materials has caused failure of buildings. Substandard materials especially reinforcement bars, steel sections and cement can contribute immensely to failure of buildings. Wright further submitted that in some instances, when other substandard materials are or have been used, the stakes are high that failure of buildings can occur.

Hall (2016) posited that the use of low quality materials is one of the major causes of structural failure. Over reliance on contractors by clients for decision making instead

of relying on consultants has caused failure of buildings. This is because most contractors are either their friends, relatives or recommended by friends. The result of this relationship is that clients rely more on the contractors for decision making than on the consultants. Poor mixing of concrete aggregate, poor quality steel reinforcement and use of sub-standard blocks from some block industries contribute their own factor to building collapse in Nigeria. Some of these constructional materials do not meet specified standard nor any quality control checks conducted on them before they are used for the construction. The frequent use of inferior and untested local building materials leads to structural failures in buildings. James (2017), opined that those incidences of building failures can be controlled or minimized if the client is ready to pay for high quality materials and for expert professional services. The same stance is reiterated by Nakibuuka (2017) whose findings indicated that some building materials are just not strong enough because they are not genuine and therefore not suitable for building structures. It is thus the responsibility of the engineer to check the quality of materials and not leave it to the Uganda National Bureau of Standards.

2.4.2 Greed and Poor Maintenance Culture

Greedy or get-rich-quick syndrome has its negative impact on the building industry. Take for instance, the case of a building that collapsed in Lagos in 2007, a building which was originally designed for a three storey but out of greediness, the owner decided to add extra two floors (Amadi et. al., 2012). This additional weight on the structure without due consideration of the foundation, column and slab led to the collapse of the building (Oke et. al., 2009a). Adequate maintenance of building is necessary for the safety and durability of the structure. Poor management and

maintenance in buildings leads to development of cracks on the walls, differential settlement and premature ageing of the structure. These deficiencies when not checked, could result to building failures.

2.4.3 Foundation Failure

All engineering works start with the foundation (Oloyede et. al., 2010). The purpose of a foundation is to transfer the load of structure to the ground without causing the ground to respond to uneven or excessive movement. Weak foundations of structures have caused structural failure of buildings (Kioko, 2014) as a firm foundation may cost almost half of the cost of the whole construction especially in swampy areas. Thus, a building structure can fail if founded on poor sub-soil, or if it is not uniformly loaded. In this line or argument, Johnson (2015) argues that if suitable foundation was not specified according to soil nature or due to soil erosion or earth movement under the foundation, then chances for building failures occurring are rife. Even on firm areas, a strong foundation is a must to ensure the strength of a building. Such load must be transferred in such a way that there will be no shear failure in the underlying soils. Many buildings have collapsed due to faulty foundation (Amadi et. al., 2012). Most of the foundations are designed without considering the soil type on which they rest upon. Therefore, it is vital that adequate soil investigation should be carried out before designing of foundation in-order to have a suitable design to suit the local geology of the area.

2.4.4 Absence of Site Investigation

According to Hornby (2001), investigation is defined as an examination or enquiry into something, especially a detailed one that is undertaken officially. Site

investigation is therefore the act of undertaking an examination of site (a piece of land). This is a process whereby surveyors, geologists, architects, engineers, builders and other professionals obtain information for successful project attainment. There is need for site investigation because it is vital to the success of any construction project, because inadequate or absence of soil investigation can lead to very large construction cost over-runs. If site investigation is to be effective, it must be carried out in a systematic way using techniques that are relevant, reliable and cost effective. Lack of site investigation has always led to foundation failure which results in building failures. Site investigation helps to reveal the weak and soluble soil in the area.

2.4.5 Engagement of Quacks/Non-professionals

Adebayo (2010), opined that efficiency in skill and experience is important in creating valuable workmanship in building construction. A number of professionals (stakeholders) exist in the building industry, but in most cases their services are not sought for due to one reason or the other, such professionals include: Architects, Quantity Surveyors, Land Surveyors, Builders/Contractors, Engineers (Structural, Civil, Mechanical, Electrical, and Geotechnical) (Amadi et. al., 2012). That said, Oloyede et. al.(2010) attributed causes of building failure to man's negligence in some vital areas in construction such as emphasizing soil investigation, incorporating design for extra loads, erecting stress shields from winds, use of substandard building materials, poor monitoring and overall poor workmanship. It has been observed that due to high cost of consultancy fees needed to engage the services of these professionals, most building proprietors prefer to cut cost by engaging the services of nonprofessionals (quacks) who lack the needed experience in

construction sector. This is reflected in poor workmanship and low standard of construction, which results in structural failure and collapse of part or the entire building.

2.4.6 Insufficient Institutional coordination

At all points of construction, the strength of the building should be tested according to the law but because of laziness, corruption and failure to enforce the law, it is not done. That is a big problem. He added that at every stage of construction there is someone with a strong motivation to save money or take money (Kioko, 2014). According to Ede (2010), illegal alteration to existing buildings has caused collapse of buildings. Clients at times, on their own, alter existing structures beyond and above the original design without any working drawings, and relevant authority approval for such development. In some cases, existing bungalows have been converted to either a stored building or two or three structures without any drawings and supervision by qualified personnel.

Absence of the authorities monitoring of sites, in some cases, Town Planning Authority staff seldom visit sites to inspect or monitor progress of approved work on sites, the result of which is documented in their forms. Unfortunately, in many cases, this inspection is non-existent, what this means is that buildings are put up without the Authority knowing anything about the details of the construction. Unfortunately, these details are only known when such buildings collapse and their elements get exposed for all to see. By that time, lives probably may have been lost (Ayedun et. al., 2012).

2.4.7 Corruption/fraud

Insincerity, fraud and corruption have caused failure of buildings. Evidence to this assertion is provided by Alamu and Gana (2014) who postulated that failures in building projects can easily be summarized as fraudulent activities and corruption. The contractor is usually the facilitator but sometimes teams up with consultants and other representatives of the client on the project to cheat the client. Corruption or fraud has become one of the easy ways to make it both in the public and private sectors of the economy. The collapse of a suspended floor slab of a two-storeyed building at Buziga, 8 km along Kampala - Ggaba Road on 2nd November 1997 was caused by corruption between the contractor and the consultants (Lubega, 2012).

2.5 Impact of building structural failure

Each collapse carries along with it tremendous effects that cannot be easily forgotten by any of its victims (Ede, 2010). The consequences are usually in form of economic and social implications. These include: loss of human lives, injuries, economic waste in terms of loss of properties, investments, jobs, incomes, loss of trust, dignity and exasperation of crises among the stakeholders and environmental disaster (Ede, 2010).

The unprecedented occurrence of structural failures has a big toll on urban life. According to Janssens et al. (2012), the consequences of structural failures can take several forms ranging from material/structural damage and human injuries/fatalities to functional downtime and environmental impact. Janssens and colleagues relay that municipal and city authorities should be quick in action to mitigate these challenges by ensuring that they develop a risk-based robustness framework within which

consequence modeling is an important step in estimating risk, both in determining the robustness of a building and in assessing the benefit of possible robustness-improving measures. However, their findings and accompanied recommendations are very silent with regard to how the framework would work and how best it would be improved and upgraded to ensure that it becomes relevant over and again. This left a contextual gap for this study.

Collapsed buildings where there are scores of deaths constitute a major challenge to the owners of the buildings in terms of compensations (Amadi et. al., 2012). At times, even when there is no reported death but a big number of injuries, the costs related to injuries are also at times higher especially in instances where the building is already operation and housing many businesses. The costs cited by Chuang and Spence (2017) could include pre-hospital emergency treatment, emergency department services, hospital physician and surgeon services provided to the causalities, visits to private physicians, rehabilitation costs and lost income following the injuries.

According to Obodoh et. al. (2016), quantification of the complete effects of any collapse is extremely difficult as there are so many factors involved, and these include emotional and subjective factors. Apart from the number of deaths that can often be truly identified, the rest of the effects are surrounded by so many uncertainties which make the analysis only approximate. Leaving aside the grossly quantifiable economic sums, the stress, trauma and shocks to the building owners may have some far-reaching effects upon others involved in one way or the other with the structure.

Faced with recurrence collapsing buildings, the government of Uganda has developed a regulatory framework to redress effects outlined above. For example, the Building Control Act No. 10 of (2013) spells out the proper strategies to be followed (Dimuna, 2010). Findings in the Office of the Auditor General of Uganda OAG Report (2016) revealed that there is weakness in enforcement (OAG report, 2016).

Property worth millions has been damaged in African countries most especially due to failure of buildings. People invest for the purpose of making profit and/or personal uses and when it collapses, it discourages investors for further investment in property. The collapsed property most time cannot be regained except such property has been insured, which most developers hardly do these days (Smith, 2017). Earlier, a study by Ede (2010) revealed that the continued collapse of buildings in cities and other urban centres discourages many developers from investing in property development, most especially those who are new in the system. As a result of this, they may move into other investments e.g. stock and shares Table 1.1 shows some of the major structural failures that have occurred in Kampala City in the last two decades.

Table 2. 1: Cases of Structural failures of buildings in Kampala city (2000-2020)

Year	Place	Number of Death/Injured	Estimated property lost
May 2020	Makindye	Storeyed building collapses killing 16 workers and injuring many others	Property in neighborhoods lost, value not reported
October 2019	Bakuli, Rubaga Division	Building collapsed killing one and injuring two	No property damages reported
April 2016	Makerere Hill	Storeyed building under construction collapsed killing 6 people and injuring many others	Property and cars parked in the neighborhood destroyed
December 2015.	Kansanga	Five construction workers died, while five sustained injuries when a storeyed building collapsed	Not reported
August 2014	Kansanga	Two people sustained severe injuries when a six-storeyed building under construction collapsed	The debris damaged a vehicle (Mercedes Benz) and some houses in the neighborhood.
June 21, 2013	Nakivubo Mews(KCBD)	Nice Time Arcade caved in, ten people were injured when a building caved in	Not reported
July 2012	Nakawa	Lugogo construction site, Two construction workers were killed when a building under construction on Lugogo-Bypass (Rotary Avenue) collapsed.	Not reported
July 2011	Ntinda	Seven people sustained injuries after a building under construction collapsed.	A lot of property, including three cars, were damaged.
January 26, 2010	Luwum Street	Two people died and five others sustained severe injuries on, when a storeyed building under construction caved in.	Not reported
October 2008	Nakasero, Lumumba Avenue	NSSF Pension Towers , at least seven people died after a wall collapsed at a National Social Security Fund (NSSF) construction site	Not reported
February 2008,	St. Peter's Secondary School, Naalya	In 10 people were killed when a building under construction collapsed	Not reported
January 2008.	Mini-Price Bata, Namirembe road	Three people died when the walls of the building collapsed.	Not reported

Source: ***Masaba et al.(2016), Sejjoba (2018), KCCA (2020), Ngwomoya (2020)***

2.6 Existing strategies against structural failure of buildings

Windapo and Rotimi (2012) examined contemporary issues around building collapse in major cities in Nigeria and their implications on its sustainable development. Their study specifically assessed whether the approach to construction by industry stakeholders followed the basic principles of sustainable development. Results revealed that incidences of building collapse were prevalent among residential

buildings of less than five floors high with major commercial centers worst affected by the under-performance of industry stakeholders. They concluded that improved levels of conformance to and compliance with sustainable construction principles by construction industry stakeholders is required to abate building collapse and recommended an overhaul of planning and implementation policies (e.g., building codes, which set out minimum performance standards for design and construction works that are based on sustainable principles. Notably, they specified the need for revising the Building Code to incorporate sustainable construction. Also, as a matter of concern was their recommendation that bye-laws developed need to be developed for big constructions because of their strategic level of development and then lastly, the need for a coordinating thread between the governments (federal, state and local), through respective regulatory agencies to ensure that there is compliance with the set standards and clauses enshrined in the building and authorization plans respectively.

Deskin and Pasternak (2018) findings revealed that building plan approval as a strategy against structural failure, before any construction work starts, the plan approval should be the first thing so as to know if the building is rightfully designed at the right place, acceptable design and load bearing capacity. The successful approvals are best handled when there is coordination between institutions that are charged with overseeing developments in the city. Akinyemi et. al., (2016) recommended all the stakeholders in the construction industry should adhere strictly to the provisions of the building code. They further recommended that the quality standards agency of Nigeria, SON (Standards Organization of Nigeria) should ensure that only certified building materials are allowed in the market together with the need for the government to put in place administrative machinery for strict monitoring of

construction sites by enforcing relevant laws to sanitize the building industry. However, mainly in developing countries, studies have established that the institutional mechanisms and capacity that have been established to prevent the collapse of buildings are extremely weak. It is clear that to reduce the incidence of building collapse in Africa, governments must move beyond knee-jerk reactions (Osam, 2015) to equipping development control institutions to enforce legal provisions. If not, thousands of dangerously weak buildings will be constructed, and millions of city residents will live under the continuous threat of building collapse (Fernandez, 2014).

Soil tests should be made mandatory in all the areas where high-rise buildings ought to be constructed. Need for lubrication of soil test, this is also very important so as to know the strength of the soil if it can bear load or not and to know the type of foundation to be used because foundation design is the strength of the building (Deskin and Pasternak 2018). Dimuna (2010) believed other key causes of building collapse in Nigeria are the absence of soil testing before construction, absence of coordination between professional bodies and town planning authorities, and inadequate enforcement of existing laws regulating physical development. This implies that building collapses in Nigeria are caused by human, construction, and institutional failures. Different soil types pose varying problems for built foundations and the structural integrity of an entire building. In this line of argument, Oloyede et. al., (2010) recommended the need to carry out soil surveys to ascertain the compressibility or consolidation potentials as well as the bearing strength of the soil of a particular site. This, they confessed is necessary because in sand and clayey sites because there are too many voids between their particles leading to many movements

or sliding. Also, Oloyede et. al., (2010) established that building constructed in areas with silt deposits are susceptible to collapse when they exposed to excessive amounts of water while then for clays which shrink in the dry season only to swell during the wet season or in the constant presence of water, a building constructed over them is liable to failure. and colleagues surmise that any contractor worth his salt would take all these points into consideration while laying the foundation of a building.

Supervision should be made mandatory in all city and urban settings because of their susceptibility to structural failures in buildings (Oloyede et. al., 2010). This should be considered a mandatory activity but not just assumed for the sake (Amadi et al., 2012) According to Alinaitwe and Ekolu (2014), despite the relatively well-established concrete practice in East Africa, there are frequent construction failures leading to loss of lives and property. In the recent past, there has been increasing public outcry over the quality of physical infrastructure countrywide. This outcry in the context of Uganda and more so in the city and urban centres are indicative of poor or peripheral supervision that is done for formality.

Emphasis on quality building materials is also a key strategy for reversing the trend of collapse of buildings in cities and other urban centres. In appraisal of this strategy, Boye (2016) in his study revealed that the quality of materials should be considered during construction; quality materials should always be used, and must be tested before usage. He believed that when purchasing the building materials, you should consider those of a reasonable price but not those of the lower price.

Also, the Construction Engineering Bill of 2018 later signed into law lays down strategies to be followed while construction is in progress such as: tight supervision, clear interpretation of construction contracts, dispute resolution and safety standards. Also, the Construction Standards and Quality Assurance Department in the Ministry of Works and Transport created in the year 2016 and Building and Construction Advisory Board of 2020 have all been instituted to ensure effective, safe and adequate delivery of the services in the construction industry.

As a result, efforts have been made in the recent past to examine the factors leading to the escalation of structural failures in Kampala city. For example, Muhwezi et. al., (2020) attributed the problem to use of substandard materials. Alinaitwe and Ekolu (2014), established that the cause of structural failure is largely caused by lack of coordination between the parties that are charged with the management of business and developments in Kampala City.

Other legal tools in addition to the above include the Uganda Physical Planning Act of (2010), section 10 (d) which breaks down the functions of physical planning committees as to enforce development plans, to approve development applications relating to housing estates, industrial locations, schools, petrol stations, dumping sites or sewage treatment, enhancing supervision by professionals. Besides the Act, in the year 2011, Physical Planning Guidelines were formulated and formalized by the government. In addition, KCCA has bye-laws that require that every construction within the city to undergo approval by the Authority before any construction is done, through submitting technical drawings for approval. After approval, the construction is supposed to be supervised by registered professional Engineer, registered with

Uganda Institution of Professional Engineers (UIPE) and Uganda Engineers Registration Board (ERB) (Odongo, 2017). All the strategies above have been designed to eliminate continuous structural failure of buildings in the construction industry in Uganda (Kakooza, 2017). However, technicalities specified by the frameworks described above seem to be side stepped every now and again since the spate of building failures has continued to take its toll on lives of people, damaged property worth millions of shillings and interrupted the smooth flow of activities in the affected zones.

2.7 Chapter Summary

This chapter summarized the findings of the previous researchers worldwide on the causes of collapse of buildings, the impact of building failure to stakeholders, the enabling factors for successful application of strategies. From the review of the literature above, it is evident that there are a number of causes of structural failure of buildings and many different strategies to eliminate structural failure of buildings were suggested but they had gaps that this study was intended to close.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter explains the methodology that was used in the study. Thus it presents the research design, area of study, population of study, sampling procedure, data collection methods, quality control of instruments of data collection (reliability and validity) research procedure and analysis.

3.2 Research Design

This study adopted a case study research design. A case study is a research design and an empirical inquiry that investigates a phenomenon within its real-life context. Case studies are based on an in-depth investigation of a single individual, group or event to explore the causes of underlying principles (Yin, 2014). For case study analysis, one of the most preferred techniques is to use a pattern-matching logic. Such a logic compares an empirically based pattern that is, one based on the findings from the case study with a predicted one made before data collection (Yon 2014: 143).

The case study design allows in-depth, multi-faceted explorations of complex issues in their real-life settings. (Fiss, 2009) asserts that potential advantages of a single case study are seen in the detailed description and analysis to gain a better understanding of ‘‘how’’ and ‘‘why’’ things happen. The case study design was used in order to generate in depth understanding of the causes of collapse of buildings, its impact as well as the performance of existing strategies against failure of buildings.

The study employed triangulation approach with qualitative and quantitative techniques. Qualitative technique was used in this study and helped in exploring the views of stakeholders on the causes of failure of buildings in Kampala. Quantitative techniques were used to capture cross sectional data from different institutions charged with operations within Kampala City.

3.3 Study Population

The study population of 200 respondents consisted of members of Uganda Institution of Professional Engineers body, management of the Engineers Registration Board, Staff of Ministry of Works and Transport, Ministry of Lands, Housing and Urban Development, Kampala Capital City Authority and chairpersons, Local Council One (1) Leaders from the respective places where we have had cases of collapsed buildings. The sample size for the questionnaire survey was 96 which was determined using Krejcie and Morgan (1970) Table of Sample size determination for finite population (See Appendix III). Krejcie and Morgan (1970) Table was preferred because the study was carried out on a known or finite population. According to Kumar (2019) and Odiya (2009), the Table is recommended for use in studies targeting a known population and enables a researcher to minimise the sampling errors.

3.4 Sample size and selection criteria

Different categories of people were chosen because they are directly responsible for the construction of buildings.

Table 3. 1: Population and Sample size of the Study

Category	Population	Sample Size	Sampling Technique	Research Instrument
UIPE	37	27	Simple random	Self-administered Questionnaire
ERB	25	20	Simple random	Self-Administered Questionnaire
MoWT	23	20	Simple random	Self-Administered Questionnaire
MLHUD	40	20	Purposive	Self-Administered Questionnaire
KCCA	36	20	Purposive	Self-Administered Questionnaire
LC1	29	20	Purposive	Self-administered Questionnaires
Key informants	10	10	Purposive	Interview guide
Total	**200**	**137**		

Source: Researcher (2019)

3.5 Sampling Technique and procedure

Both probabilistic and non probalistic sampling techniques were employed in the selection of the study participants. Stratified random and simple random sampling techniques were used under probabilistic sampling while purposive sampling was chosen under non-probabilistic sampling. In order to ensure equal representation of the study population, the sample was selected from a cross section of the population of 200. The selection of the respondents from the Uganda Institute of Professional Engineers, Engineers Registration Board and Ministry of Works and Transport and local leaders was done using stratified random sampling and then simple random sampling technique using lottery method. The two approaches were selected because they give all the respondents equal chances of being selected in the sample and so avoid biases on side of the researcher (Kumar, 2019; Odiya, 2009; Amin, 2005;

Mugenda and Mugenda, 2003). The selection of key informants (LCs and top management of the selected institutions) was done using purposive sampling because of these categories were deemed to be knowledgeable about the study variables.

3.6 Data collection Methods

A multifaceted approach using both qualitative and quantitative methodologies of data collection was employed. Both primary and secondary data were used.

3.6.1 Primary Data Collection

3.6.1.1 Questionnaire method

This method is mainly used to generate quantitative data (Odiya, 2009). In this study, it involved the use of self- administered questionnaires to respondents (junior and middle staff of the selected institutions) in relation to failure of structural buildings. In generating quantitative data only closed ended questions were used. According to Creswell (2014), this method is preferred because it gathers descriptive data, covers a wide range of topics, relatively inexpensive to use and can be analyzed using a variety of existing software.

3.6.1.2 Key Informant Interviews

Data were collected using key informant interviews. These were administered to the top management officials of each institution selected for the study. The interview method was used because it enables a researcher to come up with detailed information about the perceptions and lived experiences of the respondents more than any other method through interviews, the researcher obtained information about the scope and magnitude of structural failures in buildings and more notably about

the causes, effects and the performance of the strategies designed by the government and KCCA overtime.

3.6. 2 Secondary data collection

This involved reviewing of relevant written documents such as government publications and reports. Lincoln and Guba (1985) define a document as "any written or recorded material" not prepared for the purposes of the evaluation or at the request of the inquirer. Secondary data were obtained using documentary reviews from the registry of the Uganda Institution of Professional Engineers, the Engineers Registration Board, KCCA, MLHUD, MOWT and Ministry in charge of Kampala city on the failure of buildings. Internet sources and newspapers were also explored for secondary data. The newspapers were accessed from periodicals section of the main library of Kyambogo University. Similarly, the method enabled the researcher to obtain the necessary secondary data on failure of the buildings in the world. This method was preferred due to the fact that documents are available locally, cheap, provides information on historical trends or sequences, provides opportunity for study of trends over time (Jacobson, 2009). The data obtained from the documents reviewed were used to corroborate the findings obtained through primary means.

3.7 Data collection tools

The data collection tools employed included document review checklists, Interview guide and questionnaires.

3.7.1 Questionnaires/Quantitative data collection instrument

The study used self-administered questionnaires. This had closed ended questions where the respondents were limited to a fixed set of responses with options to select

and these responses were based on a five point Likert scale. The decision to have more close ended questions in the questionnaire was informed by Odiya (2009) and Katebire (2007) that close ended questions keep the respondent focused, weed out irrelevant and uncalled for responses and above all, increase the response rate. According to Amin (2005) questionnaires are popular with researchers because information can be obtained fairly, easily and responses are easily coded. It was preferred because a big number of respondents can be covered and it is cost effective. The questionnaire had four sections; the first section had questions seeking to establish the background identities of the respondents, section two had questions that captured the causes of structural failure of buildings, section three contained questions that captured the impact created by structural failure of building. The last section (four), contained questions that sought to establish whether the performance of the existing strategies for addressing the problem of failure of buildings are applied (See appendix I).

3.7.2 Document review checklist

This was used by the researcher to source secondary data useful in understanding the causes of failure of buildings and its impacts. The study analyzed documents on buildings that have collapsed in Kampala city from KCCA Resource Centre, Uganda Police reports on the different collapsed buildings in Kampala and newspapers in the periodicals section of Main Library at Kyambogo University. According to Creswell (2014), document review is a good source of background information and as well provides a “behind the scenes” look at a program that may not be directly observable hence enabling a researcher to come up with key and relevant issues that could not have been noticed through other means.

3.7.3 Interview guide /Qualitative data collection instrument

The researcher used a semi-structured interview guide to gather information from key informants. According to Amin (2005), an interview guide enables researchers to get in-depth information about the study in question. In addition, it is flexible and therefore allows the researcher to adjust the questions to tap the required information from the respondents (Odiya, 2009). Further, it serves as a point of reference that enables a researcher to keep reminded of the key questions to engage the interviewee on without any possibility of omission (Aleshenqeti, 2014). (See appendix II). In this study, interviews were administered to the key informants as earlier described. However, Cohen et al. (2013) revealed that they are liable to yield biased data unless precision and precaution are exercised by the interviewer. For example, the outcomes or responses may be subjectively influenced by the whims of the enumerator or interviewer. In this study, to achieve objective data guidance was sought from the wisdom of Aleshenqeeti (2014) who recommended that such can only happen when leading questions are avoided, tape recording employed to avoid missing out on detail and giving the participants chances of self-reflection, meditation and correction such that they provide well thought ideas and opinions.

3.8 Procedure of data collection

The researcher obtained an introductory letter from the Kyambogo University that introduced him to the respondents and local authorities for further permission to carry out the study in their areas of jurisdiction. This was followed by designing the research tools and then taken for a pilot study to the selected respondents. The pilot study was administered for the purpose of pre-testing the questionnaires to validate the relevance of the questions to the intended respondents; determining the

approximate time or duration taken to fill a questionnaire with one respondent and finding out the most efficient way of carrying out main survey. Following the pilot survey some amendments were made to the questionnaires and interview guidelines, whereby questions were added, some were deleted while others were reframed to make them clearer and easier to understand.

The study participants contacted during piloting of the tools were excluded from real data collection stage. To ensure confidentiality, the researcher informed the respondents that the study was purely academic. The questionnaires were distributed and data collection commenced. The respondents retained the questionnaires which were later collected after three days basing on the decision made during pretesting that allocation of three days was adequate for the respondents to provide their opinions. As for the interviews, arrangements were made with the selected key informants on the day and date of the interviews. The interviews were audio taped and responses later transcribed. The qualitative findings obtained were integrated with the quantitative ones in order to provide a holistic description, analysis and discussion of the findings.

3.9 Data Quality control

Data quality control is concerned with ensuring that the data collection instruments pass validity and reliability tests (Bryman and Bell, 2011; Odiya, 2009). In this study, validity and reliability were established by pre-testing the instruments in Jinja Municipality in Eastern Uganda which has also experienced cases of collapsed building in the last ten years or more. The pilot study involved 20 purposively selected respondents. The data obtained were analyzed using statistical package for

social sciences (SPSS) in order to compute both validity and reliability indices as follows:

3.9.1 Validity

Validity is the ability of the instrument to produce findings that are in agreement with theoretical or conceptual values. According to Amin (2005), validity refers to appropriateness of the instrument. Content validity measures the extent to which the content of the instrument corresponds to the content of the theoretical concept it is designed to measure. To obtain content validity index, inter judge was used with the help of three research consultants. Each of the judges provided his/ her opinion on a two-point rating scale of Relevant (R) and Irrelevant (IR) to calculate the average index (CVI). The items considered irrelevant were deleted or substituted with relevant ones. The formula used to calculate CVI was;

CVI = n/N……(Equation 3.1)

Where: n = number of items rated as relevant; and N= Total number of items in the instrument.

The CVI results are presented in Table 3.2.

Table 3. 2: Validity Indices

Items	**Content Validity Index**
Causes of failure of structural buildings	0.866
Impact created by structural failure of buildings	0.725
Existing strategies	0.666
Average of Validity Index	0.752

The CVIs for the questionnaire is considered valid when its value is 0.70 and above which is the benchmark in a survey (Odiya, 2009). The value of CVI obtained was 0.752 which implied that the questions in the tool were valid.

3.9.2 Reliability

Reliability for the interview guide was achieved with the help of the supervisor who read the question items and guided on the formulation of the questions. During data collection, the researcher ensured prolonged engagement and audit trails. Data collected was systematically checked, focus maintained and errors identified and corrected" (Creswell and Miller, 2000). On the other hand, the reliabilities of items in the questionnaire were tested using Cronbach Alpha (α) method provided by SPSS. Reliability for the items for the different constructs was attained at the benchmark of α = 0.70 and above (Rehman, Kyrillidou and Hasmeed, 2017). The Cronbach test results were as presented in Table 3.3.

Table 3. 3: **Reliability Indices**

Items	**Cronbach alpha (α)**	**No of Questions**
Causes of failure of buildings	0.806	12
Impacts	0.713	12
Existing strategies	0.736	9

The reliability indices were valid at above 0.7 the benchmark in a survey (Odiya, 2009). This implied that the questions in the tool were consistent.

3.10 Measurement of Variables

The variables were measured using questions developed basing on the nominal and ordinal scales. The nominal scale was used to measure questions on background characteristics. This was because the nominal scale provides labels that help to identify study items. The ordinal scale is a ranking scale that possesses the characteristic of order that was used to measure the items of the independent and dependent variables (Lovelace and Brickman, 2013). The ranking was done using

five-point Likert Scale (Where 1= strongly disagree, 2 = disagree, 3 = Not sure, 4 = agree and 5 = Strongly agree. This provided numerical data for quantitative analysis.

3.11 Data Management and Analysis

3.11.1 Quantitative data

The processing of quantitative data involved coding, entering the data into the computer using the Statistical Package for Social Sciences (SPSS 16), summarizing them using frequency tables to identify errors and editing them to remove errors (Greasley, 2007). Quantitative data analysis involved use of frequency counts and percentages and then mean and the standard deviation.

3.11.2 Qualitative Data

Processing of qualitative data involved familiarization with the data through review, reading, identification of themes, re-coding and exploration of relationships between categories after data had been collected (Lacey and Luff, 2001). Content analysis was used in analysing qualitative data and involved interpretation of the underlying contexts. The collected data was categorized into themes and then analysed basing on the research objectives.

3.12 Ethical Considerations

This study dealt with direct questioning of respondents and reviewing documents, administering of questionnaires to respondents and observations and throughout these processes, ethical concerns were considered. The researcher considered ethical issues throughout the period of the study and remained sensitive to the impact of his work on the respondents and stakeholders affected by the study. The researcher

obtained an introductory letter from Kyambogo University prior to conducting research, seeking permission to conduct research in the study area. The informed consent from the respondents was also sought by explaining the purpose and objectives of the study. The researcher observed anonymity during data collection and presentation by using codes as a means of identifying the respondents.

3.13 Achievements of specific objectives

Objective one: Causes of structural failure of buildings

This objective was achieved through administering the questionnaires bearing questions concerning the possible causes of structural failure of buildings to the respondents. The possible causes were determined with the help of the supervisors who judged the options of the causes put in the questionnaires. The questions were closed ended. The causes of structural failure of buildings were analyzed using the 5-point Likert scale that was used to generate mean values and the mean of means that acted as the benchmark for ranking the statements. The mean values were ranked in ascending order of magnitude.

Objective two: Impact created by structural failure of buildings

This objective was achieved through a questionnaire which provided the different impacts of building failure in Kampala as provided by the previous studies and prior interaction with stake holders, with the zeal to explore more information on the impact created by structural building failure, more information was obtained through interaction with the KCCA engineering staff as well as some engineers at the Uganda Institute of Professional Engineers. The impacts created by structural failure of buildings were analyzed using frequencies percentages generated in SPSS and their

mean values, mean values were generated and ranked to determine the most significant impacts created by structural failure of buildings.

Objective three: Performance of existing strategies to eliminate structural failure of buildings

This objective was achieved through the responses obtained through the questionnaires by the study participants, interviews and review of published documents The researcher also achieved this objective through interacting with the individuals in the construction industry who gave the researcher different strategies they use to eliminate structural failure of buildings. The performance of existing strategies to eliminate structural failure of buildings were analyzed using frequencies and percentages generated in SPSS and their mean values were generated and ranked to determine the most significant strategy towards elimination of structural failure.

Objective four: Developing a framework for eliminating structural failure of buildings

The researcher achieved this objective through examining the findings in this study and then designed a framework to eliminate structural failure of buildings. A framework was developed by providing a strong monitoring team that comprises the local authorities, KCCA through its physical planning unit and the building Technical Committee that will comprise of representatives from the professionals from bodies like ERB, UIPE among others. When this framework is employed, it will result into sound and long-lasting buildings constructed.

3.14 Chapter Summary

This chapter provided the procedure on how the data were collected in order to achieve the goals of this research by looking at the survey population, who provided relevant information about the study i.e. architects, engineers, contractors, stakeholders and professional institutions. This chapter has further presented the sample selection procedures, data collection, data processing and analysis as well as the formulae that were used in data analysis of the data collected.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

The chapter presents, analyzes and discusses the findings of the study in the gist of the four objectives set in Chapter One. The findings are analysed and discussed under themes developed from the specific objectives and cross referenced with the literature reviewed in Chapter Two. The beginning sections of the chapter present the response rate and the background characteristics of the respondents. This is followed by actual findings relating to the study objectives.

4.2 Response rate

Response rate is an important factor in determining the quality of a study (Krishnan and Poulose, 2016). It is the ratio of the number of targeted respondents to those interviewed or engaged in the study (Odiya, 2009; Morton et. al., 2012). Unless an interview or any other research instrument is compulsorily administered to a captive audience, rarely does it achieve a 100 per cent response rate (Krishnan and Poulose, 2016). The response rate for this study is shown in Table 4.1.

Table 4. 1: Response rate

Research instrument	**Questionnaires distributed**	**Questionnaires returned**	**Response rate**
Questionnaires	127	96	74%
Interviews	10	8	80%
Total	137	104	
Overall response rate			76%

Source: Primary Data (2019)

The study initially targeted 137 respondents out of which 104 were fully engaged. The response rate for this study thus, was 76% (104/136*100). The response rate was high implying that the findings are representative and accurate. This inference is

supported by the observations of Morton *et al.* (2012) who established that studies with a much lower response below 50% of the sample are often only marginally less accurate than those with much higher described response rates, say 70% and above. The inference made is also in line with the findings of Krishnan and Poulose (2016) that high response rates indicate that the sample is representative of a population hence improving the acceptance and credibility of the research findings amongst key stakeholders. It is indicative that the participants are interested in the study hence providing a possibility that the findings generated represent their objective opinions.

4.3 General information about the respondents

Questionnaires were administered to respondents. The study among the demographic information, sought to establish the respondents' sex, age, highest education attained and profession.

4.3.1 Description of the Respondents by Gender

The respondents were asked to indicate their gender on the questionnaire and the findings are presented in Table 4.2.

Table 4.2: Gender of the Respondents

Gender of Respondent	Frequency	Valid Percent
Male	68	70.1
Female	28	29.9
Total	96	100.0

Source: Primary Data (2019)

Table 4.2 shows that majority of the respondents, 68 (70.1%) were males as compared to females, 29(29.9%). This implies that there are more male employees in the sampled institutions concerned with management of buildings in Kampala City as compared to females. However, the slightly reasonable number of females could be

attributed to increased emphasis on women emancipation and thrust on girl child education for the last three decades that has paved way for increased access of women to education that has led to raising numbers of women civil servants. The participation of both male and female respondents shows that both categories of gender were interested in the study given that building constructions affect them equally both directly and indirectly. Therefore, the outcome (well designed, performing and long lasting buildings) anticipated to be developed in this study are a blessing to all categories of gender.

4.3.2 Description of the respondents by level of education

The respondents were asked to indicate their highest level of education and the findings are presented in Table 4.3.

Table 4.3: Levels of Education of the Respondents

Level of Education	Frequency	Valid Percent
PhD	3	3.1
Masters	38	39.6
Bachelors	45	46.9
Diploma	9	9.4
Certificate	1	1.0
Total	96	100.0

Source: Primary Data (2019)

Table 4.3 shows that majority of the respondents were bachelor holders and the least were of the certificate level. The implication here was that all the respondents were able to read and write and able to fill a questionnaire. The high level of education among the respondents was largely because the positions they hold had formal training beyond secondary school level as a minimum standard. The different levels of academic qualifications indicated a mixed category of respondents who participated in providing data for this study. As can be seen from Table 4.3, the

respondents were literate and had a high degree of understanding making it easy for them to decode the information contained in the statements that were used to measure the study constructs. By implication, the findings of the study are informative largely because they captured the views of the respondents from different academic calibers. It is therefore eminent to conclude that the study findings are based on the impeccable understanding of the respondents.

4.3.3 Description of the respondents according to age

The collection of data from the different age groups intended to establish whether the opinion of the study participants varied between different age groups or not. The respondents were asked to indicate the age bracket in which they fell and the findings are presented in Table 4.4.

Table 4.4: Age groups of the Respondents

Age groups	Frequency	Valid Percent
18-27	12	12.5
28-37 years	37	38.5
38-47 years	1	1.0
48-57 years	37	38.5
58 years and above	9	9.4
Total	96	100.0

Source: Primary Data (2019)

Results in Table 4.4 show that majority of the respondents were of the age group 18 – 27 years and 48–57 years. This finding implies that respondents from the selected institutions have more middle-aged staff than junior and adult staff. Data on age of the respondents indicate that those between 28 – 57 years constituted the core and decision-making crew of the respective institutions.

4.3.4 Description of the Respondents by Service Experience

The respondents were asked to indicate the number of years they worked in the corporation and the findings are presented in Table 4.5.

Table 4. 5: Working experience

Length of service	Frequency	Valid Percent
1 - 3 years	9	9.4
4 - 6 years	18	18.7
7 years and above	69	71.9
Total	96	100.0

Source: Primary Data (2018)

Table 4.5 shows that majority of the respondents, 69 (71.9%) had worked in their respective institutions for more than 7 years. This finding implies that majority of the respondents had experience on the service levels, service capacity and quality of the services rendered to the building construction sector in Kampala City. The findings of the study therefore are credible because they captured the experience levels of the respondents. These had the capacity to compare what is existing today and what the situation was in the past. Thus, the long experience in these respective areas provided a basis for the accumulation of knowledge about the variables investigated by this study.

4.4 Empirical findings according to objectives

4.4.1 Causes of structural failure of buildings in Kampala City

Objective one (1) assessed the causes of collapse of buildings in Kampala City. In Table 4.6, “D” represents the opinion of those that strongly disagreed and those who disagreed respectively; “NS” represents opinion of the respondents who were ambivalent or non-committal while “A” stands for those who agreed and strongly agreed to a given statement. The “Mean” is used in interpreting the findings to give a

clear description of the position of the respondents. The successive themes follow the same interpretation.

Table 4. 6 : Causes of structural failure of buildings

S/N	**Cause of collapse**	**D**	**NS**	**A**	**Mean**	**Std**	**Rank**
1	Buildings without approved drawings	7.3 (7)	9.4 (9)	83.3 (80)	4.19	1.089	1st
2	Using unqualified engineers	5.2 (5)	9.4 (9)	85.4 (82)	4.18	1.066	2nd
3	Lack of proper supervision by professionals	9.4 (9)	9.4 (9)	81.2 (78)	4.17	1.102	3rd
4	Complicated designs	9.4 (9)	5.2 (5)	85.4 (82)	4.16	1.060	4th
5	Lack of experienced contractors	24.0 (23)	13.5 (13)	62.5 (60)	3.96	0.946	5th
6	Illegal alteration of existing buildings	11.4 (11)	16.7 (16)	71.8 (69)	3.76	1.023	6th
7	Use of substandard materials	21.9 (21)	15.6 (15)	62.5. (60)	3.72	1.211	7th
8	Corruption in the industry	25.0 (24)	14.6 (14)	60.4 (58)	3.43	1.185	8th
	Mean of Means				**3.76**		

Key for interpreting mean: 1.00-2.99= Disagreed, 3.00=Not sure, 3.01-5.00= Agreed,

Source: **Primary data, (2019)**

Results in Table 4.6 shows that all the respondents agreed to most statements that measured the causes of structural failure of buildings in Kampala City since the means values ranged between 3.01-5.00. The mean of means was introduced to make it possible to identify the most common causes across the different areas, which have experienced collapse of buildings over the time covered by the study.

Item 1 from Table 4.6 shows that majority of the respondents 80 (83.3%) agreed that most of the buildings that have collapsed in the different parts of Kampala City have resulted from the failure of the building proprietors and their contracted companies to

follow approved structural designs as one of the causes of collapse of buildings in Kampala. An insignificant number disagreed and showed ambivalence; implying that over the time scope selected for the study, one of the prominent causes of structural failures has been caused by disregard for approved structural drawings. This finding was further substantiated by the key informants during interviews when they unanimously indicated that most of the causes of the recent spate of buildings that have collapsed and caused death of many people as well as damage to various properties have resulted from the alterations or total neglect of the plans approved by KCCA as summed up below;

> *"….it's been a common scenario in the investigations that our institution was part in the last five consecutive years to list failure to follow up the approved structural plans by KCCA and the consultancy companies as number one cause of the major structural failures that have occurred in Kampala City. In fact, most of the approved plans are knowingly shelved by the contractors who for reasons not yet known, use what they think could be the "better" structural drawings. These ride on the ignorance of most building owners who they hoodwink and make them to believe that they are following the approved plans when in actual sense, they are not….the owners of the buildings have on most occasions expressed ignorance because they say…they delegated every construction activity to the contractors, supervision inclusive…"* (as reported by one official, UIPE, 12 September 2019).

In consonance with the above, another respondent had this to say in relation to the matter;

> *"…, instances of deviating from approved plans by KCCA is one of the most common challenges identified among the key causes of building failures in Kampala City. At one of the sites I*

managed to visit on directives from Ministry of Works and Transport, I confirmed this anomaly where I realized that the site foreman never had a copy of the approved plans. Little can in such an instance be possible for any oversights to be made …" (Member, ERB).

Item 2 shows that majority of the respondents, 82(85.4%) agreed that structural failures of buildings normally occur in Kampala City largely because some construction projects enroll and allow unqualified technicians or engineers to become part of the technical construction teams. As further proved by the high mean value (4.19), this practice predisposes buildings to failure which exposes big numbers of people who throng these places to be exposed to unnecessarily higher risks for generations.

Resonating with the above finding, are views of the key informants who reiterated that unqualified engineers are largely incompetent and will always produce shoddy outputs. They summarised their stance in the following statements:

"…, *Incompetent engineers are liable to engage in substandard work including improper concrete mixing yet concrete determines how long the building will last. In the case of high-rise buildings typical of Kampala City, the unqualified engineers lack the knowhow of ensuring proper mixing and yet this is one of the prerequisites for giving a building proper durability. In fact, the mixture of sand, cement, aggregate or stones and water must be first approved by the engineer for its strength. This approval is after the*

stages of batching, testing and curing have been tested. Engineers who lack the knowledge of what to do, put the building at risk as they cannot for example, be informed and knowledgeable on how to maintain the moisture and temperature conditions of concrete so that the concrete develops hardened properties over time…" (As reported by a member from, KCCA).

The above sentiments were echoed by another key informant as follows;

"*…., where we have unqualified engineers especially on high rise buildings, the outcome is always disastrous because such personnel lack the expertise of ensuring that quality work is done. Little do such so called engineers know for example that they are supposed to take the concrete to the structure laboratories for testing to confirm whether the structure has reached the designed strength. The failure to do so spells doom for such high-rise buildings, with most expected to collapse even in the early stages of construction…."* (Manyozo, MLHUD)

The findings mirror Oloyedde et. al., (2010) that the skill, experience and personal ability of the workmen involved in the building construction is of utmost importance in creating value and has a multiplier effect on the quality of constructions. Not only does it become a necessity at the construction sites, but also in the phases preceding the actual construction itself. Oloyede and colleagues for example cite the example

of the decision by construction companies to use the so-called ready-made hollow sandcrete blocks sold by some block-making industries that at times, do not measure up to standard as a result of anticipated abnormal profits. Once these lapses are tolerated intentionally or otherwise, the quality of the sub-structure or super-structure cannot be guaranteed. The quality of the workmen is a measure of their effectiveness and efficiency at all times during construction while the level of building maintenance after its occupation depends on the performance of workmen. In addition, he must be willing to deliver high quality building materials to site in required quantities coupled with strict supervision of workmen by the Site Supervisor.

Item 3 shows that at most of buildings in Kampala city, failure and consequently collapse has been precipitated by limited or lack of proper supervision by professionals. As opined by majority respondents, 78 (81.2%), in situations when the contracting engineers and construction crews are left to operate on their own without any form of evaluation or supervision, stakes are high that there is a likelihood of deviations which become more costly in the long run in the wake of buildings appearing in trouble leading to collapse. The high mean value of 4.17 provides a further confirmation that supervision was not a common place on all building sites in Kampala City, tying with the revelation made by one key informant from KCCA as follows;

> "…, *KCCA realizes the urgent need for deploying supervisory staff to every point where we have given assent for a construction to start. However, quite often, we are overwhelmed by the numbers of structures viz-a-viz the limited number of*

> *technical staff that we have in that area. This has been worsened by the failure of Ministry of Public Service to recruit more civil engineers to our board. Supervision will continue to haunt the building sector unless restorative or compensatory measures are evolved*…(Manyisa, KCCA)

The finding rhymes Schweier, (2016) who revealed that inspections should be done at regular intervals, based on a risk assessment that takes into account the structure's condition, environmental factors and length of time the bracing has been in place. In increasing the inspection, the workers will be forced to employ professional ethics, an inspection should occur as soon as possible after the occurrence of an extreme weather event or another incident that could affect the durability of the structure has occurred. These findings are in line with Obodoh et. al., (2019) who added that a competent person should regularly assess the stability of the structure while temporary bracing is required, (Schweierand, 2006) revealed that inspections should be done at regular intervals, based on a risk assessment that takes into account of the structure's condition, environmental factors and length of time the bracing has been in place.

The findings are also in line with Palmer (2018) whose findings revealed that without the right supervision team in place, any strategy and plan has the potential of completely falling apart. Because of this, the core project staff, expert resources, suppliers and all stakeholders should be part of the dynamic team. Palmer (2018) added that, all of those involved must have commitment to the groups, share similar visions for the projects and strive for overall success. Poor construction supervision leads to unsustainable building construction practices (use of substandard designs,

materials, manpower and procedures) consequently leading to building failures (Agwu, 2014). To circumvent the challenge of building failures, Agwu (2014) recommends the need for effective monitoring of building projects by government agencies, establishment of building inspectorate, stiffer penalties for non-compliance with approved building plans and provision of low interest mortgage loans

Similarly, results in Table 4.6 show that the majority of the respondents, 82 (85.4%) agreed that use of complicated design has equally contributed to structural failures of buildings resulting in collapse. The higher mean value (4.16) provides a confirmatory signal that the majority of the respondents across the different institutions that participated in the study likened that increasing cases of collapse of buildings in Kampala to the abstractness of the designs used. This provides compelling evidence established earlier that some construction sites allow unqualified personnel to work on the building sites as engineers while in actual sense they lack the acumen and knowhow.

These findings were in line with Kumalasari (2017) whose study revealed that deficiency in design detailing is considered a cause of structure failure. It includes errors, mistakes, omissions, and discontinuity/loss of design concept. Construction deficiency occurs as problems with workmanship and deviation of results from the specifications. Kumalasari (2017) findings gave examples of such deficiencies as improper installation and inadequate temporary structure to support the permanent structure, maintenance deficiencies are corrosive and damaged components that take place during post construction or the service life of the buildings which all contribute to failure of buildings.

Kioko (2014) supports the findings from by Fernandez (2014) who discovered that, in 2009 Kenyan officials estimated that 65% of Kenya's buildings fail to meet code standards. Between 2006 and 2014, seventeen buildings spontaneously collapsed in Kenya alone, and caused eighty-four deaths and more than 290 injuries (Kioko, 2014).

Item 5 from Table 4.6 shows that 60(62.5%) agreed that structural failure of buildings in Kampala City is commonly caused by poor selection criteria by the owners of construction projects, making them a prey for inexperienced contractors. The high mean value of 3.96 also provides additional evidence that for the last decade or more, buildings have continued to collapse due to poor choice of engineers.

In line with this observation, were the views of all the key informants who unanimously revealed that people intending to invest in building construction fail for example to carry out due diligence exercises while selecting contracting firms. Equally, the blame could be put on KCCA for its failure to carry out routine sensitization exercises that are capable of making the public more aware of the criteria they would follow to detect and identify with a competent contracting firm. Consequently, this has led to collapse of buildings. Further confirmation was obtained from the KCC reports (2009 and 2011) and then KCCA reports (2016 and 2018) in which it was underlined that the failure of parties intending to construct high rise buildings in Kampala City is partly attributed to use of inexperienced and at times incompetent construction companies that are not glued by ethics in their

activities. The findings aligned with Mhand et. al., (2017) who accused developers of cutting costs by employing unskilled workers who are cheaper than trained builders on sites. This is done as an attempt to reduce costs.

Item 6 from Table 4.6 shows 69(71.8%) of the respondents agreed that the increased cases of alterations of existing building plans has culminated into structural failures of buildings leading to collapse. Although a moderate number of respondents disagreed with a score of others expressing ignorance in regard to the contribution of the said factor, the high mean value (3.76) is suggestive that illegal alterations of existing building plans have also led to structural failure of buildings. The finding was consolidated by the views of the key informants who revealed that illegal alterations of building plans have continued to be a problem to the management of KCCA as quite often, the challenge has been identified in scenarios where buildings have collapsed. This further provides compelling evidence of an earlier observation that there is lack of effective supervision on most construction activities in Kampala. The ugly hand of this weakness has been the continued collapse of high-rise buildings in the different parts of Kampala City. Secondary data extracted from periodicals at Kyambogo University Main Library provided corroborating information that compromise and alteration of building plans has continued to be cited as a cause of collapsing of buildings.

A responses on Item 7, revealed that 60 (62.5%) suggested that the frequent collapse of buildings in Kampala City is due to the use of substandard building materials either knowingly or unknowingly. The substandard building materials range from poorly constituted cement, low tensile iron bars and substandard aggregates and sand among others. In instances when high rise buildings are planned, testing of such

materials would be mandatory to guarantee the stability of concretes used, strength of the pillars, beams and columns among other parts. The mean value (3.72) confirms the observation that in most buildings that have collapsed, the quality of materials used has always been candidates of investigation as has been observed on site visits of collapsed buildings with police and other law enforcement officers collecting samples of the building materials from the rubble.

Item 8 shows that 58 (60.4%) of the respondents associated the increasing cases of structural failure of buildings to the blazing levels of corruption that have bedeviled many sectors had swamped almost every professional worker in the city. This finding attracted a lot of attention from the key informants who also revealed that the increasing cases of structural failures emanating from corruption which has both directly and indirectly eroded the good will among actors. Consequently, the factor has weathered through the hitherto competent committees in the supervision, compliance and enforcement wings leading to compromised standards. One of the key informants expressed their dismay to corruption in the following words:

> *"…our construction professionals and their supervisors have fallen to the trap of corruption. They have morally, orally and ethically departed from what is right and engaged in uncouth activities which have largely diluted the construction standards creating way for the execution of illicit construction activities. As a result, this has led to structural failure of buildings leading to collapse of buildings in the city…"* (ERB).

4.4.2 Impact created by structural failure of buildings

The second specific objective of the study sought to establish the impact created by structural failure of buildings in Kampala City. In Table 4.7, "D" represents the opinion of those who disagreed; NS represents opinion of those who were ambivalent or non-committal while "A" stands for those who agreed and those who strongly agreed to a given statement. The "Mean" is used in interpreting the findings to give a clear description of the position of the respondents.

Table 4. 7: Respondents' opinions on the impacts created by structural failure of buildings

S/N	Impact created	D	NS	A	Mean	Std	Rank
1	Failure to pay borrowed resources from financial institutions	7.3 (7)	9.4 (9)	83.4 (80)	4.07	0.943	1st
2	Loss of resources by the developer	7.3 (7)	10.4 (10)	83.30 (79)	4.05	0.944	2nd
3	Loss of revenue by Government	9.4 (9)	17.7 (17)	75 (72)	3.97	0.944	3rd
4	Effect on third parties	14.6 (14)	18.8 (18)	67.0 (64)	3.77	1.051	4th
5	Loss of property and life	22.9 (22)	6.2 (6)	70.8 (68)	3.60	1.334	5th
6	Unemployment	25 (24)	14.6 (14)	60.4 (58)	3.51	1.422	6th
	Mean of means (MOM)				**3.82**		

Key for interpreting mean: 1.00-2.99= Disagreed, 3.00=Not sure, 3.01-5.00= Agreed

Source: **Primary data (2019)**

Table 4.7 shows that majority of the respondents, 80 (83.3%) agreed that one of the most serious impacts of structural failure of buildings that have collapsed in Kampala

City is financial crippling of the proprietors of the buildings as most of them augment their savings money with a portion of loans from the financial institutions operating in the city.

This level of agreement is further confirmed by the mean value of 4.07, which implies a higher level of agreement by the majority of the respondents, meaning that when buildings collapse, there is a high possibility of the owners failing to meet their financial obligations with their bankers. While expressing their distress, majority of the respondents expressed that if the vice of collapsing buildings is left unchecked, it may have a long-term multiplier effect on the growth of investments in the real estate building sector in Kampala City.

On Item 2, an equally big number of respondents, 79 (82.3%) agreed to the statement that when there are cases of collapse of buildings, resources or property is lost. The loss of resources or damage to property cited by the respondents occurs in majorly three ways; firstly, it may be lost or get damaged at the site itself when property worth millions is buried under rubble, it may also occur when the collapsed building was functional and housed numerous running businesses and parked cars and motorcycles, lastly, the loss of property occurs when the falling debris spills over to the neighbouring homesteads or even other business premises. The high value of the mean (4.05) provided a confirmation that majority of the participants in the study rated the impact highly. This could be related to the aftermath when the owners of the collapsed buildings have to duly and fully compensate all the victims affected by the collapse of the buildings, culminating into a double loss.

Majority of the respondents, 72 (75%) agreed to the statement that there is loss of revenue to Government in form of taxes when buildings collapse. Practically, collapsed buildings wreck businesses in the neighboring areas. At worst, when the incident happens on buildings that are full board, lots of business property is lost. While compensations are effected, they at times delay pushing the losers of property out of business. In relative and absolute terms, collapsed buildings are injurious on the flow of businesses. The key informants on this impact revealed that while the effect on the running businesses forced to close on the taxes remitted to the government may not be quantified and disclosed in the press or even in some reports (such as those of KCCA), in reality, collapsed buildings have a big indirect effect on the performance of the economy.

On item 4, 64 (66.7%) of the respondents agreed that collapsed buildings affects the socio-economic livelihoods of the neighbouring communities. This stance was further proved by the mean value (3.77) which is indicative of the disaster that befalls a community when a building collapses especially when it is high rise. Through interviews with the key informants, it was established that collapsed buildings affect the lives of people by creating a state of anxiety, nightmares, sound pollution, noise pollution all of which become negative externalities that affect the quality of life negatively. In relation, some of the collapsed buildings are on the same circuit of utility service providers such as NWSC (for water and sewerage services) and UMEME (for electricity). After collapse of a building, some of the circuits serving a given zone or ward are temporarily disconnected which equally injures the souls of the affected communities. Collectively, these secondary effects of collapsed buildings affect the social lives of the people in affected communities.

Similarly, findings on item 5 on the statement that sought for the opinion of the respondents about loss of lives arising from collapsed buildings, 68(70%) agreed and expressed their sympathy to the survivors and the victims of the carnages. The high mean value (3.60) implied that most of the respondents agreed to the statement that collapsed buildings in Kampala City have led to loss of lives either on spot or after the accidents and more so those who sustain major and grievous body injuries such as brain damage. The findings agree with Spence (2016) who in his findings asserted that the cost related to injuries may be significantly higher than those for fatalities especially the loss of life by people. This could include pre-hospital emergency treatment, emergency department services, hospital physician and surgeon services, visits to private physicians, rehabilitation costs and lost income. Chuang and Spence (2017) further added that as there is no standard threshold at which victims may be classified as injured, and as some persons not requiring emergency treatment may seek private treatment or choose to self-medicate.

In addition, findings in Table 4.7 show that , 58 (60.4%) of the respondents agreed that the occurrence of structural failures in buildings brings about involuntary unemployment or temporary jobs losses among the people running businesses in and around collapsed complete buildings as well as those laid off when the building under construction crumbles. The findings provide a clear testimony of Jackson (2007) who surmised that when buildings collapse, many people who have been working in the building lose their jobs and remain unemployed which affects their financial status.

4.4.3 An assessment of performance of the strategies laid down to address the problem of structural failure of buildings

Objective three (3) was to assess the performance of the strategies crafted by the government and KCCA overtime to mitigate and or eliminate the problem of collapse of buildings in Kampala City. In Table 4.8,"D" represents the opinion of those that strongly disagreed and those that disagreed respectively; "NS" represents opinion of the respondents who were ambivalent or non-committal while "A" stands for those who agreed and those who strongly agreed to a given statement. The "Mean" is used in interpreting the findings to give a clear description of the position of the respondents

Table 4. 8: Respondents' opinions on performance of the existing strategies against structural failure of buildings

S/N	Enabling factors	D	NS	A	Mean	Std	Rank
1	Stakeholder engagement in building developments planning	10.4 (10)	8.3 (8)	81.3 (78)	4.23	0.957	1st
2	Emphasis on fluid communication between contracted firms and KCCA physical planning unit	6.3 (6)	10.0 (10)	83.3 (80)	4.11	0.905	2nd
3	Developed physical planning and development guidelines	7.3 (7)	12.5 (12)	80.2 (77)	3.96	0.917	4th
4	Creation of a Supervision team	10.4 (10)	12.5 (12)	55.2 (53)	3.84	1.977	5th
5	Emphasis on use of experienced Personnel	8.4 (4)	2.1 (2)	89.6 (86)	3.43	0.983	6th
	Mean of Means				**3.91**		

Source: Primary data (2019)

Findings in Table 4.8 show that the respondents agreed to all the statements that measured the effectiveness and or performance of the strategies designed by the government and KCCA over time to address the causes of collapse of buildings in

Kampala City. The validity of this assertion is reflected in the mean values that are above the 3.01 lower limit. From Table 4.8, findings revealed that one of the strategies made by the management of KCCA was the choice of involving key stakeholders in planning for building construction sector in the city. Majority of the respondents78 (81.3%) agreed to the statement. A higher mean value of (4.23) indicates that the respondents greatly agreed that KCCA engages stakeholders in planning for the building sector. The truth of the matter is provided by the Strategic Plan 2014/2015-2019/2020, which provides two slots in the administrative machinery of a representative from UIPE and USA. However, through interviews with key informants, it was established that KCCA still does not have and or embrace a balanced representation as the current systems employed do not involve key stakeholders despite their footprint in the maze of construction activities in the city. A case in point are the Local Council 1 officials who serve as the watchdogs of the government and have more local presence in their designated areas. Equally too, are members from Uganda Building Workers union. These are charged with ensuring that the working conditions of workers at building sites are well catered for in terms of ergonomics and occupational safety among others. In summery, this strategy lacks the recipe of inclusiveness and sidelines the members who matter most such as the LC1 leaders.

Similarly, majority of the respondents, 80 (83.4%) agreed that overtime, KCCA has tried its level best to ensure that there is fluid communication between the populace and the authority by for example instituting hotlines that are supposed to be called toll free. This level of agreement is represented by a mean value of 4.11, which provides backing evidence to the statements made by the respondents. However, the

key informants had a different version. In their submission, majority acknowledged the efforts of KCCA to run its operation in an open book mode.

However, they were different regarding the suitability of the communication channels used in enhancing the coordination between the authorities and the city dwellers. For example, little has KCCA made efforts to carry out outreach visits, commiserate with the people and now sensitize them on the usefulness of whistleblowing in case they doubted the status and standards of a building construction in progress in areas in and around Kampala City. This constitutes major loopholes with KCCA harbouring false confidence that the emphasis on fluid communication up to the grassroot (Zone level) exists as one strategy for arresting the frequent occurrence of structural failure of buildings.

Item 3 shows that physical development guidelines have been formulated and made public by the government. This position was agreed to by 74 (77.1%) of the respondents which by implication, indicates that majority of the respondents had seen and read the documented guidelines of the year 2011. However, through interviews, majority revealed that the guidelines have not been enforced. Thought to play a major role, the guidelines have not been popularized which by implication means that at times, the guidelines are not known to a bigger section of the population, hence constituting a major loophole or gap.

Item 4 in Table 4.8 shows that , 77 (80.2%) of the respondents agreed that KCCA has a site supervision team which is thought to ply from one extreme end of the city to the other. Largely, the mean value of 3.96 suggests that majority of the respondents

were convinced that management of KCCA was keen at supervision of the mushrooming and growth of buildings in the city. However, this strategy has not produced the desired results. It was revealed by the key informants that KCCA roams around different places in Kampala with most of the staff more focused on compliance and law enforcement targeting traders than monitoring buildings under construction in the city and suburban areas. As a result, the contracting companies in the city use this vacuum to alter plans, to use substandard materials, among others. This is supported by Palmer (2018) whose findings revealed that comprehensive planning sets up a project for success from the start. All stakeholders should be on board during the planning process and always know in which direction the project is going to go. Planning can help the team to meet deadlines and stay organized. Good planning not only keeps the project team focused and on track, but also keeps stakeholders aware of project progress.

Item 6 shows that, 86 (89.6%) of the respondents agreed that KCCA while approving the plans submitted by owners of building sites emphasizes that only professionally trained and experienced engineers should be deployed by contractors on the building sites. This is further proved by the high mean value of 3.82 which in essence portrays an image that KCCA has by and large picked a concern of unqualified people managing construction sites in Kampala City. However, through interviews with the key informants, it was established that this strategy is a mere slogan that has not had any impact on lessening the problem of structural failures of buildings in Kampala City.

4.4.4 Framework to close existing implementation gaps

Research Objective four (4) set out to design a framework that will provide a means and basis upon which the recurrent building failures and collapse can be mitigated in the short run and eliminated or prevented in the long run. The assorted remedies suggested in the entire framework arise from the contributions and opinions of the respondents as well as the documented evidence accessed from the resource centres of Ministry of Lands, Housing and Urban Development, KCCA and Ministry in Charge of Kampala District.

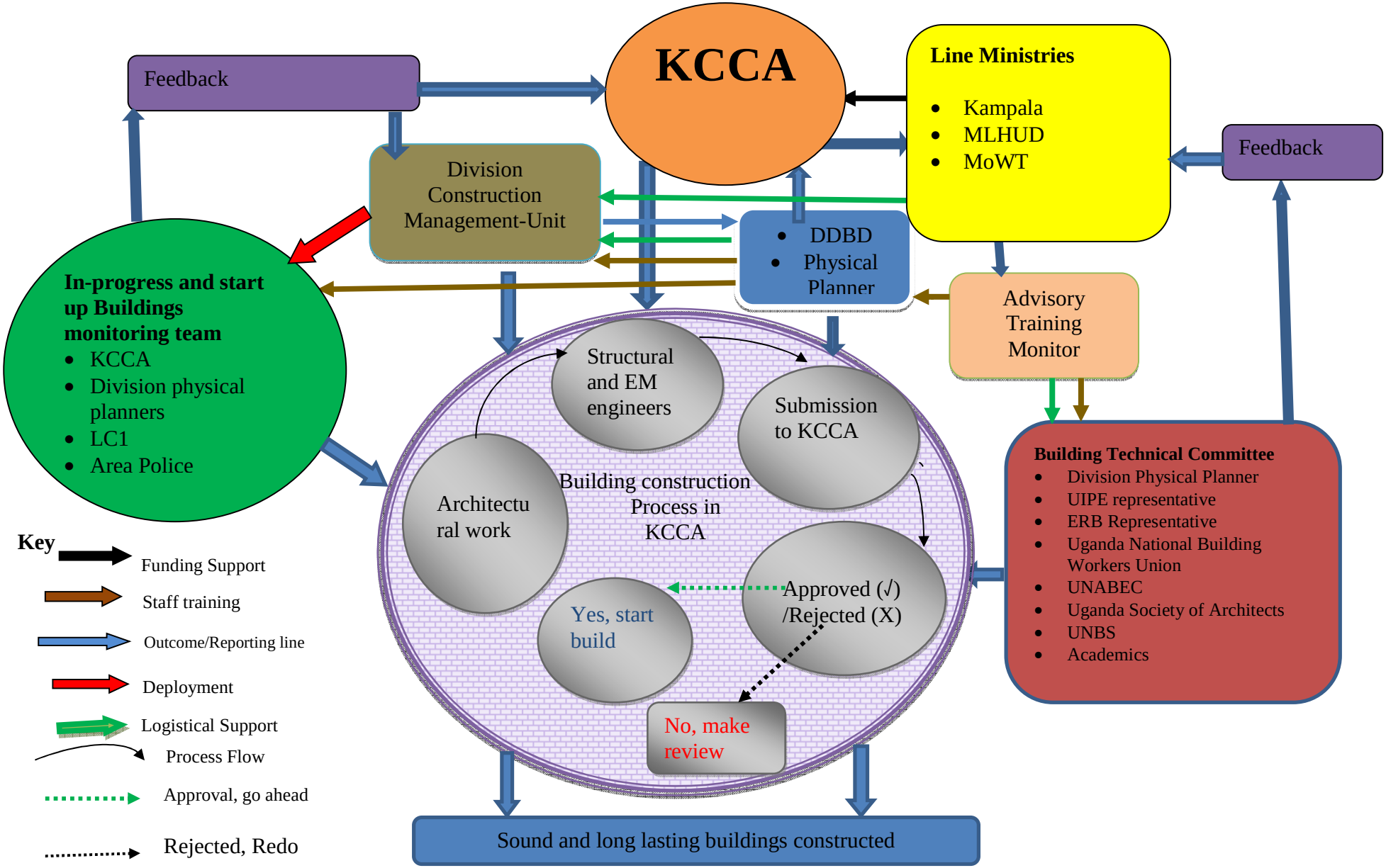

Figure 4. 1: Developed framework for closing existing gaps in building and construction management in Kampala city

MLHUD Ministry of Lands, Housing and Urban Development
DDBD Deputy Director, Buildings and Drainage

While the liberty to identify and choose a building and construction crew rests on an individual, in Kampala City, there are a series of procedures supposed to be undertaken before one can have their construction business running. In the past, the same protocol was assumed to be followed though the findings in the preceding sections reflect various gaps that have collectively led to the increased spate of building failure and collapse in the city as enumerated in the corresponding sections.

Line Ministries

The construction management sector in Uganda is overseen by the Ministry of Lands, Housing and Urban Development, Ministry of Works and Transport together with Minister for Kampala City. The two line ministries are among other duties, charged with the responsibility of ensuring that developments in Kampala City follow the formalized and structural patterns decided upon by the government, buildings inclusive. One of the noticeable challenges identified during data collection is that majority of the respondents asserted that they have never been engaged by the two line ministries other than receiving planning guidelines and instructions on how their departments are expected to perform the designed and assigned duties. This reflects a loophole of lack of coordination and cooperation among the lines ministries, departments and agencies. The primary activities of the three line ministries should be to train, monitor and offer advisory services to KCCA. They are also supposed to extend logistical support to Division construction management units. The framework suggests the following interventions to the three line ministries:

i. Offering management support to KCCA in the form of project management training services. This is necessary in order to ensure that whatever is done by KCCA in the supervision and planning as well as approval of structures with the plans and strategies at hand formulated by the line ministries.

ii. They should pioneer the birth of a Building Technical Committee. This should be an all-inclusive team as follows:

Division Physical Planners: These should be included in order to represent the interests of their respective Divisions to the committee. This will strike a balance and help in the mapping out of specific problems related to building constructions.

UIPE representative: The Institution representative should be included to help in providing technical guidance and information necessary for policy making and review.

ERB Representative: This will help in the elimination of incompetent engineers who masquerade as professional engineers with forged documentation.

Uganda National Building Workers Union: This should be represented on the committee in order to cater for the interests of the building workers. Some of the members of the union may also help to become whistle blowers whenever they realize that there are double standards and deviations to the established norms which they fear might put their lives in jeopardy.

Uganda Society of Architects (USA): The USA representative will also provide immense information that will help in the harmonization of

architectural plans as well as in vetting professional and competent architects. These professional bodies have a major role to play in ensuring that only proven and tested engineers according to their records are given assent to be contracted for any architectural, structural engineering work or ME (mechanical, electrical) services. This will eliminate the “scavengers” that have often masqueraded and shouldered responsibility of managing high rise structural constructions in Kampala City which have often collapsed and caused big losses.

Uganda National Bureau of Standards (**UNBS)**: is the premier and only quality assurance institution in Uganda charged with ensuring that whatever is consumed by the population or destined for export markets be it food or non-food related fulfills standard codes before they can be let out on the market. However, much as the institution has played an innumerable and phenomenal role to ensure that the market is not “polluted” with substandard goods, the respondents who participated in interviews from KCCA and Ministry of Lands, Housing and Urban Development intimated that most often, the officials from UNBS only act whenever there has been public outcry about substandard goods becoming awash in the market, and largely, they are quick to act when these are consumer goods, mainly food and drink related. This has created a vacuum that has been exploited by the manufacturers and importers of building materials to produce/import substandard goods. The same sentiments were shared by the UIPE and ERB officials who reiterated that they have not been largely involved by UNBS in the supervision exercises on manufacturers of building materials, which has

dealt a blow to the building industry in Kampala City. Thus, inclusion of UNBS will help in the definition of standards that could serve as the reference point for the construction companies.

Academics: Premier higher institutions of learning (such as Makerere University, Kyambogo University, Busitema University, Gulu University and Mbarara University of Science and Technology) have expert advice and technical support that is badly needed in the crusade of eliminating structural failures in Kampala City. The academics in the leading higher institutions of learning who have proven track of experience in training students are also equally important in this matrix as they possess a significant technical and theoretical knowledge from which to borrow. An example is Makerere's University's College of Engineering, Design and Technology which has reputable soil testing services in Uganda. The framework suggests that involvement of these resourceful people will help to fill the gaps in the planning, monitoring and assessment activities.

KCCA

KCCA has a directorate in charge of buildings and drainage and a fully-fledged and well facilitated physical planning unit. In addition, each of the five divisions that make up the city have physical planning units that are supposed to oversee construction and structural developments in all areas under their orbit. However, both KCCA headquarters and the periphery compliance directives have not yielded any fruits since collapse of buildings has continued to be a lacuna in the entire Kampala

City. Key issues identified by this study ranged from collusion with the owners of the buildings and giving them alerts about pending supervision, kickbacks to the physical planning units and inspection crew, concentration of the supervision schedules in and around the main busy centres and lack of adequate manpower with knowhow to detect any omissions of deeds that seem to be deviating from best construction practices. As a result, continued use of wrong methodologies in erecting buildings especially storeyed ones has occurred unabated. The framework assigns the following interventions to KCCA;

i. KCCA is reminded by the framework to ensure that there is tight coordination with line ministries. These are MoWT, MLHUD and Minister in charge of Kampala City. This is necessary in order to lay grounds for synergies and collective action, which will strengthen the planning, tracking and monitoring systems for high rise constructions in all parts of Kampala. This will fill the gap identified in the field study of lack of a gel between KCCA and line ministries which has overwhelmed KCCA with a lot of administrative work leading to various gaps.

ii. Through the two directorates (Buildings and Drainage and then Physical Planning) should ensure that the Division Construction Management Units (DCMUs) are empowered through training and as well, trained to equip them with the requisite know how. The directorates should actually deploy field officers who at random move out to the different parts of the city to ascertain the ground presence and active operations of the Division Construction

Management Units. This is necessary because it will provide a self-corrective mechanism which will give KCCA the assurance that the actions of the units are replicating the standards laid by the authority.

iii. The framework also obliges KCCA to establish hotlines for reporting of any uneasiness that any community member feels regarding the operations on high rise buildings or any other building construction in the city. This will greatly scale down the illicit activities taking place in different parts of Kampala such as unauthorized night construction activities or extension of work to late evening hours especially at sites where there are virtually no flood lights.

iv. KCCA should evolve a special task force for handling the building development funds and any other logistics that are obtained from the three line ministries that are charged with sanity in the city. This will give rise to an active and well running system since for example, some of the KCCA activities will now involve regular provision of logistics to the teams involved. This will help to break the bureaucratic red tape of making unbecoming requisitions, which in this study, were blamed for the low morale of staff who complained of succumbing to “requisition fatigue”.

Division Construction Management Unit

The unit should be empowered by KCCA and line ministries. This should be constituted of the Works and Engineering Departmental staff, Division Enforcement and Compliance Officers, Parish councilors, Division Police Units. The unit should carry out weekly monitoring of the construction works on high rise buildings and provide updates to the DDBD and Physical planner of KCCA. These should be empowered to suspend a construction activity from proceeding pending investigation and further assessments. The Unit should be given logistical support to cordon off the building or site with armed staff so that no further construction can be carried out. The Division construction management unit among other roles will validate the reports submitted by the In-progress and start-up buildings on a daily basis.

In progress and start-up buildings monitoring committee

The framework has also created space of a special committee that is constituted of police personnel, KCCA officials, LC1 and Divisional Physical Planning team. The KCCA officials should be deployed at every division to work hand in hand with the planning official, LC and Police. The KCCA officials should be rotated at the end of every quarter either by transfer to other divisions or through job rotation in which they are called back to City Hall and new faces deployed in their position. This will reduce on the chances of collusion between the parties. The police should be involved and deployed when armed so that they provide back up security to the Division compliance and enforcement staff. The Division Compliance staff included on the committee should be professional engineers so that they can help to detect any

anomalies in the configuration of the building site alongside the respect for the architectural and structural plans in line with the Building code for Uganda.

The LC1 chairpersons play a pivotal role in providing the localized information to the committee. The LC1 will play a pivotal role since they are the watchdogs at zone level with fingertip information about the residents and any development ensuing in their areas regarding buildings. The LC1 chairperson are very important because they are signatories on every sold and purchased piece of land in their areas of jurisdiction which gives them a mileage of providing a keen eye about the developments in their communities. For each of these parties to execute immaculate work, they should be facilitated.

4.5 Chapter Summary

The chapter has provided a detailed presentation and analysis of the issues related to the causes of building failures and the associated impacts. The chapter has also made an assessment of the strategies formulated by KCCA in the last decade or more as corrective strategies to fill the gaps and voids in the building sector that whose failure in the form of collapsed buildings have caused havoc to the very building occupants and people in the environs in the form of damage to property, loss of lives and paralyzing of socio-economic activities in the area. Throughout the analysis, one of the common causes rotates around lack of coordination between the supervising and planning institutions and a lack of logistical support and project management knowledge that has continued to water down any efforts made to reverse the trend at which buildings are collapsing in Kampala city. These gaps enabled the designing of

a framework that among others, spells out a number of strategies that ought to be undertaken in order to eliminate the identified gaps. Having achieved the major goal of the study by designing and developing an action framework, in next chapter, the major findings of the study are presented in a summarized form, conclusions drawn and recommendations made.

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CHATER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study investigated the implementation strategies towards elimination of structural failure of buildings in Uganda, a case study of Kampala City. This chapter presents a summary of the findings, conclusions and recommendations.

5.2 Summary of Findings

The study sought to investigate implementation strategies towards elimination of structural failure of buildings in Uganda a case study of Kampala. The study was guided by the following specific objectives; to assess the causes of collapse of buildings in Kampala, to establish the impact of building failure, to assess the performance of the existing strategies for addressing the challenge of failure of buildings in Kampala city. A cross sectional research design was employed during the study. Questionnaires and interviews were administered to the selected respondents. These yielded a response rate of 76% which by implication, revealed that the study was timely as big percentage were interested in participating. The results were analyzed using SPSS version 16 and presented using descriptive means.

Regarding the causes of collapse of buildings, the findings revealed that largely, a number of buildings were constructed without approved drawings. This allowed room for deviations that hence provided antecedents for structural failures. In the same vein, majority of the respondents cited poor workmanship as one of the causes of structural failure of buildings in Kampala. Equally, low grade construction

materials are used on the sites as well as lack of professionalism that leads some construction companies to alter the approved construction plans. Together with the deployment of unqualified personnel to work as engineers by the site construction companies, there were high incidences of messing up the different processes involved in the construction of high rise buildings such as testing processes for the quality of concrete and beams, hence leading to eventual failure and consequently, collapse of the buildings.

In the aftermath of collapse of buildings, life in and around the sites is prone to interruptions. Notably, the respondents revealed that collapsed buildings claim lives of people and lead to damage of property worth colossal sums of money. In addition, it also leads to injury of a score of people who sometimes become debilitated and infirm and pushed out of active income generating work with broken limbs and amputated legs and arms. Directly, this leads to loss of money in effecting compensations, meeting the hospital bills of those who have been injured while indirectly, the collapsed buildings paralyses traffic in a given area, lead to sudden cut off of utilities such as water, electricity and sewerage services. Collectively, these affect the quality and welfare of the dwellers in the neighborhoods negatively.

Although a series of steps have been taken in form of strategies to thwart the challenge of structural failures in Kampala City, no viable remedies have so far yielded positive results. The most important factor downplaying the efforts is that the many supervision and planning institutions for Kampala City lack a united stand and operate single handedly. This has given rise to a couple of gaps that are exploited by

the public to engage in illicit construction activities that have continued to deal a blow to life in Kampala city especially in and around areas where carnages caused by collapsed buildings have been reported in the recent past.

5.3 Conclusions

5.3.1 The causes of collapse of buildings

The study strongly confirmed that poor designs both architectural and structural, lack of proper supervision by professionals, deficient of drawings, corruption in the industry, buildings without approved drawings, illegal alteration of existing buildings, using personnel not qualified engineers were among the major causes of collapse of buildings. In conclusion, the high spate of collapse of buildings in Kampala City is of man made nature, that is arising from human errors both knowingly and accidental and yet all of them are correctible.

5.3.2 Impacts created by structural failure of buildings

The serious impacts of structural failure of buildings that have collapsed in Kampala city is financial crippling of the proprietors of the buildings as most of them augment their savings money with a portion of loans from the financial institutions operating in the city, meaning that when buildings collapse, there is a high possibility of the owners failing to meet their financial obligations with their bankers. From the study it can be concluded that there is a big impact caused by structural failure of buildings among which includes the loss of lives of the people.

5.3.3 Performance of the existing strategies to address failure of buildings

Structural failures in buildings and consequent collapse in Kampala city have not gone unnoticed by the government through the line ministries and KCCA. The current strategies have caused rage among the public and compelled the government to design new series of measures aimed at mitigating the same problems from occurring again. However, more room for improvement still exists since this study established that most of the strategies have become ineffective especially at the implementation and evaluation stages. From the study, it can be concluded that low stakeholder involvement is majorly responsible for the dismal performance of the strategies designed by the government irrespective of how sounding and focused they are.

5.4 Recommendations

There is a need for a multistage clearance and vetting of the construction projects in Kampala City. To make the clearance all binding, it is recommended to the deploy certified professionals at every stage so that the initial construction stages are designed following the building code of Uganda and other internationally agreed building and construction standards.

The government and KCCA should endeavor to bring the local community people on board as a means of ensuring that whatever constructions are taking place in a given part of Kampala are in the orbit of the supervisory and monitoring teams from KCCA and the line ministries. This could best be done through forming a union of LC1 chairpersons with a facilitated board so that these can assist in playing a stakeholder role of keeping the supervision and monitoring team informed about the progresses and any other side information on a given site in an area.

KCCA should work hand in hand with the professional bodies and construction and building unions in order to address the problem of deployment of non-professionals at sites of high rise buildings in the city. The professional bodies are necessary in this strategy as they will help to enforce standards by favouring only certified groups but again through competitive bidding processes.

The government through its quality assurance agency UNBS, should strengthen the monitoring and supervision of construction materials at import, manufacturing and

selling points to ensure that only prequalified materials that meet the standards of high rise buildings are certified and made public.

There is need for joint building quality expos and exhibitions in Uganda. These could be organized at regional level and publicized by urban authorities and line ministries in order to transmit critical information to the public about the requisite building standards and underlying processes. This could also involve the use of both electronic and print media to sensitize the public on advantages safe buildings.

There is need for periodic refresher courses on safe building planning and management practices for staff in the construction sector. Capacity building is necessary because it will enable the personnel in the construction industry to keep abreast with best practices in the management of buildings. To make the trainings comprehensive, the study recommends KCCA to integrate professionals from all relevant bodies concerned or related to building construction so that all the necessary and relevant information is disseminated and fed to the concerned groups in the construction industry.

5.5 Areas for further research

Although the findings reported in the study are informative, they are not conclusive. Specifically, they are tied to only Kampala city. Other urban centres such as municipalities and town councils where cases of collapsed buildings such as Wakiso, Jinja and many others are not reported in this study, which makes the findings to lack a comparative and comprehensive coverage. To draw more valid generalizations, a

study should be extended to cover other urban settings, the study the entire building process in Uganda as a means of unraveling other proximate and underlying causes of structural failure of buildings. Equally there is need for a longitudinal study in order to qualify and corroborate some of the causes and implementation failures reported in this study.

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Appendices

Appendix I: Survey Questionnaire

Dear Sir/Madam,

I am a final year Masters Student from the Department of Civil and Building Engineering of Kyambogo University. I am undertaking a research for my dissertation, which aims to investigate the strategies to eliminate the structural failure of buildings in Uganda: case in point Kampala Capital City Authority (KCCA). Your expertise in the building industry is extremely valuable in assisting me to learn more about the upfront building projects and solutions to minimization of structural failure of buildings in Uganda. Please be assured that your responses will be kept confidential and will only be used for academic purposes.

Part 1: General Information of the respondents; (Tick Where appropriate)

1. Your gender_____

2. How old are you? _____

3. Your highest Academic qualification.

PhD ☐
Master's Degree ☐
Bachelor's Degree ☐
Diploma ☐
Certificate ☐

4. How long have been practicing your profession?

1-5 yrs. ☐
6-10 yrs. ☐
11-15 yrs. ☐
☐

16-20 yrs.

21-Above ☐

Part 2: Main Causes of Structural Failure of Buildings

On a scale of 1-5, what would you describe as the agree causes of building collapses?

Please tick appropriately all that apply in spaces provided.

1= Strongly disagree, 2= , 3= Not sure, 4= Agree, 5=Strongly agree.

Possible causes of structural Failure of buildings	**1**	**2**	**3**	**4**	**5**
Use of substandard materials					
Poor workmanship					
Poor Designs both Architectural and Structural					
Lack of proper supervision by professionals.					
Corruption in the Industry					
Deficient of drawings					
Building without approved Drawings.					
Illegal Alteration of Existing Buildings					
Using Un Qualified Engineers					

Possible Causes	**1**	**2**	**3**	**4**	**5**
Lack of planning by Supervising Authority.					
Lack of experienced Contractors.					
Complicated Design					
Force Majeure					

Other Main causes of Structural failure of buildings, I request to specify below

Part 3: Impacts created by structural failure of buildings to stake holders

On a scale of 1-5, what would you describe as the most agree impacts created because of structural failures of building in Kampala Capital City (KCCA)? *Please tick appropriately in space provided.*

1= Strongly disagree, 2= Disagree, 3= Not sure, 4= Agree, 5=Strongly agree.

Impacts	**1**	**2**	**3**	**4**	**5**
Human Impacts					
Injuries and Loss of Life					
Psychological damage					
Economic Impacts					
Replacement/ Repair of Damaged Structure					
Loss of Functionality					
Clean Up costs					
Rescue Costs					
Loss of Revenue					
Compensation Costs					
Loss of Reputation					
Environmental Impacts					
Carbon dioxide Emissions					
Toxic Releases					

Some of these impacts are not discussed in the dissertation; please ensure you have the right copy of questionnaire used in data collection!!!!

Part 4: Performance of existing strategies for addressing failure of buildings

On a scale of 1-5, what would you describe as the existing strategies to eliminate the structural failure of buildings? *Tick appropriately in the space provided.*

1= Strongly disagree, 2= Disagree, 3= Not sure, 4= Agree, 5=Strongly agree.

Performance measures	**1**	**2**	**3**	**4**	**5**
Supervision team					
Planning					

Risk Management					
Effective Communication					
Experienced Personnel					
Proper implementation of policies in place					
Project Scope					
Available Resources					
Project Cost					
Project Time Duration					

Thank you for your participation

Appendix II: Interview Guide for key Informants

1. How old are you?
2. What is your designation in this institution?
3. How long have you worked in this institution?
4. How long have you worked under this post?
5. How is your position connected to the construction sector in Kampala city?
6. Have you heard about structural failures in buildings in Kampala city?
7. How about collapsed buildings?
8. In your opinion, what could be the causes of the collapsed buildings?
9. Could you kindly tell me the direct and indirect effects of collapsed buildings in Kampala city?
10. Could you be aware of any strategies undertaken by the government to address the challenge of collapsed buildings in Kampala city?
11. In your opinion, have the strategies been implemented as intended?
12. If yes, briefly explain

13. If No, why do you think the strategies have not been effectively implemented?
14. In your opinion, what do you think could be done to correct the gaps identified in No.13 above?

Thank you for your participation

Appendix III: Table for determining sample size

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	40000	379
180	123	900	269	50000	380
190	127	950	274	75000	381
200	132	1000	278	1000000	382
210	136	1100	285		384

Note: *N* is the population size

S is the Sample size

APPENDIX IV: VALIDITY TEST RESULTS FOR THE QUESTIONNAIRE SURVEY

Validity Results for the Causes of Structural Failure of Buildings

Judges	Relevant	Irrelevant	
Judge 1	10	4	
Judge 2	12	2	
Judge 3	9	5	
			12

CVI = 10 + 12 + 9 = 31÷3 = 10.3
10.3 ÷ 12 = 0.866

Validity Results for the Impact of structural failure of buildings

Judges	Relevant	Irrelevant	
Judge 1	7	1	
Judge 2	6	2	
Judge 3	13	1	
			12

CVI = 7 + 6 +13 = 26 ÷3 = 8.7
8.7 ÷ 12 = 0.725

Validity Results for the existing Strategies

Judges	Relevant	Irrelevant	
Judge 1	5	1	
Judge 2	9	0	
Judge 3	4	2	
			9

CVI = 5+ 9 + 4 = 18 ÷ 3 = 6
6 ÷ 9 = 0.666

Validity Results for the Enabling factors

Judges	Relevant	Irrelevant	
Judge 1	7	1	
Judge 2	9	1	
Judge 3	10	0	
			10

CVI = 7 + 9 +10 = 26 ÷3 = 8.67
8.67 ÷ 10 = 0.867

Is this part of the questionnaire?????

APPENDIX V: RELIABILITY RESULTS FOR THE QUESTIONNAIRE SURVEY

Reliability Statistics for Causes of structural failure of buildings

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.806	0.812	12

Item-Total Statistics for Causes of structural failure of buildings

	Item-Total Correlation	Cronbach's Alpha if Item Deleted
1.	0.716	0.772
2.	0.484	0.790
3.	0.551	0.784
4.	0.479	0.790
5.	0.686	0.772
6.	0.669	0.774
7.	0.685	0.772
8.	0.154	0.818
9.	0.090	0.820
10.	0.716	0.772
11.	0.552	0.783
12.	0.565	0.782

Reliability Statistics for impacts created by failure of structural buildings

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.713	0.709	12

Item-Total Statistics for impacts created by failure of structural buildings

	Item-Total Correlation	Cronbach's Alpha if Item Deleted
1.	0.476	0.668
2.	0.621	0.629
3.	0.336	0.698
4.	0.474	0.671
5.	0.686	0.617

6.	0.307	0.702
7.	0.192	0.723
8.	0.174	0.739
9.	0.686	0.772
10.	0.669	0.774
11.	0.685	0.772
12.	0.154	0.818

Reliability Statistics for existing strategies

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.736	0.730	9

Item-Total Statistics for existing strategies

1.	Item-Total Correlation	Cronbach's Alpha if Item Deleted
2.	0.448	0.706
3.	0.520	0.685
4.	0.470	0.701
5.	0.627	0.648
6.	0.292	0.742
7.	0.473	0.699
8.	0.457	0.742
9.	0.561	0.476

Reliability Statistics for enabling factors

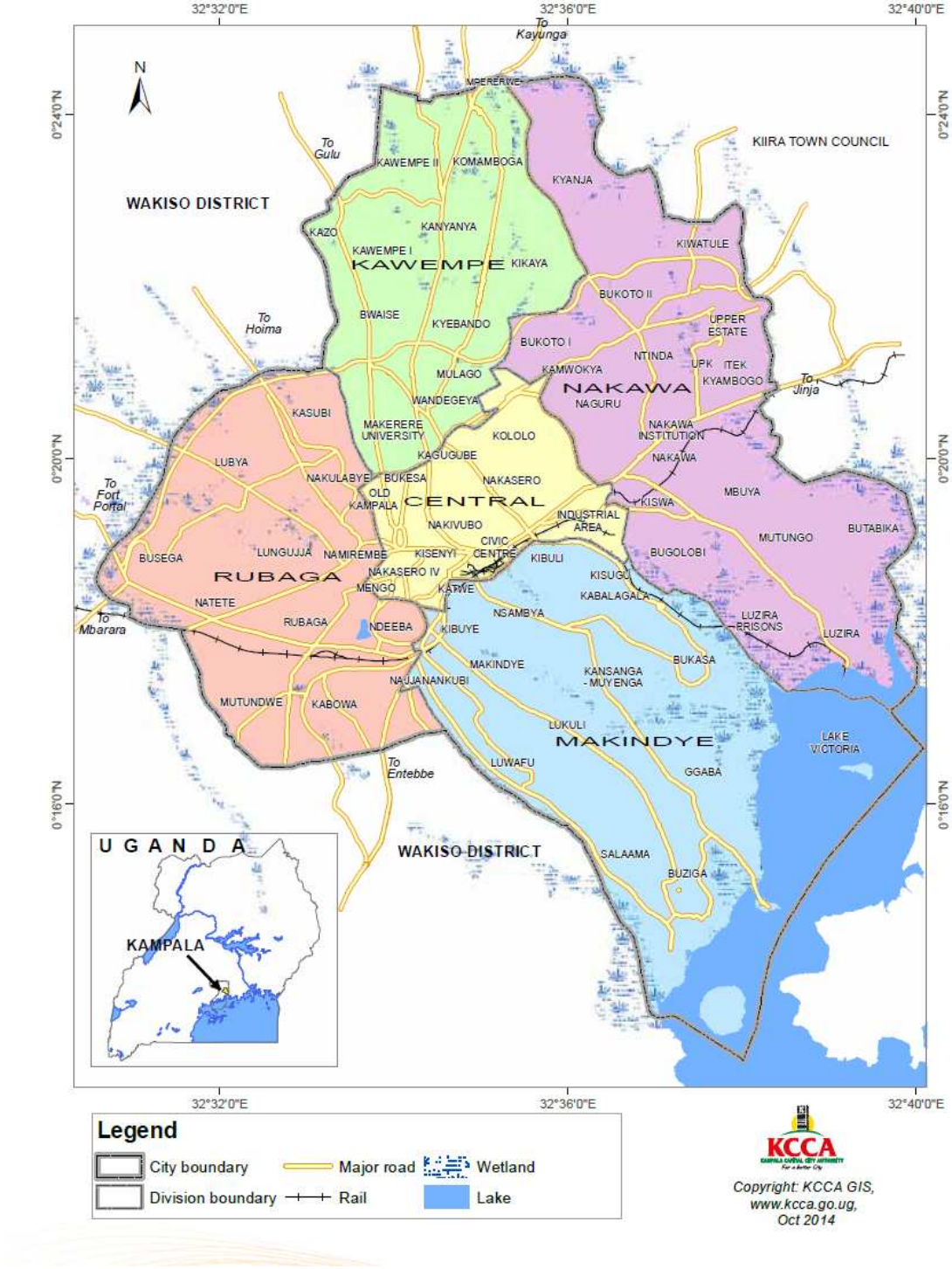
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.748	0.748	10

Reliability Statistics for enabling factors

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1.	0.544	0.696
2.	0.475	0.716

3.	0.376	0.744
4.	0.415	0.731
5.	0.651	0.663
6.	0.469	0.718
7.	0.685	0.772
8.	0.354	0.818
9.	0.890	0.620
10.	0.916	0.472

Appendix VI: Map of Kampala City showing the five Divisions



Source: *Kampala City Strategic Plan, 2014/2015-2019/2020 Page ii*