Investigation on Practice of Ethiopia Building Regulations and Codes of Standard in Mekelle City Municipality - Tigray

A Project Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Engineering in Construction Technology and Management

By

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Declaration

I, the undersigned declare that this Project work entitled Investigation on Practice of Ethiopia Building Regulations and Codes of Standard in Mekelle Zone Municipality - Tigray is my original work and has not been presented in any other university. And that all sources of materials used have been are duly acknowledged.

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Jul 18, 2025

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Executive Summery

Since 1983, Ethiopia has established three Building Codes of Standards, along with national building regulations, a building proclamation, building directives, a construction policy, training institutions, a product standardization agency, and directives for licensing contractors and consultants. However, the proper enforcement of these laws, regulations, and standards remains questionable due to poor implementation, inadequate monitoring, and weak oversight by relevant authorities. Additionally, the compatibility of these regulations, policies, codes, and standards with the country's economic development, existing technologies, and available workforce is debatable. As a result, the country continues to experience significant loss of life, property damage, and economic setbacks.

This research project aims to investigate the implementation of Ethiopia's building regulations and codes of standards in the Mekelle City Municipality, Tigray.

A review of relevant literature provides a foundation for the study, and data is collected through questionnaire surveys and records reviews. The data is then analyzed using SPSS v.20 software.

The study reveals that out of 75 targeted respondents, 61 (86.7%) participated, including contractors, consultants, building officials, and regional professionals. The findings highlight a significant gap between established building regulations and actual practices due to inadequate inspections and weak enforcement mechanisms. The lack of a centralized authority and clearly defined procedures further contributes to non-compliance. Key issues identified include unclear professional responsibilities, insufficient regulation of building materials, and a lack of standardized practices.

The failure to implement Ethiopian building regulations and codes of standards stems from multiple factors, including a lack of awareness, weak enforcement mechanisms, corruption, economic constraints, rapid urbanization, political instability, cultural preferences for traditional practices, and inadequate infrastructure for monitoring compliance.

Keywords: Building Regulation, Codes and Standard, Implementation, Enforcement

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List of Abbreviations

AAiT	Addis Ababa Institute of Technology
BC	Building code
BCS	Building Codes System
BOCA	Building Officials and Code Administration
CEN	Committee of European Nations
Cp1-78	Code of practice 1
EBCS	Ethiopian Building Code Standards
ESCP	Ethiopian Standard Code of Practice
ESEN	Ethiopian standard European Norm
EU	European Union
ICBO	International Conference of Building Officials
ICC	International Code Council
IBC	International Building Code
JSCQB	Joint Select Committee on the Quality of Buildings
MCiT	Ministry of Communication and Information Technology
SPSS	Statistical Product and Service Solution
MoWUD	Ministry of Works and Urban Development
MoU	Memorandum of Understanding
SBC	Standard Building Code
SBCCI	Southern Building Code Congress International
SEAOC	Structural Engineers Association of California
UBC	Uniform Building Code
UNESCO	United Nations Educational, Scientific and Cultural Organization
UDCB	Urban Development and Construction Bureau

Definition of Terms

Standard is a document that lists the specifications for a process, product, or service, including its dimensions, safety features, and needed performance. A standard is a written document that has been authorized by an official authority and formed by consensus. An international standard is a set of rules, guidelines, and actions aimed at achieving the highest level of order in a specific setting [1].

Building standards are created by professional associations like the American Society of Testing Materials (ASTM), American Society of Civil Engineering (ASCE), and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) through research on how buildings react to local weather and geographic hazards [2].

Codes are a collection of rules, requirements or standards that have been made binding and mandatory by a local or national government. "Code" is (with compelling power) [2].

Building codes are written and enforced by regional or local authorities; this is the code that must be legally adhered to by anyone erecting a structure within these areas [2].
Codes of practice - are usually a set of best practices for a specific product or system so as to ensure safe handling, maintenance and operation [2].

Specification: A set of conditions and requirements of precise and limited application that provide a detailed description of a procedure, process, material, product, or service for use, primarily in procurement and manufacturing. Standards may be referenced or included in the specifications [2].

Technical Regulation: A mandatory government requirement that defines the characteristics and/or the performance requirements of a product service or process [2].
Guideline: A guideline or a guide is a document generally written for a given organization, whether for its own needs, or for its customers‟ needs. Guidelines provide guidance to appropriate behavior so as to ensure safety of people (workers, users and general public). It may also give information about codes, standards and regulations to comply with and about the recommended way to meet those requirements.

Chapter -1: Introduction

1.1 Back Ground

The need for housing services is rising as Ethiopia's extensive building gets more complex. It can be confusing for all stakeholders engaged in the construction process to apply appropriate building codes, standards, and quality against specifications when developing housing. This is certainly an encouraging progress with requirement and mechanism for building plan/design/checks/reviews by building officials, requirement for ensuring safety, other construction and properties by designing according to acceptable building design codes.

Likewise, those responsible for enforcing the Building Regulations lack the appropriate competency and even compromise with the design brought for assessment or approval due to their selfish interest. Notwithstanding, these authorities due to their dubious means fail to embrace the implementation of national building regulations or policy document. As result, although development and planning authorities provide a framework for effective planning, the complexities in most building regulations often create widespread opportunities for discretion and corruption and ultimately lead to high numbers of unauthorized structures [27].

Notwithstanding, most stakeholders such as building owners, developers or building contractors violate the regulations perhaps because they are not even aware of the various regulatory processes and systems. Also, the inadequate formal engagements between the Regulator and stakeholders are partly attributable to the ineffective internal regulatory systems and processes. Likewise, the issue of corruption has also been a factor that has raised several questions about the effectiveness of enforcing the National Building Regulations in Ethiopia. Since authorities engage in corruption, developers or building contractors on the other hand also fail compliance, and these actions by developers are some of the major causes of the rapid growth of unauthorized structures in the urban communities.

This study assesses construction industry compliance with national building Regulations and standards, and whether a responsible body is established to review plans and inspect new constructions and alterations.

1.2 Problem of Statements

Developing countries often struggle to meet acceptable building standards. Simply adopting regulatory documents from developed systems without adapting them to local cultural, economic, and political conditions has led to significant implementation gaps. Since 1983, Ethiopia has established three Building Codes of Standards, along with national building regulations, a building proclamation, building directives, a construction policy, training institutions, a product standardization agency, and directives for licensing contractors and consultants. However, the proper enforcement of these laws, regulations, and standards remains a challenge due to poor oversight, weak monitoring, and inadequate enforcement by responsible authorities. Additionally, questions persist regarding the compatibility of these regulations with Ethiopia's economic development, available technologies, and workforce. Consequently, the country continues to experience frequent loss of life, property damage, and economic setbacks.

Despite these efforts, several fundamental problems persist in the implementation of Ethiopia's Building Codes of Standards, including:

a) Inadequate regulations to mitigate risks associated with earthquakes, health and safety, scaffolding, formwork, and demolitions.
b) Legislative shortcomings that fail to comprehensively address economic, quality, and safety risks in the construction sector.
c) Insufficient municipal design inspections due to a lack of expertise and the exclusion of large-scale infrastructure projects from regulatory review processes.

This research aims to assess the implementation of Ethiopian Building Regulations and Codes of Standards among key stakeholders in the construction industry. It will examine the current utilization and enforcement of these standards within the Mekelle City Municipality and identify factors affecting their applicability and effectiveness in the construction sector.

1.3 Research Questions

1. Are the Ethiopian Building regulation and Codes of Standards practicing in the Mekelle city municipality and company level?
2. What are the factors not practicing the Ethiopian Building regulation and Codes of Standards?
3. Are the Ethiopian Building regulation and Codes of Standards visible to the construction industry and the society at large?
4. What are the factors affecting the enforcement of Ethiopian Building regulation and Codes Standards in the construction companies?

1.4 General Objective

The general objective of this study was to assess practice on Ethiopia Building regulations and codes of standard in Mekelle city Municipality and give conclusion and recommendations in accordance with the outcome of the result.

1.5 Specific Objectives

1. To know the awareness, implementation and enforcement of the Ethiopian Building regulation and Codes of Standards for civil works.
2. To identify the main challenges faced in practicing the Ethiopian building regulation and code of standards.
3. To formulate conclusions and recommendations on Ethiopian building regulations and codes of standards' awareness, applicability and enforcement based on the results obtained.

1.6. Scope and Limitations

The study assesses Ethiopia's building regulations and codes in Mekelle city municipality, focusing on recommended mechanisms. Due to time and financial constraints, it only covers construction sites. Finding compiled documents and data was challenging, and the Tigray region faced financial difficulties due to post-war damage and limited internet access.

1.7. Significance of the Study

The research will give important information to construction professionals government bodies (building officials, Bureau of Urban Development and Construction) as well as house

developers on safe building construction and the benefit gained from properly applying Building regulation and Codes of Standards. The major gains are:

i. Assist responsible bodies to know the extent of the visibility, applicability and enforcement of Ethiopian Building regulation and Codes of Standards.
ii. The aim is to educate construction stakeholders on the factors influencing the applicability and enforcement of Ethiopian Building regulations and Codes of Standards.
iii. The study emphasizes the urgent need to utilize Ethiopian Building Regulation and Codes of Standards in civil works design, construction, and supervision.

1.8. Report Organization

The study is prepared in five chapters. The first chapter deals the introduction part which includes problem back ground, problem statement, questions and objective of the research project, scope and limitation of the study. Clear, related and necessary literatures are reviewed in the second chapter. The research methodology used for this research is described in chart form in chapter three of the paper. The collected data are analyzed in chapter four and finally the research is concluded precisely and also necessary recommendations are recommended for all of the concerned bodies in last chapter of the paper.

Chapter -2: Literature Review

2.1. Investigation on the Practice of Ethiopian Building Regulations and Codes of Standards

Building regulations and codes of standards play a crucial role in ensuring safety, quality, and compliance in construction. In Ethiopia, multiple regulatory frameworks, including the Ethiopian Building Code (EBC), national building regulations, and construction policies, have been introduced to enhance the construction sector. However, research indicates that the enforcement and practical implementation of these regulations face significant challenges.

Several studies highlight the gaps between regulatory frameworks and real-world construction practices. A major issue is the lack of proper enforcement mechanisms, leading to frequent non-compliance with safety, structural integrity, and material quality standards. Weak monitoring and inspection by regulatory bodies, combined with corruption, inadequate resources, and a lack of skilled professionals, further exacerbate these challenges.

Additionally, studies emphasize that Ethiopia's building codes have often been adopted from international standards without sufficient localization. This has resulted in regulations that may not fully align with the country's economic conditions, available technologies, or workforce capabilities. Moreover, municipal authorities often struggle to enforce regulations due to insufficient technical expertise and lack of coordination among stakeholders.

Key areas of concern identified in past research include:

1. Limited awareness and training among contractors, consultants, and developers regarding building regulations.
2. Weak inspection and approval processes, particularly in urban areas like Mekelle.
3. Gaps in earthquake resilience, fire safety, and environmental considerations within Ethiopian building codes.
4. Political and economic constraints affecting the enforcement of standards.

The literature suggests that improving the institutional capacity of regulatory bodies, strengthening enforcement mechanisms, and increasing awareness among stakeholders are

essential steps for addressing these challenges. Effective implementation of Ethiopian building regulations requires better coordination, stricter penalties for non-compliance, and investment in professional training and public awareness campaigns.

This review provides a foundation for further investigation into the practical challenges of Ethiopian building regulations, with a specific focus on their application in Mekelle City Municipality

2.2. The Brief History of Building Codes

In the early 1700s AD, building codes were first observed in the United States. In order to guarantee the health and safety of our population, George Washington and Thomas Jefferson promoted the creation of building laws that set minimum requirements. Insurance firms pushed for additional building code development in the early 1900s in an effort to lower loss payouts that resulted from subpar building standards and badly constructed structures. With the help of the building industry, local code enforcement officers created the majority of the building codes during this time [5].

The Code Administration and Building Officials (BOCA) were founded in 1915. The International Conference of Building Officials, or ICBO, was founded in 1927. The Uniform Building Code (UBC) was created by this organization. SBCCI, or the Southern Building Code Congress International, was established in 1940. This organization created the Standard Building Code (SBC), which was mostly applied in the American South [5].

2.2.1. Uniform Building Code

The western United States was the main user of the Uniform Building Code (UBC). The International Council of Building Officials, with its headquarters located in California, released the UBC for the first time in 1927. It offered uniform standards for safe construction that would not differ from city to city as had previously been the case, with the goal of promoting public safety [34].

Up to 1997, when the code's last version was released, updated editions were released around every three years. The International Code Council (ICC) released the new International Building Code (IBC) in 2000, replacing the UBC.

2.2.2. International Building Code

The International Code Council (ICC) created the International Building Code (IBC), a model building code. Up until it is incorporated into or modified by a government rule, a model building code is not legally binding. Depending on the location, a number of distinct building codes were in use prior to the development of the International Building Code. The IBC was created to combine several building standards into a single, consistent code that could be utilized to build structures both domestically and abroad [3].

In 1997, the first edition of the IBC was published. There were still many flaws and it was not widely accepted. In 2000, the first comprehensive and coordinated set of the IBC was published. The development of the IBC typically runs in eighteen-month (18) cycles. The first step is accepting applications for code committees and code change proposals. The next step is to publish the proposed changes. The third step is to hold public hearings on the proposed changes. Next the minutes from the hearing are published. The following step is to collect public comments. The fifth step is to publish the public comments. Next the final public hearing is held. After the final public hearing the annual ICC meeting is held. Finally the revised or new code is published. The amendments are issued to incorporate approved changes, lessons learned and new technology [3].

2.2.3. Euro Codes

The structural design and construction regulations for civil engineering infrastructure works in Europe are collectively known as the Euro codes. These regulations were developed to harmonize standards across member states, facilitating a unified approach to building safety and performance. Between 1992 and 1998, a series of experimental European Pre-standards (ENVs), commonly referred to as Euro code standards, were introduced. The primary objective of these ENVs was to allow practitioners in the field an opportunity to apply these documents in practical scenarios while providing feedback and insights to the European Standards Organization (CEN). This initiative was undertaken under a directive from the European Commission, which tasked CEN with the responsibility of formulating these guidelines.

By 2006, CEN had successfully transitioned these experimental standards into comprehensive specifications that could be uniformly adopted across Europe. The complete set of Euro codes

is organized into ten distinct packages, encompassing a total of 58 components that address various aspects of structural design and construction practices [20].

EN 1990 – Euro code: Basis of Structural Design
EN 1991 – Euro code 1: Actions on Structures
EN 1992 – Euro code 2: Design of Concrete Structures
EN 1993 – Euro code 3: Design of Steel Structures
EN 1994 – Euro code 4: Design of Composite Steel and Concrete Structures
EN 1995 – Euro code 5: Design of Timber Structures
EN 1996 – Euro code 6: Design of Masonry Structures
EN 1997 – Euro code 7: Geotechnical Design
EN 1998 – Euro code 8: Design of Structures for Earthquake Resistance
EN 1999 – Euro code 9: Design of Aluminum

2.2.4. The stated advantages of Euro codes

1. Euro codes standardize design practices, addressing fire safety, structural stability, mechanical resistance, durability, and cost-effectiveness, while also considering factors like durability.
2. Euro codes foster a shared understanding among building industry stakeholders, including designers, contractors, owners, operators, and users, regarding structural design principles and methodologies.
3. The Euro codes promote the use of standardized design tools like guidebooks, manuals, and software applications to streamline the design process.
4. The adoption of these codes aims to improve construction safety consistency across Europe, thereby enhancing public safety in built environments [20].

2.3 Developing and Using Code

According to [19], the standards and guidelines specific to code development and implementation are outlined in the section that follows.

2.3.1 How to create model codes

Standards production in many regions is top-down and government-driven, despite countries like the US and Europe establishing fair, open, and transparent standards. Model code

development aims to achieve consensus on commercial gain and public health and safety, involving scientific and engineering principles, technical expertise, and customer preferences.

2.3.2 How laws are made based on building codes

Model codes adopted by local legislatures become local building regulations, serving as the construction industry's guidebooks and modernizing buildings. Local codes are less advantageous than state-wide building codes, as they provide consistent requirements across the state. Insurance industry supports statewide regulations, as they reduce vulnerability to weather disasters.

2.3.3 The significance of code updates

Three-year code cycles in most countries foster innovation, product development, and economic growth, while also resulting in new products and operational cost-savings for building owners.

2.4 Selection and Adoption of Codes

Some researchers set a number of principles that should frame the formulation of building codes and regulations. These principles are [7**]:**

i. Be simple to implement.
ii. Be suitable for various kinds of structures and systems.
iii. Possess the necessary flexibility and adaptability to embrace new design concepts and technology.
iv. Be dependable and simple to implement.
v. Generate dependable results.
vi. Be consistent in application and
vii. Apply consistently and without causing negative side effects (e.g., safety or health consequences).

2.5 Standards in Codes

Standards in codes refer to a set of established guidelines, technical specifications, and regulations designed to ensure safety, quality, efficiency, and uniformity in construction, manufacturing, and various industries. In the context of building and construction, standards

define materials, design principles, construction techniques, and safety measures that must be followed to achieve structural integrity and public safety. These standards are often enforced through building codes, which are legal frameworks governing construction practices.

2.6. History of Standards in Codes

The concept of standards and codes dates back to ancient civilizations, where rulers and governments established rules for construction to prevent disasters and ensure structural durability.

Ancient Mesopotamia (1750 BC): One of the earliest known building regulations appeared in Hammurabi's Code, which specified severe punishments for builders if a structure failed and caused harm.

Ancient Rome (1st Century BC): The Romans developed sophisticated building standards, including rules on materials, urban planning, and fire prevention.

Medieval Europe: Guilds and local authorities introduced construction regulations to control quality and prevent collapses.

Industrial Revolution (18th–19th Century): Rapid urbanization and technological advancements led to the formalization of building codes to address fire hazards, sanitation, and structural safety.

20th Century: Modern building codes emerged, incorporating scientific research, engineering principles, and safety standards. Organizations like the International Code Council (ICC), British Standards Institution (BSI), and International Organization for Standardization (ISO) played key roles in developing internationally recognized codes.

Present Day: Most countries have national building codes tailored to their specific needs, addressing areas such as earthquake resistance, fire safety, energy efficiency, and environmental sustainability.

2.7. Building Code Types

There are three kinds of building codes each with a different objective. These are prescriptive or descriptive building codes, performance-based building codes, and a third type which is a combination of the previous two. The two major types are prescriptive and performance building codes [3].

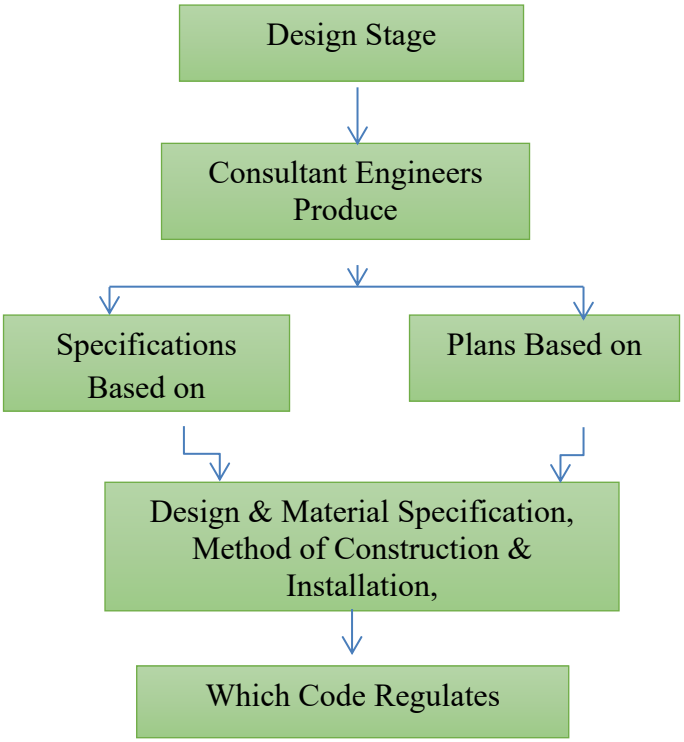

Figure 1 The Relation between Building Codes and Design [3]

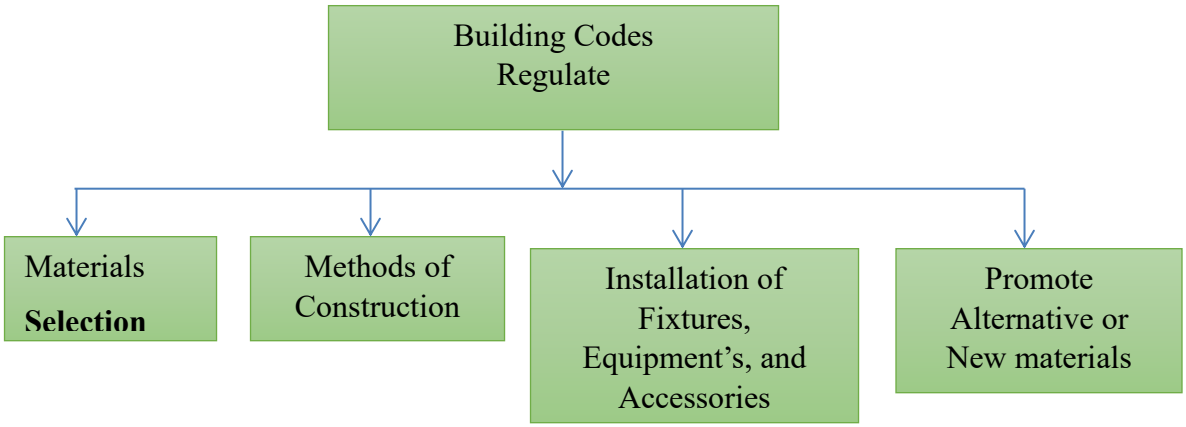

Figure 2 Building Codes Purposes [3]

2.8. Building Codes and Project Stages

Building Code Enforcement is the administrative process utilized by the Department of Building Officials. The National Building Code has conveniently divided the enforcement process into four stages. These are; Pre design stage, design stage, construction, and post construction [3].

Building inspections are conducted before and during construction, with architects and engineers verifying plans against current norms and standards. Municipal authorities review the drawings, and design teams update designs based on feedback.

Once the permission is acquired, work can begin. Local authorities should periodically audit and enforce codes during construction. During this phase, items overlooked throughout the approval process are discovered. Architects and consulting engineers inspect the building once more after construction is almost finished, at which point they apply for an occupancy permit.

2.9. Aspects of Building Codes

Four components are covered by building codes: legislative, social, administrative, and technical. The legal standing of building rules and regulations is the focus of the legislative component. Human relationships, the physical environment, and the impact of structures are all part of the social component.

The text discusses the challenges of transgression, confusion in regulations, and legal delays, while also highlighting social norms like work ethics and honesty. It also covers administrative and technical aspects of building code bodies [3].

2.10. Administration and Enforcement of Building Codes

There are two departments that oversee building codes. Building codes vary depending on the region, but generally speaking, they are divided into two sections, as shown in Fig. 2.5. Administrative and enforcement matters, including licenses, permits, inspections, certificates of occupancy, safety, modifications, upkeep, approval of drawings, and halt work orders, are often included in the first section. The second section imposes design and construction criteria

for things like electrical distribution, stairs, hallways, doors, windows, elevators, escalators, lighting, plumbing, and fixtures [5].

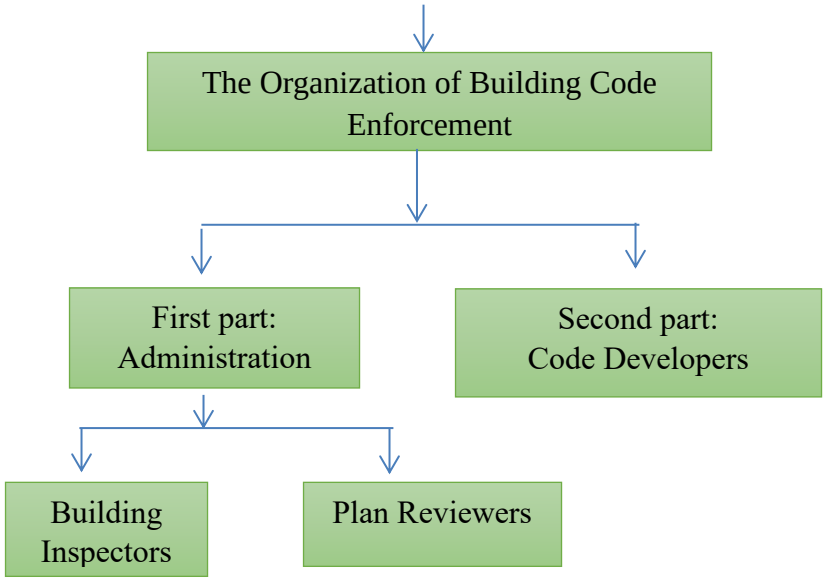

Figure 3 Building Codes and the Organization of Building Code Enforcement [10]

2.11. Issuance of the occupancy permit

After a final inspection that is successful, several jurisdictions require the issue of occupancy permits. The occupancy permit attests to builder liability, insurance and finance requirements, and code compliance. A certificate of occupancy is typically issued by local building authorities after consulting with other governmental organizations [22].

2.12. Connection between Building Issues and Enforcing Building Regulations

Building regulations are not strictly enforced, which results in numerous violations and poor building construction. UNESCO-sponsored research on typical building failures found that owners, designers, and contractors held building officials accountable for construction failures by failing to adhere to predetermined standards both prior to and post building permit approval. The study discovered that one of the main reasons for building failures is the absence of laws pertaining to construction health and safety as well as building rules [2].

A Report on the Quality of Buildings was released in Australia by the Joint Select Committee on the Quality of Buildings (JSCQB). The Committee discovered that the primary reason for low-quality structures was violations of building codes, which occurred when chief certifiers failed to carry out their duties in a proper manner, and homes that complied with building codes but did not follow approved designs due to; poor enforcement of building code causes extra losses during hurricanes, factors affecting building code enforcement in low and middle income countries, weaknesses in building code administration and institutional capacity, insufficient legislative foundation, ineffective building control regimes, regulatory capture and corruption, insufficient recognition of prevalent building practices, inadequate building codes, inappropriate transfer of codes from high-income countries, non-participation in balancing acceptable risk and affordability, failure of codes to address locally prevalent non-engineered construction, lack of quality control for building materials and equipment, limited access to code documents or training for code compliance, shortage of technically qualified personnel and funding at local and municipal level.

2.13. Building Code Implementation in Developing Countries

Different countries follow different system of building code implementation. Among the many countries reviewed, the Nepal building code implementation is discussed as follows.

2.13.1. Building code implementation in Nepal

According to [28], Although Nepal's building code was drafted in 1994, it wasn't until 2001 that it was successfully implemented in one municipality, indicating a bottom-up strategy for improving code compliance rates. The first municipality's experience has expanded the scope of code implementation.

Thus, the most effective way to execute building codes is through a bottom-up strategy that involves educating the general public, increasing motivation, and providing appropriate approaches and recommendations to local stakeholders. The national building code of Nepal addresses four distinct degrees of design and construction sophistication, which are as follows:

a. Global state-of-the-art
b. Structures with expert engineering
c. Structures with limited dimensions that adhere to basic or required laws of thumb
d. Remote rural structures those are difficult to manage The Nepal National Building Code

2.13.2. The Problems with Building Code Implementation in Developing Countries

Compliance costs for builders are often high due to construction permits, inspection procedures, legislation, and governance design issues, with administrative processes being a major deterrent.

Without a discernible gain in safety, the needless bureaucratic processes involved in obtaining building permits raise the cost of construction. The administrative processes required to get a formal building or occupancy permit are so onerous, expensive, and time-consuming in many nations that they prevent code compliance. Code compliance can result in higher building expenses, which may discourage builders from adhering to the standards of the regulations. This is due to the issue of administrative barriers posed by building codes. Insufficient skills, disagreements in the workplace, long wait times, exorbitant costs, and other difficulties are these are failure to mobilize private sector resources for code implementation and Absence of appeal process for dispute resolution.

The absence of professional appeal processes for building code administrative judgments may discourage builders from adopting solutions that align with legal and technical specifications. Uncertainty and costly delays can result from discrepancies in interpretation between inspectors and design practitioners. ICT online construction permission system solutions have only slightly realized their potential due to lack of competence in building code administration systems [6].

2.14. The Consequence of Poor Application of Building Codes of Standards

2.14.1. Factors affecting applicability of National Building Code in Ghana

In Ghana, the National Building Code was passed in 1996 to control the construction of new buildings, the modification of existing structures, and the installation of fixtures or other work related to any building. Despite the fact that this regulation has been passed, its application is

dubious. The study's conclusions showed that the primary elements influencing how local governments in Ghana apply the Building Code Regulation are indicated in Table 2.1 [30].

Table 2.1: Factors Affecting Applicability of the Ghana National Building Codes [30]

Factors Affecting Application of National Building Codes in Ghana	Rank
Corruption	1
Bureaucratic Procedures	2
Unavailability Of highly experienced Personnel	3
Lack of public education about the national building regulations	4
Inadequate resources for implementer	5
Political interference	6
Inadequate Personnel	7
Lack of qualified personnel	8
Inadequate knowledge of the regulations by implementers	9
Lack of commitment by central government	10
Lack of commitment by Local	11
Ambiguities of some part of the national building regulations	12

2.14.2. A case study on failure collapse of structures in Nigeria

Here, two essential ideas emerge: building collapse and failure. Although professionals in the built environment hold differing views on each idea, they all agree that the former strongly influences the latter. Failure is defined as a performance gap between predicted and observed that is intolerable. When a building component can no longer be counted on to perform its primary function, a failure has occurred [26].

2.14.3. Causes of building collapse

As can be shown in Figure 2.6 below, approximately 53% of the causes are related to design flaws, 27% to construction site faults, 11% to product failures, 4% to overloading potential building causes, and 5% to unidentified causes [26]. One additional aspect contributing to building failure is corruption. Corrupt practices in the built environment include the use of

inferior materials by the client, inefficient and dishonest labor input, and construction without an authorized building drawing, among other irregularities. In an effort to spend the least amount of money possible on construction, some clients have a tendency to take short cuts by not hiring experienced staff to prepare the contract agreements and oversee the building's development. Inferior materials, particularly the reinforcement rods and cement can contribute greatly to failure of building. Recent studies have validated this assertion, low quality materials are one of the causes of structural failure. When a building fails, it brings the integrity of the person or contracting firm that handles it to question [26].

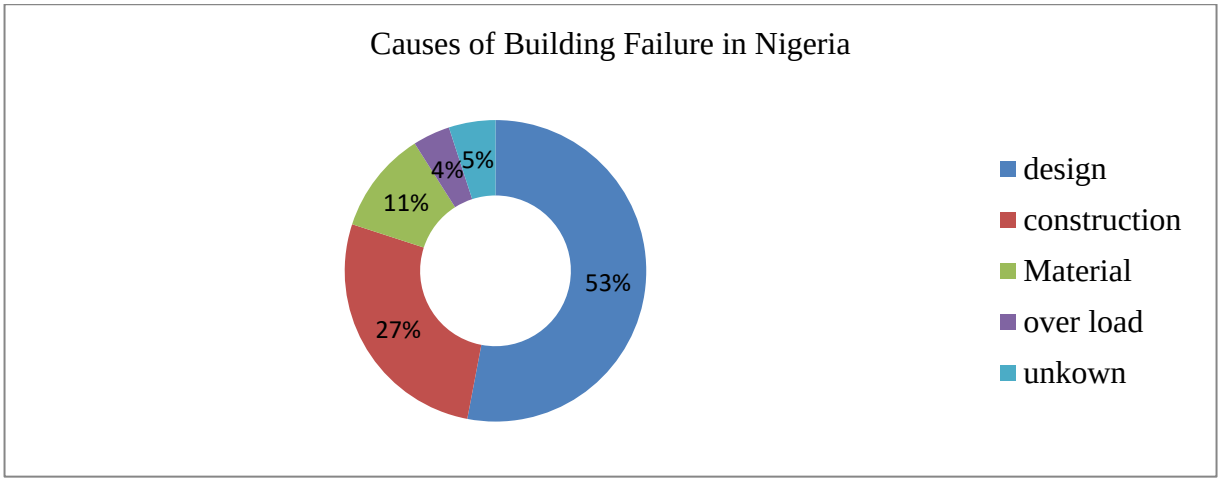

Figure 4 Causes of Building Failure in Nigeria [26]

2.14.4. A case study on collapsing structures in Kenya

The several reasons why buildings in Africa, especially Kenya, fail are explained in detail in this article. A issue that should be taken into consideration, in addition to the many reasons of building collapses, is a lack of code of practice. Although they employ indigenous resources for construction, the majority of codes of practice used in African nations are foreign codes, either from Britain, Europe, or India. In Kenya, the number of building failures and the ensuing collapse of structures has increased alarmingly in recent years.

In January 2013, a five-story building that was still under construction collapsed in Nairobi's core business center, leaving at least eleven people dead and numerous others injured. When the incomplete structure in central Nairobi came, there were more than 280 construction workers inside down. Over 200 people were trapped under the debris of the collapsed

structure. At least 90 people were pulled out of the rubble alive, but six of those later died [34].

2.14.5. Reasons suggested to have caused the failures

The collapse of the buildings was attributed to a variety of factors, such as improper concrete mix ratio, excessive column spacing, inadequate reinforcement, excessive slenderness ratio, noncompliance with standards or specifications by developers and contractors, inadequate inspection and monitoring, structural flaws, defective design/structure, illegal conversion and alteration, contractors cutting costs by altering the recommended concrete mix or lowering the recommended amount of reinforcement, and a host of other factors [34].

In general, as research done by [16], demonstrates that Kenya's current structural concrete quality control methods are not as effective as they should be. Buildings are frequently certified safe for habitation by architects and engineers, in part because of erroneous or fraudulent laboratory tests. Thousands of dangerously flimsy buildings have been and will be constructed as a result, and millions of people will probably be exposed to needlessly increased hazards for years to come unless better control measures are put in place [16].

2.15. Historical Development of the Ethiopian Building Codes of Standards

The Ministry of Works and Urban Development is authorized by the Proclamation to define the powers and duties of the Central and Regional Executive Organs of the Transitional Government of Ethiopia No. 41/1993 to draft the nation's building code, establish standards for design and construction projects, and monitor and oversee their implementation. These standards are intended to function as nationally recognized guidelines, the adoption of which is thought to guarantee that buildings adhere to the National Building Code's minimal specifications for design, construction, and material quality. Applying these standards will primarily help professional practice harmonization as well as guaranteeing acceptable levels of economy, safety, and health while taking the demands and objective conditions of the nation into mind. Since these standards are technical in nature and must thus be updated on a regular basis, the Ministry will periodically release amended editions when necessary [12].

Adoption of Ethiopian Standard Codes of Practices (ESCP -1983)

Prior to the 1980s, Ethiopia lacked its own set of standards. It was utilizing standards codes from other nations. Before the 1980s, foreign consultants and contractors handled the majority of building design and construction. 1978 saw the introduction of the first building code (CP1), which addresses the nation's seismic concerns. The Ethiopian Standard Code of Practice (ESCP1) was created in 1983 after the subsequent version was approved. That takes care of loading. The so-called UBC (Uniform Building Code) and SEAOC (Structural Engineers Association of California) had an impact on both codes [29].

The CP1-78 code mainly addressed seismic zoning and the calculation of equivalent static loads on structures; it did not address the actual seismic design of structural members, such as beams, columns, and shear walls. Instead, the decision-making for seismic design was left to the engineers who are knowledgeable about the established international building codes, mainly the UBC. The Ethiopian Standard Code of Practice 2, or ESCP 2:1983, addresses the structural application of concrete and provides guidelines for concrete design. ESCP 3:1983, which addresses a structure's foundation. Ethiopia has generally embraced three Standard Codes of Practice: ESCP 1 (loading), ESCP 2 (using concrete structurally), and ESCP 3 (foundation) [29].

2.15.1 Establishment of Building Codes of Standards (EBCS -1995)

As was previously said, the Ethiopian government is directly utilizing Euro Codes without the consent or agreement of European nations, giving rise to an intellectual property rights issue with the Ethiopian Standard Codes of Practices of 1983. The other reason for EBCS 1995's adoption is that, in 1983, there were only three Standard Codes of Practices. As a result, it became necessary to adopt additional codes to guarantee that buildings complied with the National Building Code's minimal standards for material quality, construction, and design. So, a significant modification that was implemented in 1995 comes after these. The Ministry of Works and Urban Development adopted the EBCS-1995, which was divided into 11 volumetric portions as follows [29].

a. EBCS-1 (BASIS OF DESIGN AND ACTIONS ON STRUCTURES)
b. EBCS-2 (SRTUCTURAL USE OF CONCERTE)
c. EBCS-3 (DESIGN OF STEEL STRUCTURES)

d. EBCS-4 (DESIGN OF COMPOSITE STEEL AND CONCERETE STRUCTURES)
e. EBCS-5 (UTILIZATION OF TIMBER)
f. EBCS-6 (DESIGN OF MASONARY STRUCTURES)
g. EBCS-7 (FOUNDATIONS)
h. EBCS-8 (DESIGN OF STRUCTURES FOR EARTH QUACKE RESISTANCE)
i. EBCS-9 (PLUMBING SERVICE OF BUILDINGS)
j. EBCS-10 (ELECTRICAL INSTALLATION OF BUILDINGS)
k. EBCS-11 (MECHANICAL VENTILATION AND AIR CONDITIONING BUILDINGS).

On the other hand, the eleven volume Ethiopian Building Code Standards (EBCS) were largely based on the European pre-standard (experimental) code (ENV 1998), which was created by the Committee of European Nations (CEN). the draft Euro Code marked a significant shift from previous codes, primarily using UBC as a model, seemingly without any technical reason.

Furthermore, there are a lot of important contradictions and disputes as a result of the adoption of this "draft" code before the European Union themselves reviewed it and approved a revised version as standing code. [16, 9].

2.15.2. Newly revised Ethiopian Building Codes of Standards (EBCS-EN 2013)

According to [30], Ethiopia's Ministry of Works and Urban Development is likely to establish a new building code that will replace the country's eighteen-year-old one (MoWUD). The new code will be based on European building codes that are currently in place. In January 2012, the Addis Ababa Institute of Technology (AAiT) was given a duty by the Ministry to create a draft for architects and contractors throughout the nation. Started in March 2012, the draft consists of 58 sections divided into 14 standard code headers. On April 9, 2013, the Institute gave the ministry eight of the 58 pieces.

The Ethiopian Ministry of Works and Urban Development has formally implemented construction Codes having 11 summarized Codes in 1995 and now three summarized codes have been reestablished to boost the sector to offer a better standard. The Ministry signed Memorandum of Understanding (MoU) with the European Union (EU) and European

standardization committee in 2011. The Ministry was provided with the EU‟s Building Code, which was last updated in 2010.

The Ministry of Construction in Ethiopia is not allowed to alter the Euro code or its name, despite the need for unique Ethiopian data. The new code considers wind and earthquake effects, necessitating larger structural frame works and new design requirements.

The development of the code took twenty years in European countries. A proposal to create a construction council in Ethiopia that will oversee the codes' implementation is also being worked on. The construction industry will be regulated by the council, which will also enforce the consistent standards set forth by Euro Code. The Ethiopian Standardization Agency will receive the final document before the Ministry of Communication and Information Technology (MCiT) sends it for correction. [37].

The following list includes the 14 EBCS that the Ethiopian Ministry of Urban Development and Construction established in 2013 [12].

a. EBCS-1 EN1991 (ACTIONS ON STRUCTURE)
b. EBCS-2 EN 1992 (DESIGN OF CONCERETE STRUCTURE)
c. EBCS-3EN 1993 (DESIGN OF STEEL STRUCTURES)
d. EBCS-4 EN 1994 (DESIGN OF COMPOSITE STEEL AND CONCERETE STRUCTURES)
e. EBCS-5 EN 1995 (DESIGN OF TIMBER)
f. EBCS-6 EN 1996 (DESIGN OF MASONARY STRUCTURES)
g. EBCS-7 EN 1997 (FOUNDATIONS)
h. EBCS-8 1998 (DESIGN OF STRUCTURES FOR EARTH QUACKE RESISTANCE)
i. EBCS-9 (PLUMBING SERVICE OF BUILDINGS)
j. EBCS-10 (ELECTRICAL INSTALLATION OF BUILDINGS)
k. ES -EBCS11 (MECHANICAL VENTILATION AND AIR CONDITIONING IN BUILDINGS)
l. EBCS-G (EBCS 12) (BUILDING SPATIAL DESIGN)
m. EBCS13 (FIRE PRECAUTIONS DURING BUILDING CONSTRUCTION DESIGN, WORKS AND USE)

n. EBCS 14 (HEALTH AND SAFETY IN BUILDING CONSTRUCTION

2.16 Building Regulations and Codes in Ethiopia

Ethiopia, like many other nations, has several Building Codes System (BCS) components and buildings. The components, structure, and many characteristics of EBCS are thoroughly explained in the sections that follow.

Historical background

Building Directive No. 5/2003 was established by the Ministry of Construction and Urban Development in 2003. It outlines the steps that must be taken, from design approval to building occupancy, to guarantee the public's safety and health. Enforcing these directions to the ongoing building construction around the nation is mandatory. Furthermore, on May 6, 2009, Ethiopia issued Building Proclamations Nos. 691, 2005, and 624, 2009, which address the duty of stakeholders to uphold and implement the laws and regulations outlined in building proclamations. In accordance with Article 5 of the Federal Democratic Republic of Ethiopia Proclamation, which defines the powers and responsibilities of the executive organs, the Council of Ministers is making this proclamation. Furthermore, in accordance with Article 5 of the Definitions of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia, the Council of Ministers issued Building Regulation No. 624/2009. The building regulation addresses the rules, legislation, and guidelines that are relevant to the construction industry [14].

2.17 Application of Appropriate Building Regulations and Standards

Since 1963, the Ethiopian Standards agency has been in operation. The agency's lack of adequate financial and human resources as well as the industry's lack of direct participation in standardization efforts are the key reasons for the slow pace of standardization. The primary source of funding for the establishment of standards has been inadequate government subvention. Owing to the identified shortcomings, the sector mostly still uses foreign standards without conducting a thorough assessment of their suitability [25].

Furthermore, the enforcement of building regulations is not very strong. Building codes are created by the Ministry in charge of lands and human settlements, although local governments

are also partially in charge of enforcing them. One of the things that lead to low-quality goods and services is the absence of proper building codes and standards [25].

Almost all residential construction projects have to go by extensive building rules or regulations that are regulated by municipal and state legislation. State and local governments usually adopt nationally known model codes, often modifying them to fit local construction methods, climate, and geography, due to the expense and difficulty of drafting and maintaining such standards. For this reason, the majority of nations and groups embrace globally recognized codes [37].

To address a number of specific code-related concerns, such as cost effectiveness, affordability, hazard mitigation, and performance-based design, voluntary energy and green programs, accessibility, stair geometry, and other crucial factors, policies and codes of conduct that are critically designed and drawn from the practice of various countries are used. This kind of development is crucial and significant, particularly for buildings where the rules can significantly affect occupant comfort and safety as well as building and operating costs [25].

2.18. Building regulations

It is a legally binding document that gives all local authorities the authority to supervise the upkeep of the building code and bylaws in the regions under their purview. But because Ethiopia's housing policy was lax in the past, there are a number of haphazard urban designs, plans, and building techniques that are apparent. Research is still being done to find solutions to these issues, including upgrading low-income homes, coming up with new affordable housing projects, introducing new sanitation practices, employing local building materials, and transferring construction technologies [31].

2.19. Summary of the Review of Literature

Building codes are designed to protect public health, safety, and welfare, but their enforcement and applicability vary globally. Low- and middle-income nations often face challenges due to limited awareness, inadequate knowledge, and economic constraints, leading to poor implementation of building standards. Many of these countries adopt codes

from highly regulated nations without adapting them to local construction methods and available materials. As a result, non-engineered and self-built structures frequently disregard building codes, relying on imported materials while neglecting affordable domestic alternatives.

Code enforcement methods differ worldwide. In the U.S., both enforced and voluntary compliance approaches are used, with voluntary compliance being more common due to positive collaboration between designers and contractors. In Europe, code enforcement has seen increasing privatization, supported by certification and accreditation systems. Some emerging nations, like Nepal, have successfully implemented building codes through public engagement, awareness programs, and capacity-building initiatives tailored to different levels of construction sophistication. Ethiopian building codes are directly adapted from the Euro Code, but many professionals lack a clear understanding of their principles. Local construction often relies on traditional materials and techniques, which are not adequately governed by the existing regulations. Additionally, a shortage of skilled workers and weak management practices hinder enforcement. Given these challenges, it is essential to assess the visibility, applicability, and enforcement of Ethiopian building codes in Mekelle City Municipality to identify barriers and propose solutions for better implementation.

Chapter -3: Methodology

The following methodology was employed to meet the requirements of the objectives.

3.1 Research Design

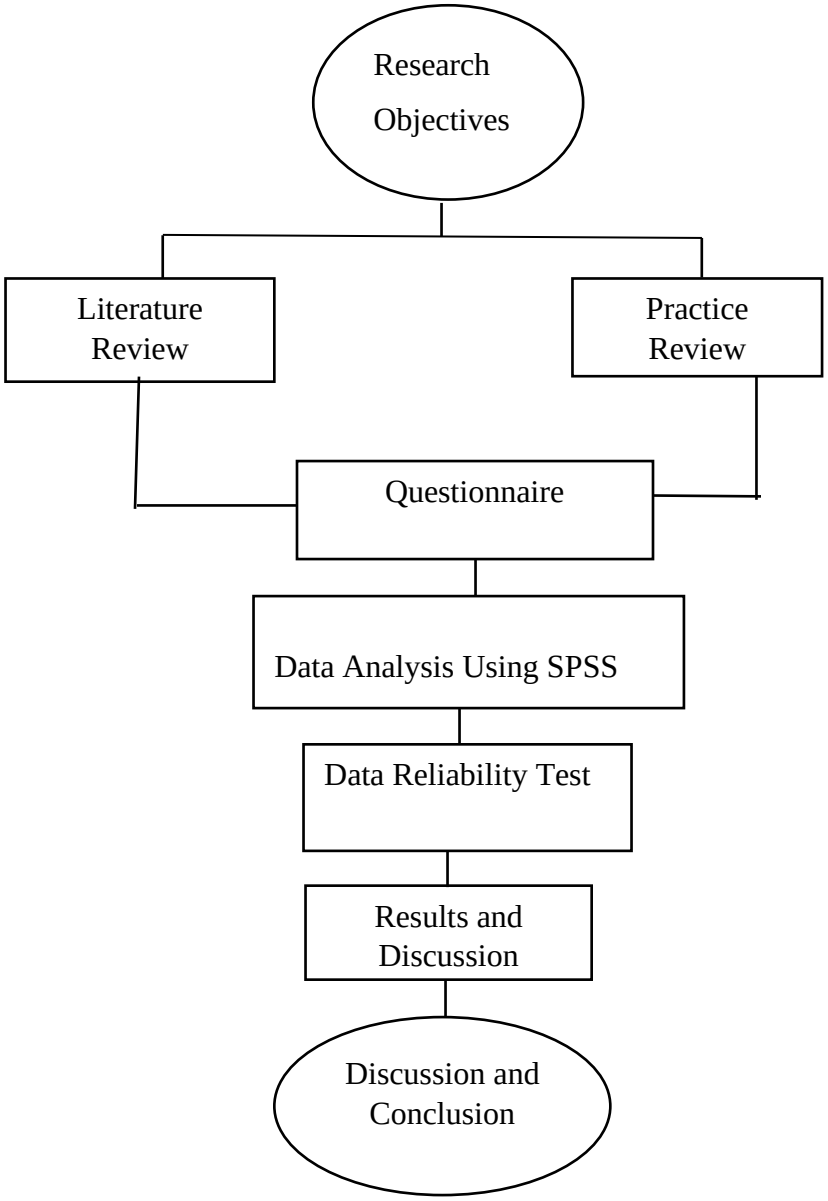

Figure 5 Methodology

3.2 Study area

This study was conducted in the Mekelle City Municipality of Tigray, Ethiopia. Tigray is located in the northern part of Ethiopia. As the capital city of the Tigray region, Mekelle hosts many public construction projects and government offices, making it a valuable source of data for this study. Mekelle was established in the 1880s and became the capital of Tigray during the reign of Emperor Yohannes IV. The city is located at 39.4670°E, 13.4830°N, and is approximately 780 kilometers from Addis Ababa.

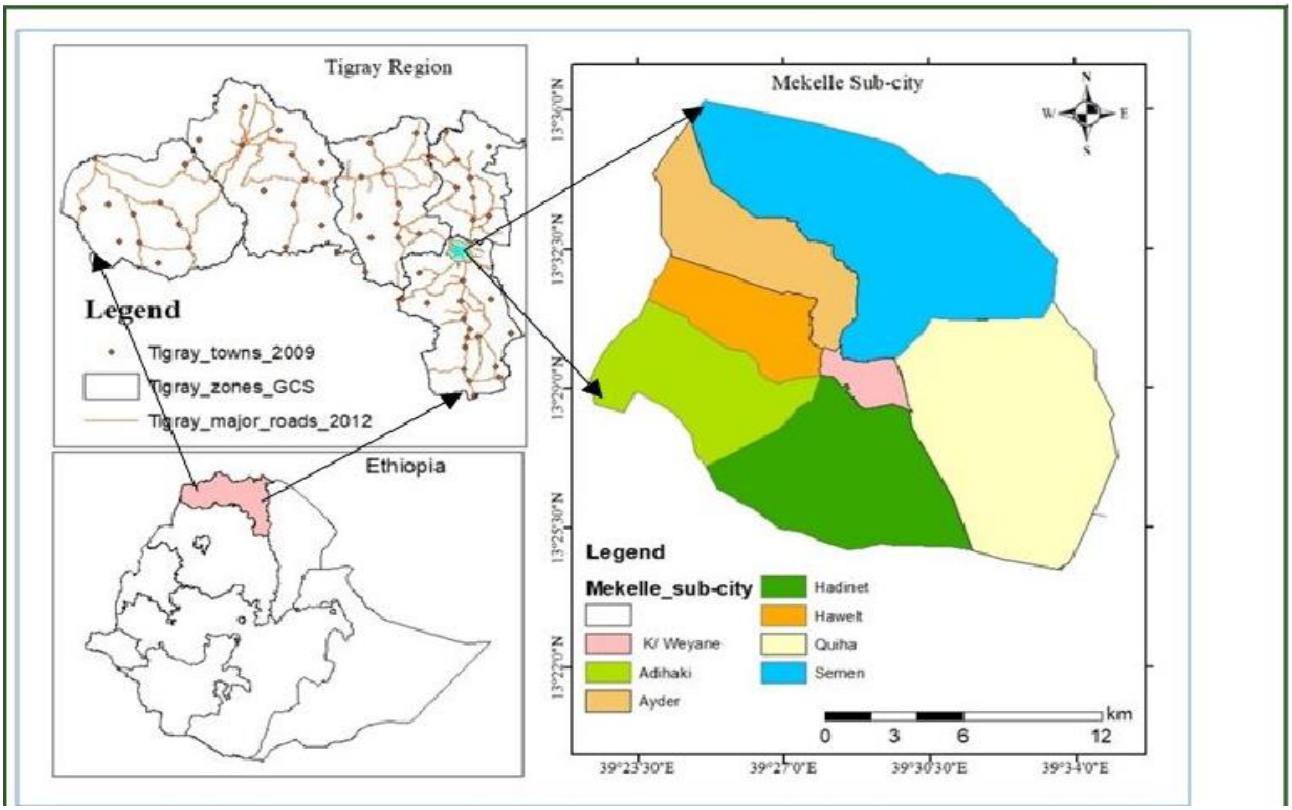

Figure 6 Study location area

3.3. Research Design and Methodology

The study evaluates the implementation of Ethiopian building regulations and standards in Mekelle City Municipality, providing conclusions and recommendations based on the findings. Data was collected from both primary and secondary sources. Primary data came from questionnaires, interviews, and observations involving contractors, consultants, project owners, and other construction professionals. Secondary data was obtained from previous research, online sources, journals, seminar papers, books, and published articles.

A cross-sectional survey approach was used to collect statistical data, with the study population consisting of consulting, contracting, and construction development professionals involved in building projects. The collected data was analyzed using SPSS statistical software.

3.4. Questionnaire Survey

The researcher distributed questionnaires to various organizations. Respondents included Grade 1 to 4 contractors, Grade 1 to 3 consultants, and professionals from government construction sectors. The questions were simple and straightforward to encourage maximum participation.

3.4.1. Questionnaire design

Hence, a total of 75 questionnaires were distributed for building construction projects undertaking by grade one to four of all contractors, Consultants and other Construction related organizations. A total of 66 are successfully collected and 61 accepted for analysis.

3.4.2. Relative importance index

The Relative Importance Index (RII) is a statistical method which is used to determine the ranking of different project success factors. As this survey was designed to investigate the relative importance of various major success factors, the method was adopted in this study within various groups. The RII of Likert five or six -point scale, for example ranging from 1 (strongly dis agree) to 4 (strongly agree) was adopted and transformed the relative importance indices' for each success factors as follows;

$$RII = \frac{\sum_{i=1}^{5} W_i}{A*N} = \frac{(1*n_1)+(2*n_2)+(3*n_3)+(4*n_4)+(5*n_5)}{A*N}, \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where W is weighting given to each factor by respondents ranging from 1 to 5. (n_1 = number of respondents for strongly dis agree, n_2 = number of respondents for disagree, n_3 = number of respondents for agree, n_4 = number of respondents for strongly agree). "A"' is the highest weight (that is 5 in this case), and N is the total number of respondents. The RII value had a range between $0 \leq RII \leq 1$. The highest value of RII, the more important success factor and it is the major success factors. The RII was used to rank different success factors. Ethiopia.

3.4.3. Factor Analysis

In order to identify critical factors, factor analysis is employed in this study. The study assumed factor loading of 0.6 as acceptable. Conventionally, variables that have a factor

loading of 0.4 or greater within a particular factor are considered to be major components, and factors are usually given names relating to their major components.

The KMO statistics vary between 0 and 1 (Argyrols, 2005). A value of zero indicates that the sum of partial correlation is large relative to the sum of correlations indicating diffusions in the patterns of correlations, and hence, factor analysis is likely to be inappropriate (Costello & Osborne, 2005). A value close to 1 indicates that the patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors (Cooper & Schindler, 2011).

According to Kaiser (1974), factor loading values that are greater than 0.4 should be accepted and values below 0.4 should lead to correction of more data to help researcher to determine the values to include. Values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great, and values above 0.9 are superb.

3.4.4 Reliability Analysis

Reliability of internal consistency was used to test the reliability of the questionnaire. The reliability coefficient of the scale was established by Cronback's Alfa using SPSS Version 20 (Statistical Package for the Social Sciences) software. All data and information from the questionnaire were entered into SPSS program for statistical analysis in order to obtain Relative Important Index (RII) and Rank of variables.

Reliability analysis is carried out to measure the consistency of ranking scale data or ordinal data in survey questionnaire. Reliability analysis used the Cronbach's alpha to measure data in SPSS. Below shows the Cronbach's Alpha Value Coefficient Range.

Table 1.1: Cronbach's Alpha Value Coefficient Range

Cronbach's Alpha Range	Internal consistency
$\alpha < 0.6$	Poor reliability
$0.6 < \alpha < 0.7$	Acceptable reliability
$0.7 < \alpha < 0.8$	Good reliability

$0.8 < \alpha < 0.9$	Very good reliability
$\alpha > 0.9$	Excellent reliability

3.5. Sampling Technique Methods and Sample Size

Based on the data from the Bureau of Urban Development and Construction of the Tigray National Regional State, during the start of this research (June, 2024) there were about 35 newly registered and renewed grade I up to grade IV contractors and about 20 registered grade I up to grade III consultants. In addition, from the Mekelle city municipality building officials, 10 were selected and 10 professionals from Bureau of Urban Development and Construction (design team, contract administration team and regulatory team) were selected. Therefore, the study has conducted to all population and no need of sample size calculation for the case of to increase reliability of the data.

3.6 Data Collection Instrument

A combination of both quantitative and qualitative data was considered in this study. Quantitative research is based on the measurement of quantity or amount. The questions of Likert scale type is categorized under quantitative data since it has intensity of responses. The data obtained through interviews in this project, the yes or no questions and questions of testing the awareness level of Ethiopian building regulation and codes of standards among stakeholders, level of applicability and enforcement of ESEN are a qualitative type.

Similar literatures reviews help for this study as a reference to know the factors affecting the implementation of Ethiopian building regulation and codes of standards. The research has conducted through questionnaires, interviews and case studies.

3.6.1 Questionnaire

The questionnaire survey targeted the professionals who were directly engaged in the construction projects. Structured questionnaire with closed-ended questions was prepared to ensure consistency of respondent's feedback. Likert scale is basically a type of scale used to measure the respondent's opinions towards a specific subject. To interpret a 4/5-point scale, assign each response a point value from 1 to 4/5 based on the number of responses. The following rating scale has been used for the survey on the occurrence of cause factor affecting enforcement of Ethiopian building regulation and codes of standards, using a 1-5 scale.

Table 3.2: rating scale for the survey

Response	Response (Points)
Strongly Disagree (SD)	1
Disagree (D)	2
Neutral (N)	3
Agree (A)	4
Strongly Agree (SA)	5

The levels of responses were; Strongly Disagree (SD) [100%, Disagree (D) [75%, Neutral (N) [50%], Agree (A) [25%] and Strongly Agree (SA) [0%].

3.7 Respondents Composition

The professionals which were targeted to participate in the study as respondents were; project managers of construction professional background, resident engineers, office engineers/quantity surveyors, contractors, consultants, building officials, Bureau of Urban Development and Construction. All the respondents have a direct involvement in applying and enforcing national building regulation and codes of standards in the construction sites.

3.8. Method of Data Analysis

The quantitative data from the questionnaires were entered into the Statistical Package for Social Sciences (SPSS 20) software, which was deemed user-friendly, following the reliability and consistency tests. The reasons for violations and inadequacies in building regulations, standards, and reduction strategies found in literature were thought to contribute to varying degrees. This study examined the relative levels of important contribution of causes and actions to reduce their effects on the goals of Building regulation and Codes of Standards as perceived by construction practitioners using the weighted average model below.

Data analysis is the process of cleaning, changing, and processing raw data and extracting actionable, relevant information that helps businesses make informed decisions and the procedure helps to reduce the risks essential in decision making by providing useful insights and statistics (51). Method of data analysis is the last step and it needs high attention in order to remove false recording of data as they generate false result.

Chapter - 4: Data Analysis, Result and Discussion

4.1. Result Analysis on table and graph form

In this chapter, the survey results are presented and discussed. Statistical analyses of the responses were conducted using various techniques outlined in the research methodology, following the completion of the questionnaire survey and data encoding.

Survey data was analyzed using SPSS (Statistical Package for the Social Sciences) and Excel. The results include information on the respondents' backgrounds, sample size, response rate, and the overall application of Building Codes and Standards in the Mekelle City Municipality construction sector.

4.2. Profile of Respondents and Questionnaire Responses

Questionnaire Response Rate

Totally, 75 questionnaires were distributed throughout the city to the available main respondent parties or professionals representing them who are directly participating in building construction projects. The distribution of questionnaire was done with clear clarification to avoid biasing and blind guess filling. Hereafter, 61 questionnaires were collected and properly filled and by dividing collected questionnaire to questionnaire distributed, response rate also summarized in Table 4.1.

Table 4.1: Questionnaire Response Rate

No	Respondents	Questionnaire Distributed	Questionnaire Collected	Response Rate
1	Contractors	35	27	77.14%
2	Consultants	20	14	70%
3	Mekelle Municipality	10	10	100%
4	UDCB	10	10	100%
Total		75	61	86.78%

Table above shows the respondent's area of expertise in number and percentage. The analyzed data were responded by 27 professionals from contractors, 14 consultants, and 10 professionals from building offices (Mekelle city municipality, 10 professionals from Bureau of Urban Development and Construction. Figure 4.1 below shows the category of respondents by grade of their company. The grade of contractors and consultants participated in this thesis work are presented as below.

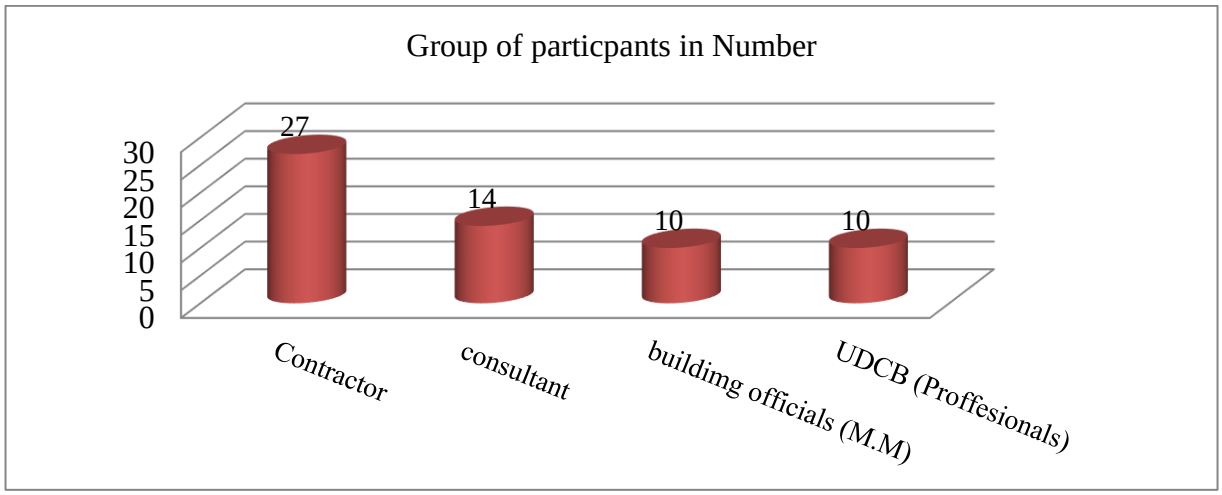

Figure 7 Categories (Grades) of the Respondents

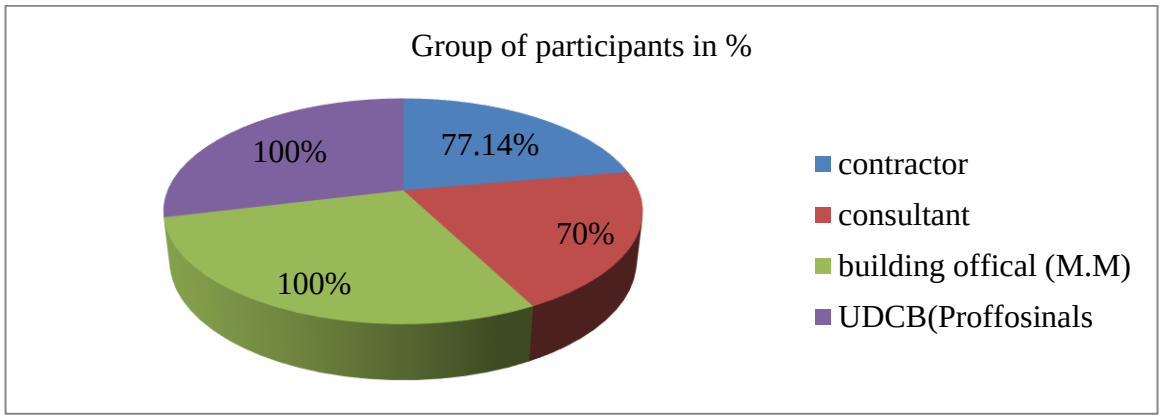

Figure 8 Respondents Group or Party in %

4.3 Respondents by category of their company

Figure 4.4 below shows the category of respondents by grade of their company. The grade of contractors and consultants participated in this thesis work are presented as below.

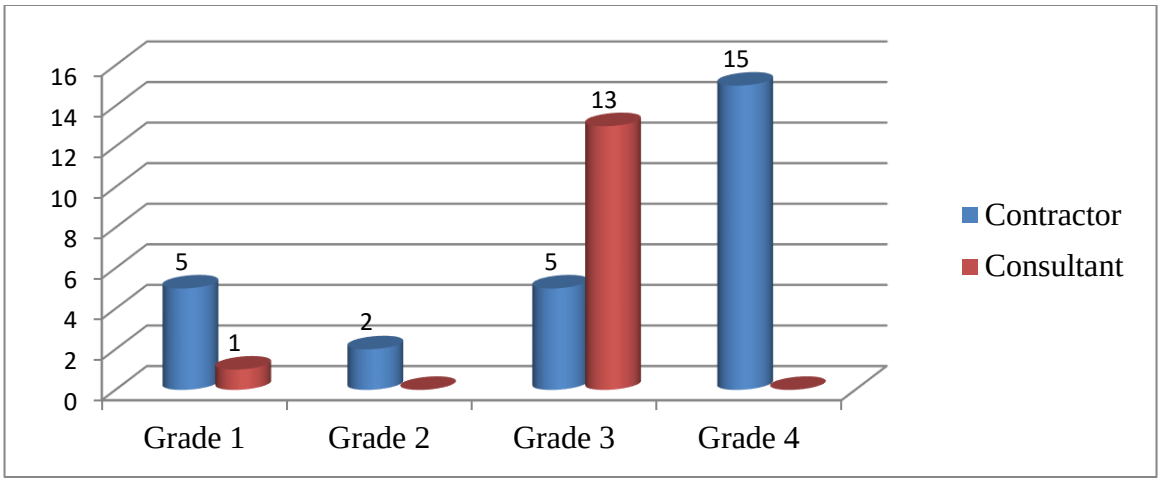

Figure 9 Categories (Grades) of the Respondents

4.4 Respondents level of education

Figure 4.4 shows the respondent's level of education. As it is observed from this figure, all groups of respondents are masters and bachelor degree level of education except contractors. 27 respondents from contractors have bachelor degree level of education, 3 of them have masters and 1 respondent has diploma. From consultants, 14 respondents have bachelor degree, 6 of them have masters, of education.

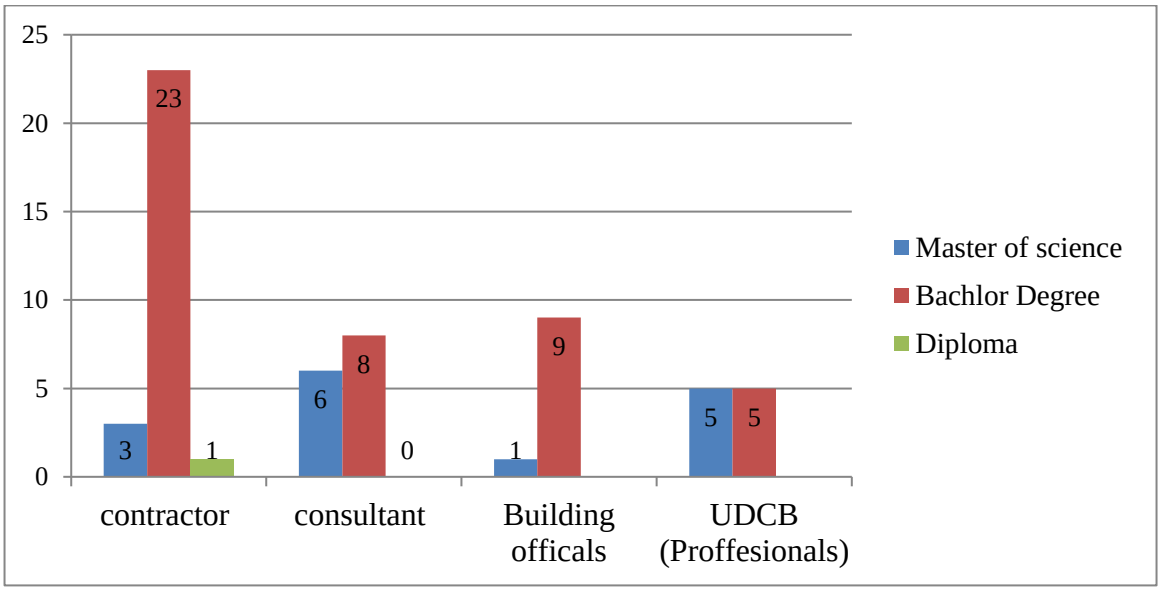

Figure 10 Level of Education of the Respondents

4.5 Respondents years of experience

As it can be seen from Figure 4.6, most of the respondents have >10 years of experience. Among 61 respondents analyzed, there were 27 contractors who replied the questionnaires. From these, 22 professionals from contractors have experience of greater than 10 years. Again three (3) professionals have experience of 0-5years and 2 professionals have experience of 5-10 years.

The consultants considered were 14 in number. From these, three professionals of consultant side have 0-5 years of experience and four professionals 5-10 years of experience. seven has greater than 10 years of experience.

Ten construction professionals from the Regional Bureau of Urban Development and Construction were considered in the analysis. Four of them have from 5-10 years of experience; six of them have greater than 10 years of experience.

When we come to building officials (Mekelle city municipality) among 10 respondents, one of them has 0-5years of experience and 2 of them has 5-10 years of experience while seven respondents have greater than 10 years of experience. Figure 4.6 illustrates how the years of experience are segmented: 11.47% of respondents have between zero and five and 19.67 % between five and ten years of experience, whereas 68. 85 % have more than ten years.

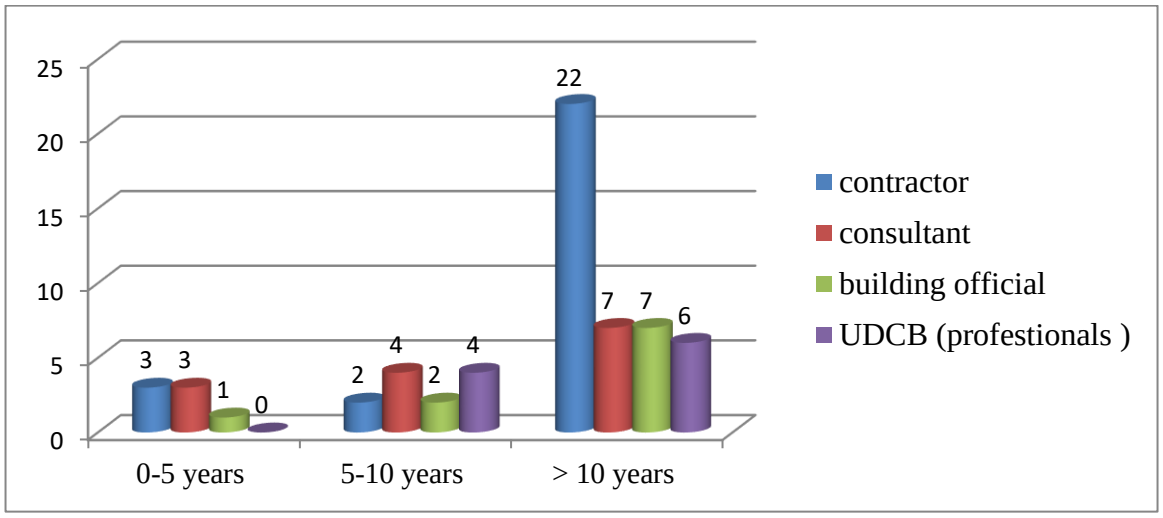

Figure 11 Years of Experience of Respondents

4.2.2 Respondents job title

Figure 4.3 below shows the respondent's percentage from each category of professional title. From total respondents, site engineers constituted 4.91%, office engineers were 13.11%, general managers from contractor and consultant side were 34.42%, project managers from contractor and consultant side were 11.47%, and building officials (Mekelle city municipality) were 16.39%; whereas, Bureau of Urban Development and Construction constitute 16.39% from the total.

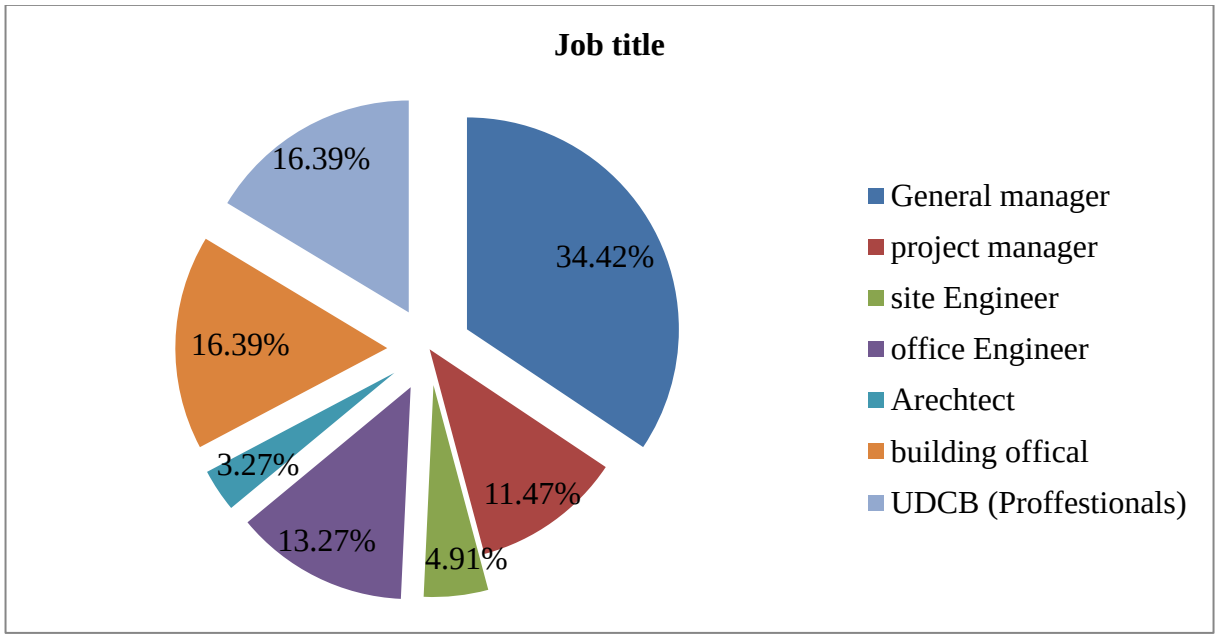

Figure 12 Job Title of Respondents

3.5 Data Analysis and Findings

This part of the study covers all the results collected by different methods and their detail analysis and discussion in Tigray in case of Mekelle city Municipality. This section covers three sections. investigate the current practice of Ethiopia building regulations and codes of standard in Mekelle city municipality; identify the main challenges faced in practicing the Ethiopian regulation and code of standards public building and the awareness, implementation and enforcement of the Ethiopian Building regulation and Codes of Standards for civil works.

3.6 Factorial Analysis and Validity Test

In this section, the study made an evaluation of responses to checkup for validity and reliability in order to avoid biases and inconsistent responses. Validity test was analyzed using the average value of Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity whereas reliability test was analyzed using Cronbach's alpha. The accepted value for Kaiser-Meyer-Olkin (KMO), Bartlett's Sphericity and Cronbach's alpha was >0.6, <0.05, and >0.7 respectively.

Based on those accepted amounts, the validity test and reliability test (internal consistency) was done for Factor (Reason) type for implementing the Ethiopian building regulations and standards, level of awareness on implementation Ethiopian Building code (ES EN), main factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works and remedial measures should be taken to utilize building regulation and ES EN well in the Ethiopian construction industry as listed in the tables below.

For Factor (Reason) type for implementing the Ethiopian building regulations and standards, the value of KMO and Bartlett's test of Sphericity was .645 and .000 consecutively as stated in Table 4.6, so those values satisfied the required criteria which show how the investigators data was suitable for factor analysis or good sampling adequacy.

Table 4.2 KMO and Bartlett's test value

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.645
Bartlett's Test of Sphericity	Approx. Chi-Square	116.171
	df	28
	Sig.	.000

Based on Table 4.2, the value of KMO was .702 which is >.6 and the value of Bartlett's test of Sphericity was .000 which is<0.05. Therefore, both values were accepted as it shows the level of awareness on implementation Ethiopian Building code (ES EN) was valid.

Table 4.3 KMO and Bartlett's test value for Frequency of ICT Applications:

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.702
Bartlett's Test of Sphericity	Approx. Chi-Square	210.100
	df	105
	Sig.	.000

Similarly, the value KMO was .701 which is >.6 and the value of Bartlett's test of Sphericity was .000 which is<0.05, both values was accepted as they show the variables of the main factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works valid as stated in Table 4.8.

Table 4.4 KMO and Bartlett's Test Value for Factors Affecting the Use of ICT

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.701
Bartlett's Test of Sphericity	Approx. Chi-Square	534.464
	df	210
	Sig.	.000

A construct is reliable if the Cronbach's alpha (α) value is greater than 0.70. Construct reliability was assessed using Cronbach's alpha. The results discovered that the factors reason type with seven items (α=.712), the frequency of level of awareness on implementation Ethiopian Building code (ES EN) with twenty items (α=.81) and the factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works with twenty items (α=.743), shows all constructs was reliable. as summarized in Table 4.8.

Table 4.5 Reliability Statistics and Cronbach's Alpha for each dimension in the questionnaire

Dimensions/ variables	Cronbach's Alpha value	Internal consistency	Number of items	Loading Factor>0.6

Reasons Type	0.712	Good reliability	7	6
Level of awareness	0.810	Very good reliability	20	15
Enforcement factor	0.743	Good reliability	20	17
remedial measures	0.883	Very good reliability	16	12

Based on Table 4.5, 7 items (sub variables) of the reasons type of companies practicing Ethiopian building regulations and code of standards is passed with acceptance value of 0.7 which Cronbach's Alpha value is 0.712 that indicate good reliability. Fifteen items of factors that level of awareness on implementation Ethiopian Building code (ES EN) is passed with acceptance value of 0.7 which Cronbach's Alpha value is 0.810 that indicate very good reliability. The Cronbach's Alpha value of factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works is found 0.743 indicate good reliability whereas the Cronbach's Alpha value of remedial measures should be taken to utilize building regulation and ES EN is found 0.883 indicate very good reliability.

Table 4.6 Descriptive summary the respondents' opinion on Query types

No.	**Query Type**	**Yes**	**No**	**NA**
1	Do you agree that the concepts and ideas presented in provisions of Ethiopian building regulations and codes of Standards currently used in the Construction industry are very clear and understandable for users?	42	16	3
2	Do you have a specific unit/cell for building regulations and codes of Standards?	40	16	5
3	Do you have written Inspection and Testing Procedures?	38	21	2
4	Does material supply is inspected to assure technical conformance?	34	24	3
5	Do you agree that construction stake holders in your project are well aware of the principles and Concepts stated under ES EN?	26	27	8
Total number of respondents N, is 61				

Results of query type shows that, more than half of the respondents follow concepts and ideas presented in provisions of Ethiopian building regulations and codes of Standards currently used in the Construction industry. A descriptive statistics result also indicates that material supply is inspected to assure technical conformance by majority of the respondents. They also procure the materials they used is inspected to assure technical conformance. Regarding providing specific unit/cell for building regulations and codes of Standards, only 40 responds and about 38 of the respondents follow the written Inspection and Testing Procedures, 27 of the respondents segregate construction stake holders project are not aware of the principles and concepts stated under ES EN.

Table 4.7 Descriptive summary of respondents' opinion for not practicing Ethiopian building regulations and code of standards

No.	Factors or reason Type	Level of Agreement in frequency					RII	Rank	Loading Factor
		Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable			
1	We are satisfied with our present traditional practice	2	44	10	2	3	0.52	5	0.641
2	ES is not efficient and effective in monitoring and control	4	33	21	1	2	0.56	3	0.712
3	Principles and Concepts stated under ES EN is not a Customer/Client/Bidding Requirement	5	36	16	2	2	0.55	4	0.603
4	ESEN is not a Legal/Ministry Requirement	11	44	3		3	0.44	7	0.642
5	Ethiopian Standards is very costly for implementation	7	30	22	2	0	0.58	1	0.612
6	ESEN is difficult to understand, document, and practice	4	30	24	1	2	0.57	2	0.662
7	Our company staff is unwilling for ESEN implementation	11	37	9	1	3	0.48	6	0.598

Table 4.7 above presents that frequency distributions and RII of each factor or reason types for not practicing Ethiopian building regulations and code of standards. The computed RIIs and their respective ranks as perceived by the respondents are summarized in the last column. It illustrates ranking of reasons or factors for not practicing the Ethiopian building regulations and code of standards. It can be inferred from the above table that most important factor according to the perception of respondents are Ethiopian Standards is very costly for implementation, ESEN is difficult to understand, and ES is not efficient and effective in monitoring and control are the top 3 ranked factors or reasons for not practicing ESEN. According to respondents' perception, it seems that Ethiopian Standards is very costly for implementation is the most important performance factor or reason as it has the first rank among all factors with relative importance index (RII) equal to 0.58. The factor analysis showed that from the main variable of reason type's six sub variables with values more than 0.6 loading factor were accepted and one sub variables with factor loadings less than 0.6 were dropped. The sub variables dropped is company staff is unwilling for ESEN implementation. The Kaiser-Mayor-Oklin measures of sampling adequacy showed the value of test statistic of 0.654 which showed a high partial correlation and that factor analysis was appropriate. In addition to this Bartlett's test of sphericity showed that relationship among the variables was significant.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.654
Bartlett's Test of Sphericity	Approx. Chi-Square	242.829
	Df	45
	Sig.	0.000

Table 4.8 Descriptive summary of level of awareness on implementation Ethiopian Building code (ES EN)

S. No.	Level of awareness on implementation Ethiopian Building code (ES EN)	Never	Rarely	Sometime	Always	NA	RII	Rank	Loading factor
1	Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and general welfare.	2	26	24	8	1	0.65	13	0.772
2	Inexistence of testing and certification system for building engineer's, consultants, contractors and skilled labors.	2	18	26	14	1	0.70	11	0.790
3	Weakness in building code administration and institutional capacity insufficient legislative foundation.	1	25	21	9	5	0.61	14	0.796
4	Absence of community awareness in building regulations and nature of building regulation task of municipality.	4	21	25	10	1	0.66	12	0.742
5	Ineffective engineering supervision and inspection tasks to prevent violations or cheating.	2	13	26	19	1	0.75	8	0.565
6	Administration procedures at municipality are the main obstacles to implement and enforce regulations and codes.	0	12	22	25	2	0.78	6	0.772
7	Improper municipality procedures to organize the works of consultant offices from preparing plans and engineering supervision on projects.	1	18	21	18	3	0.70	11	0.557
8	municipality are not clear and not with satisfying performance	0	12	27	22	0	0.79	5	0.796
9	Failure of building law and codes to address locally available construction materials and Techniques.	0	5	26	30	0	0.84	2	0.675

10	Lack of effective participation of concerned stake holders in code development and Maintenance.	2	9	31	17	2	0.74	9	0.702
11	Corruption and regulatory capture	0	17	27	15	2	0.72	10	0.773
12	Improper municipality technical and managerial capabilities to follow up and control building and construction works.	3	12	21	25	0	0.78	6	0.564
13	Many construction problems are due to unclear professional practice and workmanship Standards.	1	6	26	28	0	0.83	3	0.746
14	Weak technical and financial capabilities at municipality branches	1	10	26	23	1	0.78	6	0.741
15	Municipality don’t perform its responsibilities effectively to license, follow up and monitor local construction works.	1	7	20	33	0	0.85	1	0.823
16	Building officers at municipality don't care to use comprehensive checklists to review plans, and monitor projects to faithfully fulfill their work requirements.	2	11	28	20	0	0.77	7	0.759
17	Neglecting of building materials and concrete by certified testing centers during projects are not executed as per professional standards and proper workmanship.	2	10	17	32	0	0.82	4	0.757
18	unclear and inadequate procedures of review of building plans at municipality.	2	10	21	27	1	0.79	5	0.718
19	absence of safety department at municipality	2	26	24	8	1	0.65	13	0.798
20	Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and general welfare.	2	18	26	14	1	0.70	11	0.568

According to the respondents perception, Municipality don't perform its responsibilities effectively to license, follow up and monitor local construction works, Many construction problems are due to unclear professional practice and workmanship Standards, and better defined responsibilities and authorities and Neglecting of building materials and concrete by certified testing centers during projects are not executed as per professional standards and proper workmanship are the top three ranked based on high level of awareness on implementation Ethiopian Building code (ES EN)`. The RII of Weakness in building code administration and institutional capacity insufficient legislative foundation 0.61 which is the lowest from the twenty factors stated in Table 4.8.

The factor analysis showed that from the main variable of awareness type fifteen sub variables were accepted because the five sub variables have values less than 0.6 loading factor. The Kaiser-Mayor-Oklin measures of sampling adequacy showed the value of test statistic of 0.67 which showed a high partial correlation among the variables and that factor analysis was appropriate. In addition to this Bartlett's test of sphericity showed that relationship among the variables was significant.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.671
Bartlett's Test of Sphericity	Approx. Chi-Square	598.443
	df	210
	Sig.	0.000

Table 4.9 Descriptive summary of main factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works

S. No.	**Enforcement Factors**	Level of importance in frequency/percent					RII	Rank	Loading factor
		Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable			
1	Ineffective implementation of law to prepare and enforce building codes to safe guard minimum	2	5	44	10	0	0.75	2	0.750
2	Inexistence of testing and certification system for building engineer's, consultants, contractors and	2	4	44	11	0	0.76	1	0.752
3	Weakness in building code administration and institutional capacity insufficient legislative	1	9	39	11	1	0.74	3	0.706
4	Absence of community awareness in building regulations and nature of building regulation task of	1	7	42	10	1	0.74	3	0.801
5	Ineffective engineering supervision and inspection tasks to prevent violations or cheating.	1	7	38	14	1	0.76	1	0.697
6	Administration procedures at municipality are the main obstacles to implement and enforce	2	16	33	10	0	0.71	6	0.599
7	Improper municipality procedures to organize the works of consultant offices from preparing plans	2	9	42	8	0	0.73	4	0.614
8	municipality are not clear and not with satisfying performance.	1	12	36	11	1	0.73	4	0.564

9	Failure of building law and codes to address locally available construction materials and Techniques.	0	22	33	5	1	0.67	8	0.695
10	Lack of effective participation of concerned stake holders in code development and Maintenance.	3	6	42	10	0	0.74	3	0.672
11	Corruption and regulatory capture.	1	14	34	11	1	0.72	5	0.611
12	Improper municipality technical and managerial capabilities to follow up and control building and	1	9	40	11	0	0.75	2	0.658
13	Many construction problems are due to unclear professional practice and workmanship Standards	2	10	36	13	0	0.75	2	0.459
14	Weak technical and financial capabilities at municipality branches.	3	12	39	7	0	0.70	7	0.841
15	Municipality don’t perform its responsibilities effectively to license, follow up and monitor local	2	11	43	5	0	0.71	6	0.751
16	Building officers at municipality don't care to use comprehensive checklists to review plans, and monitor projects to faithfully fulfill their work	2	8	44	7	0	0.73	4	0.803
17	Neglecting of building materials and concrete by certified testing centers during projects are not executed as per professional standards and proper	1	7	42	11	0	0.76	1	0.735
18	unclear and inadequate procedures of review of building plans at municipality.	2	13	41	5	0	0.70	7	0.837
19	absence of safety department at municipality	2	8	41	10	0	0.74	3	0.864

20	Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and welfare.	2	5	44	10	0	0.75	2	0.713
Total number of respondents N, is 61									

The computed RIIs and their respective ranks as perceived by the respondents are summarized in Table. 4.9. It illustrates ranking of the main factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works. It can be inferred from the above Table 4.9 that most important factor according to the perception of respondents are: Inexistence of testing and certification system for building engineer's, consultants, contractors and skilled labors, Ineffective engineering supervision and inspection tasks to prevent violations or cheating and Neglecting of building materials and concrete by certified testing centers during projects are not executed as per professional standards and proper workmanship are the first rank among all factors with relative importance index (RII) equal to 0.76.

Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and welfare, Improper municipality technical and managerial capabilities to follow up and control building and construction works and Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and welfare have been ranked in the second position with RII equal to 0.75. The RII greater than 0.5 indicate that the factor is high affected to Ethiopian Building Codes Standards ESEN in civil works. According to the respondents' perception, Failure of building law and codes to address locally available construction materials and Techniques has been ranked in the last order with RII of 0.67 indicates that it is not a serious factor in affecting the ESEN standards.

The factor analysis showed that from the main variable of enforcement factor seventeen variables with values more than 0.6 loading factor were accepted and three sub variables with factor loadings less than 0.6 were dropped. The Kaiser-Mayor-Oklin measures of sampling adequacy showed the value of test statistic of 0.764 which showed a high partial correlation among the variables and that factor analysis was appropriate. In addition to this Bartlett's test of sphericity showed that relationship among the variables was significant.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.764
Bartlett's Test of Sphericity	Approx. Chi-Square	79.841
	df	21
	Sig.	0.000

Table 4.10 Descriptive summary of remedial measures should be taken to utilize building regulation and ES EN

	Remedial Measures	No Importance	Minor Importance	Important	Highly Important	RII	Rank	Loading Factor
I	**Regarding National Level Legislation and Institution**							
1	Adopt a legal framework to support the effective enforcement of building code regulations at the local level.	2	4	35	0.490	0.80	4	0.672
2	Improve the capability and accountability of regulatory agency through quality control measure.	1	2	30	0.096	0.85	1	0.690
3	Regular training and workshops regarding the enforcement of ES EN need to be provided for parties involved in construction.	2	1	35	0.742	0.82	3	0.696
4	Ensure effective co-ordination and collaboration of institutions responsible for formulation, updating and enforcement of regulations and standards.	0	4	31	0.565	0.84	2	0.742
5	Provide adequate legal support.	2	4	37	0.672	0.79	5	0.565
II	**Regarding Building Code Development and Maintenance**							

1	Develop a comprehensive building code that covers the full range of relevant construction materials, types and practices.	0	3	42	16	0.80	3	0.699
2	Building Codes Standards should be accessible, clear, and understandable for building practitioners.	1	4	28	28	0.84	1	0.609
3	The code should allow alternative compliance solution to support innovation or traditional practices that meet safety requirement.	1	4	38	18	0.80	3	0.574
4	Contractors and consultants should be recruited and evaluated by their technique and methods of enforcing the EBCS in construction works.	3	3	44	11	0.76	4	0.743
5	Common understanding on importance of national building codes and standards should be created.	4	1	36	20	0.80	3	0.826
6	Common understanding on achieving quality of built structures importance of national building codes and standards should be created.	2	3	35	21	0.81	2	0.572
III	**Regarding Local Implementation**							
1	Strengthen implementation of building regulation and code through plan review, site inspection and permitting at local at local level.	2	5	36	18	0.79	2	0.827

2	Introducing private sector for building regulation and code implementation.	5	2	38	16	0.77	4	0.455
3	Create and maintain public awareness of basic safe construction principles for the community, building owners, and informal sector builders.	3	4	32	22	0.80	1	0.687
4	Provide funding and support to building department at local level with technically qualified and adequate building officials.	3	3	37	18	0.79	2	0.767
5	Engineers (professional experts) should be well utilized in proper guiding of construction works.	3	2	40	16	0.78	3	0.649

Table 4.10 presents the descriptive summary of remedial measures that should be taken to utilize building regulation and ES EN. According to the respondents' Improve the capability and accountability of regulatory agency through quality control measure, Building Codes Standards should be accessible, clear, and understandable for building practitioners and Create and maintain public awareness of basic safe construction principles for the community, building owners, and informal sector builders have been ranked as the top three remedial measures that should be taken to utilize building regulation and ES EN with RII 0.85, 0.84 and 0.80 respectively.

From the sixteen parameters stated in the above Table 4.10, Adopt a legal framework to support the effective enforcement of building code regulations at the local level, Contractors and consultants should be recruited and evaluated by their technique and methods of enforcing the ESEN in construction works and Engineers (professional experts) should be well utilized in proper guiding of construction works is ranked in the last.

The factor analysis showed that from the main variable of motivation type twelve sub variables with values more than 0.6 loading factor were accepted and four sub variables with factor loadings less than 0.6 were dropped. The sub variables dropped were usefulness in marketing and international competition outside Ethiopia. The Kaiser-Mayor-Oklin measures of sampling adequacy showed the value of test statistic of 0.43 which showed a high partial correlation among the variables and that factor analysis was appropriate. In addition to this Bartlett's test of sphericity showed that relationship among the variables was significant.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.503
Bartlett's Test of Sphericity	Approx. Chi-Square	262.386
	Df	105
	Sig.	.000

Chapter - 5: Conclusion and Recommendations

5.1 Conclusion

1. **Visibility of Ethiopian Building Codes (ESEN) in the Mekelle Municipality**
   The Ethiopian Building Codes (ESEN) are not adequately visible among construction sector stakeholders in Mekelle. The revised 2013 ESEN has not been delivered or practiced, with the project focusing only on the 1995 version. Many practitioners are unaware of most ESEN, knowing only nine out of the fourteen standards. There is a significant lack of awareness about key codes like those on structural actions, mechanical ventilation, earthquake resistance, and steel structure design. However, some codes, such as those related to concrete structures and geotechnical design, are better known.
2. **Applicability of Building Codes**
   The applicability of building codes and standards in Mekelle's civil works is lower than expected, largely due to several factors. The most prominent factors include: lack of regular training and workshops for practitioners and regulatory bodies, ineffective engineering supervision, inadequate community awareness, corruption, and insufficient knowledge of the codes among stakeholders.
3. **Enforcement of Building Codes**
   The enforcement of building regulations and codes in Mekelle is also insufficient, with factors affecting enforcement categorized into legal, administrative, and social components. The administrative component was ranked as the most significant issue, followed by legal and social components. Key issues include ineffective involvement of insurance companies, poor licensing and monitoring by municipal offices, and limited access to training for code compliance.
4. **Exclusion of Tigray Cities from the Ethiopian Building Proclamation**
   The Ethiopian Building Proclamation and Regulations are not applicable in Tigray's cities, including Mekelle. The building official's role, which should be appointed by the city administration, is an obstacle to proper implementation of the regulations.

5. **Potential for Improvement**

   Despite the low visibility, applicability, and enforcement of building codes, improvements are possible in Mekelle's construction industry. Achieving these changes requires strong commitment from the entire construction sector, regulatory bodies, and society as a whole.

5.2 Recommendations for Improving Visibility, Applicability, and Enforcement of Building Regulations

5.2.1 Governmental Bodies

1. Legislation & Enforcement: Introduce legislation for the application and enforcement of ESEN at all stages of construction and design projects.
2. Funding & Support: Provide funding and support to local building departments with qualified officials to effectively enforce the codes.
3. Public Awareness: Increase public awareness on safe construction practices, targeting communities, building owners, and informal sector builders.
4. Regulatory Agency Improvement: Strengthen regulatory agencies with quality control measures to ensure effective enforcement.
5. Code Development & Updates: Develop comprehensive building codes covering all construction materials and types, and update them regularly to include emerging materials and techniques.
6. Staff Availability & Training: Ensure the availability of key professionals and provide regular training on the application and enforcement of building regulations.

5.2.2 Contractors

1. Staff Training: Provide regular training for site staff to raise awareness on the importance of building regulations and the consequences of negligence.

2. Workforce Skill Development: Address the issue of insufficient workforce training by ensuring that workers are well-trained in implementing building codes and understanding their benefits.
3. Work Execution & Ethical Practices: Ensure construction is done according to the design and technical specifications, focusing on safety, health, and welfare over quick profits or illegal practices.

5.2.3 Consultants

1. Ethical Responsibility: Consultants should prioritize risk management for property, human life, and national wealth, maintaining professional ethics at all times.
2. Qualified Professionals: Hire qualified professionals capable of understanding and applying building codes during design and supervision.
3. Capacity Building: Facilitate regular training and workshops for workers involved in design and supervision to improve the understanding of building regulations and codes.

5.2.4 Owners

1. Professional Hiring: Owners should prioritize hiring professional engineers for high-quality construction work.
2. Long-Term Considerations: Owners should focus on long-term benefits, including reducing maintenance costs, ensuring safety, and protecting their investment, rather than only minimizing initial construction costs.
3. Legal Responsibility: Owners must understand their legal responsibility for any construction-related accidents or disasters.

5.3 Recommendations for Future Studies

1. Technical Flaws & Violations: Investigate the technical flaws and violations in current building regulations and codes in the construction sector.
2. Impact on Sustainability Goals: Assess the impact of building regulations and codes on sustainability goals.

3. Stakeholder Engagement: Research stakeholder engagement in the development of building regulations and codes.

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Appendix - Questionnaire

Investigation the Practice of Ethiopian Building Regulations and Codes of Standards in Mekelle Municipality

A research project work at School of Civil Engineering, Ethiopian Institute of Technology, Mekelle University, Mekelle

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Questionnaire

Request

The objectives of this questionnaire are to Assess the practice of Ethiopian Building Regulations and Codes of Standards in Mekelle Municipality; under the Mekelle building construction companies.

Data and information collected through this questionnaire shall be confidential, and will be analyzed only for this research project without reporting the person or company biodata.

The research findings will be useful for the various construction stakeholders and will be

Contractin	GC	BC	Grade	Grade	Grade	Grade
Consultant	Architect	Designer	1	2	3	4
Other						

disseminated to you.

This research work is possible only through your kind support and cooperation, we request you to respond to our representative approaching you for questionnaire.

Thanking you in anticipation.

QUESTIONNAIRE

A_1 Organization Name (Optional) _____

A2 Telephone No (Email Address) _____

A3 Year of Establishment EC_____GC_____

A4 Respondent Name (Optional) _____Position_____

A5 Respondent Education_____Experience_____

B1 Are you practicing Ethiopian building regulations and code of standards in your company? Please Tick ✓ your response from the following option (a), (b), or (c)

Option (a) Yes practicing _____then please give the following details

Office Name_____

Option (b) Not practicing _____ but we are planning / under the process for implementing the Ethiopian building regulations and standards

Option (c) Not practicing _____then please rank your reasons (using the following tabulated factors and Likert scale) for not practicing

Agreement Level	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Likert Point	1	2	3	4	0

S. No.	Factor (Reason) Type	Likert Point				
		1	2	3	4	0
1	We are satisfied with our present traditional practice					
2	ES is not efficient and effective in monitoring and control					
3	Principles and Concepts stated under ES EN					
4	ESEN is not a Legal/Ministry Requirement					
5	Ethiopian Standards is very costly for implementation					
6	ESEN is difficult to understand, document, and practice					
7	Our company staff is unwilling for ESEN implementation					

B_2 Please write 1, -1 or 0 corresponding to your choice for Yes, No, or NA (Not Applicable) for the following queries

S. No	Query Type	1	-1	0

1	Do you agree that the concepts and ideas presented in provisions of Ethiopian building regulations and codes of Standards currently used in the Construction industry are very clear and understandable for users?			
2	Do you have a specific unit/cell for building regulations and codes of Standards?			
3	Do you have written Inspection and Testing Procedures?			
4	Does material supply is inspected to assure technical conformance?			
5	Do you agree that construction stake holders in your project are well aware of the principles and Concepts stated under ES EN?			

B3 Rank the level of awareness on implementation Ethiopian Building code (ES EN) to the following Likert scale

Implementation Level	Never	Rarely	Sometime	Always	Not Applicable
Likert Point	1	2	3	4	0

No.	Level of awareness on implementation Ethiopian Building code (ES EN)	Likert Point				
		1	2	3	4	0
1	ES 3962 Mechanical Ventilation and Air Conditioning in Building					
2	ES EN 1991:2015 Actions on Structures – Part 1-7 General Action -Accidental Actions					
3	ES EN 1991:2015 Actions on Structures – Part 3 General Action - Crane Loads					
4	ES EN 1991:2015 Actions on structures – Part 1-2 General action -					

	Actions on Structures Exposed to Fire					
5	ES EN 1991:2015 Actions on Structures –Part 1-4 General Action - Wind Actions					
6	ES 3960 Plumbing Services of Building					
7	ES EN 1995:2015 Design of Timbers Structures Part 1-1 General-Common Rules and Rules for Building					
8	ES EN 1997 Geotechnical Design Part -1 General rules					
9	ES EN 1997:2015 Geotechnical Design Part 2 Ground Investigation and Testing					
10	ES EN 1994 Design of Composite Steel and concrete Structures Part 1-1 General Rules and Rules for Building					
11	ES EN 1996 :2015 Design of Masonry Structures Part 1-2 General Rules- Structural Fire Design					
12	ES 3965 Occupational Health and Safety					
13	ES EN 1990:2015 Basis Structural Design					
14	ES EN 1998 :2015 Design of Structures for Earthquake Resistance Part 1 General Rules - Seismic Action and Rules for Building					
16	ES EN 2015 Electrical Work					
17	ES 1993 Design of Steel Structures part 1-1 General Rules and Rules for Building					
18	ES-EN 1992 Design of concrete Structures part 1-1 General Rules and Rules for Building					

19	ES EN 2015 Actions on Structures Part 1-1 General Action Densities self –Weight Imposed Loads for Building					
20	ES EN 1997 Geotechnical Design Part -1 General rules					

B4 Rank the main factors affecting the enforcement of Ethiopian Building Codes Standards ESEN in civil works to the following Likert scale

Agreement Level	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
Likert Point	1	2	3	4	0

No.	Factor Type	Likert Point				
		1	2	3	4	0
1	Ineffective implementation of law to prepare and enforce building codes to safe guard minimum requirement of public health safety and general welfare					
2	Inexistence of testing and certification system for building engineer's, consultants, contractors and skilled labors					
3	Weakness in building code administration and institutional capacity insufficient legislative foundation					
4	Absence of community awareness in building regulations and nature of building regulation task of municipality					
5	Ineffective engineering supervision and inspection tasks to prevent violations or cheating					

6	Administration procedures at municipality are the main obstacles to implement and enforce regulations and codes					
7	Improper municipality procedures to organize the works of consultant offices from preparing plans and engineering supervision on projects					
9	municipality are not clear and not with satisfying performance					
10	Failure of building law and codes to address locally available construction materials and Techniques					
11	Lack of effective participation of concerned stake holders in code development and Maintenance					
12	Corruption and regulatory capture					
13	Improper municipality technical and managerial capabilities to follow up and control building and construction works					
14	Many construction problems are due to unclear professional practice and workmanship Standards					
15	Weak technical and financial capabilities at municipality branches					
16	Municipality don’t perform its responsibilities effectively to license, follow up and monitor local construction works					
17	Building officers at municipality don't care to use comprehensive checklists to review plans, and monitor projects to faithfully fulfill their work requirements					
18	Neglecting of building materials and concrete by certified testing centers during projects are not executed as per professional					

	standards and proper workmanship					
19	unclear and inadequate procedures of review of building plans at municipality					
20	absence of safety department at municipality					

B5 Rank the remedial measures should be taken to utilize building regulation and ES EN well in the Ethiopian construction industry (Please Tick ✓ the Likert Point to the following scale).

Importance	No	Minor	Important	Highly	Not
Likert Point	1	2	3	4	0

No.	Measure Type					
		1	2	3	4	0
I	**Regarding National Level Legislation and Institution**					
1	Adopt a legal framework to support the effective enforcement of building code regulations at the local level.					
2	Improve the capability and accountability of regulatory agency through quality control measure.					
3	Regular training and workshops regarding the enforcement of ES EN					
4	Ensure effective co-ordination and collaboration of institutions responsible for formulation, updating and enforcement of regulations					
5	Provide funding of materials testing facilities and equipment, training of staff, research into safer construction local construction method.					

6	Provide adequate legal support.					
7	Certifying local enforcement personnel to ensure they understand the provision of building codes.					
II	**Regarding Building Code Development and Maintenance**					
1	Develop a comprehensive building code that covers the full range of relevant construction materials, types and practices.					
2	Establish an open, participatory, consensus-based process for building					
3	Building Codes Standards should be accessible, clear, and understandable for building practitioners.					
4	The code should allow alternative compliance solution to support innovation or traditional practices that meet safety requirement					
5	Sharing pain and gain among project stake holders.					
6	Contractors and consultants should be recruited and evaluated by their technique and methods of enforcing the EBCS in construction works.					
7	The risk reduction measures should be affordable and consistent with local capabilities					
8	They encompass non engineered construction to support gradual improvements in quality and safety.					
9	Common understanding on importance of national building codes and standards should be created					
10	Common understanding on achieving quality of built structures importance of national building codes and standards should be created					
III	**Regarding Local Implementation**					
1	Strengthen implementation of building regulation and code through plan review, site inspection and permitting at local at local level.					
2	Introducing private sector for building regulation and code implementation					

3	Create and maintain public awareness of basic safe construction principles for the community, building owners, and informal sector builders					
4	Provide funding and support to building department at local level with technically qualified and adequate building officials.					
5	Engineers (professional experts) should be well utilized in proper guiding of construction works.					

(Thank you)