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**SECONDARY FACETS ON STABILITY OF MULTI-STOREY  
BUILDINGS IN KASARANI SUB-COUNTY, NAIROBI  
COUNTY, KENYA**

Silas Njeru Ngari, Dr Felistus Mwikali and Dr Sabas Kimani



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## **SECONDARY FACETS ON STABILITY OF MULTI-STOREY BUILDINGS IN KASARANI SUB-COUNTY, NAIROBI COUNTY, KENYA**

**Silas Njeru Ngari**

Faculty of Arts & Social Science, Catholic University of Eastern Africa  
P.O Box 62157 Bogani E Rd, Nairobi, Kenya

**Corresponding email:** [njerungari@yahoo.com](mailto:njerungari@yahoo.com)

**Dr Felistus Mwikali**

Faculty of Arts & Social Science, Catholic University of Eastern Africa  
P.O Box 62157 Bogani E Rd, Nairobi, Kenya

**Dr Sabas Kimani**

Faculty of Arts & Social Science, Catholic University of Eastern Africa  
P.O Box 62157 Bogani E Rd, Nairobi, Kenya

### **ABSTRACT**

**Purpose:** Instability of buildings is a global phenomenon that results in loss of lives, wasted infrastructure and injuries. Most of the existing literature has concentrated on technical causes of instability of buildings and recommended technical solutions that have not been successful in taming the problem. The purpose of this study was to examine non-technical secondary causes that lead to instability of buildings in Kasarani Sub-county, Nairobi County, Kenya. The study specifically sought to address the following objectives: To determine the influence of social facets on stability of multistorey buildings; To examine the influence of economic facets on stability of multistorey buildings; To determine the influence of environmental facets on stability of multistorey buildings; To examine the influence of political facets on stability of multistorey buildings.

**Methodology:** The study adopted the Joint Committee's Structural Reliability Theory and Robert Giacalone's with Mark Promislo's Ethical Impact Theory to guide it. The study used survey research design with the target population being 7,373 participants from Kasarani sub-county. The sample size was 365 respondents which was determined from Krejcie and Morgan's formula and it included 262 developers, 87 contractors and 16 building professionals. The study used a structured questionnaire to collect quantitative data. Validity of the instrument that is concerned with whether the instrument measures what it is supposed to measure was achieved through use of content validity which draws an inference from test scores to a large domain of items similar to the ones in the test. Reliability of the instrument which is concerned with whether the results are consistent was achieved through conducting a pilot study and checked by use of the Cronbach Alpha's reliability coefficient. The independent variable was secondary facets while the dependent variable was stability of multistorey buildings. The intervening variable was enforcement of bylaws.

**Results:** All the secondary facets (social, economic, environmental and political) were found to be statistically significant having a p-value less than 0.05 and  $F = 13.846$ , which is more than F Critical of 3.09. The study yielded a regression model of  $Y = 1.053 + 0.174X_1 + 0.166X_2 + 0.200X_3$ . The study found that secondary facets play a significant role in stability of multistorey buildings including social, economic, environmental and political ones. Addressing these and other secondary facets could go a long way in addressing the menace of building collapses.

**Policy recommendation:** It is recommended that the various stakeholders in the construction industry address each of the secondary facets as indicated in the report.

**Key Words:** *Social Facets, Economic Facets, Environmental Facets, Political Facets and Instability of Buildings*

## Introduction

Buildings are an important part of people's lives since they provide shelter during windy and rainy seasons and keep families warm during cold weather (Buys & Roux, 2013). It is therefore important that due diligence is applied during the construction of a building. Design, materials, construction and subsurface deficiencies could compromise stability of buildings. Instability and collapse of buildings or structures is a global phenomenon and in most cases result in loss of human lives and infrastructures (Bikoko et al., 2019). A good example is the 25 storey Ronan apartments in UK which among other building collapses was reported to have been caused by fire, gas and air blasts. Similarly the collapse of lower floors of Murray Federal Building in USA led to progressive collapse of the upper floors. In 2013, an industrial fire accident resulted in collapse of Rana Plaza, an eight storey garment factory in Bangladesh that killed over one thousand workers and injured many more (Otlewski, 2014). To date, the collapse of Rana Plaza is the worst industrial accident in Bangladesh's ready-made garment sector. The fires weakened the structural elements of these buildings leading to their ultimate collapse. Structural failure from a collapsed pool deck could have led to the recent collapse of a 12 storey condo building in Miami USA, that resulted in loss of 98 lives and investment (Swaine et al., 2021).

Earthquakes caused the collapse of several buildings including the Canterbury Television building in New Zealand in 2011, resulting in 115 deaths as a result of structural inadequacies (World Atlas, 2019). Following a similar collapse in Romania in 1999, casualties were reported in rounded figures as 1,570 dead and 11,300 injured (Georgescu & Pomonis, 2011). These were in Bucharest and mainly due to collapse of 18 high-rise apartment buildings (7 to 14 floors) that were constructed as reinforced concrete frames designed for gravity loads only. A recent 7.2 magnitude earthquake in Haiti resulted in over 2,000 deaths, several injuries and over 10,000 homeless, due to collapse of buildings (Abi-Habib, 2021). 180 people have recently died and several are missing due to flooding in western Germany that left a trail of damaged and collapsed buildings in its wake (Deutsche Welle News, 2021). Between 2006 and 2014, there were building collapse tragedies



attributed to poor workmanship in Ghana (8), Casablanca (13) and Nigeria (14), demonstrating that the problem affects the whole region (Fernandez, 2014). These included a five storey residential building under construction in Yaounde Cameroon in 2010, where 4 deaths were reported (Bikoko et al., 2019). Oni (2010) cites among others the 2007 collapse of a twelve storey building in Alexandria, Egypt as a notable one. In 2008, a six storey police building collapsed in Luanda, Angola with several detainees and other people injured. Similarly, in 2013 a building under construction collapsed in downtown Kampala, Uganda while one collapsed in Dar es Salaam, Tanzania killing at least 30 people (Muhumuza, 2013).

Over 100 cases of building collapses due to structural failure have been recorded in Kenya since 1990 (National Construction Authority, 2019). These include seventeen buildings that collapsed between 2006 and 2014, causing 84 deaths and more than 290 injuries. An audit of 14,895 buildings by the National Building Inspectorate revealed that 723 are very dangerous, 10,791 are unsafe, 1217 are fair and 2,194 are safe. It is estimated that over 200 people have lost their lives since the first collapse in 1990, with thousands injured and over KShs 2.4 billion worth of investments lost (National Construction Authority, 2019). In Kisumu city, a building under construction adjacent to Imperial Hotel came down when workers were leaving for home. Buys and Roux (2013) argue that the risk of defects occurring in housing projects is greater due to incompetent and unqualified construction professionals. Human error may be responsible for loss of lives in collapsed buildings under construction, like the 2006 site in Nairobi that resulted in 16 deaths and over 200 injured (Mutugi & Maingi, 2011). It may have also caused, the collapse of a five-storey building under construction in central business district in Nairobi in 2013, killing 11 people and injuring dozens (Kioko, 2014). In Mlolongo, a four storey building collapsed in June 2012 due to poor workmanship leading to 5 deaths and 10 injuries. Heavy rainfall caused the collapse of a seven storey building in Huruma in 2016, leaving 12 dead and 146 injured (Kenya Red Cross Society, 2016). According to the Government of Kenya (2018), rainfall patterns have changed with droughts and heavy rainfall becoming more frequent in Eastern Africa leading to increase in floods.

Kasarani sub-county is on the Northern end of Nairobi County, an area that has witnessed several cases of structural failures. A four storey building earmarked for demolition collapsed in Zimmerman due to lack of reinforcement and weak floors (Kalekye, 2016). Two people died and scores were trapped after a five storey building under construction that had been approved for three floors only collapsed at Roysambu (Kenya Engineer, 2015). Tenants of five buildings in Kahawa west had to be forcibly removed from their houses after they were deemed unsafe and the buildings ordered to be demolished (Kosgey, 2015). Gichuhi (2012) concludes that a building in Mwiki collapsed due improper consultancy team, lack of enforcement and poor design. In 2018, a four storey building in Ruai collapsed due to heavy rains, supporting the Government of Kenya (2018) assertion that the frequency of rainfall events causing flooding have increased from three to ten per year. Developers trying to cash in on the huge housing demand play a big role in creating unstable multistorey buildings in Kasarani sub-county. From the foregoing, it can be argued that quality of buildings in Kasarani sub-county may be affected by greed of developers, professionals and contractors

who use deficient materials and poor designs. They could also use unethical methods of construction, build on unstable grounds, build unapproved extensions, employ unqualified quacks to save on cost and corrupt the enforcement officers. All these could lead to unstable multistorey buildings in Kasarani sub-county, hence the need for this study.

### **Statement of the Problem**

Several multistorey buildings have continued to collapse in Kasarani sub-county in spite of the many initiatives that have been undertaken by the government and its agents, in an effort to eradicate the problem. These building collapses have left trails of death, injuries and loss of investments whenever they happen (Bikoko et al., 2019). In building sites there are normally three major players that include the developer, contractor and the building professionals who despite their being present in various configurations, some buildings collapse and others do not. It is notable that most building failures in Nairobi do not occur in the Central Business District or leafy suburbs, where construction still takes place but in the low and middle class areas. In these areas abound certain specific secondary issues that are not common in the leafy suburbs. Tackling technical (primary) causes of building instability has not yielded much success in reducing the incidences of failure (Oyadele, 2008). Solving non-technical (secondary) factors that underlie the technical ones could be the big step in reducing the catastrophic incidences of building collapses.

There are several determinants or causes that could lead to instability of a building structure (Chendo & Obi, 2015). These include both technical and non-technical causes but most existing literature has tended to concentrate on the technical ones. A lot of the reviewed studies have focused on solutions that target technical causes and have not been successful in taming the calamity of building failures. Much of the studies that have been encountered relied solely on secondary data sources including investigative reports, media and other existing literature (Almarwae, 2017). Another gap that has been noted is that many of the studies have used small convenient samples that could lead to bias and are unrepresentative of the stakeholders in the building industry. According to Oyadele (2018), it was found that majority of building failures were due to use of substandard building materials, bad design, wrong site and bad usage of structure. Use of poor technology and inexperienced contractors also contributed to a building instability. Though technical, majority of the above causes could have a non-technical background behind them that has not been forthcoming in most studies and reports.

Corruption and poor ethics could result in unapproved modifications and plans, while greed and poor income could lead to use of poor quality materials. Use of unqualified builders and professionals coupled with negligence could lead to unsound construction (Oyadele, 2018). High housing demand could lead to hurried construction and unapproved modifications, while poverty and high cost of land due to population pressure could lead to construction on unstable grounds (World Bank, 2016). Unethical practices could lead to poor enforcement of bylaws while literacy levels and seniority of developers or contractors could lead to poor construction. Senior developers in the society could influence actions of younger and junior

contractors/professionals and vice versa, thereby compromising the stability of buildings. Environmental mismanagement coupled with climate change could result in floods and earth movements, leading to structural failure (Safruddin et al., 2019). Outdated building regulations and codes could also lead to building collapses, more so when dissemination of the same to the relevant stakeholders still remains a big challenge. Many of these secondary facets abound in Kasarani sub-county, being an area occupied by mostly low and middle income population. Inadequate supply of houses coupled against rising demand encourages greedy developers, professionals and enforcement officers to cut corners, thereby compromising the quality of construction (Zhao et al., 2019). The same developers and professionals would not do the same in Central Business District or leafy suburbs. Up to now solutions targeting technical causes have been unsuccessful in solving the issue of building instability. This study explored the secondary facets of stability of buildings in Kasarani sub-county and established whether there is a relationship between them.

### **Research Objectives**

- i. To determine the influence of social facets on the stability of multistorey buildings in Kasarani Sub-county, Nairobi County, Kenya;
- ii. To examine the influence of economic facets on the stability of multistorey buildings in Kasarani Sub-county, Nairobi County Kenya;
- iii. To determine the influence of environmental facets on the stability of multistorey buildings in Kasarani Sub-county, Nairobi County, Kenya;
- iv. To examine the influence of political facets on the stability of multistorey buildings in Kasarani Sub-county, Nairobi County, Kenya.

### **Literature Review**

#### **Theoretical Review**

##### **Structural Reliability Theory**

Structural reliability theory is concerned with rational treatment of uncertainties in structural engineering, including methods for assessing the safety and serviceability of structures (Christen & Baker, 1982). Its accomplishment was coordinated by the Joint Committee on Structural Safety and forms the basis upon which the current structural design codes are prepared. Stability is concerned with the capacity of a structure to withstand the design loads without excessive deformation, permanent damage or structural failure (Almarwae, 2017). Safety of a structure is defined in terms of its ability to perform the intended functions. Conversely, the inability of a structure to satisfy any such intended performance criteria is termed as failure (Almarwae, 2017). From a demand/capacity perspective, a structure is stable when the total demand on the structure (load effects) for typical performance criteria is less than its capacity. The reverse situation is considered to be failure of the structure (Oni, 2010). The reliability of a structure is generally understood as the probability that it will not fail to satisfy its intended functions, hence stable. Structural design aims at achieving

structures that satisfy safety criteria, serviceability and durability under specified service conditions (Huang et al., 2016). Reliability of a structure can be defined as the probability that a structure or system can perform a required function under specified service conditions during a given period of time. Conversely, failure is the probability that a structure does not perform satisfactorily within a given period of time and stated conditions.

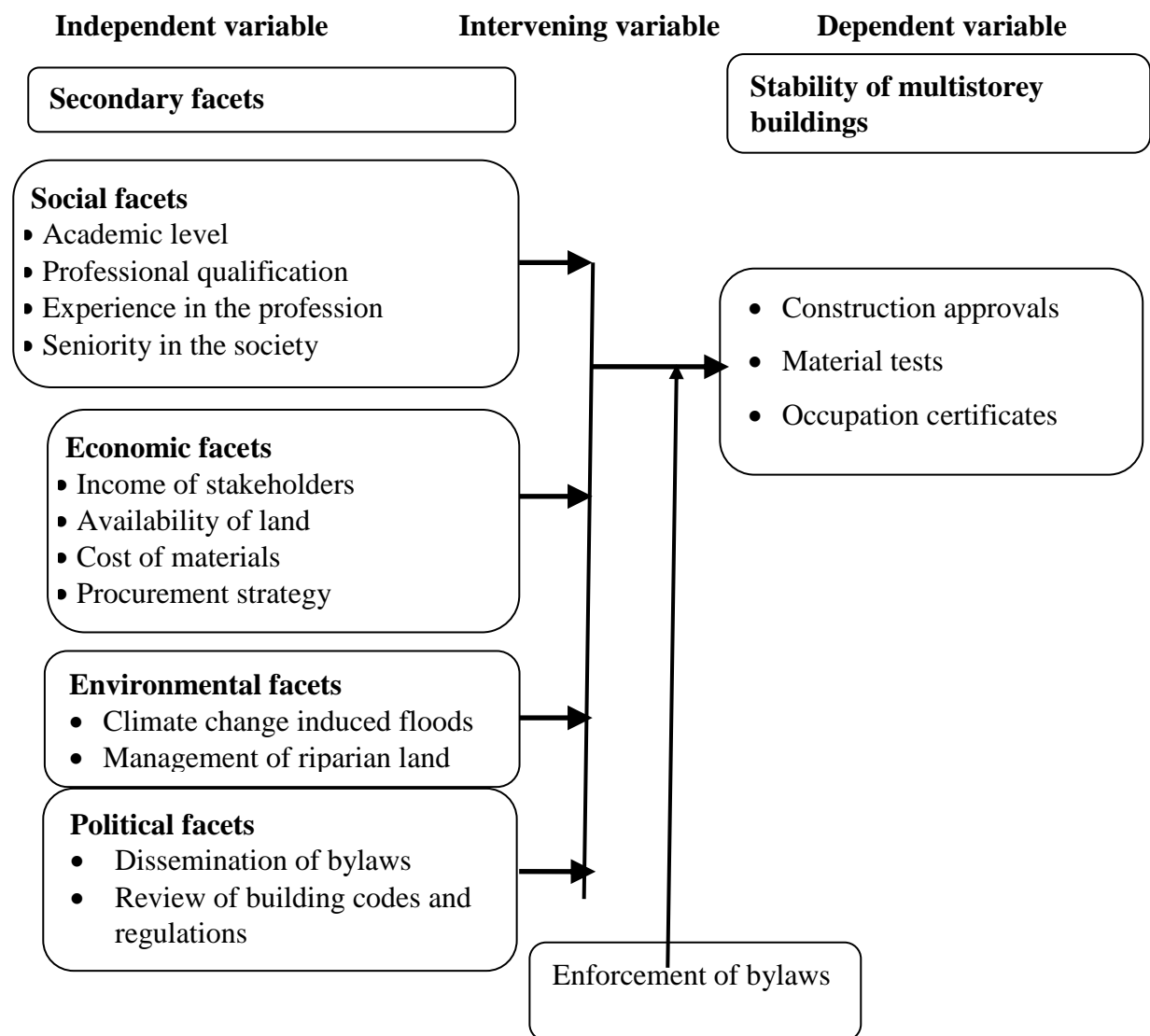
To assess the real probability of failure, all effects have to be accounted for including human error and loading variability. When only variability of loading, structure and material properties are considered, the resulting probability of failure is only a token measure of failure (Eekelen, 1997). Conventional structural design has dealt with variability in loading and other properties by applying a safety factor. Although this approach does not take into account human error explicitly, experience has shown that the resulting structures have acceptable failure rates (Eekelen, 1997). The deterministic design principle considers all the demand (load effects) and capacity (structural strength) variables to be single-valued quantities. It therefore assumes every design to be either safe or unsafe (Ghosh, 2014). However, these variables are actually not deterministic quantities but random variables and real designs are never categorically safe or unsafe. The reality-based design concept recognizes the uncertainties in the whole design process and encompasses the principle that there is some chance of failure or instability to an acceptable level (Ghosh, 2014). Structural design forms the core upon which all the other determinants of stability of structures derive from. The standardised form of the Euronorms ensures stability of building structures from the design perspective, which is the dependent variable of this study. It also provides a good basis for investigations in case of structural failures, thereby enabling identification of issues that may require revision in future designs. However in spite of the importance of the structural reliability theory in the stability of building structures, it does not specifically address the secondary issues that occur after the designs have been completed. It is therefore necessary that a theory that addresses some of these secondary facets is also considered.

### **Ethical Impact Theory**

Ethical impact theory is a theoretical concept that delineates the repercussions of unethical work behaviour on individual welfare (Kivunja, 2018), and whose proponents are Robert Giacalone and Mark Promislo. The theory states that unethical behaviours can result in weakened welfare (psychological and/or physical) either directly or indirectly. It further contends that the impact of unethical behaviour is revealed by three mediums – stress, trauma and poor health behaviours (Giacalone et al., 2016). The theory also broadens the extent of the people affected by unethical work behaviour to encompass the perpetrators, witnesses to the act and others that are indirectly involved including co-workers, family and friends. Those committing unethical acts can be harmed by their behaviour as they still feel uncomfortable doing so, but are too weak to withstand the pressures they face though cognitively afflicted by it. Stressed by guilt and the fear of being caught or the shame they may face, they suffer harm to their well-being, either mentally or physically (Kivunja, 2018). Witnesses of unethical acts could have their welfare compromised either due to their sympathy for the victim's consequences, fear of being similarly victimised as witnesses and

shattering their perception of workplaces. The others who can be affected are those who simply hear about the disturbing developments without witnessing them first hand, including the victims’ co-workers, friends and families (Giacolone et al., 2016). There are many unethical acts being perpetuated in the building industry including corruption, use of substandard materials, approval of substandard work, greed, building on riparian lands and quacks masquerading as professionals or contractors. There are many facets of instability of multistorey buildings that are associated with unethical behaviour, thereby impacting the stakeholders. These include poor enforcement of bylaws, corruption, misuse of seniority in the society, use of substandard materials to cut costs, recklessness and environmental mismanagement. All these fall within the objectives of this study which included social, economic, environmental and political facets of building stability. The impacts cited in the theory affect stakeholders in the building industry, their friends and families especially when their buildings collapse leading to deaths, injuries and loss of investments.

**Conceptual framework**





## **Figure 1: Conceptual Framework**

### **Social Facet in Stability of Multistorey Buildings**

#### **i) Skills Level Including Academic, Professional and Experience**

When a contractor cannot interpret drawings, refuses to listen to the instruction of consultants or does not understand the basic construction principles, then anything can happen (Almarwae, 2017). Ahzahar et al., (2011) carried out a study aimed at identifying factors that contribute to building failures which occur frequently in Malaysia. Results indicated that substandard construction materials was rated the highest factor with a relative index of 0.982 followed by poor workmanship with a relative index of 0.923. Use of low quality materials and poor workmanship are closely related to the developer and the contractor, especially where skills and knowledge are lacking. The study recommended that building professionals, contractors and all those involved in building management should be familiar with the building materials in common use. They should also have deeper comprehension into appropriate methods of preservation of materials and structures (Ahzahar et al., 2011). The study indicated lack of skills (social facet) as a key factor in poor workmanship and use of substandard materials but did not evaluate the skills levels available in the study area. This study has evaluated the skills possessed by the stakeholders in the building industry in Kasarani sub-county.

In a study aimed at establishing the prevalence, causes and possible remedies to the incessant collapse of buildings in major towns in Kenya, Wambua and Otieno (2018) used a survey research design. Results showed that descriptively, the contribution of workmanship was highest while inferentially it increased odds of collapse by 144%, implying that it contributes significantly to incessant collapses of buildings in Kenya. The study concluded that workmanship was mainly compromised by incompetent contractors, non-compliance with building standards, poor development processes and inadequate supervision, all attributable to poor skills (Wambua & Otieno, 2018). The convenient sampling method used could have introduced bias; leading to the conclusion that majority of the participants in the construction industry have high literacy levels. This study has used purposive random sampling which is likely to obtain a more representative sample.

#### **ii) Seniority in Society**

Seniority in society including age of stakeholders could play a significant role in the building industry, with several disagreements being witnessed on sites due to interference by one group. In his study, Almarwae (2017) examined issues that cause structural failures using secondary data from investigations on collapsed buildings, including the 5 floor Sampoong building in Korea. The study found that 502 people died and 937 got injured when the building collapsed after building plans were altered from residential use to apartment stores by the powerful group chairman, without approvals. The contractor was also fired after refusing to cut columns in order to install escalators and replaced with the chairman's company. Further findings were that the chairman also changed the 5<sup>th</sup> floor usage from roller skating to eight restaurants without approval and replaced the contractor who advised

against the change. Additional findings are that when cracks appeared in the building, the management failed to shut the building down or issue formal evacuation orders, to avoid losing revenue from customers (Almarwae, 2017). The study concluded that this action aggravated the collapse due to sustained loading on the weakened structure, thereby contributing to the large number of casualties. Also, that the powerful chairman enforced acts that significantly contributed to the collapse of the building, which supported the social facet (seniority of stakeholders) affecting stability of buildings. The reviewed study used secondary sources only but this study has used both primary and secondary sources. In order to establish the leading causes of building collapses in Mombasa, Kenya, Obuya (2012) administered questionnaires to operatives (39%), skilled workers (24%) and professionals (10%). Findings were that 45.9% of the respondents felt that developers interfered directly with the construction process by giving orders to the contractors to construct as the developers pleased in order to save money. Other findings included that 13.3% of the respondents indicating that developers like cheap construction process minding less about the quality of construction, which results in unstable buildings. These findings supported the social facet objective (seniority of stakeholders) influencing stability of buildings. The reviewed study relied on a small sample of 98, which could be unrepresentative of the stakeholders but this study has used a larger sample.

### **Economic Facet in Stability of Multistorey Buildings**

#### **i) Income Levels**

Projects have experienced several setbacks such as total desertion and delays mostly due financial problems, with payment delays sometimes resulting in project abandonment (Muhwezi et al., 2020). Zhao et al., (2019) carried out a study to find the degree to which urban enlargements lead to the creation of unsafe buildings in various cities, hence contribute to the incidences of building collapses. The study found that at every level of construction, economic and safety considerations compete seriously such that if the right balance is not achieved, structural integrity could be negatively affected. Also, that clients do not have access to unlimited supply of finances and however critical safety considerations may be, the designer may as well have to give economy a serious thought. The study concluded that the resources available for the project could present a powerful counterforce to safety and structural integrity concerns (Zhao et al., 2019). This supported the objective of economic facet (income levels of stakeholders) affecting stability of buildings due to compromised workmanship and use of substandard materials, in order to save cost. The reviewed study relied solely on secondary sources but this study has relied on both primary and secondary sources.

Windapo and Rotimi (2012) conducted a study to examine the current issues in building collapses and their implications for sustainable construction in Nigeria, between 1974 and 2010. Findings were that 39.7% of the cases of collapsed buildings in the period were residential buildings, 14.3% were commercial and educational, 12.7% were assembly use and the rest were institutional. The study also found the main causes of building collapses to be structural failure (0.32), poor supervision (0.23), use of substandard materials (0.18),

carelessness (0.18) and faulty design (0.15). Other findings were that during periods of prosperity (1974-1984), the lowest incidents of building collapses were reported and high capital growth was recorded for building construction. From 1995-1999, there was economic hardship and devaluation of the Naira, accounting for the poor construction industry performance and high incidences of building collapse. The study concluded that at periods of economic prosperity, construction practice is sustainable while at recessionary periods, industry stakeholders tend to cut corners and underperform. Contractors may resort to use of sub-standard and non-compliant materials, while developers engage unqualified/incompetent professionals in a bid to lower project costs (Windapo & Rotimi, 2012). This supported the objective of economic facet (income levels of stakeholders) playing a significant role in stability of buildings, with stability being high when incomes are high. However, the findings of the study were based on the situation in Nigeria which could differ from Kenya, hence the need for this local study.

#### **ii) Availability of Land**

In a study that reviewed data from secondary sources on building failures, Zhao et al. (2019) considered data on growth and development of many cities. Their findings were that urban lands are under pressure everywhere because of the increased demand and speculation. For low and middle income urban dwellers, the high cost of owning land absorbs the bulk of finances available for housing, thereby limiting their capacity to invest in safe housing. The study concluded that significant portions of the urban population that cannot afford building in planned zones due to high cost end up constructing low-cost unsafe houses, mostly in hazard prone zones (Zhao et al., 2019). This supported the objective of economic facet (availability of land) contributing to stability of multistorey buildings. The reviewed study relied solely on secondary data sources but this study has used both secondary and primary data. Oni (2010) carried out a study to examine the incidences of collapsed buildings in Lagos, Nigeria, with a view to determining their spatial distribution and prediction of their trends. Results indicated that collapses largely occurred around a swampy terrain in Lagos lagoon, where land was reclaimed for building purposes years ago without a strict approval process. The study recommended that a detailed study of the geophysical characteristics of the soils in all locations of the study area be carried out to establish their composition. Another recommendation was that appropriate measures be taken to avert stunning future predictions from the study. The study concluded that cost of land in this unapproved, reclaimed and swampy area was found to be affordable for low to middle income developers (Oni, 2010). This supported the objective of economic facet (availability of land) affecting stability of buildings. The reviewed study solely relied on secondary data sources but this study has used both primary and secondary data. Land is a major constraint in Nairobi as most of the residents do not own land, which is owned by the two governments making it inaccessible to the majority who cannot afford its premium prices. In a study for Nairobi County, Moko and Olima (2014) studied the influence of finance, building materials, labour, land and infrastructure on cost of construction. The findings from the study showed that the most influential determinant of house construction in Nairobi County was land (4.65) followed by building materials (4.5), infrastructure cost (4.15) capital finance charges (3.18)

and labour (2.23) (Moko & Olima, 2014). The findings supported the assumption of availability of land (economic facet) influencing stability of multistorey buildings, though the sample of 70 professionals might not be representative of all stakeholders in the building industry. This study has targeted a larger sample that has included other stakeholders in addition to the professionals.

### **iii) Cost of materials**

A construction project involves use of resources and one of the key resources is materials which include cement, ballast, sand, timber, steel, paint, tiles, glass, aluminium, soil, gravel, stone and water. All these require materials could be sourced locally or outside the country depending on cost, time and taste and this would determine the quality of material to be used. A key component of materials is cost which included the cost of buying or preparing the materials, cost of ferrying the materials to site, storage cost of the materials and materials testing cost. Cost of materials has continued to rise forcing many developers to abandon projects, use alternative materials or use substandard materials, all of which have serious consequences to the stability of buildings (Zhao et al., 2019). Use of substandard materials meant that the required specifications would not be met while quality, level of performance and useful life of the building would get compromised. Use of poor mixing ratios coupled with poor vibration and compaction resulted in weak structures that could end up collapsing. In a study to investigate the collapse of a building in India, Masurkar and Attar (2014) found that the strength of concrete used was less than the required strength which contributed to the collapse of the building and is in line with the economic facet of this study. Testing of the materials in the study should have included some validation of the designed strength as well. Ahzahar et al., (2011) carried out a study on factors contributing to building failures in Malaysia where it was concluded that low quality of construction materials was the most common factor that led to building failures. Use of low quality materials could be attributed to high cost of materials which supports the economic facet in this study.

### **iv) Procurement Strategy**

In a study to appraise the labour only procurement system, Akinkunmi et al., (2018) assessed its cost performance, suitability, merits and the willingness to use it. Findings were that both construction professionals and contractors believe that labour only procurement system is most suitable for residential buildings with a 4.84 mean score. Major merits of labour only contracts are adequate savings for the client, discouraging short changing of specifications and reducing contractors' overheads with mean scores of 4.45, 4.38 and 4.18 respectively. The least merits were standard of workmanship and adoption in any procurement method, though these were still significant. Major demerits included developer time commitment, energy and diplomacy (4.36), contractors' profitability (4.22), limitation to small contractors (4.18) and clients' knowledge of materials procurement (3.71). Results showed that out of 32 contracts, 21 finished below the initial cost estimate while 11 were above the initial estimates (Akinkunmi et al., 2018). Many times the cost estimates that are provided do not take into account the additional inputs required from the clients and the possibility of the client acquiring substandard materials that could affect the quality of the building. The findings



supported the objective of economic facet (procurement strategy) affecting the stability of multistorey buildings. In his study, Maina (2012) sought to investigate the impact of the type of construction contract on project time and cost performance in Kenya. The study findings were that majority of projects (77.6%) were carried out using traditional contracts against 13.8% that used integrated contracts. Also, traditional contracts perform poorly with regard to control of cost and time overruns than integrated contracts, hence impacting the projects. It concluded that the reason why integrated contracts performed better than the traditional contracts is that they are better suited to control the risks of time and cost overruns than traditional contracts (Maina 2012). The findings of the study supported the objective of economic facets (procurement strategy) affecting the stability of multistorey buildings.

### **Environmental Facet in Stability of Multistorey Buildings**

#### **i) Climate Change Induced Floods**

Ciskar et al. (2018) carried out a study based on a methodological framework that integrates climate and socio-economic projections, impact models and economic analysis in Europe. The main findings were that under a 2° C global warming scenario, flood impacts could more than double with around 525,000 people exposed to floods. Under a 2° C warming, Mediterranean regions would experience the strongest reduction in soil moisture, which may occur equally over the full year. Also an increase in temperature in Europe with global warming would lead to a decrease of heating needs and an increase in demand for cooling, with air cooling projected to increase by approximately 50% (Ciskar et al. 2018). On infrastructure, climate change would increase the frequency and magnitude of extreme events, with about 200 airports and 850 seaports of different sizes across the European Union facing risk of inundation. The danger of forest fires could increase around the Mediterranean region due to climate change, with Spain, Portugal and Turkey being the three countries with highest danger (Ciskar et al., 2018). These impacts could pose the risk of instability to many multistorey buildings and supported the objective of environmental facet (climate change) affecting stability of multistorey buildings.

In order to address the lack of a comprehensive analysis of climate related risks facing Kenya, Parry et al. (2012) undertook a desk study. Major findings were that Kenya's exposure to climate risk is high, it already being one of the most disaster-prone countries in the world. It experiences major droughts about every 10 years plus moderate droughts and floods every three to four years. Its mean annual temperatures have increased 1.0° C since 1960 and rainfall patterns changed, most notably greater rainfall during the short rains of October to December. It recommended the need to improve understanding of urban vulnerability and climate risk options, with centres such as Nairobi and Mombasa expected to play a vital role in future economic development (Parry et al, 2012). The findings supported the objective of environmental facet (climate change) affecting stability of multistorey buildings.

## **ii) Management of Riparian Land**

KIPPRA (2017) studied the magnitude of the encroachment problem and the effectiveness of management approaches to ensuring sustainable protection and management of riparian buffer zones. Findings were that a rate of increase in the built up acreage on the buffer zones of above 200 percent was recorded in Nairobi Metropolitan region between 2010 and 2014. Other findings were that significant increase in encroachment by built up areas had been experienced in the Northern and Southern metros leading to flooding. Recommendations included the need for harmonization of legislative framework in the definition of riparian buffer width and enhancement of enforcement capacity of government agencies (KIPPRA, 2017). The above would be achieved through participatory methods and prioritization of development of National land use and urban development policies. The study findings supported the objective of environmental facet (environmental management) affecting the stability of multistorey buildings.

## **Political Facet in Stability of Multistorey Buildings**

### **i) Dissemination of Bylaws**

To establish if the Ministry of Works and Transport had taken adequate measures to ensure effective oversight over the construction sector in Uganda, the Office of the Auditor General (2015) conducted a value for money study. Some of the key findings were that Ministry of Works and Transport was involved in implementation of various projects in addition to its role in policy formulation, thereby creating a conflict. Also, that no standards, guidelines or manuals had been disseminated to stakeholders for the last ten years and that there was no new research carried out by the ministry since 1990. The study recommended that the ministry should prioritise the review of manuals, standards and guidelines, and also endeavour to disseminate the standards and training of stakeholders (Office of the Auditor General, 2015). This shows the importance of disseminating regulations and codes to stakeholders which supported the political facets of stability of multistorey buildings.

### **ii) Review of Building Codes and Regulations**

Aiming to strengthen the resilience of the built up environment in Kenya, an assessment of the building regulatory capacity was carried out by World Bank Group (2019). The findings included that Kenya does not currently have a legally enforceable building code. This was because in 2012 as part of the devolution process, the local government act was repealed leaving the 1968 code as the informal reference. Also, there was no overarching national legislation in Kenya that defined the Government's responsibility to regulate buildings and principles for local enforcement. County building departments required additional resources to effectively administer building codes and land use regulations. Recommendations included the need to strengthen and finalize the 2009 draft code, by addressing technical gaps and establishing an inclusive process for its maintenance, publication and dissemination (World Bank Group, 2019). On legislative reforms and institution framework, strengthen and pass the Built Environment Bill referencing the new code and streamline national legislation

related to building control. The recommendations supported the political facet in stability of multistorey buildings including dissemination of regulations and building codes.

### **Research Methodology**

The study employed survey research design which is used to quantitatively describe certain aspects of a given population. The study population of this study included the developers, contractors and building professionals in Kasarani sub-county. The Nairobi County website indicated that Kasarani sub-county had 5,294 developers, while there were 1,764 building contractors and 315 building professionals, according to the National Construction Authority website and National Construction Authority (2019) respectively. This gave a study population of 7,373 from which the sample was determined. The study employed Krejcie & Morgan's formula to develop a sample of 365. The study used both primary and secondary data. A questionnaire was employed to collect primary data from the selected target areas. An interview schedule was used to interview 5 respondents comprising ward administrators from the sub-county. Descriptive statistics such as frequencies, percentages, mean score and standard deviation were calculated and presented in form of tables and charts. Inferential data analysis was undertaken using multiple regressions, in order to establish the relationship between the independent and dependent variables. Multiple regression analysis was used because it is the method that used two or more variables to predict a dependent variable. There were four independent variables in the study which required adoption of the following multiple regression equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

Where Y = Stability of multistorey buildings,  $\beta_0$  = Constant,  $\beta_1, \beta_2, \beta_3$  and  $\beta_4$  = Regression coefficients,  $X_1$  = Social facets,  $X_2$  = Economic facets,  $X_3$  = Environmental facets, and  $X_4$  = Political facets. The results that were obtained from the analysis were presented and guided in deducing the relationship between the variables.

### **Results**

A total of 365 questionnaires were disbursed to sampled developers, contractors and building professionals within Kasarani sub-county. The respondents returned 332 questionnaires giving a response rate of 91%. Kothari (2004) opines that a response rate of 50% is acceptable for analysis hence the achieved rate for the study was even much better.

### **Descriptive Statistics**

#### **Secondary Facets on stability of Multistorey Buildings**

Further, the study sought to examine how secondary facets influence the stability of multistorey buildings in Kasarani Sub-county. Respondents were therefore requested to indicate the extent to which secondary non-technical causes influence stability of multistorey buildings in Kasarani Sub-county. Their responses are presented in table 1.

**Table 1: Secondary causes of building collapses**

	Mean	Std deviation
Social	2.20	1.165
Economic	2.46	1.378
Environmental	2.47	1.081
Political	2.32	0.993

Majority of respondents at a mean of 2.47 felt that environmental facets influence the stability of multistorey in Kasarani sub-county. Economic facets followed with a mean of 2.46 while political facets had a mean of 2.32 with social facets having the lowest influence with a mean 2.20. This infers that most respondents felt that environmental and economic facets had the greatest influence on the stability of multistorey buildings in Kasarani sub-county. A study carried out in Nigeria by Emokoma (2019) found that 7 out of the 9 top causes of collapses of buildings were related to education, training and experience which are within the social facets of building stability. In a study carried out in Mombasa, Kenya, Obuya (2012) found that developers majorly interfered with construction processes by ordering contractors to construct as the developers pleased, as a way of saving money. This relates to the social facet of stability of multistorey buildings. Other finding by Obuya (2012) was that developers prefer cheap construction without minding about quality, which relates to the economic facet of stability of multistorey buildings. In a study carried out in Nigeria by windipo and Rotimi (2012), findings were that lowest incidences of building collapses occurred during periods of prosperity while the highest incidences occurred during periods of recession. This relates to the economic facet of stability of multistorey buildings. A study carried out in Nairobi, Kenya by Moko and Olima found that land was the most influential determinant of house construction, which supports the economic facet of stability of multistorey buildings.

Tchamba and Bikoko (2015) carried out a study in Yaounde and Douala, Cameroon where they found out that the major causes of building collapses included excessive loading, structural design and degradation due environmental factors. The last one supports the environmental facets of stability of buildings. Ciskar et al., (2018) carried out a study on climate change and concluded that climate change would amplify the frequency and magnitude of extreme events. The above would lead to many seaports and airports in European Union facing danger of inundation and failure. In their study in Ghana, Asante and Sasu (2018) found that developers in Ghana do not intentionally violate building regulations but this is because they are not aware that these exist. This supports the need for dissemination of these regulations and bylaws to the parties in the construction industry including developers, contractors and building professionals. The above narration indicates that social, economic, environmental and political facets are encountered hidden in many studies in various configurations, though not recognized as such. The studies highlighted above indicate that these facets have significant influence on stability of buildings though not necessarily in the ranking order obtained in the current study. It was observed that the means



that were obtained in this study were fairly close indicating that these facets are within the same range in terms of influencing stability of multistorey buildings.

### **Social Aspects on Stability of Multistorey Buildings**

The study further sought to determine how various aspects of social causes influence stability of multistorey buildings in Kasarani Sub-county. The respondents were therefore requested to indicate the extent to which these aspects influence stability of multistorey buildings in Kasarani Sub-county. Results are presented in Table 2.

**Table 2: Various aspects of social causes**

	<b>Mean</b>	<b>Std Deviation</b>
Academic level	2.25	1.328
Professional level	2.63	1.446
Years of experience	2.52	1.461
Seniority in society	2.86	1.368

Seniority in society of developers, contractors and building professionals with a mean of 2.68 had the highest ranking followed by professional level at a mean of 2.63. Experience of developers, contractors and building professionals in the construction in industry with a mean of 2.52 was third, while academic qualification at a mean of 2.25 ranked the lowest. This infers that most respondents ranked Seniority in society as having the greatest influence among the social facets on stability of multistorey buildings in Kasarani Sub-county followed by professional level. These findings support the conclusion by Almarwe (2019) in his study on the collapse of Sampoong building in Korea, where it was found that the powerful Chairman's interference led to the collapse of the building. In a study carried out in Mombasa, Kenya, Obuya (2012) found that some developers controlled the operations of contractors by instructing them on how to construct in order to save costs which supported the above findings.

The findings in the current study supported the findings in Emokoma (2019) where 7 out of 9 top causes of building collapses were related to skills and training. Experience is a great asset as found out by Ahzahar (2011) in a study on factors influencing building failures in Malaysia, where the findings were that poor workmanship had a high index. Poor workmanship relates to professionalism and level of experience hence supporting the findings of the current study.

Most respondents in Kasarani sub-county had at least a bachelors degree, which supported the findings by Wambua and Otieno (2018) in their study that respondents in major towns in Kenya had high literacy levels. It was however surprising that respondents in Kasarani sub-county ranked academic level of developers, contractors and building professionals lowest among the other factors in the social facet. This could be attributed to the current economic situation in the country where highly qualified personnel end up working in areas outside their professions due to lack of jobs, leading to frustration. All aspects of social facet

including academic level, professional level, experience and seniority had fairly close means indicating that they are significant in influencing stability of multistorey buildings. Other aspects of the social facet that were suggested by respondents included greed, site disagreements, corruption and size of plots.

### **Economic Aspects of Stability of Multistorey Buildings**

The study also sought to determine how the various aspects of economic causes influenced stability of multistorey buildings in Kasarani Sub-county. The respondents were therefore requested to indicate the extent to which these aspects influenced stability of multistorey buildings in Kasarani Sub-county. Results are presented in Table 3.

**Table 3: Various Aspects of Economic Causes**

	<b>Mean</b>	<b>Std Deviation</b>
Income level	2.41	1.416
Availability of land	2.60	1.321
Cost of materials	2.59	1.463
Procurement strategy	2.44	1.221

Most respondents ranked availability of land with a mean of 2.60 as the highest aspect of economic facets in influencing the stability of multistorey buildings in Kasarani Sub-county followed by cost of materials with a mean of 2.59. Procurement strategy was ranked third at a mean of 2.44 while level of income was ranked lowest at a mean of 2.41. This infers that availability of land and cost of materials contributed greatly among the aspects of economic facets in influencing stability of multistorey buildings in Kasarani Sub-county. In a study on factors that influence construction in Nairobi County, Kenya Moko and Olima (2014) found that land had the greatest influence, which supported the findings from the current study. Findings from a study carried out by Oni (2010) in Lagos, Nigeria concluded that affordable cost in an unapproved reclaimed swampy terrain in Lagos lagoon contributed to most of the building collapses in Lagos. The above conclusion supported the finding in current study that land contributes highly among the aspects of the economic facet of stability of multistorey buildings.

The study by Moko and Olima (2014) on factors that contributed to construction in Nairobi County, Kenya also found that cost of materials was the second ranked factor among all the other factors. The findings supported the findings from the current study that cost of materials is a very critical aspect of the economic facet of stability of multistorey buildings. Zhao et al., (2019) states that low incomes when coupled with high cost of materials force many developers to go for low quality alternatives. This finding supported the finding of the current study on the high influence of cost of materials in the stability of multistorey buildings. All aspects of the economic facet depend entirely on the level of income of the developer, contractor and building professional but it was surprising that it was ranked lowest. This could be attributed to the fact that many people are normally not comfortable

discussing their incomes and may not have even given the true figures. Level of income of developers, contractors and building professionals contributed the least which is not supported by the findings by Windapo and Rotimi (2012) who had concluded that it plays a significant role in the stability of multistorey buildings. The means of the four aspects of economic facets of stability of buildings are fairly close indicating that the four aspects are significant in influencing the stability of multistorey buildings. Other aspects of the economic facet that were suggested by the respondents included taxation, cost of credit and delayed payments.

### **Environmental Aspects of Stability of Multistorey Buildings**

The study also sought to determine how the various aspects of environmental causes influenced stability of multistorey buildings in Kasarani Sub-county. Respondents were therefore requested to indicate how these aspects influenced stability of multistorey buildings in Kasarani Sub-county. Results are presented in Table 4.

**Table 4: Various Aspects of Environmental causes**

	Mean	Std Deviation
Flooding due to Climate change	2.78	1.392
Riparian land management	2.45	1.322

Flooding due to climate change with a mean of 2.78 was ranked the highest aspect of the environmental facet in influencing stability of multistorey buildings in Kasarani Sub-county, followed by Management of riparian land with a mean of 2.45. This infers that flooding contributes greatly to the environmental facet in influencing stability of multistorey buildings in Kasarani Sub-county. A study carried out by Cisker et al. (2018) concluded that flooding impacts could double under a 2°C global warming scenario thereby affecting more than half a million people and inundating infrastructure. The conclusion from the study supported the findings in the current study that flooding due to climate change highly influenced the stability of multistorey buildings. A study in Kenya by Parry et al., (2012) found that mean annual temperatures had increased by 1°C thereby changing rain patterns which has led to increased droughts and flooding. These findings support the findings in the current study that climate change floods are a reality that could highly influence the stability of multistorey buildings. A study by KIPPRA (2017) found that the built up areas in riparian land in Nairobi Metropolitan had more than doubled in four years leading to flooding in low land areas. Mismanagement of riparian has been indicated as a significant factor in stability of multistorey buildings in the current study and is supported by the findings in the above study. The means of climate change flooding and management of riparian land are fairly close indicating that they are both significant in influencing stability of multistorey buildings. Other aspects of the environmental facet that were suggested by the respondents included earthquakes, winds and waste water disposal.

### **Political Aspects of Stability of Multistorey Buildings**

The study also sought to determine how the various aspects of political facets influenced stability of multistorey buildings in Kasarani Sub-county. Respondents were therefore requested to indicate how these aspects influenced stability of multistorey buildings in Kasarani Sub-county. Results are presented in Table 5.

**Table 5: Various aspects of political causes**

	<b>Mean</b>	<b>Std Deviation</b>
Dissemination of bylaws	2.29	1.380
Review of codes and regulations	2.47	1.367

Majority of the respondents ranked review of building codes and regulations with a mean of 2.47 as the greatest aspect of political facets in influencing stability of multistorey buildings in Kasarani Sub-county, followed by dissemination of bylaws with a mean of 2.29. This infers that review of codes and regulations plays a great role among the aspects of political facets in influencing stability of multistorey buildings in Kasarani Sub-county. In a study by World Bank Group (2019) in Kenya, it was found that Kenya does not currently have a legally enforceable building code leaving the 1968 code as the unofficial reference. The above findings supported the findings in the current study that review of codes and regulations is a significant aspect in stability of multistorey buildings. In Uganda, a study by the Office of Auditor General (2015) recommended that there is need to prioritise review of manuals, standards and guidelines which had not been reviewed for 15 years. The above findings supported the findings in the current study on the significance of review of codes and regulations in stability of multistorey buildings.

Both the World Bank Group (2019) and the Office of the Auditor General (2015) studies recommended prioritization of dissemination of the reviewed codes, regulations and bylaws to the public. These recommendations supported the findings in the current study that dissemination of bylaws, codes and regulations to developers, contractors and building professionals is significant in influencing stability of multistorey buildings. Review of codes and regulations and dissemination of bylaws had fairly close means indicating that they are both significant in influencing the stability of multistorey buildings. Other aspects of the political facet that were suggested by the respondents included enforcement at sites, enactment of favourable policies, poor leadership and political instability.

### **Stability of Multistorey buildings**

Respondents were requested to gauge the effectiveness of various measures in ensuring the stability of multistorey buildings in Kasarani Sub-county. The results from their rankings are presented in Table 6.



**Table 6: Various measures of ensuring stability of multistorey buildings**

	Mean	Std Deviation
Construction approvals	2.36	1.470
Material testing	2.79	1.490
Occupation certificates	2.31	1.443

The results indicated that material testing with a mean of 2.79 was the most effective measure in ensuring the stability of multistorey buildings in Kasarani Sub-county. This was followed by construction approvals with a mean of 2.36, while issuing of occupation certificates with a mean of 2.31 was the least effective measure. This infers that material testing was considered the most effective measure in ensuring stability of multistorey buildings in Kasarani Sub-county. In a study carried out by Windapo and Rotimi (2012) on current issues in building collapses, findings were that main causes were structural failure, poor supervision and use of substandard materials. All these causes require some form of testing in order to confirm that specifications are met and the desired results are attained. These findings therefore support the findings of the current study on the need for testing as a measure of ensuring stability of multistorey buildings. In examining issues that caused the collapse of Sampoong building in Korea Almarwae (2017) found that the Chairman altered the building plans from residential use to apartment stores and also 5<sup>th</sup> floor usage from roller skating to eight restaurants, all without approvals. Getting approvals required design checks which would have likely identified the inadequacies that were encountered. The above findings supported the findings in the current study on the significance of approvals as measure to ensure stability of multistorey structures.

Approval certificates, testing certificates and other completion documentations form the package that leads to issuance of occupation certificates. It is therefore the final certification to the building process. Though the occupation certificate is very important, it was ranked the lowest among measures that ensure stability of multistorey buildings. This could be attributed to the fact that majority of the building owners do not acquire the occupation certificates and most people are not aware of it. The measures that ensure stability of multistorey buildings had means that were fairly close indicating that they were all considered to be significant. Other measures of ensuring stability of multistorey buildings in Kasarani sub-county that were suggested included regular inspections during construction and assessment of sites before commencing construction.

### **Multiple Regression Analysis**

The researcher conducted a multiple regression analysis so as to test the relationship among the independent variables on the stability of multistorey buildings in Kasarani Sub-county. This was accomplished by use of the Statistical Package for Social Science (SPSS V 28.0) to code, input and determine multiple regression parameters for the study. Results are presented in Table 7.

**Table 7: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
1	0.335	0.112	0.104	1.366

R was found to be 0.335 which indicates a moderate positive correlation among the social, economic, environmental and political facets with stability of multistorey buildings. The adjusted R<sup>2</sup> was found to be 0.104 indicating that variations on the influence on stability of multistorey buildings in Kasarani Sub-county that are explained by social, economic, environmental and political facets were 10.4%. This shows that social, economic, environmental and political facets explain a small fraction (10.4%) on the influence on stability multistorey buildings in Kasarni sub-county. Other variables including primary facets explain the larger remaining fraction (89.6%) but the above secondary facets are still significant.

**Table 8:ANOVA Results**

Model		Sum of Squares	df	Mean Square	F	Significance
3	Regression	77.453	3	25.818	13.846	<0.001
	Residual	611.592	328	1.865		
	<b>Total</b>	<b>689.045</b>	<b>331</b>			

In order to predict the effects of social, economic, environmental and political facets on stability of multistorey buildings, the regression model test was found to be significant since the p-value was less than 0.001 for a 5% significance and the calculated F(13.846) was larger than the critical value of F = 3.09 indicating some correlation.

**Table 9: Regression Coefficients**

Model	Unstandardized		Standardized	Significance
	Coefficients		Coefficients	
	B	Std. Error	Beta	
(Constant)	1.053	0.212		<0.001
Social facets	0.174	0.057	0.160	0.003
Environmental facets	0.166	0.058	0.152	0.005
Political facets	0.200	0.057	0.192	<0.001

The determined model for the study was:

$$Y = 1.053 + 0.174X_1 + 0.166X_2 + 0.200X_3$$

Where Y = Stability of multistorey buildings, X<sub>1</sub> = Social facet, X<sub>2</sub> = Environmental facet and X<sub>3</sub>=Political facet. The economic facet was not significant having a p-value greater than 0.05 and was therefore ignored. The results show that the influence of secondary facets on

stability on multistorey buildings will be 1.053 if all other factors are held constant. They also show that an increase in the social facet will lead to a 0.174 increase in the influence of secondary facets on stability of multistorey buildings if all factors are held constant. From the study, an increase in the environmental facet would lead to a 0.166 increase in the influence of secondary facets on stability of multistorey buildings if all other factors are held constant. The study further showed that an increase in the political facet would result in a 0.200 increase in the influence of secondary facets if all the other factors are held constant. The results further showed that all variables were significant since p-values were less than 0.05 (except for the regression model where the economic facet had p-value greater than 0.05). The political facet with a p-value less than 0.001 had the greatest effect while the economic facet had least effect on the influence on secondary facets on stability of multistorey buildings in Kasarani Sub-county.

### **Conclusion**

Findings from this study showed that secondary facets play a significant role in stability of multistorey buildings including social, economic, environmental and political facets. The specific indicators from each of the secondary facets were considered and their roles in stability of multistorey buildings evaluated. The findings from the study could go a long way in addressing the existing literature gaps that were noted in background to the study and literature review sections. Addressing these secondary facets will go a long way in addressing the menace of building collapses that has continued to cause deaths, injuries and loss of investment as noted in Bikoko et al. (2019). This will also help to boost the Government of Kenya Agenda 4 pillar on provision of housing and Sustainable Development Goal No.11 on sustainable cities and human settlements (Government of Kenya, 2018). In addition, addressing the secondary facets will help minimize the mental and physical trauma associated with unethical acts of building collapses as noted in Giacalone et al. (2016).

### **Recommendations**

Social facets of stability need to be addressed. The skills of stakeholders in the building industry need to be enhanced at all levels and opportunities accorded for best practices to be imparted to developers, contractors and building professionals for them to gain the required experience in the field. This could be achieved through internships and attachments for young graduates in construction related courses. These could be arranged by the Ministry of works, Ministry of devolution, County governments, National Construction Authority and the individual colleges and polytechnics.

Economic facets can be addressed by having policies that make it easier for stakeholders to access finances and have favourable tax regimes. These will have to be legislated by parliament, senate and county governments. Treasury, Kenya revenue authority and financial institutions including banks, building societies and cooperatives will also require to play a significant role. Developers and contractors will be required to be responsible and use these special funds strictly for the intended purposes and repay as soon as they fall due. Land

ownership, access and transfer processes need to be reviewed with the process made easier and more open by the Ministry of lands and the Lands commission. Infrastructure facilities should be planned and installed near lands that are to be developed in order to encourage development in outlying areas. This will require participation of the county governments and bodies like Kenya Urban Roads Authority, Water and Sewerage Authorities, Power companies and Telecommunication companies. The above will help reduce pressure on lands that are considered as prime since the less prime lands will become developed without them being overpriced. Developers need to be advised on the merits and demerits of the various construction procurement strategies and the risks encountered in the construction of buildings with the necessary mitigation measures. This can be achieved through various seminars by various developer groups like Kenya Alliance of Residents Association, various gated communities groups, financial institutions and cooperatives.

The government and other stakeholders should take a more proactive approach in dealing with the issue of climate change and its consequences including flooding, landslides and hurricanes. The National Environmental Management Authority should take environmental management issues and enforcement including protection of riparian land and vegetation cover very seriously and restore sanity. County governments also need to take the issue of environmental management and climate change adaptation measures more seriously. Review of the existing building codes and regulations need to undertaken on a regular basis in order to incorporate current practices and requirements. This involves all stakeholders in the construction industry including central and county government agencies, professional bodies, legal experts, Universities and research institutions. These and the bylaws will need to be regularly disseminated to the stakeholders and the general public, which will make their enforcement easier. County governments, National Environmental Management Authority, National Construction Authority, professional bodies, utility companies and Kenya Civil Aviation Authority have really failed on this aspect. They only engage the public when they want to penalize them using regulations that the public are not aware of. They could organize seminars, media adverts, barazas, bill boards and road caravans regularly to disseminate the information to the public.

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