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ACADEMIC YEAR 2020/2021

DEPARTMENT OF CIVIL ENGINEERING

OPTION OF CONSTRUCTION TECHNOLOGY

STRUCTURAL DESIGN OF A MODERN CLINIC

CASE STUDY: KICUKIRO DISTRICT.

Submitted in partial fulfillment of the requirement for the award of the Advanced Diploma (A1) in construction technology option

PRESENTED BY: MANZI DIACRE

ROLL Nº:20215053

UNDER THE GUIDANCE OF: NGORORANO Eric

Kigali, October 2024

DECLARATION

I'M here by declare that the work presented in this dissertation is our own contribution to be the best of our knowledge. The same work has never been submitted to any other University or Institution. We, therefore declare that this work is our own for the partial fulfillment of the award of advanced diploma (A1) in Civil Engineering at **ULK Polytechnic Institute**

Candidate's names: **MANZI Diacre**

Signature …………………………………………

date of submition...

CERTIFICATION

This is to certify that this dissertation work entitled “architectural and structural design four stories building hotel at Kicukiro District case study Shyorongi Sector” is an original study conducted by **MANZI Diacre** in partial fulfillment of the requirement for the award of advanced diploma in civil engineering department, construction technology option at **ULK Polytechnic Institute** during the academic year 2020-2021.

Supervisor: **NGORORANO Eric**

Signature…………………………..

HOD of CE: **Eng Bonaventure NKIRANTUYE**

Signature…………………………...

Date…………………………...

DEDICATION

I would relish to dedicate this final project report to The Almighty God, who has been our ultimate source of bliss, vigour, good health and sustenance for visually perceiving us through and for the prosperous completion of my advanced diploma program in one piece at ULK Polytechnic Institute. Would additionally want to dedicate this report to our parents, our siblings, only God knows who we are without them. It is withal dedicated to the Civil Engineering Department of ULK Polytechnic Institute and to our supervisor for the attention and understanding throughout the completion of this project.

ACKNOWLEDGEMENT

In the name of God, the gracious, the most merciful praised to God the Almighty, for all the spirit and strength given to me in order to fulfill the academic requirements in completing this research.

I would like to express my gratitude and appreciation to my supervisor Eng. **NGORORANO Eric**; for his support and patience. This research was made successful with his

guidance and invaluable knowledge to the research. I would also like to express my gratitude to all lecturers of Civil Engineering for their trust and knowledge. Thanks for providing me all necessary information either directly or indirectly and participating in making this research possible.

Most importantly, I would like to thank all Parents, my Brothers and Sisters for their encouragement and support.

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LIST OF SYMBOLS AND ABREVEATIONS

A	: cross section area
Ac	: total cross-section area of concrete section
As	: area of tensile steel
As‘‘	: area of compressive reinforcement
ASV	: area of steel in links
B	: width of foundation
B	: width of reinforced concrete section
Bf	: width of flange in a beam
BW	: width of web in a beam
C	: cover
D	: effective depth of tensile reinforcement
D	: depth of foundation
E	: young’s modulus
Fcu	: characteristic yield strength of concrete
Fv	: shear force
Fs	: estimated design service stress in the reinforcement
Fsv	: characteristic yield strength of the links
FY	: characteristic yield strength of steel
G	: going
H	: overall depth of a concrete section
Hf	: thickness of flange in a T-beam
L	: span length
Lx	: short-span length
Ly	: long-span length
Rb	: Design concrete compressive strength

Rs	: Design steel tensile strength
M	: maximum moment that the reinforced concrete element will resist
Mc	: Moment capacity
N	: ultimate axial load on column
Pa	: allowable bearing pressure
.t	: thickness
V	: shear force
N	: number of blow
Φ	: Diameter of steel
RDF	: Depth correction factor
SA	: Permissible stress

ABTRACT

This dissertation titled “Architectural and Structural Design of a Three-storey Clinic in Kicukiro District: addresses the pressing need for modern infrastructure in Rwanda, particularly in meeting the growing demands of the hospitality industry. Given Rwanda’s socio-economic landscape, where the tourism and hospitality sectors are pivotal for economic growth, this study aims to evaluate and create a sustainable architectural framework and structural design for a hotel that integrates modern design principles and sustainability.

Problem Statement: As Rwanda advances towards its vision for sustainable development, there is a critical requirement for infrastructures, such as hotels, that cater to the influx of tourists while promoting local economic growth. This study seeks to address the gap in architectural and structural frameworks within the hospitality sector, particularly in densely populated regions like Kicukiro District.

Objectives: The primary objective of this study is to design a comprehensive architectural model and structural configuration for a three-storey Clinic, aiming for efficiency, safety, and aesthetic appeal. The specific objectives include:

1. To develop detailed architectural designs that optimize space and functionality.
2. To create structural designs using proficient engineering practices and tools.
3. To estimate the costs involved through a thorough bill of quantities.

Methodology: This study adopted a case study methodology focusing on Kicukiro District. Data was collected through site observations and analysis of the existing infrastructure. Architectural designs were rendered using ARCHICAD, while structural designs—including slabs, beams, columns, and foundations—were analyzed using PROKON software. Reinforcement specifications were calculated for each structural element to ensure safety and durability.

Results and Discussions: The architectural design emphasized the integration of modern aesthetics with functional spaces, including reception areas, guest accommodations, and service rooms. The structural analysis revealed that the designed building could effectively support anticipated live and dead loads while maintaining safety standards. Key dimensions, such as slab thickness and reinforcement placement, were determined to enhance structural integrity. Cost estimations indicated a total project expenditure of approximately 1,116,519,944 RWF.

Conclusion: The study successfully developed a blueprint for a multi-storey Clinic that aligns with contemporary architectural trends and structural requirements. It highlights the importance of integrating design with sustainable practices to promote economic viability in the hospitality sector.

Recommendation: It is recommended that further research focuses on environmental impacts and how to incorporate renewable energy practices into hotel designs. Additionally, policymakers should facilitate training programs for civil engineering students to enhance competencies in using modern design software, which is crucial for sustainable infrastructure development in Rwanda.

CHAPTER ONE GENERAL INTRODUCTION

1.1 Background

The conceptual and structural analysis of a modern clinic involves a comprehensive examination of the design, functionality, and overall layout of healthcare facilities aimed at providing efficient and patient-centered care. Modern clinics are designed to optimize patient experience, enhance workflow efficiency, accommodate advanced medical technologies, and facilitate seamless communication between healthcare providers and patients.

Modern healthcare facilities have evolved significantly to meet the changing needs of patients and healthcare providers. A modern clinic incorporates innovative design principles, advanced technology integration, and patient-focused care delivery to create a healing environment that promotes well-being and enhances the overall quality of care. Conceptual and structural analysis plays a crucial role in ensuring that these clinics are designed to meet the highest standards of healthcare delivery.

Anticipating future healthcare trends and advancements, the conceptual analysis of modern clinics prioritizes flexibility and adaptability. Designing spaces that can easily accommodate changing medical practices, evolving technologies, and expanding services ensures long-term viability and relevance. such as clinic and sustainable development, which obviously affect the human life. With the substantial growth, this sector has become one of the world biggest . It's also the largest and fastest growing and dynamic economic sector (J. M Hamilton & Richard S. J. Tol, 2003). The clinic industry employs more people than the automobile, electronics, steel and textile industry combined. This sector currently supported more than 21.5 million jobs, in year 2020, it’s projected to be the largest industry in the world with an estimation of 10.5% employees in World and more than 112 million people internationally (Daya, 2007).

Rwandan government has identified clinic industry as one of priority sectors in achieving vision 2025 and contributor to the eradication of reduce effected diseases in the country.

The worldwide consensus that employment generated by clinic industry can be substantial in many national economies, contributing to their economic growth and providing income to people. Sustainable Development reported as development that meets the needs of the present with-out compromising the ability of future generations to meet their own needs.

1.2 Problem Statement

Rwanda is developing country with about 90% of population engaged in agriculture with limited participation in market economy (30 to 50% of rural population on a given year may not produce a marketable surplus, It is the most densely populated country in Africa, landlocked with few natural resources and minimal industry and its depends heavily on its bussiness.

Like other developing countries, Rwanda need to achieve sustainable development whereby the government of Rwanda is undertaking various policies and measures for sustainable development.

The clinic industries contributes to a balanced and healthy economy by generating related jobs, revenues, and taxes while protecting and enhancing the destinations social-economic .historical, natural and built resources for the enjoyment and well-being of both residents and visitors.

1.3 Objectives of study

1.3.1 General objective

Analyzing the conceptual and structural aspects of a modern clinic involves various objectives aimed at ensuring efficient operations, high-quality patient care, and overall effectiveness

1.3.2 Specific objectives

The specific objectives of this research are the following:

To make an architectural design.

To make a structural design.

To make a bill of quantity.

1.4 Research questions

How does design multi-storey clinic contribute to land use management in Shyorongi sector?

What is the role of structural design and architectural and structural design for sustainable hclinic in Shyorongi sector?

1.5 Research methodology

With gaining to those objectives above, the methods that will take into account are the

Observation and Data analysis methods (Architectural and Design tools)

1.6. Significance of the study

The project "Conceptual and Structural analysis of four stories mordern clinic ,case study SHYORONGI sector", aims to incentivize people of SHYORONGI sector for being aware about Design multi-storey clinic and how can use it for achieving economic sustainability with persons. The Government of Rwanda will continue to support day-to-day measures which help to achieve economic sustainability without comprising environment.

1.7. Purpose of the Study

The study was set to identify the relationship between multi-storey building for sustainable clinic and land use management in Rwanda.

1.8. Significance of the Study

This study is made with interests such as personal interest, academic interest, and social interest.

1.8.1. Personal Interest.

In order getting the degree of relevancy, the class theories ought to be paralleled with the genuine practical skills on the field. Thus, the following interests are targeted:

This research work is primarily designed to contribute to the role of architectural and structural design of multi-storey clinic for sustainable clinic in Rwanda, especially in Shyorongi sector; as such we are interested in studying the role of multi-storey building clinic in land use management in Rwanda.

1.8.2. Academic Interest.

This project will be in the library of the institution and it will help students in civil engineering, this research also helps the students because the academic Law recommends that each student must do a research work in order to achieve the end of studies

1.8.3. Social Interest

This research helps the Planners or Government what they do for achieving a sustainable development in using multi-story building for sustainable clinic and it helps to the readers of this dissertation to know the impact of multi-story building for in promotion of sustainable clinic and land use management in Rwanda.

1.8.4 Scientific Interest

Scientific issue, this research helps the other researchers for this field for doing the other research to the same field. This research also helps the students because the academic Law recommends that each student must do a research work in order to achieve the end of diploma

1.9. Scope of the study

This research focuses on the following:

Architectural design

Engineering design

Structural design

1.10. Organization of the study

This research study has divided into five chapters.

The chapter one deals with the general introduction which presents the background to the study, the problem statement, the objectives, the research questions, significance and scope of the study, while the second chapter deals with the literature review, which highlights the theoretical framework related to Architectural and Structural Design of Four multi-storey building for sustainable clinic

The third chapter concerns in much more the methodological details, while the forth chapter deals with Architectural and Structural element design overview, data presentation, their analysis and interpretation of findings. Finally, the fifth chapter is about, conclusions and recommendations or suggestions.

CHAPTER TWO: LITERUTURE REVIEW

"**Architecture** is concerned with the selection of architectural elements, their interaction, and the constraints on those elements and their interactions. Design are concerned with the modularization and detailed interfaces of the design elements, their algorithms and procedures, and the data types needed to support the architecture and to satisfy the requirements." Software architecture is "concerned with issues beyond the algorithms and data structures of the computation" (Eden, 2003).

2.2. structure

A structure is the assemblage of two or more basic structural components connected together in such a way that they serve the user functionally and carry the load arising out of the self and superimposed loads safely without causing any problem of serviceability. Basic structural components in a building are the beams, the columns, the slabs and the footings. These components when connected in a proper way form a building (B.D.NAUTIYAL, 2001).

A structure can be defined as a body which can resist the applied loads without appreciable deformations. Civil engineering structures are created to serve some specific functions like human habitation, transportation, bridges, storage etc., in a safe and economical way.

A structure is an assemblage of individual elements like pinned elements (truss elements), beam element, column, shear wall slab cable or arch. Structural engineering is concerned with the planning, designing and the construction of structures. Structure analysis involves the determination of the forces and displacements of the structures or components of a structure (K.Hari, 2011).

2.3. design

The design is made using software on structural analysis design (staad-pro). The building subjected to both the vertical loads as well as horizontal loads. The vertical load consists of dead load of structural components such as beams, columns, slabs etc., and live loads.

The horizontal load consists of the wind forces thus building is designed for dead load, live load and wind load as per IS 875. The building is designed as two dimensional vertical frame and analysed for the maximum and minimum bending moments and shear forces by trial and error methods as per IS 456-2000.

The help is taken by software available in institute and the computations of loads, moments and shear forces and obtained from this software (Kumar, 2011).

2.4. multi-storey building

A multi-story building is a building that supports two or more floors above ground. There is no formal restriction on the height of such a building or the number of floors a multistory building may contain, though taller buildings do face more practical difficulties.

A multi-story building may be designed as a place of business, such as a clinic. or a government building. Other types of multi-story buildings include apartment compounds and local museums. Some communities include many multi-story apartment buildings to provide adequate housing within the local area, or to meet the housing needs of a growing community (K.Hari, 2011).

2.5. building:

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses.

Buildings are the important indicator of social progress of the county. Every human has desire to own comfortable homes on an average generally one spends his two-third life times in the houses.

The security civic sense of the responsibility. These are the few reasons which are responsible that the person do utmost effort and spend hard earned saving in owning houses (K.Hari, 2011).

2.6. Analysis of the clinic Concept

Nowadays, traveling is becoming more and more common activity. The growth of economy in some countries gives the opportunity to not only travel more, but also use the early retirement opportunities, and thus become consumers of tourism products. The growth of the youth market has also played a significant role for increase of traveling.

Young people today have become experienced consumers of hotels, air planes and frequent travelers to various tourist destinations. Technological change is a very important factor for growing tourism, as development of transportation means (cars, trains, and air jets), telecommunication systems and others gave an opportunity to people to communicate and travel easily and get all the necessary information quicker. The social change influenced the increase of consumption in all aspects. The growing influence of mass media and expanding the facilitating means (credit cards, store cards, mail order, and television shopping channels) made products and services more available.

Williams (2002) the increased globalization made the influence of multinational companies more significant and made traveling a necessary prerequisite of developing and expanding business. These factors insured the expanding of tourism; actually the increasing number of people can afford traveling.

Jones et al., (2006) claim that every day 300 million people sleep away from home. Today the motivations that make people stay away from home can be different: business, meetings, leisure, culture, religion, education and health.

2.7. structure elements analysis

2.7.1. slab

The slab provides a horizontal surface and is usually supported by columns, beams or walls.

Slabs can be categorized into two main types: one-way slabs and two-way slabs. One-way slab is the most basic and common type of slab. One-way slabs are supported by two opposite sides and bending occurs in one direction only. Two-way slabs are supported on four sides and bending occurs in two directions.

2.7.2. Beam:

Beams can be described as members that are mainly subjected to flexure and it is essential to focus on the analysis of bending moment, shear, and deflection. When the bending moment acts on the beam, bending strain is produced. The resisting moment is developed by internal stresses. Under positive moment, Compressive strains are produced in the top of beam and tensile strains in the bottom.

The T-shape and L-shape beams are typical types of beam because the beams are built monolithically with the slab. When slab and beams are poured together, the slab on the beam serves as the flange of a T-beam and the supporting beam below slab is the stem or web. For positive applied bending moment, the bottom of section produces the tension and the slab acts as compression flange. But negative bending on a rectangular beam puts the stem in compression and the flange is ineffective in tension. Joists consist of spaced ribs and a top flange (Choi, 2002).

2.7.3. Column:

A column is vertical structural element that transmits, through compression, the weight of the structure above to the foundation. For the purpose of wind or earthquake, column may be designed to resist lateral forces. (Schwartz, 1993)

Although the column is essentially a compression member, the manner in which it tends to fail and the amount of load that causes failure depend on:

The first point is obvious: a steel column can carry a greater load than a timber column of similar size. Columns with a large cross-section area compared with the height are likely to fail by crushing. These „short columns‟ have been discussed earlier (F. & Morgan, 2010).

Reinforced concrete columns are categorized into five main types; rectangular tied column, rectangular spiral column, round tied column, round spiral column, and columns of other geometry (Hexagonal, L-shaped, T-Shaped, etc.).

Tied columns have horizontal ties to enclose and hold in place longitudinal bars. Ties are commonly No. 3 or No.4 steel bars. Tie spacing should be calculated with ACI (American Concrete Institute) Code.

Spiral columns have reinforced longitudinal bars that are enclosed by continuous steel spiral. The spiral is made up of either large diameter steel wire or steel rod and formed in the shape of helix. The spiral columns are slightly stronger than tied columns.

The columns are also categorized into three types by the applied load types; the column with small eccentricity, the column with large eccentricity (also called eccentric column) and biaxial bending column. (Choi, 2002).

Eccentricity is usually defined by location: oInterior columns usually have oExterior columns usually have large eccentricity oCorner column usually has biaxial eccentricity. But eccentricity is not always decided by location of columns (Choi, 2002)

2.7.4. Footing:

The foundation of a building is the part of a structure that transmits the load to ground to support the superstructure and it is usually the last element of a building to pass the load into soil, rock or piles. The primary purpose of the footing is to spread the loads into supporting materials so the footing has to be designed not to be exceeded the load capacity of the soil or foundation bed.

The footing compresses the soil and causes settlement. The amount of settlement depends on many factors. Excessive and differential settlement can damage structural and nonstructural elements. Therefore, it is important to avoid or reduce differential settlement(Schierle G. , 2002).

2.7.5. Stairs:

Stairs are designed as reinforced concrete slabs whose depths are equal to the waist thickness of the stair, and which are normally an integral part of the structure.

The requirements in respect of the ratio of span to depth which is specified are the same as for one-way-spanning slabs(Macdonald, 1994).

2.8. structure composite materials

2.8.1. Concrete:

Concrete is a poor material for tensile strength and it is not suitable for flexure member by itself. Otherwise Concrete is one of the most popular materials for buildings because it has high compressive strength, flexibility in its form and it is widely available. Despite the high compressive strength, concrete has limited tensile strength, only about ten percent of its compressive strength and zero strength after cracks develop. Also it is essential that concrete and steel deform together and deformed reinforcing bars are being used to increase the capacity to resist bond stresses (Schierle, 2002).

2.8.2. Cement

Cement is made from limestone, which is mainly calcium carbonate. Limestone is mined and processed by crushing and roasting, or calcining, it with clay in rotating kilns. This leaves a dehydrated porous material called clinkers. The clinkers are ground into a fined powder called cement, which is used to make concrete. The most used cement is Portland cement(Schwartz, 1993).

All of the cements which are used for structural concrete are dependent on water for the development of strength; when water is added to dry cement a fairly complex series of chemical reactions takes place in a process which is called hydration and which causes the resulting paste to stiffen(J.Macdonald, 1997).

2.8.3. Aggregates

Aggregate, being cheaper than cement, is used as a bulking agent in concrete and, typically, will account for 75% to 80% of its volume. It also serves to control shrinkage and to improve dimensional stability. It normally consists of small pieces of stone, of various sizes in the form of either naturally occurring sand or gravel, or crushed rock fragments; other materials, such as crushed brick, blast furnace slag or recycled building materials, are sometimes used. Aggregate must be durable, of reasonable strength, chemically and physically stable, and free of constituents which react unfavourably with cement (J.Macdonald, 1997)

2.8.4. Water:

Water has a key role in the production of concrete, it is an important ingredient. It changes the loose mixture into a rock-like solid material. When you mix water with cement, it makes a paste. The paste goes around the particles and fills in the empty spaces. Typically, 150 to 200 kg/m3 of water are used. The old rule of thumb for water quality is "If you can drink it, you can use it in concrete" (Schwartz, 1993).

2.8.5. Reinforcement

The reinforcement which is used in concrete is normally in the form of steel bars, either of plain circular cross-section or with various surface treatments which increase the bond with the concrete. The preferred diameters are 6, 8, 10, 12, 16, 20, 25, 32 and 40 mm, and the normal maximum length is 12 m.

The steel reinforcement resists all tensile bending stress because tensile strength of concrete is zero when cracks develop. Reinforcement is produced in both mild steel and high-yield steel (J.Macdonald, 1997).

2.9. load on structures

The principal forms of loading to which buildings are subjected are gravitational loads, wind pressure loads and inertial loads caused by seismic activity. Gravitational loads, which are caused by the weight of the building itself and of its contents, act vertically downwards; wind and seismic loads have significant horizontal components but can also act vertically.

To perform satisfactorily a structure must be capable of achieving a stable state of static equilibrium in response to all of these loads to load from any direction, in other words.

Dead loads: Dead loads consist of the permanent construction material loads compressing the roof, floor, wall, and foundation systems, including claddings, finishes and fixed equipment. Dead load is the total load of all of the components of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

For most reinforced concrete a typical value for the self-weight is 24KN cubic meter. But a higher density should be taken heavily reinforced or dense concretes. In the case of building, the weights any partitions should be calculated from architect‟s drawings. A minimum partition imposed loading of 1.0KN per square meter is usually specified, but this is only adequate for light weight partitions.

Live (imposed loads): Live loads are produced by the use and occupancy of a building. Loads include those from human occupants, furnishings, no fixed equipment, storage, and construction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform area loads, concentrated loads, and uniform line loads. The uniform and concentrated live loads should not be applied simultaneously n a structural evaluation. Concentrated loads should be applied to a small area or surface consistent with the application and should be located or directed to give the maximum load effect possible in endues conditions.

Wind loads: this load depends on the location and building size. (Codes of practice give guidance on how to compute the wind load)

The pressure exerted by the wind is related to the square of its velocity. Due to the roughness of the earth‟s surface, the wind velocity at any particular instants of an average velocity plus superimposed turbulence, referred to as gusts. As a result, a structure subjected to wind loads assumes an average deflected position due to the average velocity pressure and vibrates from this position in response to the gust pressure.

Snow Loads: snow accumulation on roofs is influenced by climatic factors, roof geometry, and the exposure of the roof to the wind. Unbalanced snow loads due to drifting or sliding of snow or uneven removal of snow by workers very common.

Construction Loads: during the construction of concrete building, the weight of the fresh concrete is supported by formwork, which frequently rests on floors lower down in the structure. In addition, construction materials are often piled on floors or roofs during construction. ACI Code Section 6.2.2.2 states the following No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshared portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads (W.H.Mosley, 1976).

CHAPTER THREE: MATERIALS AND METHODS

This chapter describes the study area and the methods with tools used to fulfill the objectives of this study, the methodology used to collect data from the field, which means the way followed in order to obtain the required information, the materials, and equipment. It describes the process by which the research was carried out and analysis data what was done. It includes various collaboration techniques.

In Methodology include method and tools used in this research that help to get how the report did. In this project report, there is the show the multi-storey clinic at Shyorongi sector; this building will increase the incame; the sustainability economic and an adequate with achievement of that structural design, there is the use of software such as: ArchCAD used for drawing and Prokon, and pybar which used for calculating the reinforced concrete design within diagrams.

3.1 Case study description

clinic construction is especially reinforced concrete structure. The project site is a rectangular shape includes four stories, first storey composed by employee's services, second storey composed by officers (leaders) rooms with services for clients such as: nurses room Wherever all storeys (level) are contain docter rooms for surgers patient and medical treatement whole structure is in reinforced concrete.

FIGURE 3. 1: Map of the site description

3.2. Observation

This method was used as a source of information about clinic in shyorongi sector as eyewitness through direct observation. The researcher used this method to observe and seeking information about design multi-storey clinic and it's sustainable.

3.3. Office Equipment and software

3.3.1. Software and their function

ArchiCAD: it is a powerful modelling application which enables architects to design buildings more productively, based on the virtual buildings approach and all needs to drawings.

prokon: This soft was use in the design of beams in this building. Prokon is fully customizable and can be modified to suit your office workflow and standards. You should find the prokon structural analysis and design suites a useful tool for solving everyday building design problems especially for beams.

3.3.2. Office equipment and their function

Microsoft office Excel: used in calculation of bill of quantities and estimating

Microsoft office word: For literature typing.

Laptop: where all software includes.

3.4 Cost estimation

Estimating is the technique of calculating or computing the various quantities and expected expenditure to be incurred on a particular work or project.

The quantity like earth work, foundation concrete, brickwork, can be workout by Long wall-short wall method: in this method,

the wall along the length of room is considered to be long wall while the wall perpendicular to long wall is said to be short wall. To get the length of long wall or short wall, calculate first the center line lengths of individual walls. Then the length of long wall, (out to out) may be Calculated after adding half breadth at each end to its canter line length.

Thus the length of short wall measured into in and may be found by deducting half breadth from its center line length at each end. These lengths are multiplied by breadth and depth to get quantities.

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TABLE 3. 1: Methods used in bill of quantity

Item No	Description of item	Quantity	Unit	Rate	Amount

CHAPTER FOUR: RESULTS AND RECOMMENDETIONS.

This chapter deals with interpretation according to the findings in the design of the structure. The main consideration in this design is to ensure against the failure of superstructure and to check if it has the ability to carry the anticipated loading with an adequate margin of safety, so that it does not deform excessively within service.

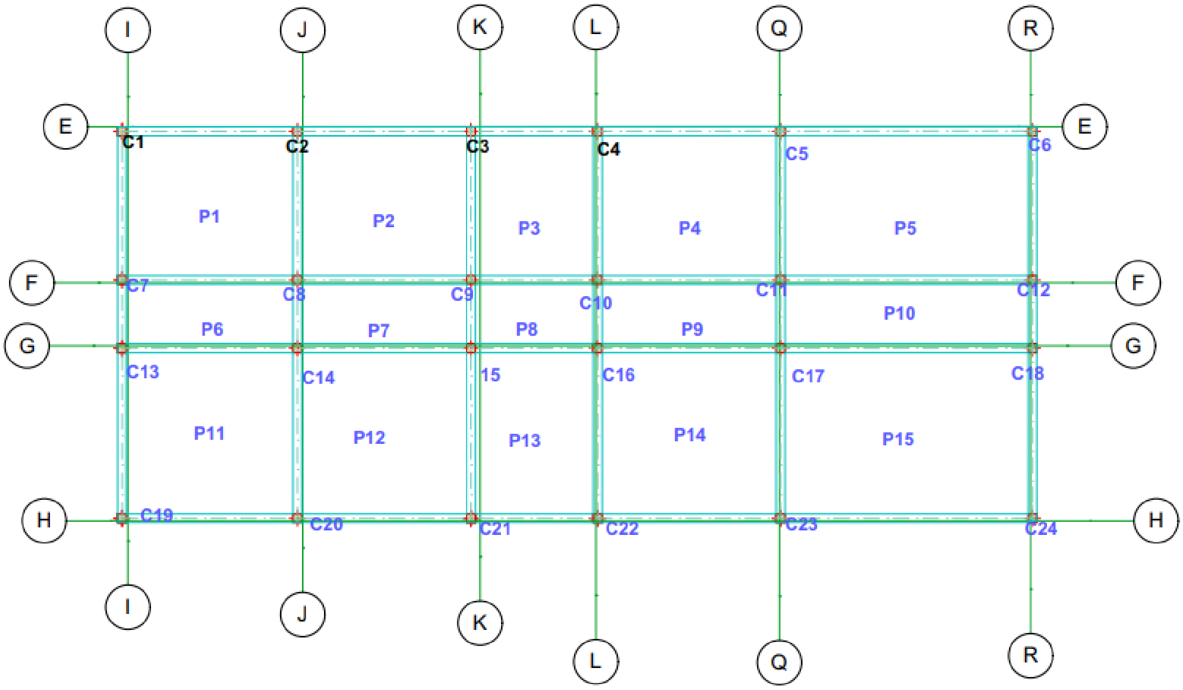

FIGURE 4. 1: structure element

4.1 slab design

4.1.1. panel 11

Thickness of the slab lies in the range between

$\frac{Lx}{40} \leq hf \leq \frac{Lx}{20} \Leftrightarrow \frac{470cm}{40} \leq hf \leq \frac{470cm}{20}$

11.75≤hf≤23.5 let us take hf =15cm

Effective height ho=Thickness of the slab – the clear cover ho = 15cm-2.5cm=12.5cm

Calculation of dead load

Self-load= 1.4110.1524KN/ m=5.04KN/m

Finishes= 1.4111.5 KN/m=2.1 KN/m

DEAD LOAD =5.04KN/m+2.1KN/m=7.14KN/m

Calculation of live load

Live load= (1.6112)KN/m=3.2KN/m

LIVE LOAD =3.2KN/m

Total load on slab (p) = (7.14+3.2)KN/m=10.34 KN/m

➢Type of the panel

$\frac{Ly}{Lx} = \frac{6.2m}{470m} = 1.31 < 2$(We have two ways slab)

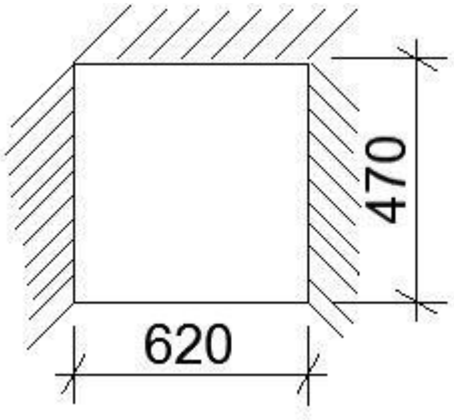

FIGURE 4. 2: considered panel 11

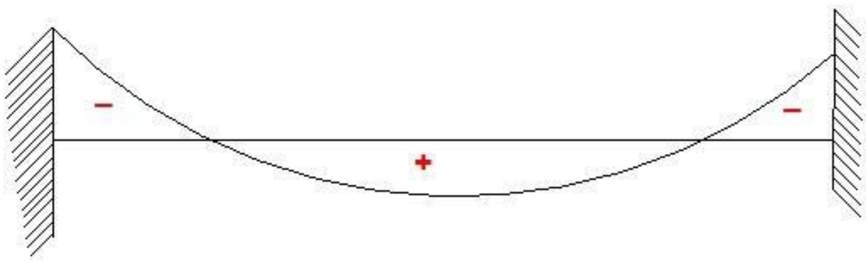

FIGURE 4. 3: moment of the slab panel

M+x= α+sxpL2x

M-x= α-sxpL2x

M+y= α+sypL2x

M-y= α-sypL2x

As we have $\lambda = \frac{Ly}{Lx} = \frac{6.2m}{4.7m} = 1.31$

Let take 1.4

M-x=0.08110.344.72=18.50KNm

M+x=0.03810.344.72=8.68KNm

M-y=0.05710.344.72=13.02KNm

M+x=0.02310.344.72=5.25KNm

M-max=18.50KNm

M+max=8.68KNm

Design of steel reinforcement at the top

M-max= 18.50KNm

$\alpha_m = \frac{M}{ho^2 * b * Rb} = \frac{18.50*100}{(12.5)^2*100*1.3}$ = 0.091let us take 0.095

ξ=0.10; ξ< ξR=0.393 (Case of singly reinforcements) η=0.950

$As = \frac{M}{ho*\eta*Rs} = \frac{18.50*100}{12.5*0.950*40}$ = 3.89cm2

Let us take 6ϕ10/m with AS=4.71 cm2

Space between bars= $\frac{100}{(6-1)}$ = 20cm

Design of steel reinforcement at the bottom

$M^{+}_{max=8.68}$KNm

$\alpha_m = \frac{M}{ho^2 * b * Rb} = \frac{8.68*100}{(12.5)^2*100*1.3}$ =0.042 let us take 0.049

ξ=0.05; ξ< ξR=0.393 (Case of singly reinforcements) η=0.975

$As = \frac{M}{ho*\eta*Rs} = \frac{8.68*100}{12.5*0.975*40}$ = 1.780cm2

Let us take 6ϕ8/m with AS=3.02 cm

Space between bars= $\frac{100}{(6-1)}$ = 20cm

Steel bars arrangement

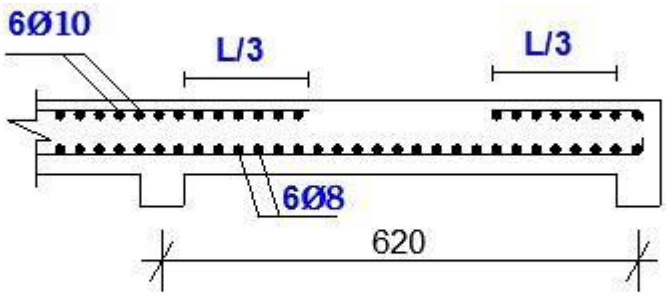

FIGURE 4. 4: Arrangement of reinforcements in slab

Note: The slabs were primarily designed with reinforcing steel parallel to the numerical grid lines. This is because the floor system is a one-way slab, which means that bending will occur between the two supporting beams in a parabolic shape, with the largest moments being at the top of the slab near the supports and at the bottom of the slabs at the mid-spans, and then hf =15cm, Steel reinforcement 6ϕ10/m on the top and 6ϕ8/m on the bottom. For this result from the design calculation it is better because this slab is most loaded to another slab.

4.2. Beams design

4.2.1. Design of beam 2-2 (Most loaded longitudinal internal beam)

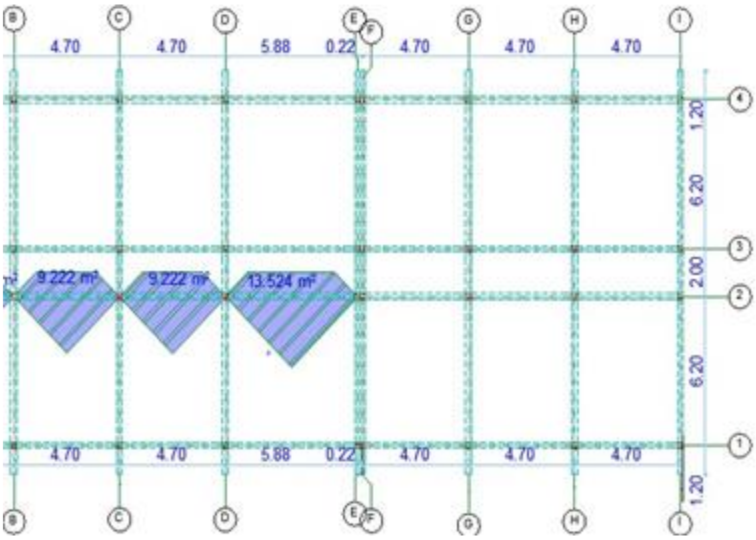

FIGURE 4. 5:loading area on the beam

The beam can be analysed and designed using coefficients method or Prokon software can be used. The choice for the analysis and design of this beam is the use Prokon software.

a)Computation for the overall depth of the beam (h)

The overall depth of the beam (h) lies within the following interval.

$$\frac{Lmax}{12} \leq h \leq \frac{Lmax}{8}$$

Where:

Lmax is the largest span between two Consecutive beams

For this beam Lmax is equal to520cm which will give $\frac{588}{12} \leq h \leq \frac{588}{8}$

Then 49cm≤ h ≤73.5cm

Let"s take h =65cm

$\frac{h}{3} \leq b \leq \frac{h}{2}$ for this beam the breath is ranging in the interval of $\frac{65}{3} \leq b \leq \frac{65}{2}$ which is from

21.66cm to 32.5cm.

In line with the above assumption, let"s take b = 30cm 2.1.3. Computation for the breath of the flange (bf) bf for T beam is equal to the smallest value of the following:

- 12hf +b=1215cm+30cm = 210cm
- $\text{A third of the beam span} = \frac{588}{3} = 196cm$
- $\text{The half of the distance between beams} = \frac{620}{2} = 310cm$

So, the bf of the beam will be 196cm

The height of the wall masonry =3.55m-0.65m=2.90m

The height of the area of the plaster=3.55m-0.15m=3.4m

Additional loadings on the beam (self-weight is computed by the software but nonfactored)

Non- factored own weight of the beam = {24[(1.960.15) +(0.300.65)]} = 11.736 KN/m

Factored own weight of the beam= 1.411.736= 16.430KN/m

Beam own weight deference = Factored own weight of the beam minus Non- factored own weight of the beam i.e.: 16.430KN/m – 11.736 KN/m = 4.694KN/m

Wall load: 1.40.22.90119= 15.428KN/m

Wall finishes: 1.40.033.4202 = 5.712KN/m

Subtotal dead load: (15.428+5.712+4.694) = 25.834 KN/m

Load from the slab:

Self-weight of the slab = 1.4110.1524 = 5.04 KN/m2

Slab Finishes = 1.4111.5= 2.1 KN/m2

Dead load from the slab = 5.04+2.1= 7.14 KN/m2

Uniformly distributed live loads (KN/m) = 1.6112= 3.2 KN/m2

TABLE 4. 1: Shows characteristic strength of the beam

Fcu (MPa)	25
Fy (MPa)	450
Fyv (MPa)	250
% Redistribution	0
Downward/Optimized redistr.	D
Cover to centre top steel(mm)	40
Cover to centre bot.steel(mm)	40
Dead Load Factor	1.4
Live Load Factor	1.6
Density of concrete (kN/m3)	24
% Live load permanent	25
Ø (Creep coefficient)	2
Ecs (Free shrinkage strain)	300E-6

Where:

Fcu: is the characteristic concrete cube strength.

Fy: is the characteristic strength of reinforcements

Fyv: is the characteristic strength of link reinforcements

Table 2: Section input parameters

Sec No.	Bw (mm)	D (mm)	Bf-top (mm)	Hf-top (mm)
1	300	650	1960	150

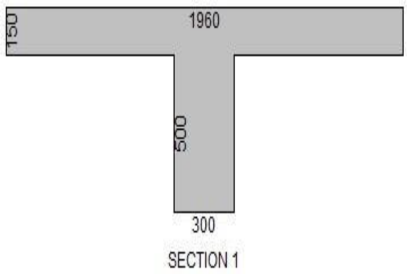

Figure 4 7: Beam section

Continuous beam: beam 2-2 (Design code: Euro code 2-1992)

TABLE 4. 2: Shows spans and their loads

Case D,L	Span	Wleft (kN/m)
D	1	36.934
D	2	39.844
D	3	39.844
D	4	42.374
L	1	4.976
L	2	6.278
L	3	6.278
L	4	7.414

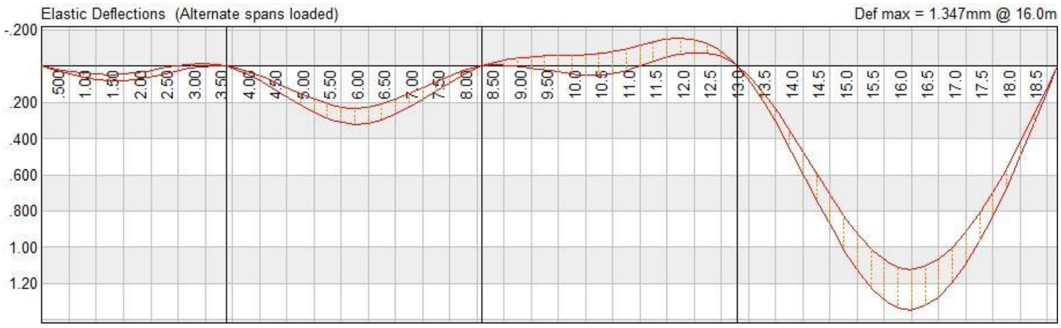

FIGURE 4. 6: Elastic deflection of beam

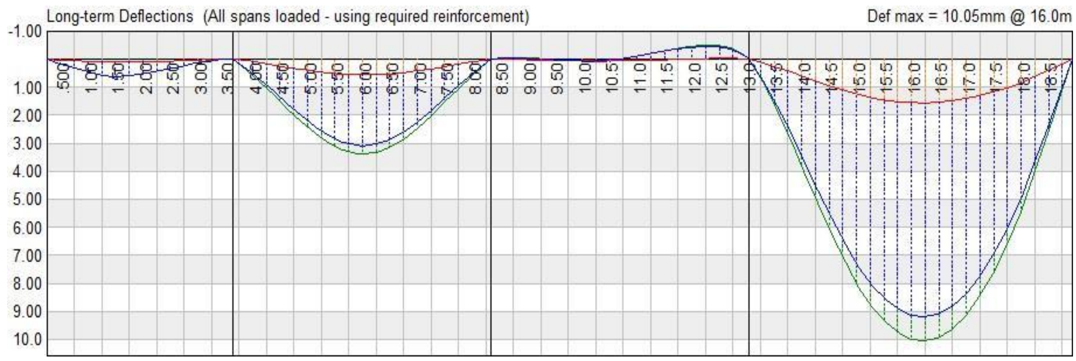

FIGURE 4. 7: long-term delection of the beam

The ultimate deflection fu $= \frac{\text{Lmax}}{500}$

fu $= \frac{5880}{500} = 11.76$ m

The maximum long- term deflection should be lesser than the ultimate deflection for suitable beam; otherwise the depth of the beam can be changed. For the beam 2-2 the maximum long-term deflection is 10.05mm which is lesser than the ultimate deflection fu=11.76mmthus the beam cross sectional. Dimensions are suitable.

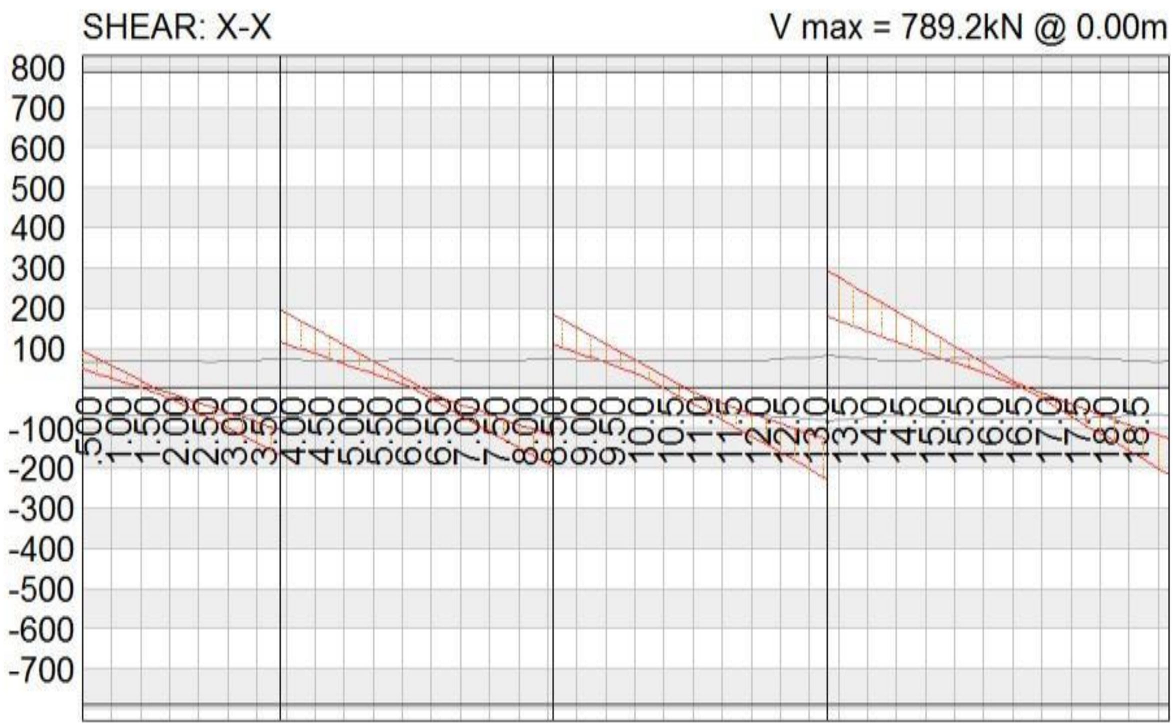

FIGURE 4. 8: Shear force diagram

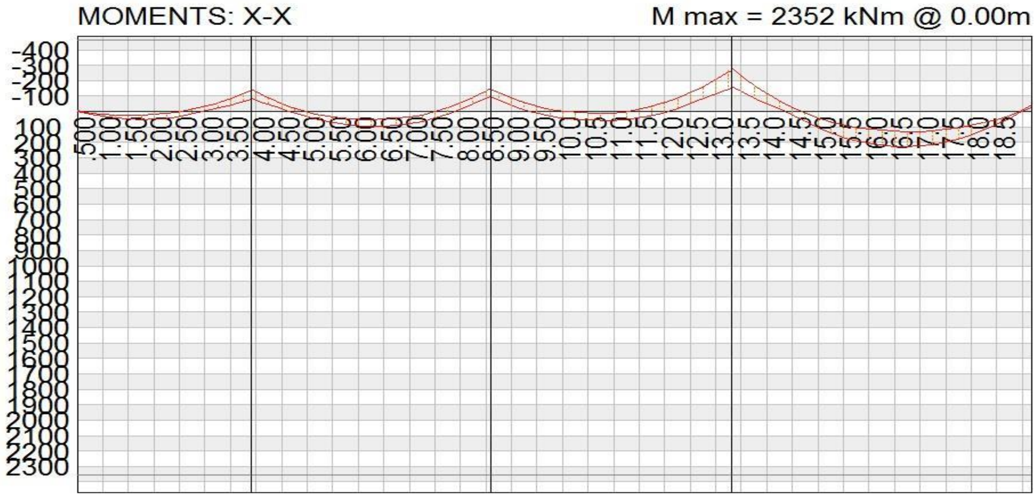

FIGURE 4. 9: Bending moment diagram

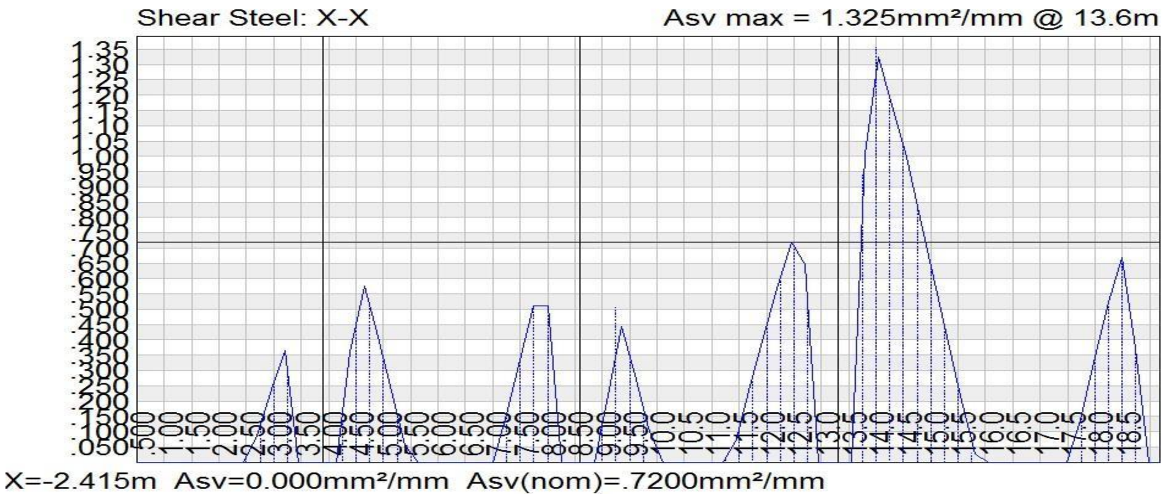

FIGURE 4. 10: Sear reinforcement

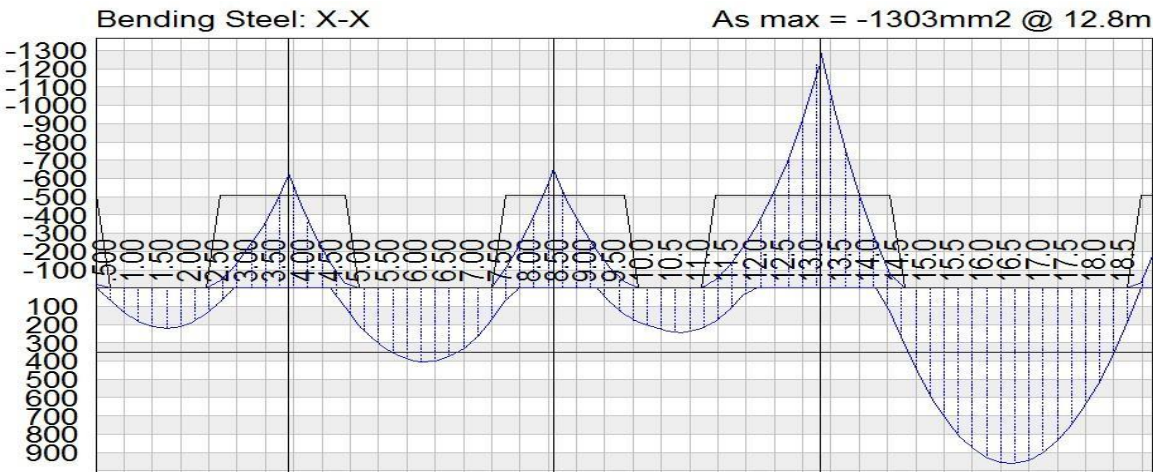

FIGURE 4. 11: Bending reinforcements

The Asv = 1.325 mm2/mm = 13.25mm2/cm which gives the use of links of minimum Asv = 50.2 mm2/cm of Φ8.

The area of required steel reinforcement at the top As max = 1303mm2 which gives the use of 5Φ20of As = 1571mm2

The area of required steel reinforcement at the bottom As max = 959.5mm2 which gives the use of 5Φ16of As = 1005mm2

TABLE 4. 3: link reinforcements spacing

Stirrup Number	Spacing	Span	Offset	Length (m)
14	200	1	0.25	2.80
21	200	2	0.25	4.20
21	200	3	0.25	4.20
4	300	4	0.25	1.20
19	200	4	1.70	3.80

Let’s consider 200mm for stirrups spacing.

Longitudinal cross section of the beam.

Section A-A

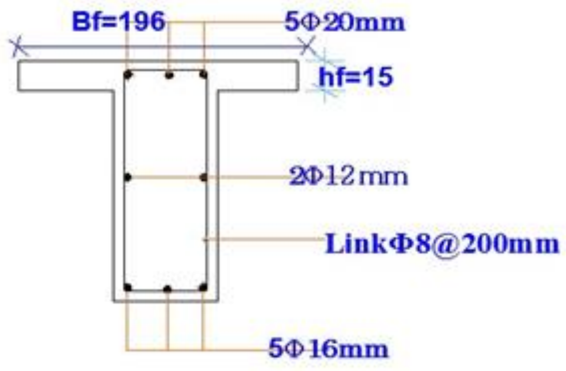

FIGURE 4. 12: Steel arrangement in the beam

4.2.2.column design

Consider the C16

Load calculations

Calculation of dead load

The height of the wall masonry=3.55m-0.65m=2.90m

The height of the area of the plaster=3.55m-0.15m=3.4m

Self-load of column/m= (1.40.300.30124)KN=3.02KN/m

Load from the slab = (7.144.14.7) KN=137.59KN

Load from the Plaster=1.40.033.4(4.1+4.7)220KN= 50.26KN

Load of Masonry wall=1.410.20(4.1+4.7)2.919KN=135.77KN

Load from the beam =1.410.300.30(4.1+4.7)24KN=26.61KN

Calculation of live load

Live load=2(4.14.7) =38.54KN

GROUND FLOOR PART OF THE COLUMN

N1=[(137.59+50.26+135.77+26.61+38.54)3+3.0215.35+137.59+26.61+38.54]KN =1415KN

1st FLOOR PART OF THE COLUMN

N2=[(137.59+50.26+135.77+26.61+38.54)2+3.0211.8+137.59+26.61+38.54]KN =1016KN

2nd FLOOR PART OF THE COLUMN

N3=[(137.59+50.26+135.77+26.61+38.54)1+3.028.25+137.59+26.61+38.54]KN=616KN

3rd FLOOR PART OF THE COLUMN

N4=[3.024.7+137.59+26.61+38.54] KN=216.9KN

Slender ratio

$\lambda = = \frac{0.7*h}{a} = \frac{0.7*355}{30}$ =8.3 let us take 8

TABLE 4. 4: shows the value of φ

Λ	6	8	10	12	14	16	18	20
φ	0.92	0.91	0.89	0.86	0.82	0.77	0.71	0.64

Using table we saw that φ= 0.91

Steel reinforcement on ground floor part of the column

$$As=\frac{\frac{N}{\varphi}-Ab*Rb}{Rs}=\frac{\frac{1415}{0.91}-\frac{1.3}{1}*30*30}{1*40}=9.62cm^2$$

Let us take 4ϕ18withAS=10.18cm2/m

The percentage of the as with respect to column cross section must lie between 0.4% and 4%

In this case we have [(10.18100)/900]%=1.131% the steel reinforcement are (OK)

Steel reinforcement on 1st floor part of the column

$$As=\frac{\frac{N}{\varphi}-Ab*Rb}{Rs}=\frac{\frac{1016\,KN}{0.91}-\frac{1.3}{1}*30*30}{1*40}=-1.34cm^2$$

Let us take 4ϕ12 with AS=-4.52cm2/m

Steel reinforcement on 2nd floor part of the column

$$As=\frac{\frac{N}{\varphi}-Ab*Rb}{Rs}=\frac{\frac{816\,KN}{0.91}-\frac{1.3}{1}*30*30}{1*40}=-12.33cm^2$$

Let us take 4ϕ12withAS=4.52cm

Steel reinforcement on 3rd floor part of the column

$$As=\frac{\frac{N}{\varphi}-Ab*Rb}{Rs}=\frac{\frac{216.9\,KN}{0.91}-\frac{1.3}{1}*30*30}{1*40}=-23.29cm^2$$

Let us take 4ϕ12withAS=4.52cm

The diameter of links should not be less than 6mm or one-quarter of the size of the largest compression bar. $\geq\frac{18}{4}=4.5 let$ take ϕ6

Stirrup spacing

The maximum spacing should be l2 times the size of the smallest compression bar.

Spacing<1212=14.4cm, Let us take spacing=140mm and stirrup= ϕ6

Steel arrangement in column

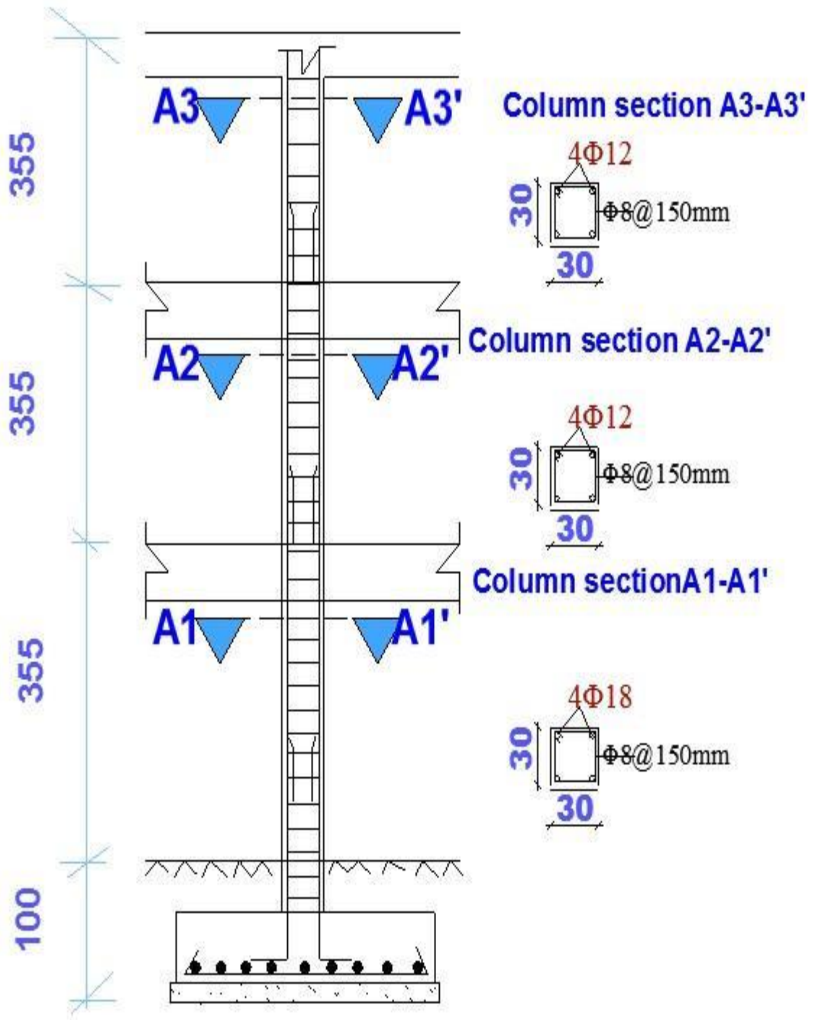

FIGURE 4. 13: Steel arrangement in column

4.3. Design of pad foundation for the column

Loading C16

Column design load=1415KN

Total design live load=38.544KN=154.16KN

Total design dead load=1415KN -154.16KN=1260.84KN

Total characteristic live load=154.16KN/1.6=96.35KN

Total characteristic dead load=1260.84KN /1.4 =900.6KN

Total characteristic load=900.6KN +96.35KN =996.95KN

Estimated foundation weight +soil on it=996.9510%=99.695KN

Total load on the soil=996.95KN +99.695KN =1096.645KN

This project has proposed to be done on the soil that has high cohesiveness, so the value of that soil should be lay between 300KN/m2and 600KN/m², so that the chosen value bearing capacity was 350KN/m².

Bearing capacity of soil=350KN/m2

Af=1096.645KN /350KN/m2

=3.13m2=177177cm

Let us take 190cm x 190cm

DESIGN SOIL PRESSURE (P)

P=1415/190190cm2=0.039KN/cm2

Horizontal distance from the column to the edge of foundation is

(190-30) cm/2=80cm

Let us take the thickness of foundation of 55cm   h0=55cm- 5m=50cm

By considering the inclination of 450, from the corner where column connects the foundation, going to the bottom of the foundation, We get the dimensions of the: 80cm -50cm=30cm

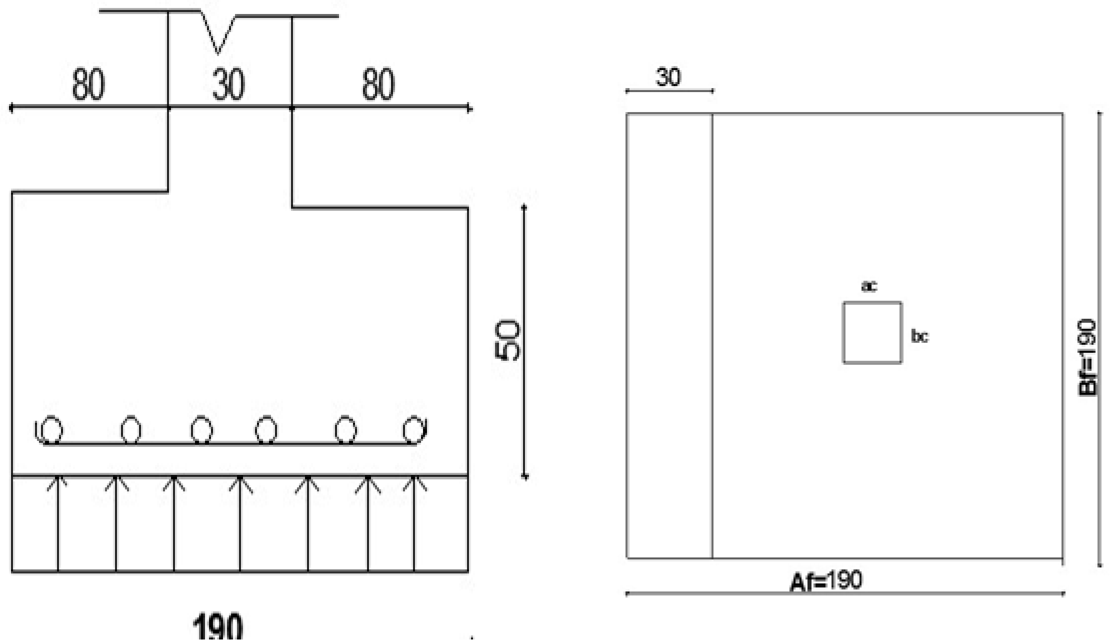

FIGURE 4. 14: Section of foundation

Shears

Q≤ 0.54RbtAb

Q=Pbf30=0.03919030=222.3KN

0.54RbtAb=0.540.0919030=277.23KN

Therefore Q=222.3<277.23KN (the thickness is OK with this shear)

PUNCHING SHEARS (2nd trial)

Qf=Nf-Δq≤RbtAb

Ab=Umho

Um=2(ac+bc+2ho) =2(30+30+250) =320cm

Ab=32050=16000cm2

Δq=p (ac+2ho) (bc+2ho)=0.039(30+250)(30+250)=659.1KN

Qf =Nf-Δq ≤ RbtAb

(1415-659.1)KN ≤0.0916000

755.9KN ≤1440KN (the thickness is ok)

Thickness of the pad foundation must be of 55cm

BENDING MOMENT

Mmax= (Paf /2)[(bf -bc)/2]2= (0.039190/2)[(190 -30)/2]2KNcm

Mmax=23712KNcm

STEEL BARS CALCULATION

AS=$\frac{M}{0.9*ho*Rs}$== $\frac{23712}{0.9*50*40}$=13.17cm^2 /m

Let us take 8ϕ16/m with AS=16.08cm/m

Steel arrangement in footing

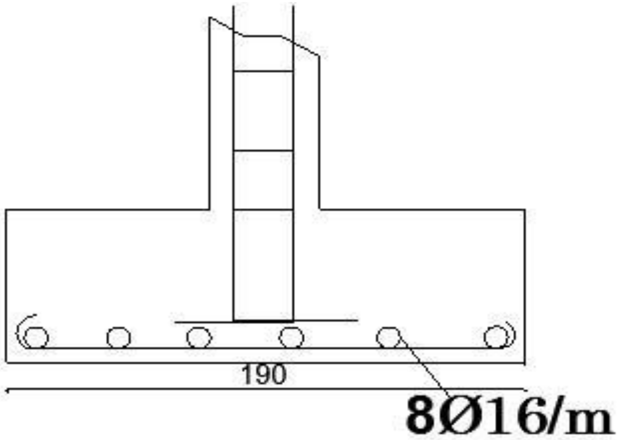

FIGURE 4. 15: Reinforcement in footing

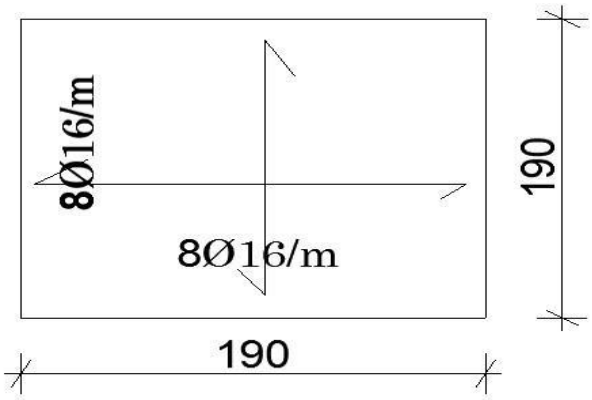

FIGURE 4. 16: Stair case design

Assume arise H=16cm 2H+B=60-64

B= 64-216=32cm

Angleα= tan-1 16/32=26.60 =270

dl= $355(\frac{1}{20}-\frac{1}{30}) \leftrightarrow$ dl=17.75cm

(17.75, 11.83) let take dl=15cm

Thickness $=\frac{15}{\cos 27}+\frac{16}{2}$ =24.8cm =25cm

h0=25-2.5=22.5cm

4.5. Load on outside landing

Dead load= 1.40.2251124KN/m3 = 7.55KN/m

Finishing = 1.41.511 = 2.1KN/m2

Live load =1.64 =6.4 KN/m2

Total load= 6.4 +2.1+= 7.55=16.05 KN/m2

Landing

Dead load=1.40.15124=5.04KN/m

Live load=1.62=3.2KN/m

Finishes=1.41.511=2.1KN/m

Total=10.34KN/m

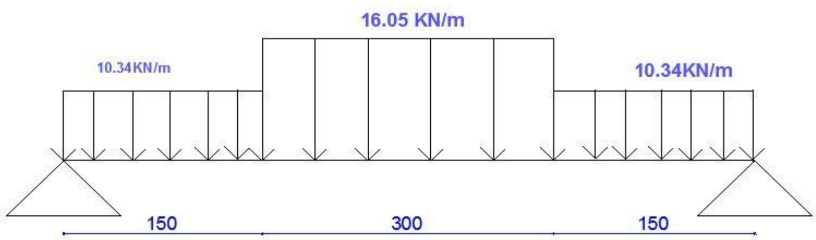

FIGURE 4. 17: loads on stair

Fy =AY+BY(10.344)+(16.054)=105.6KN

$\alpha m = \frac{M}{ho^2 * b * Rb} = \frac{105.6}{(22.5)^2 * 100 * 1.3} = 0.16$

ξ=0.18 η=0.910

Steel bars calculation

$As = \frac{M}{ho * Rs * \eta} = \frac{105.6 * 100}{22.5 * 40 * 0.910} = 12.89cm2/m$

Let use 6ϕ8with corresponding As=14.07cm2/m

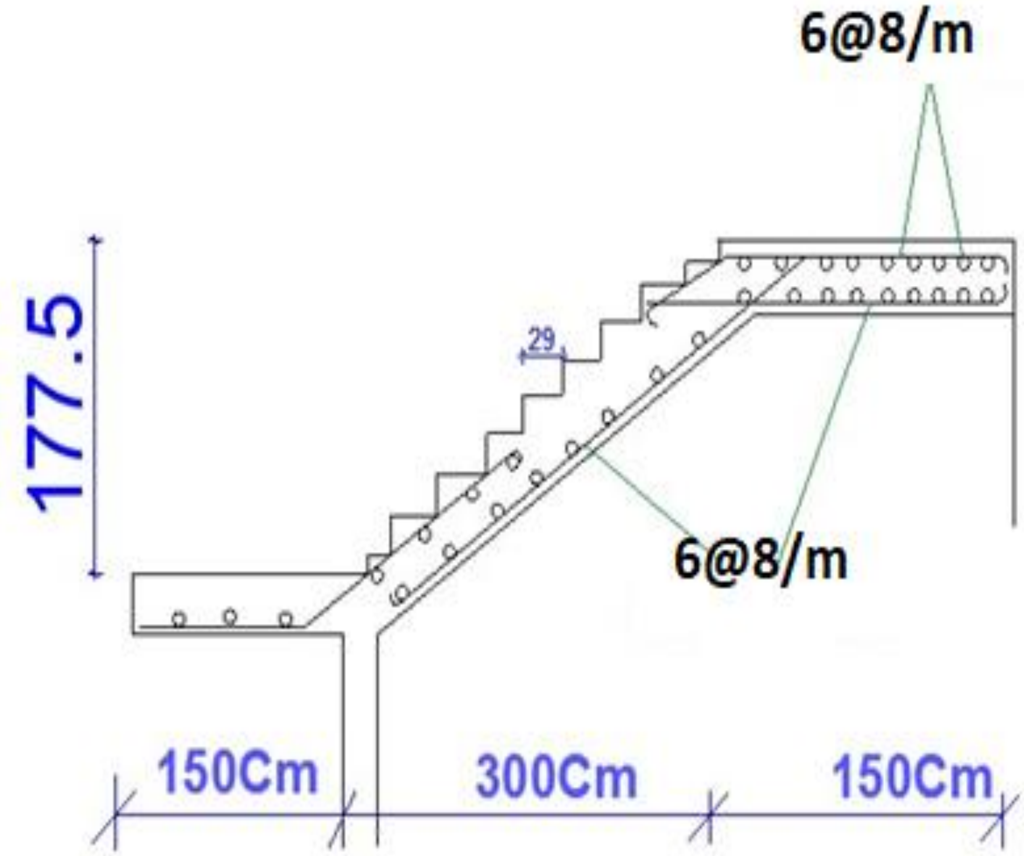

FIGURE 4. 18: Reinforcement in stair

TABLE 4. 5: Summary of bills of quantities

No	Names	Sub/total cost estimation (Rwandan francs (RWF)
1	Ground floor	325,639,246
2	First floor	201,721,300
3	Second floor	201,721,300
4	Third floor	201,721,300
5	Fourth floor	308,396,300
Total cost		1,116,519,944 Rwf

1. Discrepancy in Ground and Fourth Floor Costs:

•The Ground floor cost is significantly higher (325,639,246 RWF) than the other floors, which might be due to foundational work, utilities, or site preparation. However, this variance should be well-justified and documented in the detailed BOQ.

•The Fourth floor also shows a notable increase (308,396,300 RWF) compared to the first, second, and third floors. If this floor includes additional features or specialized construction work, it should be clearly detailed to explain the cost difference.

2. Similar Costs for Intermediate Floors:

•The First, Second, and Third floors have identical costs (201,721,300 RWF each), which suggests uniformity in construction work and materials for these floors. This consistency is expected unless there are floor-specific variations that were not captured. Ensure that these estimates accurately reflect the actual scope of work, such as mechanical or electrical services unique to each floor.

3. Clear Justification of Cost Breakdown:

•Ensure that the detailed BOQ includes a breakdown of how the costs are derived for each floor (e.g., materials, labor, equipment). For example, the increase in the Ground and Fourth floors could be due to elevators, specialized finishes, or mechanical systems, which should be clear in the individual cost line items.

4. Clarification on Overall Cost:

•The total cost is 1,116,519,944 RWF. It would be helpful to ensure that this summary matches with the individual cost breakdowns and that the BOQ reflects any contingencies or allowances (if applicable) for unexpected variations.

CHAPTER FIVE CONLUSION AND RECOMMENDATION

5.1. conclusion

This dissertation has presented a thorough architectural and structural design for a three-storey Clinic located of Kicukiro District, Rwanda. The findings demonstrate the vital role that effective design plays in catering to both the functional needs of a multi-storey building and the growing demands of the hospitality industry amidst Rwanda's rapid socio-economic development.

The architectural design, developed with modern aesthetics and efficient use of space in mind, encompasses areas such as guest accommodations, service facilities, and communal spaces. The analyses of structural components—including slabs, beams, columns, and foundations—using advanced engineering methodologies and software tools like ARCHICAD and PROKON have confirmed that the proposed design can safely support anticipated loads. The design not only meets local building codes and standards but also incorporates contemporary practices aimed at enhancing user experience and safety.

Furthermore, the estimated total cost for the project aligns with market expectations and reflects a comprehensive approach to budgeting, including considerations for materials, labor, and ancillary services. The detailed bill of quantities shows a commitment to transparency and careful financial planning, ensuring stakeholders have a clear understanding of project expenses.

Importantly, the project's emphasis on sustainability signifies a forward-thinking approach that is crucial for future developments in Rwanda. The options for incorporating sustainable materials and practices into the construction and operation of the hotel are pivotal not only for environmental stewardship but also for long-term economic viability.

In conclusion, this study serves as a significant contribution to the field of civil engineering and construction technology in Rwanda. It offers a replicable model for future multi-storey architectures, particularly in tourism, which is poised to become an increasingly vital sector of the Rwandan economy. As the tourism industry evolves, so too should the methodologies and practices in infrastructure development to ensure that they are both sustainable and beneficial for local communities.

5.2. RECOMMENDATIONS

The following recommendations are proposed to enhance the implementation of similar projects and promote sustainable development in the construction sector in Rwanda:

1 three-storey Clinic Integration of Sustainable Practices three-storey Clinic three-storey Clinic: Future construction projects, particularly in the hospitality sector, should prioritize the incorporation of sustainable materials and practices. Emphasizing energy-efficient systems, rainwater harvesting, and solar energy solutions can significantly reduce the environmental impact of hotel operations and align with global sustainability goals.

2. Three-storey Clinic Strengthening Training Programs three-storey Clinic three-storey Clinic: The enhancement of training programs for civil engineering students is vital. Institutions like ULK Polytechnic should increase access to hands-on training in modern design software such as ARCHICAD and PROKON. This will empower students with the skills necessary to meet the evolving demands of the construction industry, fostering a generation of engineers proficient in sustainable design principles.

3. three-storey Clinic Clinic Policy Support for Multi-Storey Developments three-storey Clinic: Policymakers should support initiatives that facilitate the construction of multi-storey buildings in urban areas. Providing incentives for developers who choose sustainable building materials and practices can encourage construction that is not only economically viable but also environmentally friendly.

4. Three-storey Clinic Comprehensive Cost Analysis and Documentation three-storey Clinic: A standardized approach to cost estimation should be adopted, ensuring transparent communication regarding expenses associated with each building component. The discrepancies noted in the cost analysis of different floors of the building highlight the need for standard breakdown practices that will aid in better financial planning and project management.

5. Three-storey Clinic Community Engagement and Input Clinic three-storey Clinic: Engaging local communities in the planning and design phases of new constructions can improve acceptance and usability of the structures. This participatory approach ensures that the developments align with local needs and cultural aesthetics, enhancing the overall impact of the project.

6. three-storey Clinicthree-storey ClinicContinual Research and Developmentthree-storey Clinicthree-storey Clinic: Ongoing research into innovative construction methods and materials should be encouraged within Rwanda's civil engineering faculties. Establishing partnerships with industry stakeholders can lead to the development of new technologies and best practices tailored to Rwanda's unique environmental and social conditions.

In conclusion, these recommendations aim to not only enhance the quality and sustainability of construction projects in Rwanda but also to promote economic growth through a well-developed hospitality sector that can competently cater to the increasing demands of both local and international visitors.

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APPANDICES

GROUND FLOOR					
CODE	**DESCRIPTION OF WORKS / ACTIVITIES**	**UNIT**	**QUANTITY**	**U.P.**	**T.P.**
I	**PRELIMINARY WORK**				
1	Demolition and evacuation of existing building				3,000,000
2	Site installation				3,000,000
	S/TOTAL				**6,000,000**
II	**FOUNDATION EXCAVATION**				
1	Trench excavation	m³	148.29	2,700	400,383
2	excavation for footing	m³	101.09	2,700	272,943
3	bases concrete	m2	`472.5	8,000	3,780,000
4	foundation in masonry stone joined by cement mortar	m³	89	55,000	4,895,000
5	Cap on foundation	m2	198	7000	1,386,000
6	damp proof	m2	198	5000	990,000
7	Back filling	m³	1300	2,500	3,250,000
8	Compacting	m2	620	1,300	806,000
9	Paving	m2	620	8,000	4,960,000
	S/TOTAL				**20,740,326**

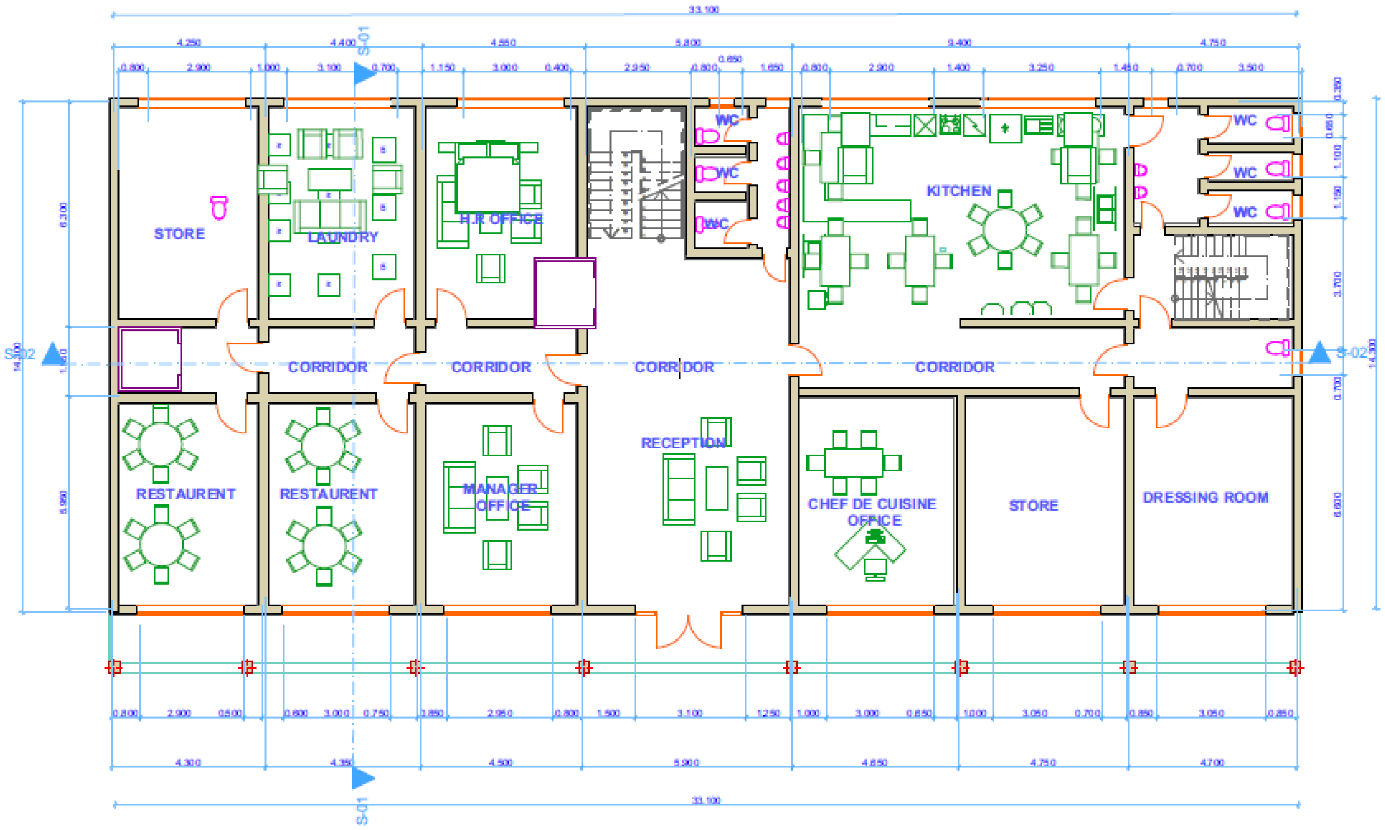
III	**CONCRETE**				
1	for blinding concrete	m3	67.46	7,000	472,220
2	for footings	m^3	248.6	380,000	94,468,000
3	for sub column	m^3	42	380,000	15,960,000
4	for beam	m^3	154.5	380,000	58,710,000
5	for column	m^3	52.5	380,000	19,950,000
6	for slabs	m^3	180	380,000	68,400,000
7	for stairs	m^3	7	380,000	2,660,000
	S/TOTAL				**246,256,220**
IV	**Masonry**				
1	Elevation of the walls with burnt bricks	m^3	311.5	60,000	18,690,000
	S/TOTAL				**18,690,000**
V	**FURNITURE**				
1	Simple door (90x210)	pcs	17	70,000	1,190,000
2	Double door (180x240)	pcs	5	180,000	900,000
3	Window (150x170)	pcs	17	80,000	1,360,000
4	Window (100x120)	pcs	2	60,000	120,000
5	window (60x70)	pcs	7	35,000	245,000
	S/total				**3,815,000**
VI	**PLASTERING**				
1	Sand and cement mortar rendering to slab soffit. (ceiling)	m^2	472.5	4,000	1,890,000
2	Plastering internal & external wall and beams	m^2	585	4,000	2,340,000
3	Tiles in the toilet	m^2	47.88	15,000	718,200

4	Tiles on the slab	m²	472.5	20,000	9,450,000
	S/TOTAL				**14,398,200**
VII	**PAINTING**				
1	painting of, column, and beam (double side)	m²	402	3,500	1,407,000
2	Painting wall (2 sides)	m²	2047.5	2,000	4,095,000
3	Painting of door and window	m²	200	2,250	450,000
	S/TOTAL				**5,952,000**
VIII	**SANITARY DETAILS**				
1	Wash hand basin	pcs	14	75,000	1,050,000
2	Toilet	pcs	14	140,000	1,960,000
3	Shower	pcs	14	85,000	1,190,000
	S/total				**4,200,000**
IX	**ELECTRICAL INSTALLATION**				
1	Electrical cables and conduits	1	5,500,000	5,500,000	
2	Socket	pcs	35	1,500	52,500
3	Lamps	pcs	35	1,000	35,000
	S/total VII				**5,587,500**
	GROUND FLOOR TOTAL				**325,639,246 Rwf**
1st,2nd, 3rd and 4th floor					
1	for beam	m³	23.4	380,000	8,892,000
2	for column	m³	12.6	380,000	4,788,000
3	for slabs	m³	75.87	380,000	28,830,600
4	for stairs	m³	7	380,000	2,660,000

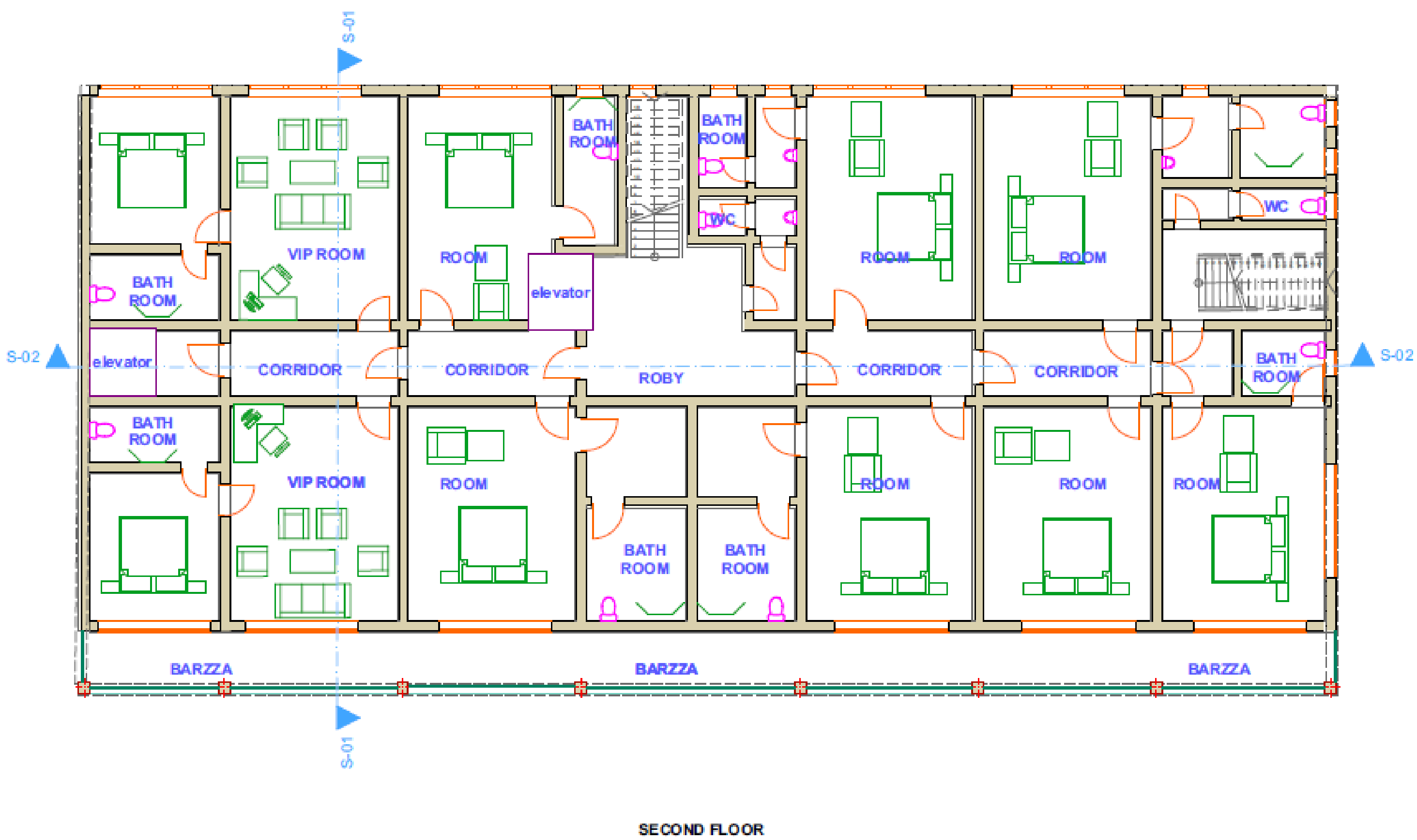
	S/TOTAL				**45,170,600**
II	**Masonry**				
1	Elevation of the walls with burnt brick.	m³	311.5	60,000	18,690,000
	S/TOTAL				**18,690,000**
III	**FURNITURE**				
1	Simple door (90x210)	pcs	17	70,000	1,190,000
2	Double door (180x240)	pcs	5	180,000	900,000
3	Window (150x170)	pcs	18	80,000	1,440,000
4	Window (100x120)	pcs	2	60,000	120,000
5	window (60x70)	pcs	7	35,000	245,000
	S/total				**3,895,000**
IV	**PLASTERING**				
1	Sand and cement mortar rendering to slab soffit. (ceiling)	m²	472.5	4,000	1,890,000
2	Plastering internal & external wall and beams	m²	585	4,000	2,340,000
3	Tiles in the toilet	m²	47.28	15,000	718,200
4	Tiles on the slab	m²	472.5	20,000	9,450,000
	S/TOTAL				**14,398,200**
V	**PAINTING**				
1	painting of, column, and beam (double side)	m²	402	3,500	1,407,000
2	Painting wall (2 sides)	m²	2047.5	2,000	4,095,000

3	Painting of door and window	m²	200	2,250	450,000
	S/TOTAL				**5,952,000**
VI	**SANITARY DETAILS**				
1	Wash hand basin	pcs	14	75,000	1,050,000
2	Toilet	pcs	14	140,000	1,960,000
3	Shower	pcs	14	85,000	1,190,000
	S/total				**S/total**
VII	**ELECTRICAL INSTALLATION**				
1	Electrical cables and conduits		1	5,500,000	5,500,000
2	Socket	pcs	40	1,500	60,000
3	Lamps	pcs	40	1,000	40,000
	S/total VII				**5,600,000**
VIII	**RAILS**				
1	Rail grassed frame	m	58.6	65,000	3,815,500
	1st,2nd, and 3rd floor TOTAL (Each)				**101,721,300 Rwf**
IX	**PARAPET WALL**				
	Bricks parapet wall	m³	89	75000	6,675,000
	4th floor TOTAL				**308,396,300Rwf**
VARIOUS SUPPLIES & FACILITIES					
1	Purchase &installation of electrical				260,500,000
2	Purchase &installation of fire protection				80,000,000
3	Networking & generator purchase & installation				85,500,000
S/Total					**426,000,000**
TOTAL					**1,165,199,446 Rwf**
UNEXPECTED 10%					**116,519,944Rwf**

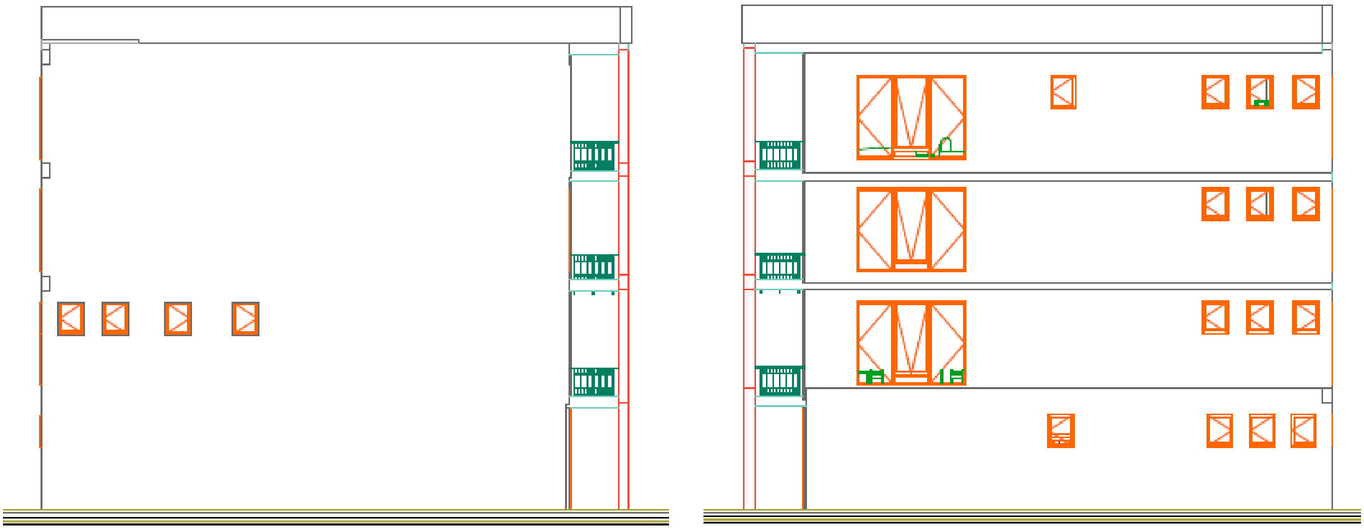
APPANDICES aa: Ground floor



APPANDICES bb: 1st floor

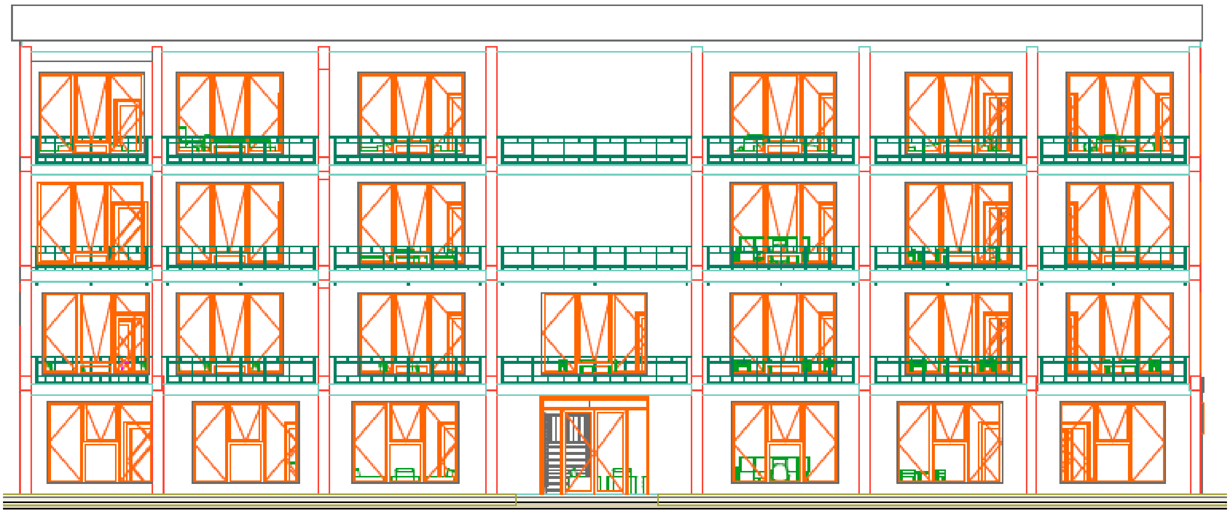


APPANDICES cc: Sides views



SIDE VIEWS

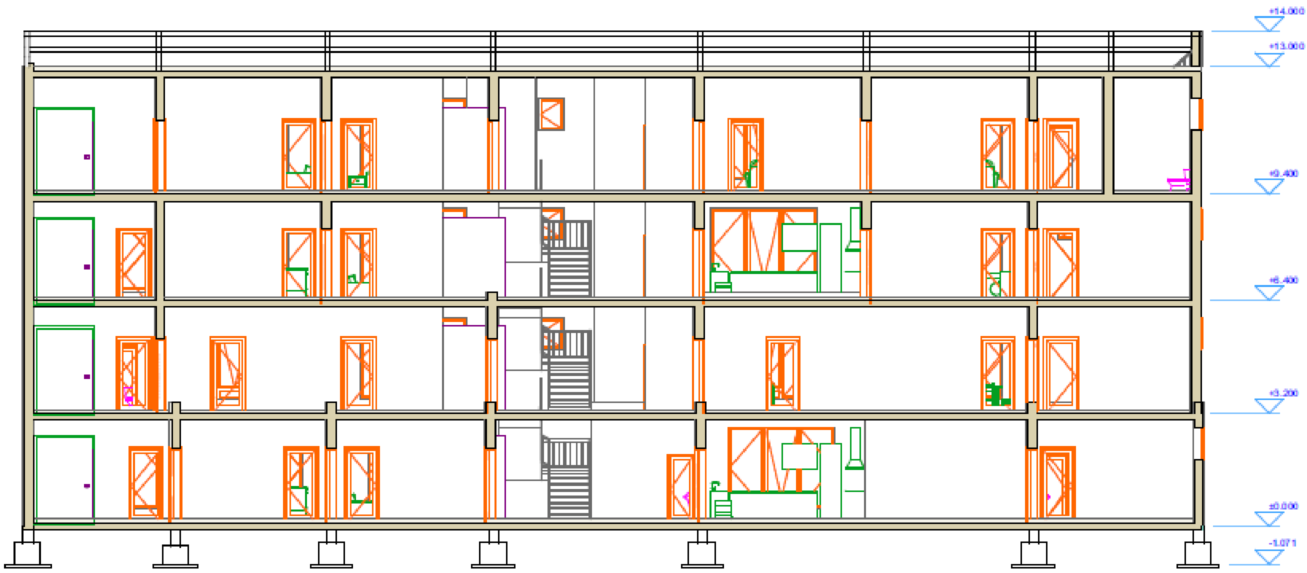
APPANDICES dd : Front and back views



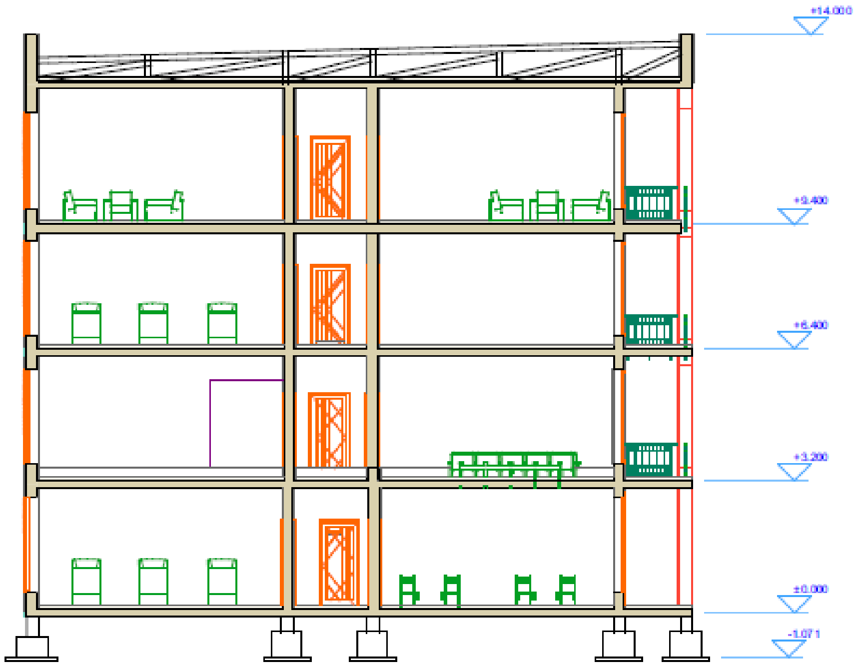
FRONT VIEW

BACK VIEW

APPANDICES ee: Sections



logitidunal section



Transversal section

APPANDICES ff: Perspective