ST. MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

FACULTY OF BUSINESS

THE PROSPECT AND CHALLENGES OF SHIPPING CONTAINER AS RESIDENTIAL UNIT: ALTERNATIVE HOUSING SOLUTION FOR ETHIOPIA.

BY;

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ADDIS ABABA, ETHIOPIA

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A THESIS SUBMITTED TO ST. MARY'S UNIVERSITY, SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF BUSINESS ADMINISTRATION.

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DECLARATION

I, the undersigned, declare that this thesis entitled “The Prospect and Challenges of Shipping Container as Residential Unit: Alternative Housing Solution For Ethiopia” is my own unaided work. It is submitted for the MBA Honors degree at St. Marry University, Addis Ababa, Ethiopia to the Faculty of Business Administration post graduate program. It has not been submitted before for any degree or examination to any other University.

Name	**Signature**
Lidya Tamiru Balcha	_____

St. Mary’s University, Addis Ababa June, 2021GC.

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ACRONYMS

- **CBE: -** Commercial Bank of Ethiopia
- **CAHF: -** Centre for Affordable Housing Finance in Africa
- **ESC: -** Economic, social and cultural rights
- **GDP: -** Gross domestic product
- **GDV: -** Gross development value
- **ICCPR: -** International Covenant on Civil and Political Rights
- **IHDP: -** Integrated Housing Development Program
- **ISBU: -** Intermodal Steel Building Units
- **ISO: -** International Organization for Standardization
- **RC: -** Reinforced concrete
- **TEU: -** Twenty-foot equivalent unit
- **US: -** United States
- **USD: -** United States Dollar
- **WBG: -** World Bank Group

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ABSTRACT

The aim of this thesis is to understand the prospect and challenge of using shipping containers as a residential unit as an alternative housing solution for Ethiopia. The research is in the most urbanized city of the country Addis Ababa. With the perception of understanding the views held towards shipping containers as an alternative housing solution, this study set out to understand peoples' opinions on Socio-cultural, economic, technological, and environmental aspects of shipping container housing as a solution. It also looks into the cost comparison of the unit with other construction materials (Concrete building). The type of research designs used to do the research was explanatory research design and descriptive research design. The research approach is also both qualitative and quantitative type of approach. The surveying result shows that accepting shipping container homes as an alternative is not dependent on educational background, age, or income level. According to the survey, the result rather depends on economics (affordability) and social status issues. The cost comparison done between a residential unit of the same design yet made of concrete home and shipping container shows, Container homes are more affordable than concrete homes. Regarding the result from the study, some recommendations suggested how best to deliver this shipping container alternative home regarding the socio-cultural issue stated and how the state government supporting the implementation could impact the result.

Key Words: Housing backlog, Prospect and challenges, Alternative housing solution

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND OF THE STUDY.

A House is a basic human need and according to Article 11 of the International Covenant on Civil and Political Rights (ICCPR), to have an adequate house is a human right. This article is interpreted and used differently as such in different countries. According to research done by Army Assefa in Nov 2011, in the institutional and legal framework in Ethiopia, the right to adequate housing in Ethiopia is not clearly stated in the Ethiopian constitution. And it is generalized under Economic, social and Cultural right (ESC rights), which makes it difficult to determine whether it is justifiable.

CAHF states that with a population that is over one hundred million, Ethiopia is the second-most populous country in Africa. Ethiopia has been experiencing increased urbanization with a 4.9 percent rate and a 21.2 percent urban population in 2019.

According to the urban land supply and affordable housing study by WBG, the demand for new housing in Ethiopia far exceeds the pacing supply with an annual projected demand of 381,000. The World Bank Group (WBG) study also shows that Government-led housing supply is in the form of an Integrated Organization for Standardization (IHDP). The solution only meets 10% of the annual demand, is fiscally unsustainable, and is not affordable for the bottom 40% of the population.

The public housing programs have not been the only source of new housing solutions. Private residential developments have been increasing from 2006 to 2016. However, private contractors and real estate companies must lease land from the government. In residential areas, private investors bid for 99-year leases costing $2260 per meter square. As a result of the high land costs, housing developed by the private sector is mostly in service to the wealthiest residents and the Ethiopian diaspora (Land, 2019).

The government also provides rental houses which meet a substantial demand. Most of the rentals in the urban centers are houses owned by the government and rented to residents at a comparatively low fee. Although these houses were constructed during the past socialist regime and are old, their number is significant (Africa housing finance yearbook, 2020).

As the finding of IHDP indicates, one single program cannot reach all the countries household incomes level and suggests that there should be different solutions for affordable solution challenges. One of the solutions for supplying affordable housing is to change the construction material. The commonly used material for building construction in Ethiopia is usually Reinforced Concrete (RC) but nowadays, the cost of the material is expensive. Under an article about construction cost as a percentage of a project, the price of the construction material for buildings, specifically residential houses estimated to be 70% of material cost and 30% of labor cost.

The shipping container is one of the construction material building approaches that can be a solution. The main benefits of steel shipping containers are their durability and the ability to be modified for numerous uses. The container's purpose is to endure extreme loads and heavy wear and tear (Zuiderwyk, 2014). They are made of weathering steel, resist harsh environments, such as weather or salt corrosion, etc (HL Design Group, 2010).

Even though shipping containers have been known for their purpose of storing and transporting goods, according to Judah Levine (Shipping Container History May 11, 2020), Shipping containers have been used as building material starting back in 1962GC. However, Phillip C. Clark filed for the United States patent on November 23, 1987, described as "Method for converting one or more steel shipping containers into a habitable building at a building site and the product thereof." He claimed that shipping containers make the perfect modular building material. He also commented reusing shipping containers can be used as a solution to make homes economically.

The relevancy of this study lies in the fact that Ethiopia is facing challenges due to the housing backlog. On an article by (CAHF), Ethiopia's housing backlog is by 1.2 million houses. Different solutions are in need, and shipping containers hold some potential that can be exploited to meet those needs, especially in the case of rapid urbanization and modernization. Given this background, this study will assess Shipping containers as residential units for an alternative and affordable yet stable housing solution for Ethiopia.

1.2 STATEMENT OF THE PROBLEM

Housing is a basic human need; with-out a decent place to live there won't be a productive healthy society. Now a days housing is becoming more and more concerning due to an increasing housing demand regarding economic change, population growth and housing backlog. According to CAHF Since 2019 Ethiopia has been facing increasing urbanization with 4.9% rate and increasing urban population with 21.2% rate. Due to this Ethiopia's housing backlog is estimated to be 1.2 million houses.

According to the urban land supply and affordability housing study by World Bank Group (WBG, 2015), the government has come with solutions to fill the housing backlog in the country. And among those solutions, the provision of housing supply mainly in the form of IHDP is only meeting 10% of annual demand and is not affordable for the bottom 40% of the population. And the government also provides rental houses which were constructed during the past socialist regime and are old, and their number is significant (Africa Housing Finance Yearbook 2020). Even though the private residential developments have increased from 2006 to 2016, the housing program is expensive due to high land costs and only serves the wealthiest residents and the Ethiopian diaspora.

On a report by Africa Housing Finance Yearbook (2020), the concern for the country is the need for better affordable housing and the need for more approaches towards delivering it. And these are the main challenge that should be looked into and given a solution in shipping container developments. This problem seems to be mainly due to:

- Urbanization
- The shortage of affordable housing for economically deprived groups.
- High cost of building material
- High population growth and
- Lack of more alternative housing solutions

At last, the approach of solving the housing problem in Ethiopia over the years is limited and is focuses on IHDP programs. Considering all the limitations towards the solution, and the article

about construction cost as a percentage of a project (which is 70% of the construction cost), looking into the alternative solutions regarding construction materials such as shipping container-based building technology Could be a better choice for mitigating the housing problem.

1.3 RESEARCH QUESTIONS

Aligning with the statement of the problem, the following research questions are formulated and will be answered on the research

- ✓ What is the current housing condition of the country and the challenges still confronting housing delivery?
- ✓ How durable, resistant, and feasible are shipping container houses?
- ✓ What are the factors that come with using the alternative solution?
- ✓ How available is the resources (Shipping Containers) to consider it as a possible solution?
- ✓ How economical is using Shipping Container as construction materials compared with the most used construction material (Concrete homes) based on cost estimation.
- ✓ How adaptable is shipping container related to peoples' educational level, Tradition, way of life, status, and household size?
- ✓ According to the society's point of view, what environmental factor shipping container homes could bring?

1.4 OBJECTIVES OF THE STUDY

1.4.1 GENERAL OBJECTIVE OF THE STUDY

The general objective of this study is to research the prospect and challenges of shipping containers as a residential unit for an alternative housing solution in Ethiopia. Specifically in Addis Ababa, as a possible alternative and affordable housing solution, to reduce the country's unbalanced house demand-supply gap.

1.4.2 SPECIFIC OBJECTIVES OF THE STUDY

- Understanding the current situation of housing in Ethiopia as well as the challenges still confronting housing delivery.

- Understanding the nature of shipping containers in order to use it as a residential unit.
- Evaluate the factors that could come with using a Shipping container as a residential unit.
- Comparison of a shipping container with the conventional methods (Reinforced concrete) in terms of cost and time.
- Exploring the availability of the resources (Shipping Containers) in order to consider it as a possible solution.
- Determining the adaptability of shipping container related to peoples' educational level, Tradition, way of life, status, and household size?
- Evaluate the kind of impact it could bring to the environment regarding to the societies possible concern.

1.5 SIGNIFICANCE OF THE STUDY

- The importance of studying the problem of housing backlog and Shipping containers as alternative housing solutions in Ethiopia is to help see the significance of the problem and come up with a solution by filling the demand-supply gap. It also will open ways to explore other solutions and possible contributions moving forward.
- The research is also to be practically used to fill the gaps specified by the problem. It will bring more research approaches and questions in the future for more other building solutions as well.

1.6 SCOPE OF THE STUDY

Conceptually the research is delimited to assess the challenges of affordable housing and the gap in available housing solutions in Ethiopia. The study focuses on introducing shipping containers as an alternative housing solution to fill this gap or reduce it somehow. Geographically, since researching all parts of Ethiopia would be a massive topic to cover as a thesis due to financial and time constrain, it was in Addis Ababa, the capital and the most urbanized city in the country. The research was done using qualitative and quantitative methods of approach by using a questioner survey and cost estimation based on the current construction market price.

1.7 LIMITATION OF THE STUDY

The research intended; to investigate the affordability and acceptance of shipping containers as a residential unit. Different challenges were faced when doing the research. One of the first challenges encountered in this research process was that there is a limited amount of academic research on the reuse of containers for housing in the world and, there was no research in the city at all. The other challenge is that it was hard to collect available data on the availability of the resource and people's awareness of the solution. The surveying process was challenging since people were not as corporative as expected; when it was to answer the surveying questions. The other issue is; there are no policy-developed for container houses in the city, and it is impossible to tell if it is a reliable solution considering housing policies.

And the other limitation is during the cost estimation comparison between the concrete building and container building, estimation of both buildings does not include overhead cost for both construction futures. And the cost estimation is done on the current market price. Due to the limitation of time and money, the research was limited only to Addis Ababa, the most urbanized city in Ethiopia.

1.8 ORGANIZATION OF THE STUDY

The research is organized by comprising five chapters. Each chapter summarized is as follow:-

- **Chapter One:** Introduction

This chapter contains the background of the study, statement of the problem, the research questions, objectives of the study, significance of the study, the scope of the study, Organization of the study, and definition of terms.

- **Chapter Two:** Literature Review:

This chapter deals with the theoretical and empirical literature relevant to the study. It also covers the conceptual framework of the research.

- **Chapter Three:** Research Design and Methodology.

This chapter describes the type and design of the research, the subjects/participant of the study, the sources of the data, the data collection tools/instruments employed; the procedures of data collection; and the methods of data analysis used.

- **Chapter Four:** Data presentation, analysis and integration.

This chapter summarizes the results/findings of the study and interprets and discusses the findings.

- **Chapter five:** Summary, Conclusions, and Recommendations

This chapter comprises four sections, each including a summary of findings, conclusions, limitations of the study, and recommendations.

1.9 DEFINITION OF TERMS

The following are operational definitions of some of the most commonly used terms in this study.

- **Urbanization**: The process whereby a society changes from a rural to an urban way of life. It refers to the gradual increase in the proportion of people living in urban areas. (National Library of Medicine. Retrieved 5 November 2014.)
- **Housing Backlog**: Backlog or shortfall; is often defined as the under-provision in housing that has accrued against previous development plan targets. (Cornwall Local Plan: Housing Evidence Base)
- **Demand**: is the quantity of a good that consumers are willing and able to purchase at various prices during a given period. (O'Sullivan, Arthur; Sheffrin, Steven M. 2003)
- **Mortgage**: is a loan for the purchase of real property secured by a lien on the property. Construction material (Free Dictionary)
- **Affordable housing**: is housing that is not too expensive for people of limited means (Merriam - Webster Dictionary)
- **Infrastructure** is the set of fundamental facilities and systems that support the sustainable functionality of households and firms. (Dictionery.com)

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

This chapter provides an understanding of the existing literature. It informs points like affordable housing solutions, the investigation of shipping container developments as a building material, shipping container homes in developing countries, shipping containers with a prospect of housing solution, Ethiopian current housing condition, and currently available solutions. The literature generally covers the Theoretical, Empirical Aspects of the research and discusses the conceptual framework.

The literature has revealed housing as a sensitive concern in Ethiopia, especially in urban areas, and the government has developed solutions to help decrease the housing backlog. The existing literature also provides information on what shipping containers are and the debate on whether shipping containers can be considered adequate housing and home.

2.2 THEORETICAL LIETRATURE

2.2.1 ETHIOPIAN CURRENT HOUSING CONDITION.

According to Africa Housing Finance Yearbook 2020, Ethiopia is the second most populous country in Africa with an estimated population of more than 110 million people. Although classified as a low income country, Ethiopia emerged as one of Africa's fastest growing economies, averaging 10.5 percent a year from 2004 to 2018.

Ethiopia is considered to be one of the least urbanized countries on the continent, but this has been rapidly changing. As stated by CAHF, the country's urban population was 21.2 percent in 2019, with an urbanization rate of 4.9 percent. Rapid urbanization has outpaced urban investment needs and development of infrastructure and service delivery. Due to this an estimated 1.2 million housing backlog exists in the country with a projected demand of 655, 800 housing units during 2015-2025. As such, Ethiopia's cities are characterized by little formal planning, an organic road network and widespread informal housing.

The largest industrial sub-sector, construction, which accounted for 12.5 percent of GDP in 2018 and is currently the largest employer, has underpinned Ethiopia's high growth. The

government has invested significantly in social housing projects attracting foreign and local building contractors, and stimulating the expansion of integrated industries.

According to the article the study, Ethiopia entered the COVID-19 pandemic with a strong growth rate, but real GDP growth is expected to decline from pre-pandemic estimates of 7.2 percent to 3.2 percent. In the first quarter of 2020, inflation increased by more than five percent, mainly due to a weakening currency and disruptions in imported food supplies and energy. The African Development Bank estimates that reduced economic activity could result in up to 2.5 million job losses, putting Ethiopian livelihoods at risk and that the economic contraction will likely have a negative impact on housing investment and delivery.

2.2.2 AFFORDABILITY OF HOUSEHOLD IN ETHIOPIA .

2.2.2.1 AFFORDABLE HOUSING SOLUTIONS

A survey taken by the (Lincoln, Nov2018) Institute revealed that across the globe, there is an immediate desire for affordable housing solutions. The survey reveals out of 200 cities polled around the world, 90% considered unaffordable. When applying the widely-used standard of average house prices, it is more than the three-times median income. The unprecedented rate of urbanization across the world has led to increased demand for affordable housing. The factors contributing to a lack of affordability vary from city to city but broadly include the housing costs rising faster than incomes, the supply of houses not keeping up with demand, scarcity of land, and demographic changes such as population growth, aging, and shift in household composition.

[The World Economic Forum 06 Jun 2019 in Sydney], Australia launched a new report called "Making Affordable Housing a Reality for Cities." The article provides a comprehensive overview of affordable housing challenges across the housing value chain. The report identifies factors that affect housing affordability beyond the direct costs of purchase and maintenance – including location, housing type, access to social infrastructure, the legal and regulatory environment, and the state of financial markets.

Considering the problem that arises with house affordability, different mitigation measures given at times, and changing the construction material is one of them, and using a shipping container is one of the new ones.

2.2.2.2 AFFORDABLITY OF HOUSEHOLD IN ETHIOPIA

Lack of affordable and quality housing stock is the two main barriers to owning a house for a lower income household. And the difficulty of obtaining housing finance is the other one. The unmet housing demand is estimated at approximately 1.2 million (CAHF 2020). The World Bank estimates that 400, 000 new housing units would need to be delivered annually, to meet new demand. Due to the country's low income per capita, household saving power is extremely low. Affordability is becoming more and more an issue due to construction material and unreasonably high land prices.

The government IHDP condominium scheme is the dominant housing program in urban Ethiopia. Opportunities to buy newly built IHDP housing are allocated by lottery. In the latest round of the lottery the average size of apartments varies between "a studio apartment ($32m^2$) and a one, two or three-bedroom apartment (51, 75, or $100m^2$, respectively)." The cost of construction of IHDP houses is Br4, 918 (US$141) per m2 (excluding costs of finishing and infrastructure connection). If land costs, administration and compensation costs for people who occupied the land prior to the IHDP, as well as the cost of infrastructure are included, the average production cost per unit increases to Br16, 725 (US$480) (against the approximately Br10, 000 or US$287 winning households pay) which suggests a 40 percent subsidy. The down payment required to be saved in the event of winning a lottery and the monthly contributions registrants need to pay generally exceeds a household's annual consumption, making the scheme largely unaffordable for those for whom it is targeted.

Unlike a traditional subsidized social housing lottery, winners are free to rent out their apartment at market rates, but not allowed to sell them before five years from the date of taking ownership of the house. Thus, once they have won the lottery many people rent out the houses at a better price and generate revenue to pay the mortgage. Due to this and other reasons, therefore, only 46 percent of lottery winners move into their apartments.

On the whole, only the upper income groups and members of the Ethiopian diaspora can afford formally constructed housing in Ethiopia. Due to limited opportunities to access land formally, squatter settlement is one affordable way of owning houses at less than market prices. This comes with a risk of demolition by administrators.

2.2.3 ETHIOPIAN FINANCIAL ACCESS FOR AFFORDABLE MORTGAGE

The Ethiopian mortgage market primarily serves upper and upper middle income salaried households. No more than 16 percent of the population receives a formal salary and collateral requirements leave only a few households eligible for mortgage loans. The World Bank estimates that mortgages represent only 1.87 percent of GDP of the country, which is small by African standards.

Passing a bill that allows people living in the diaspora to invest in the financial sector, buy shares, and set up lending businesses and introducing policies to establish interest-free banks and policy focused on providing residential mortgages are some of the ideas that the government has come to solve the affordable mortgage problems.

According to the Ethiopian Herald (2019) the government is also aiming a new mortgage bank, Goh Betoch (housing) Bank, which is in its final stages of establishment. The bank is expected to meet the high demand for affordable loans for housing construction and contribute to solving Ethiopia's housing problem. By its fifth year of operation, the bank plans to invest approximately Br7 billion (approximately US$201 million) annually in housing development, with a projected 32 percent return on investment. Although foreign banks are currently not permitted to operate in Ethiopia, there are plans in place "to open the financial sector in the global market".

The article on Ethiopian Herald (2019) also shows looking in to the worlds' current situation in the context of COVID-19, it is unclear if commercial banks cut lending rates. However, to ease financial sector liquidity constraints, facilitate debt restructuring and prevent bankruptcies triggered by the pandemic, the central bank injected Br15 billion (US$431 million) to private banks. The largest commercial bank (CBE) was provided with additional liquidity of Br33 billion (US$948 million) and introduced a three month (April to June 2020) debt relief on mortgages, for affected clients.

2.2.4 ETHIOPIAN CURRENT HOUSING SOLUTION

According to Africa Housing Finance Yearbook 2020 there are different housing solutions in Ethiopia and the main dominant one is the IHDP condominium scheme of the government-initiated housing program in urban areas. As of 2020, the government, through the IHDP, has

built 400 000 condominiums, indicating that there is still a significant supply gap. In an effort to increase home ownership opportunities, the government of Ethiopia's 10-year development master plan sets out to build 4.4 million houses. The private sector is expected to meet 80 percent of this target. Rental houses also meet a substantial demand. Most of the rentals in the urban centers are houses owned by the government and rented to residents at a comparatively low fee. Although these houses were constructed during the past regime and are old, their number is insignificant.

Private developers (Real estates): The private sector involvement had been restricted during the period between1974 – 1991. This was mainly due to the socialist ideology of the government that was dictated by the 1974 proclamation. A report by the World Bank in 2005 indicated that the private real estate developers cover only 0.6% of the housing stock. Even though, the figure reached to 3.8% between the period 2000-2011, it was still very low when compared with 61% by the government and 35.1% by individuals (Journal of EEA, Vol. 36, July, 2018).

2.2.5 SHIPPING CONTAINERS

2.2.5.1 THE INVENTION OF THE SHIPPING CONTAINER

In A brief history of shipping containers, the shipping container invention was by Malcolm McLean In 1952. McLean owned a trucking business in the United States of America, who purchased a steamship company because he wanted an easy method to transport goods from the truck to the ship. The theory was that the vessel for storage itself needed to be transportable, not the goods within (Sophie Koenig, 2016).

The article on the history of shipping containers states, patented in 1956 after numerous tests, the first ISO container was born. It was stackable and built with steel. Reinforced corners made it possible to stack the containers without causing damage. They were uniform in size, theft-proof, and easy to load. Buyers and sellers of goods quickly saw the potential of container shipping, and only after six years later in1961, the international standards for container size for the first time were agreed – making way for container ships to use for transport goods between countries. In 1968, ISO 668 was introduced, which defined the dimensions we use today.

ISO Standards (seven common lengths)

- 8 ft. (2.43 m)
- 9 ft. (2.99 m)
- 20 ft. (6.10 m)
- 40 ft. (12.19 m)
- 45 ft. (13.72 m)
- 48 ft. (14.63 m)
- 53 ft. (16.15 m)

The most commonly used ones are 20 ft. (6.10 m) and 40 ft. (12.19 m) Containers.

Figure2. 1 Modern shipping containers

2.2.5.2 SHIPPING CONTAINER TRANSFORMATIONS

History of the Shipping Container, (2020) state that ISO shipping containers are the rugged modular structures in the world. They are stackable, easy to cut, relatively cheap, and plentiful. So it's not surprising they have other uses. Storage sheds, generator housing, and even housing for humans are just some of the many. The article of the 1977 architectural report looked at the possibilities of using containers for structural purposes by the US military. It wasn't until 1987 that the first container homes started to appear.

Using containers for construction purposes was born due to the surplus of shipping containers in countries. In many western countries like the US, they import a lot more than they export.

When goods ship into the country, the shipping container is not used to export goods back. It means that there is a surplus of shipping containers. Based on the US Department of Transportation: Maritime Administration, in2012, the US imported 17,541,120 TEU's, yet only exported 11,935,906. Since there was a surplus of shipping containers in the US and it's usually not very efficient to melt them down and make them into other steel products, reusing of Shipping Containers was explored further. (Shipping Container History: Boxes to Buildings, 2020)

The article Shipping Container History, Boxes to Buildings reveals that the first official record of a shipping container home was a man named Phillip Clark. On Monday, November 23, 1987 GC, Clark filed a patent called the "Method for converting one or more steel shipping containers into a habitable building." in the patent, Clark outlines how shipping containers can be beard on a weight-bearing foundation to create a habitable building. He claimed that shipping containers make the perfect modular building material. He also commented that shipping containers could be reused as construction materials to make homes economically. It took two years for the patent to get granted. On August 8, 1989, Clark presented with his approved patent #US4854094A.

Even though Filip Clark consider as the inventor of shipping container homes, he was not the first person to ever think of shipping containers as construction material (Shipping Container History May 11, 2020). In 1985, in the film Space Rage, shipping containers were used as a construction material to make numerous buildings on the production set. Going way back into the 1970s, UK architect Nicholas Lacey wrote his university thesis on the concept of reusing shipping containers and turning them into habitable dwellings. He has since gone on to construct several of these shipping container buildings with Urban Space Management.

There are still findings of earlier examples of shipping containers being used as buildings starting back in 1962. On October 12, 1962, Insbrandtsen Company Inc. filed a patent titled Combination shipping container and showcase. Within this patent, Christopher Betjemann is on the list as the inventor. and it states that shipping containers can be used as an exhibition booth when companies are touring and showcasing their products. (Shipping Container History: Boxes to Buildings)

Exploring the shipping container mainstream, researchers show that; In 1994, Stewart Brand, an American writer, published a book titled How Buildings Learn. In it, Brand goes on to write ideas about how to convert shipping containers into office space. It was the first publication that

mansion building with shipping containers. From here, shipping container homes started to gain momentum, and the first completed build we could find on record was the "The Simon's Town High School Hostel." The project was conceived when Safmarine donated forty used shipping containers to Simon's Town High School. The school wanted to use the containers to build a hostel. It was capable of housing 120 people at any given time. The project cost a total of $227,000 and was ready for its first guests on November 30, 1998.

In 2006, Peter De Maria, a Californian Architect, designed the first shipping container home in the US. Known as the Redondo Beach House, the home was approved under the national Uniform Building Code (One of the predecessors of the IBC) and completed in 2007. It was the first shipping container home (The Container House by Monica Michael Willis).

Figure 2. 2 Shipping Container Home

2.2.5.3 FEATURES OF SHIPPING CONTAINERS.

- **Structure -** The boxes have sides that are not flat, and have multiple surfaces. The corners have cast "feet" that allow for the boxes to be stacked up to 7 boxes tall. They also have two doors at each end and there are twists lock fasteners at all corners.12 columns that are used to create the frame. They allow for the walls to be held up. (GDV, 2018)

  "Thermal Performance assessment of shipping container architecture in hot and humid climates" states Shipping container is made out of weathering steel and it comprises of four corner posts with castings, two bottom side and two top side rails, two bottom cross

members, a front top end rail and a door header which are the major load bearing elements while the side walls, end wall, and roof bears the least load which is dependent on the material used for that particular component (Ghada Mohammad Elrayies,2017).

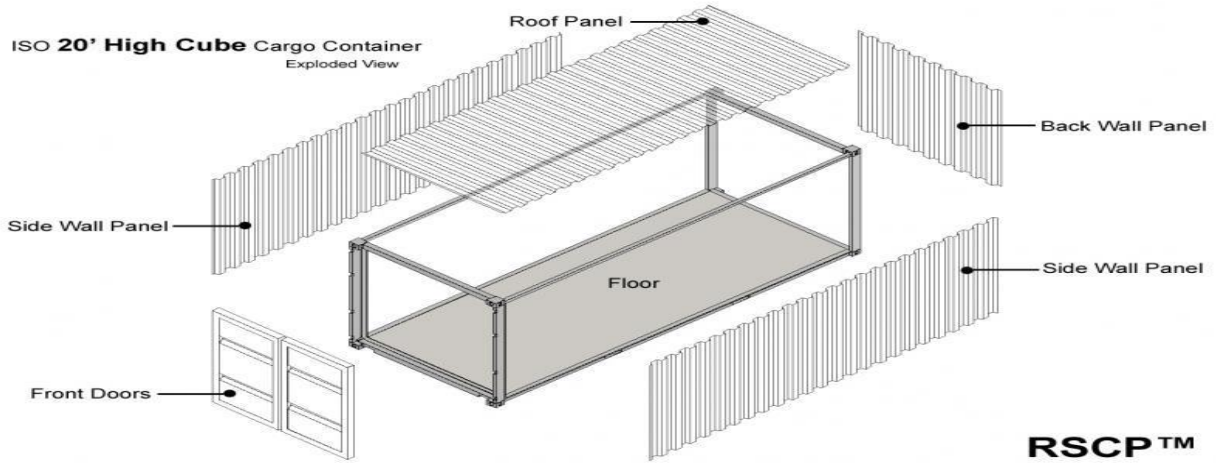


Figure 2. 3 Shipping Container Structural Feature (Ghada Mohammad Elrayies, 2017)

According to the research by (Ghada Mohammad Elrayies, 2017), Modified shipping containers require no foundation, no assembly and little space in which to be placed. They can be quickly outfitted and delivered using nearly every means of transport available, whether it is by truck, plane, boat or train. Their portability means they can be sent to even remote or inaccessible areas. In addition, their standard, modular sizes mean they can be arranged in a variety of ways that optimize square footage, while keeping their collective footprint to a minimum.

On an article called shipping containers favorable features(STB, 2016), it state that shipping containers are built to withstand the corrosive elements of the high seas, conditions that are some of the most intense on the planet. Because they're designed to hold tons of cargo and be stacked one on top of another during long ocean voyages, shipping containers are extremely durable and weather- and water-resistant. The shipping container's floors are made of planking or plywood, which is very strong and resilient, does not dent and may be easily replaced during repairs. The panels are varnished with a protective coating, which makes sure that bugs and other pests aren't present in the wood. The steel frame is welded and sealed to be both wind and watertight.

New containers are often used only one time — on a one-way trip — because it’s more advantageous for the shipping company to sell the container than it is to return it empty to its point of origin. Used shipping containers that made more than one trip are less desirable for container homes. Why? Their water-tightness may have been compromised, and they are more likely to be damaged.

2.2.5.4. SHIPPING CONTAINER STRUCTURAL MODIFICATION

Since Shipping containers are originally presented to storing and transporting goods, it is made as a rigid box. And as a structural component in building construction, they require some modification to create openings to install windows, doors, other openings and insulation.

In the process carrying out these modifications, the structural strength of the shipping container might be lost which makes the balance of load during the process of creating those openings and high modification; as such minimal modification will be of greater value in cost reduction. Being sure to have a simple design and to maintain the container's structural integrity is the most important aspect of design.

As containers boast strengthened corners, they can handle the stacking of other units, and they are easy to place on most foundations. This ties in with the cost as a simple foundation can be used for architects, depending on the nature of a development.

Containers can be used for different types of structural features like office buildings, temporary military camps, stores, shopping centers, restaurants, residential unit, luxurious sweats and others.

Figure 2.4 Highly modified shipping container home

Figure 2. 5 Slightly modified shipping container home

2.2.6.5 ADVANTAGE AND DISADVANTAGE OF SHIPPING CONTAINER HOMES.

According to Justin-Anley article Published on July 11, 2016, Advantages and disadvantages of shipping container homes is: -

Advantages of a container home:

- Ideal building material. These containers are well known for their durability, adaptability, Lightweight, low cost, and ease of stacking, creating a recycling trend that we are feeding off.
- They are easy to build into a home.
- They can be properly insulated and prepared to be a warm and cozy home in the winter and cool in the summer.
- Since containers are mainly for transportation purposes, they are easy to move around when needed.
- Designed to carry heavy loads, stacked in columns, resist harsh environments - weather and resistant to salt corrosion, etc.
- They can withstand practically any extreme weather, such as hurricanes, tornadoes, and earthquakes. Standing alone, an ISBU can handle 100 miles per hour winds. Securely anchored, it can take winds up to 175 miles per hour. You can also rest assured that it will never collapse during an earthquake. By far, they make for the safest storm shelters.
- Steel shipping containers outlived their usefulness as cargo carriers within five years, and they used to sit abandoned shipyards for years. The idea is to reuse these containers and promote a “Go Green" sustainable and environment-friendly lifestyle.
- It is a relatively cheap construction material.
- Fast to build

Disadvantages:

- Still need a building permit and build codes (same as usual residential)
- Finding contractors with experience might be difficult.
- It is a fixed structural unit.

2.2.5.6 SHIPPING CONTAINERS AS A HOUSING SOLUTION

According to shipping container experts Cleveland Containers on their web page, House prices are soaring across the world, which is placing home ownership out of reach for millions. And that's just in the developed world. Around 850 million people are currently living in "informal settlements".

Cleveland Containers explained that shipping container homes are single or multi-family residences that use new or used shipping containers as their primary material. A 2019 report on shipping container homes predicts that by 2025, container homes will be a $73 billion global industry. Since containers are usually in use for one way purchase, Millions of shipping containers are going unused worldwide which make them available for use.

Using shipping containers for accommodation is a form of modular construction. Most of the work can be done off-site, and then it's simply a case of transporting the containers to location for installation. Because of this, it's possible to completely transform areas in a very short time frame.

2.2.5.7 SHIPPING CONTAINER HOMES IN DEVELOPING COUNTRIES

Shipping Container homes in developing Countries are a new industry and not many studies are presented on the feedback on current bases. According to different studies most countries, especially the developing ones are in need of different housing solutions due to a major backlog of families waiting for homes. This has led to various companies implementing low-cost housing solutions, and one of the best brainwave ideas turned out to be container structures. On an article called "How much do shipping container homes cost in South Africa?" (Johannes van Graan20 June, 2019), "the price of shipping container homes is nowhere near the price you'd pay for a traditionally built house!" and are very much cheaper.

On an article on 13-south-african-homes-built-in-old-shipping-containers shows currently shipping containers are starting to be accepted in South Africa. In modern architecture and design, they are increasingly coming across innovative and creative ways to build sustainable homes. One of the ways this country ensures is by getting in touch with a container home

shipping firm who not only ship the structure but can also build the structure as well. Companies like A4AC Architects, and Big Box Containers has accomplished several projects in Africa.

On a study done in Nigeria on shipping container as an alternative housing solution by Lukmon Abiodun Balogun, The demand for affordable and adequate housing has been on the increases over the past few years. There are several reasons for the increasing housing deficit in Lagos and rapid urbanization alongside the regular rise in population is the main one, which seems to be the main problems that cause house deficit worldwide.

2.2.5.8 SHIPPING CONTAINERS IN ETHIOPIA.

According to National Bank of Ethiopia, Imports in Ethiopia averaged 3,014.48 USD Million and exports in Ethiopia averaged 650.96 USD Million from 2006 until 2020 which shows the country import more than export. And this can lead to assume that the cargo containers used for shipping are surpassed in the country. Even though there are no studies it can be found that used shipping containers or available shipping containers for construction purpose in Ethiopia, in the past few years the country has been using shipping containers to build site office and commercial centers.

2.3 EMPIRICAL LITERATURE

2.3.1 RESEARCHES ON SHIPPING CONTAINER HOUSES AS HOUSING SOLUTIONS

Several studies have been conducted in relation to shipping container houses around the world. (International Journal of Engineering and Technology, 2018); on the Feasibility of using ISO Shipping Container to build low-cost housing in Malaysia, the research findings show that the development of container houses in Malaysia is partially recommended as there are 45% of Malaysian citizens who can accept the idea of living inside a container house. And on analysis done on four companies, all have rated 50% trust in the development of container house in Malaysia. As a recommendation, future research should also investigate the perception of the government sector about the feasibility development of container houses in Malaysia.

In another research called Implication for using shipping containers to provide affordable housing (Minenhle Maphumulo, Nov 2016), the report looked into a new type of house typology

called “the 61 on Countesses building” in the Windsor East neighborhood that is catering for the low to lower-middle income earners. The existing container housing typology utilizes a case study to understand the experiences and perceptions of residents within and around the development. A series of qualitative interviews with ten residents in the study area was conducted, employing standardized discussion guidelines to analyze the views held towards this specific container residential development and the experience of the tenants in the “61 Countesses building”. The findings have shown that residents see the container development as adequate housing and their respective units as homes where they can generally express themselves, grow and develop.

A Case study in Lagos, Nigeria by (Lukmon Abiodun Balogun, 2018) showed that in Lagos, the price of a shipping container is almost the same and somewhat higher than that of a conventional building if similar standards are put in place. Therefore, the provision of shipping container housing as an alternative is viable as it is fast to construct yet difficult as a suitable alternative to compete and possibly replace conventional buildings. In the case study survey result, shipping containers are acceptable by the community if they fulfill their choice of housing to rent or buy such a house. Result come-up as 16% will not rent or buy such a house even though it achieves their housing needs, and 84% of the respondent will rent or buy, such housing which shows the given solution was somewhat acceptable by the community. Therefore, extensive enlightenment and practical experience are recommended to comprehend that shipping container homes are as good as any home when constructed, made affordable, and environmentally friendly.

According to the study, further studies are necessary to prepare a suitable subsidized program for shipping container housing development. The program will also give more insight to private landowners and developers. The study also discussed how to significantly reduce the price of shipping container houses using local materials compared to current prices in and around Lagos. And how lower, lower-middle-income earners will be able to purchase it using less than 30% of their salary.

In addition, it suggests how great of an advantage it is to combine shipping container housing with conventional housing methods. To provide an adequate amount of housing in Lagos,

knowing that the current construction methods cannot deliver the needed numbers of housing annually as the population of Lagos is nowhere near reduced.

2.3.2 STUDIES ON SHIPPING CONTAINERS AS HOUSING SOLUTIONS IN ETHIOPIA

Shipping container as a housing solution for Ethiopia is a new concept. There is no clear sign of how far Ethiopian society can accept this idea. There is no indicator of what the expectations from Ethiopian society about the container house. This research serves as a base reference for both government and private sector to the future property industry development of shipping container houses in Ethiopia.

Even though shipping containers are commonly used nowadays, like construction site offices, marketplaces, and other small business centers looking back on research done in Ethiopia, there are no research findings on shipping containers as building materials.

2.3.3 RESEARCH GAP

Looking in to research questions that are done in Ethiopia regarding Ethiopian housing condition and current alternate housing solutions in the country, there are many studies and possible answers to this question. However, regarding the research question on the prospect and challenges of using shipping container as residential unit: an alternative housing solution for Ethiopia, we would not find much-existing data and this is the research gap.

2.4 CONCEPTUAL FRAMEWORK

A conceptual framework is a system of concepts, assumptions, expectations, beliefs and theories that supports and informs research (Maxwell, 2005). It is a body of interrelated objectives and fundamentals. The frame work is intended to identify the prospect and challenges of using shipping container as a residential unit to come up with alternative solution for Ethiopia. The frame work is constructed to cover all the aspects regarding the research questions and meat the research objective and it is constructed as follows:-

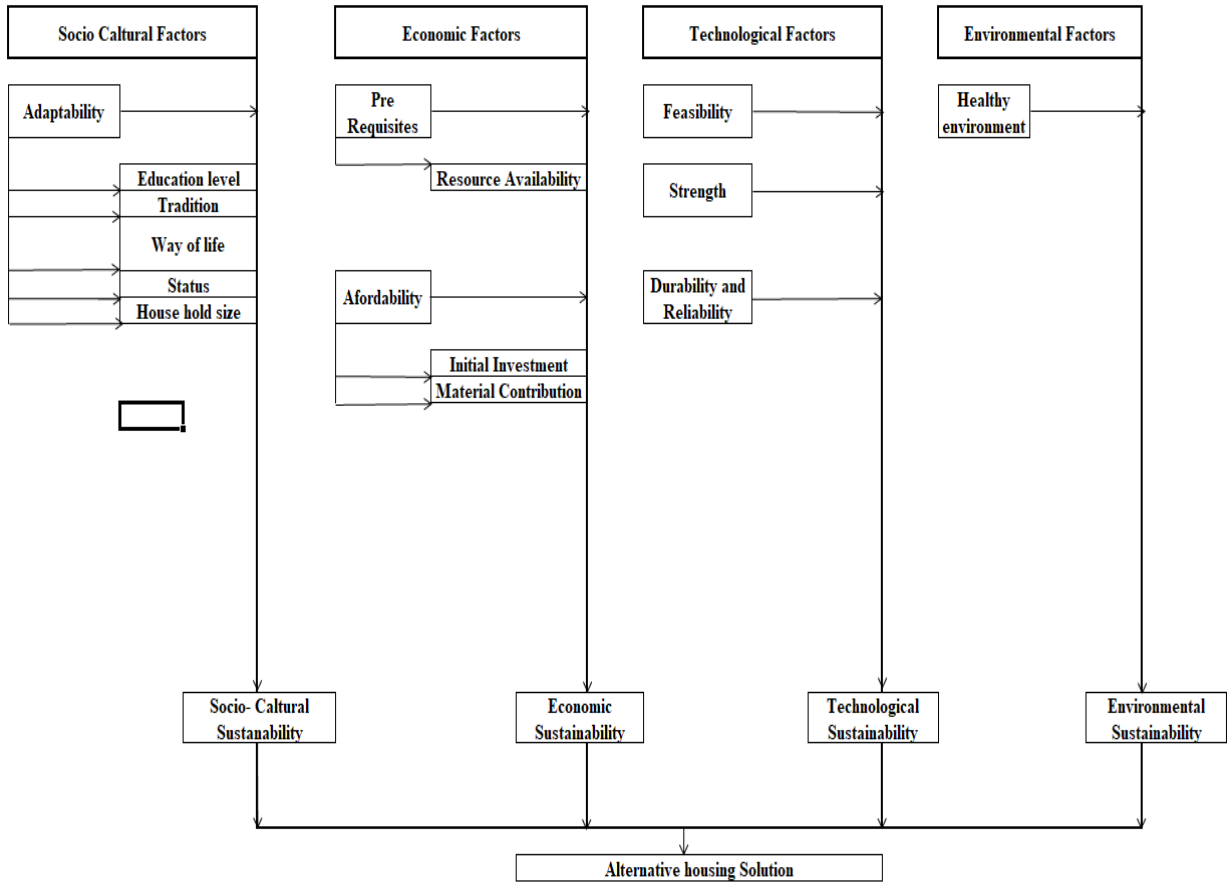


Figure 2. 6 Conceptual frame work

Socio cultural Factor

The concept of shelter differs from individual to individual depending on culture, tradition, profession and way of living. The design and materials used for the house should correspond to the user's way of living and local building traditions (Christel Ebsen and Bjarke Ramboll, 2000). Sustainable housing should respond to the socio- cultural needs and practices of the beneficiary households and communities. It is focused on housing development that promotes social interaction of individuals and cultural enrichment of the community and is aimed to reduce the inequality of housing between social classes (Islam. N, 1996). At the same time it accelerates the improvement in social development, relations and interactions.

Economic Factor

The most important financial resources are the actual and potential savings of the inhabitants. This probably represents between 10 to 15% of all personal incomes (Turner, J, F, C 1976). Housing programmers may be linked to programmers generating employment or income enabling the poor to afford their own houses and maintain them (Bhattacharya, K, P 1994). The housing sector is employment intensive; it generates employment during the construction period and also during its life for proper maintenance providing employment opportunities for skilled as well as unskilled labor (Glaeser, B 1995 and Tiwari, P 2001). Economic sustainability or affordability of housing should be embedded in an economic development strategy, which strengthens the economic self-reliance of household members.

Technology Factor

Alternative materials, methods and techniques of construction replacing conventional building construction can result in reducing the depletion of natural resources and save energy (Reddy, B, V, V and Jagadish, K, S 2001). Technology can be said to be sustainable only if, it takes advantage of local resources and can be produced locally using unskilled labor, utilizing already available materials without the need for heavy capital investment. It should benefit as many people as possible and should be flexible and functional.

Environmental Factor

Environmental sustainability in housing can be achieved by addressing resource limits of the environment through efficient consumption of non-renewable resources, minimizing the impact of waste materials and pollution by utilizing appropriate technologies and making use of local work forces. The construction industry is involved in activities, which adversely affect the environment through the over exploitation of non-renewable resources.

2.5 RESEARCH HYPOTHESIS

"Hypothesis is a formal statement that presents the expected relationship between an independent and dependent variable."(Creswell, 1994)

Null hypothesis represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

Alternative hypothesis is a statement of what a hypothesis test is set up to establish.

- Opposite of Null Hypothesis.
- Only reached if H0 is rejected.
- Frequently “alternative” is actual desired conclusion of the researcher!

H0 = Null hypothesis = There is no significant relationship between variables

H1 = Alternative = There is significant relationship between variables.

$H_{O1=}$ There is no significant relationship between Age and (Suitability) = Shipping container houses are suitable for my income type and social status.

$H_{O2=}$ There is no significant relationship between Age and (Incentives or subsidy) = If the government puts incentives/subsidies on container houses renting, buying will be convenient for people to acquire one.

$H_{O3=}$ There is no significant relationship between Age and (Likely to buy or rent) = If a shipping container house fulfills all your choice in question number 5, (on the economic factor), it is likely for people to rent or buy such an apartment or house.

$H_{O4=}$ There is no significant relationship between education level and (Suitability) = Shipping container houses are suitable for my income type and social status.

$H_{O5=}$ There is no significant relationship between education level and (Incentives or subsidy) = If the government puts incentives/subsidies on container houses renting, buying will be convenient for people to acquire one.

$H_{O6=}$ There is no significant relationship between education level and (Likely to buy or rent) = If a shipping container house fulfills all your choice in question number 5, (on the economic factor), it is likely for people to rent or buy such an apartment or house.

$H_{O7=}$ There is no significant relationship between Income level and (Suitability) = Shipping container houses are suitable for my income type and social status.

$H_{O8=}$ There is no significant relationship between Income level and (Incentives or subsidy) = If the government puts incentives/subsidies on container houses renting, buying will be convenient for people to acquire one.

$H_{O9=}$ There is no significant relationship between Income level and (Likely to buy or rent) = If a shipping container house fulfills all your choice in question number 5, (on the economic factor), it is likely for people to rent or buy such an apartment or house.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1INTRODUCTION

This chapter shows the design and methodology of the study that to approach the research objective. The section specifies the type of research conducted, the work designed, and the methods used in carrying out the research.

A research method is a strategy used to implement the research approach. Research design and methods are different but closely related; because good research design ensures that the data obtained will help to answer the research question more effectively (Kassu Jilcha Sileyew, 2019)

3.2 RESEARCH DESIGN

The research explores the possibility of a shipping container as an alternative housing solution to fill the housing backlog gap in Ethiopia. The type of research designs used to do the research was explanatory research design and descriptive research design. Explanatory research design is one of the research design types that establish a relationship between the cause and effect of a particular happening. Descriptive research design is the other design type which is a theory-based design and is a way of describing the topic which; is the subject of the research. This method includes data collection, analysis, and presentation. The process helps present the problem statement that allows others better understand the need for this kind of research.

3.3 RESEARCH APPROACH

The research approach is also both qualitative and quantitative type of approach. A qualitative research approach is an approach that explores the behavior, perspectives, experiences, and feelings of people which, emphasizes the understanding of these elements and also collects data on shipping container availability and affordability. The quantitative approach is emphasizing on objective measurements. The statistical, mathematical, or numerical analysis of data; is collected through questionnaires and surveys.

A quantitative approach was to compare b/n the concrete house and Container house using the same design. By first doing data collection on material cost, labor cost, and other building construction costs, an analysis will be carried out on both, by estimating the total construction cost of each.

3.4 POPULATION, SAMPLE SIZE AND SAMPLING TECHNIQUES.

3.4.1 POPULATION

The population sample was taken from Addis Ababa, Ethiopia, the most urbanized city in the country. The population is then divided, into subgroups which are by gender, education level, and employment status, the highest level of education, and income level) to do the analysis and ensure to have an insight from each subgroup accordingly.

Based on the article by Marianna Charitonidou on February 2021, she states Felix Heisel notes, "Addis Ababa was burdened by a housing shortage of an estimated 700,000 units". According to this the housing backlog of the city is considered as 700,000. Since the research is intended to study whether shipping container has the potential in reducing this gap, And taking 700,000 potential buyers by taking one owner for each house, the population size is taken to be 700,000

3.4.2 SAMPLE SIZE

The sample size is selected; by taking the data below into consideration.

- According to housing provisions and affordability in private residential real estates in Addis Ababa, Addis Ababa's population is estimated to be 4.6 million (Journal of EEA, Vol. 36, July 2018).

- Felix Heisel notes, "Addis Ababa was burdened by a housing shortage of an estimated 700,000 units" in 2017 (Marianna Charitonidou, February 2021)

- On a survey done on Household Population and Characteristics, the average household size observed is estimated to be 4.8 persons. (Ethiopia DHS, 2000)

The data implies there is a 700,000 housing shortage. The study aims to fill this gap so, the population size (N) is 700,000. And the sample size is determined as follows using Slovin's formula.

$n = N / (1 + Ne2)$

Where:

n = number of samples,

N = population size and

e = Error tolerance (level). Where e=0.05-0.09…. taking 0.05

$$n= \frac{700000}{(1+(700000\times 0.05^2))} =399.77\approx 400$$

So by taking the number of samples which is 400 respondents, the questions were distributed in all 11 sub-cities using Google surveying link and manually.

3.4.3 SAMPLIQNG TECHNIQUES

The sampling techniques of the study are simple random sampling methods. The samples are selected randomly from a subset of the population which means the population has an equal chance of being selected. The sampling method is used when the sample size is large and to cull a smaller sampling size that can generalize the larger group.

3.6 TYPES OF DATA AND TOOLS/INSTRUMENTS OF DATA COLLECTION

The data collected on the research is both qualitative and quantitative in nature. The data gathering tool was questionnaire. And surveying on construction material cost in Ethiopia and using goggle surveying.

3.7 PROCEDURES OF DATA COLLECTION

The procedure followed to collect data is by distributing 400 questioners to different peoples, at different ages (above18), living standards, and educational levels using a manual questioner and Google surveying link (https://bit.ly/3aZoRPE). And the questioner was filled by them and collected accordingly. Google surveying was another way to gather online data. It helps in the study, especially gathering the current construction market materials and laborers (https://con.2merkato.com/prices).

3.8 METHODS OF DATA ANALYSIS

After the data gathering, the questioners were checked, evaluated, refined, organized, tabulated, and put in frequency and percentage form using Microsoft excel software, Google survey soft were, and IBM SPSS statistics analysis. The Questioner is attached, in APPENDIX1 and it is prepared both in English and translated to Amharic to include those who can't understand the English language. Their answers are translated and analyzed accordingly. A detailed IBM SPSS statistical outcome are included on APPENDIX2. The Final data analysis is

on the construction material by estimating the cost and comparing the current commonly used; construction materials concrete and the new alternative presented solution by taking a sample design (The design and analysis, on APPENDIX3).

3.9 ETHICAL CONSIDERATION

Ethical consideration is a significant part of doing a survey. There are different Ethical grounds to take into consideration. Taking the most important principles related to ethical considerations by Bryman and Bell (2007) in into account, ethical considerations during doing the survey were as follows:-

- Research participants were not subject to harm in any way whatsoever.
- Respect for the dignity of research participants; was prioritized.
- Full consent from the participants before the study; was obtained.
- The privacy of the participants was protected and ensured.
- An adequate level of confidentiality of the research was in place.
- The anonymity of individuals and organizations who participated in the survey was protected.
- Any deception or exaggeration about the aims and the objectives; was avoided.
- Affiliations in any form, sources of funding, as well as any possible conflicts of interests, were declared.
- Any communication concerning the survey was with honesty and transparency.
- Any misleading information or representation of primary data findings in a biased way to the participants; was avoided.

3.10 RELIABILITY TEST

Reliability refers to the degree to which; a test is consistent and stable in measuring what it measures. The reliability of the surveying result was analyzed using the IBM SPSS Application. The application analyzed; the correlation between the variables and the probability of the hypothesis. The test is reliable when the reliability coefficient must be 0.7 or higher.

3.11 VALIDITY TEST

A validity test is an extent to which a test accurately measures what it is supposed to measure. The test was valid because the analysis was done using SPSS which shows the dependent and independent variables of the study to be a high coefficient of correlation, which indicates the assumption and method used in the study are valid.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter summarizes the data presentation, analysis and interpretation. The data obtained through the questionnaire was analyzed and interpreted accordingly presented as such. In addition, material cost estimation and comparison; were analyzed and interpreted.

4.2 DEMOGRAPHIQC CHARACTERSTICS OF SUREY RESPONDES

1. SUB-CITY

The survey was targeted to get Four hundred people to participate and intended to cover all sub-cities of Addis Ababa. While four hundred four people participated, four out of four hundred four were not from the city. The highest respondents were from Kolfe Keraniyo (K/K) Sub-city. The bar chart of the Sub-city of the respondents that filled the questionnaire is as follows:-

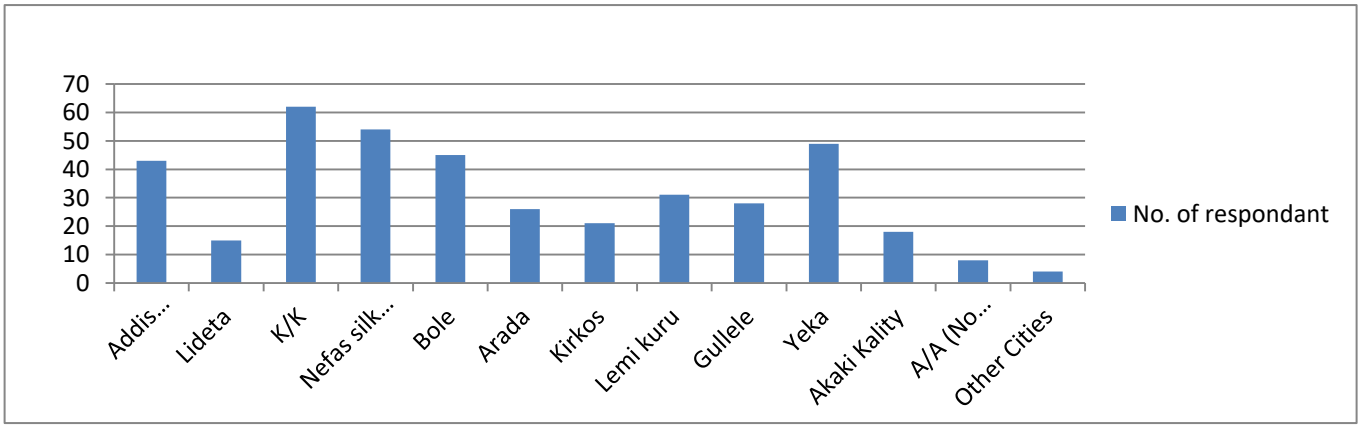


Figure 4. 1 Sub city of respondant

2. Gender

Among The respondents on the chart below, the Female respondent estimated to be 48.8%, and the Male respondents were 51.2%.

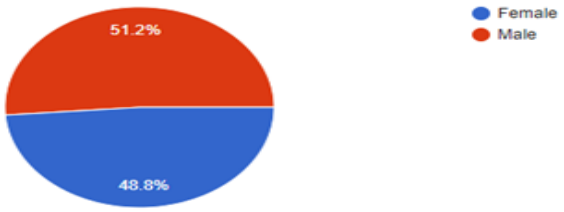


Figure 4. 2 Gender of respondant

3. Age Distribution of the respondents

The result shows, most of the respondent is between the age of 21 to 29, which is about (227) 56.2% of the responses. The second-largest group of respondents is between the age of 30-39. (98) 24.3% of the responses followed by the age range between 40-49, with (29) 7.2% of the response. The fourth-largest group respondent age is between 18-20. with (21) 5.2% of the responses followed by the age range between 50-60, with (17) 4.2% of the response. Lastly, the respondents falls within 60 & above with (9) 2.2% responses and the list of all (3) 0.7% of the responses are from the age 18 and below 18.

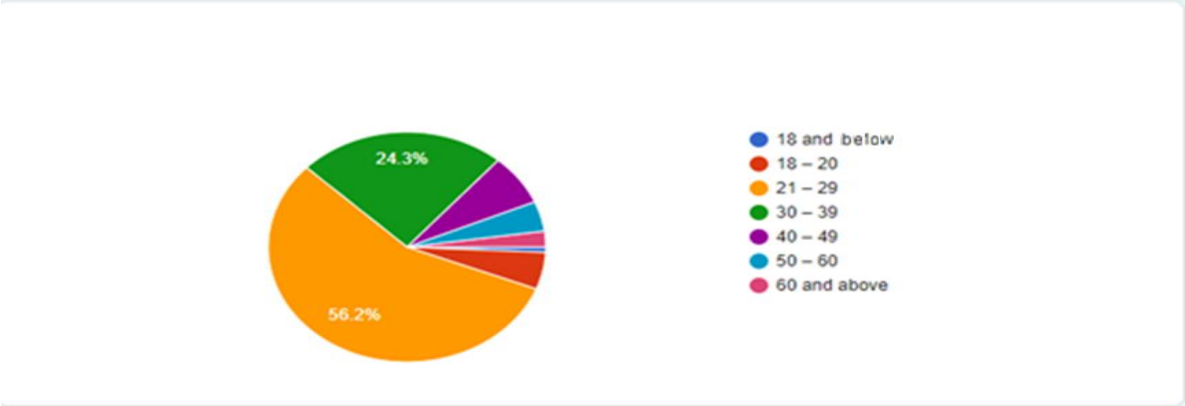


Figure 4. 3 Age of respondant

SOCIO CULTURAL FACTOR

1. Employment Status

63.4% (256) of the respondents are employed, 17.1% (69) are entrepreneur, 13.1% (53) are Unemployed, 2.7 % (11) are retired and 2.7% (11) of the respondents are students.

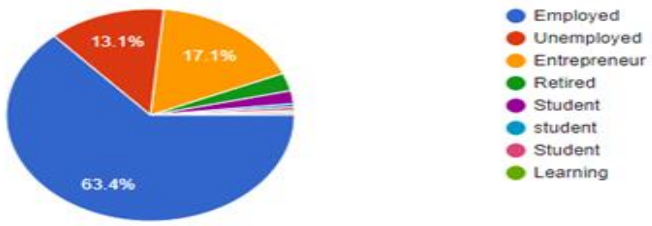


Figure 4. 4 Employment status of respondant

2. Level of Education

Most of respondents are with higher education levels. 59.7% (241) respondents have Bachelor degree, 18.8% (76) respondents have 10+1, 10+2, 10+3 and Diploma, 13.4% (54) respondents have Master degree, 6.2% (25) respondents attended secondary education, 1.7% (7) respondents attended Primary education and 0.2% (1) respondent Have PhD.

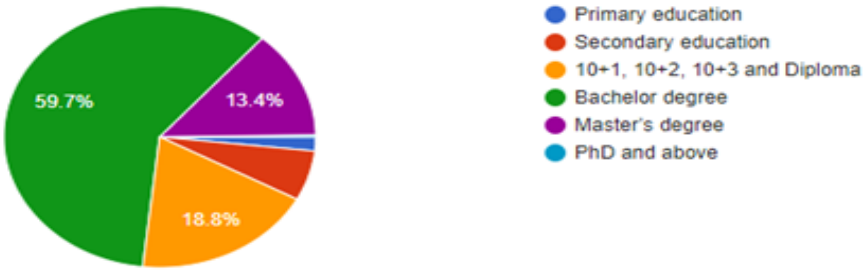
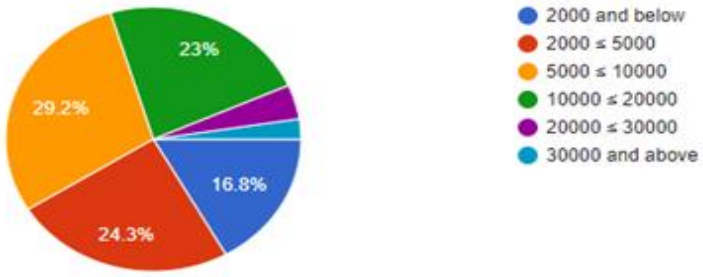


Figure 4. 5 Level of education of respondant

3. Monthly Income level

29.2% (118) of the respondents' monthly income level is between 5000 – 10000, 24.3 (98) of the respondents' monthly income level is between 2000 – 5000, 23% (93) of the respondents' monthly income level is between 10,000 – 20,000, 16.8% (68) of the respondents' monthly income level is between 2000 and below, 4.2% (17) of the

respondents' monthly income level is between 20,000 and 30,000 and 2.5% (10) of the



respondents' monthly income level is between 30,000 and above.

Figure 4. 6 income level of respondant

4. **Current Living situation**

   48% (192) of the respondants are living with others but not paying mortgage or rent, 34% (135) of the respondants are living in rental homes and 18% (75) of the respondants areliving with other s and paying mortgage or rent.

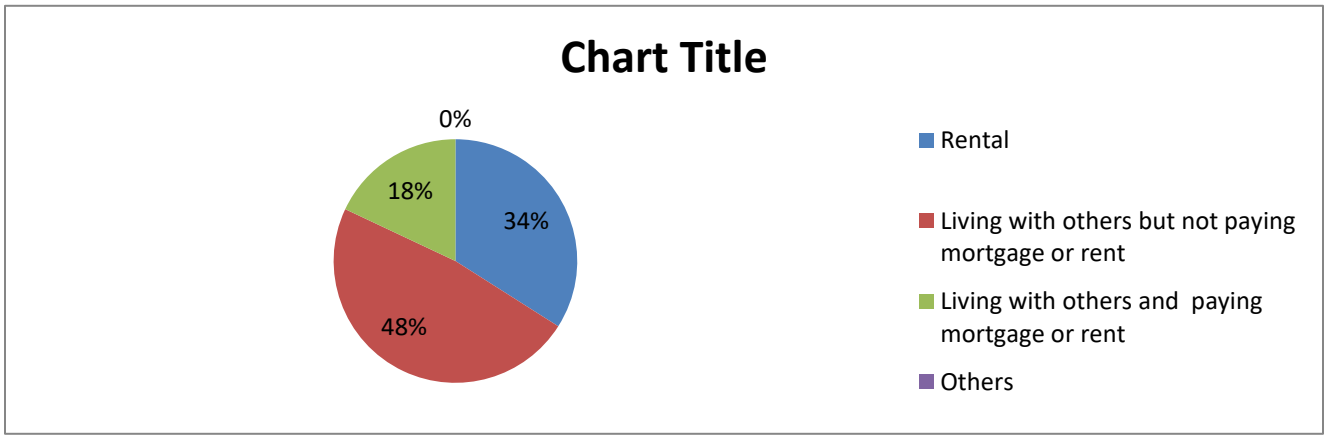


Figure 4. 7 Current living situation of respondant

5. **Factors to be considered when renting or buying an apartment/ house or building ones own house.**

This result shows; the factors the respondents consider as a priority when renting or buying an apartment/ house or building one's own. One respondent could choose more than one of the alternatives, and the response is as below

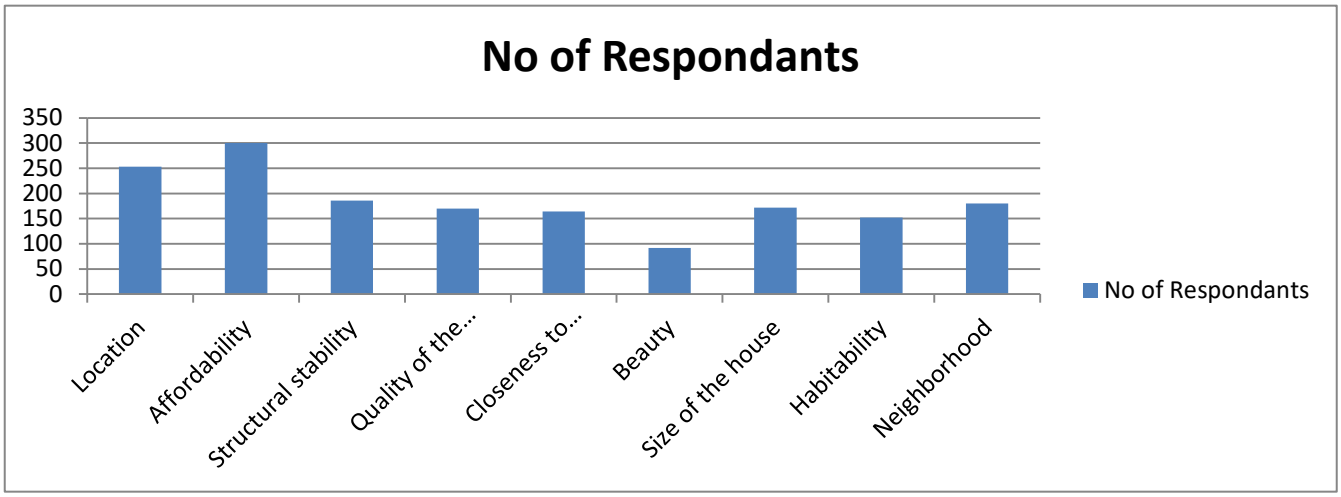


Figure 4. 8 Factors considered when buying or renting a house by respondant

6. Acceptability

When the question, if a shipping container house fulfills all the choices of housing and if it is likely for people to rent or buy such an apartment or house was asked, 38.1%(154) Somewhat agree, 30.2% (122) Strongly agree, 17.8% (72) was neutral, 8.9% (36) strongly disagree and 5% (20) Somewhat disagree.

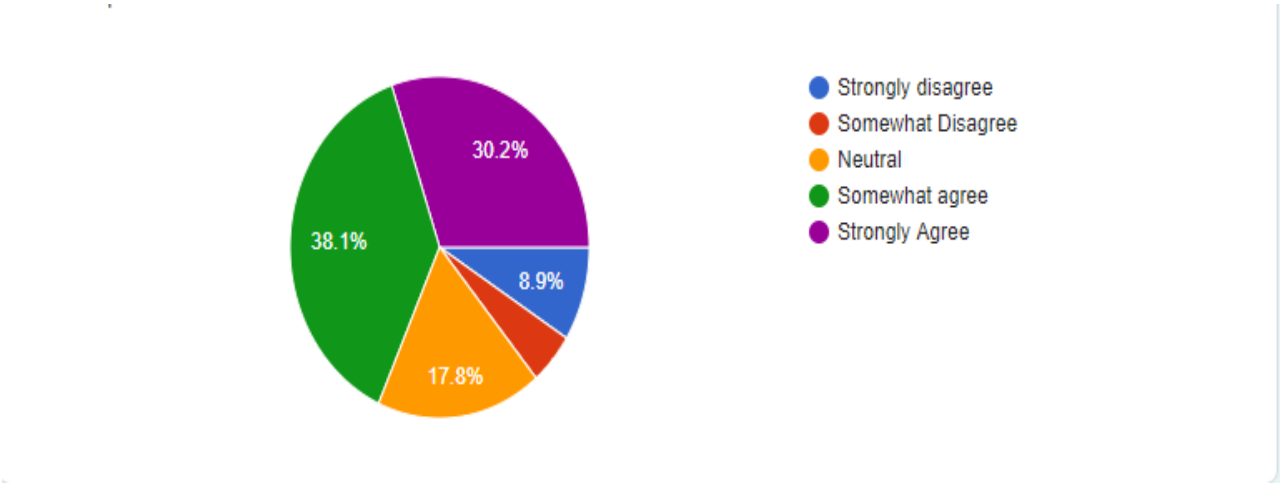


Figure 4. 9 Accaptability of respondant/ Socio cultural factor

ECONOMIC FACTOR

1. Resource availability and conveniency of using shipping container

When asked to respond to the statement, there is enough resource available, and it is convenient to use a shipping container as a residential unit. 32.4% (131) of the respondent was neutral, 29.5% (119) of the respondent somewhat agreed, 14.9% (60) somewhat disagreed, 10.9% (44) strongly agreed, and 12.4% (50) strongly disagreed.

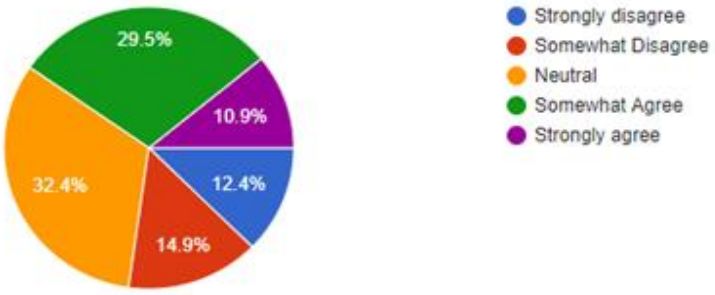


Figure 4. 10 Response on resource availability and conviniency of using shipping container

2. Suitability of shipping container for income level.

When asked to respond to the statement, shipping container houses are suitable for my income type and social status. 39.6% (160) somewhat agree, 28.5% (115) was neutral, 12.1% (49) strongly agree, 10.6% (43) strongly disagree and 9.2%(37) somewhat disagreed.

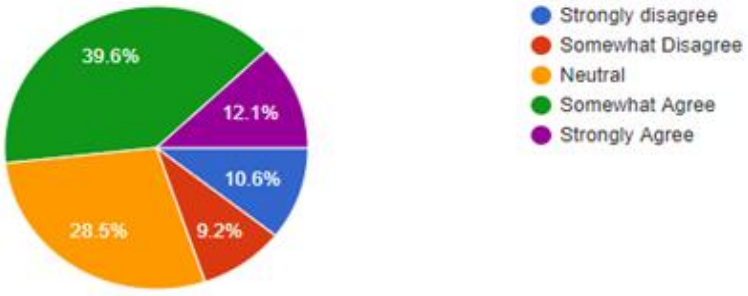


Figure 4. 11 Response on Suitability of shipping container for income level

3. **Solving Affordability problem**

When asked to respond to the statement, shipping container houses are likely to solve house affordability. 42.1% (170) somewhat agree, 35.4% (143) strongly agree, 10.4% neutral, 6.2% (25) strongly disagree and 5.9% (24) somewhat disagree.

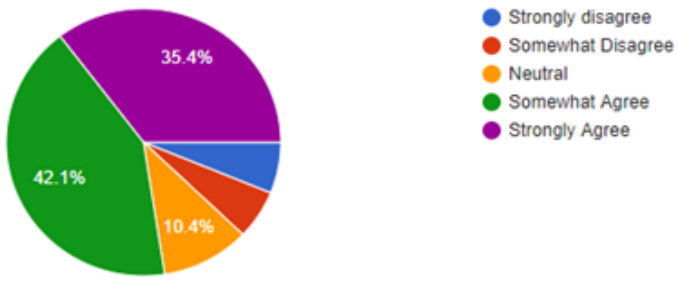


Figure 4. 12 Response on Solving Affordability problem

4. **Affordability Comparison**

To the statement Shipping container houses are likely to be more affordable than concrete houses, 35.9% (145) somewhat agree, 33.7% (136) strongly agree, 15.8% (64) neutral, 7.9% (32) somewhat disagree, and 6.7% (27) strongly disagree.

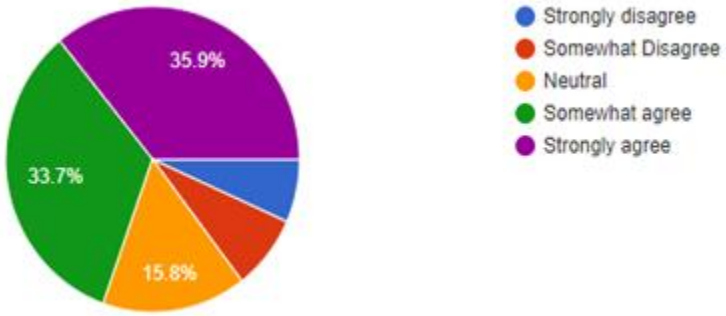


Figure 4. 13 Response on Affordability Comparison

5. **Acceptability**

When asked if the government puts incentives/subsidies on container houses renting and buying it will be convenient for people to acquire one, 40.8% (165) strongly agree, 36.9% (149) somewhat agree, 11.6% (47) neutral, 5.9% (24) somewhat disagree and 4.7% (19) strongly disagree.

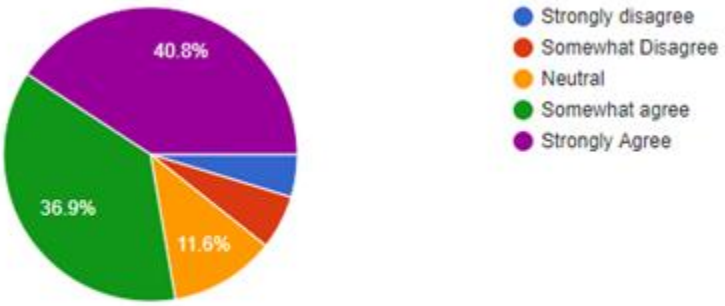


Figure 4. 14 Acceptability of respondant/ Economic factor

TECHNOLOGICAL FACTOR

1. **Feasibility**

Given a statement that says using shipping Container as an alternative housing solution is a feasible solution, 39.1% (158) somewhat agree, 35.1% (142) strongly agree, 14.6% (59) neutral, 5.7% (23) somewhat disagree, and 5.4% (22) strongly disagree.

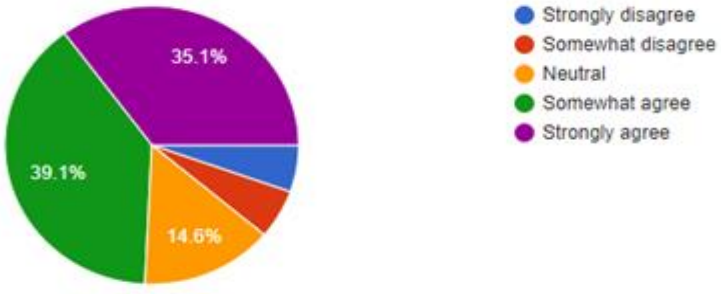


Figure 4. 15 Response on Feasibility

2. **Strength**

Given a statement that says Shipping Container houses are Strong enough to be used as construction material, 40.1% (162) somewhat agree, 21.8% (88) Neutral, 20% (59) Strongly agree, 10.1% (41) somewhat disagree and 7.9% (32) strongly agree.

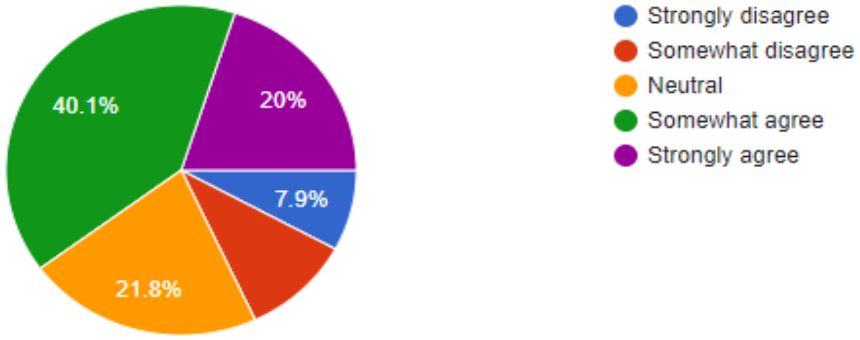


Figure 4. 16 Response on strength

3. **Durability and reliability**

On the statement that says Shipping Container houses are durable and reliable to use as a residential unit, 39.9% (161) somewhat agree, 21.5% (87) Neutral, 20.3% (82) strongly agree, 10.1% (41) somewhat disagree, and 8.2% (33) strongly disagree.

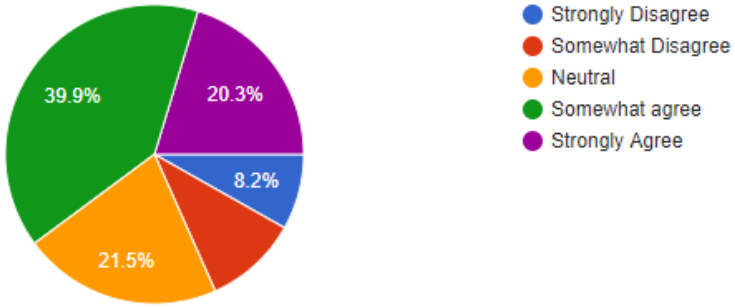


Figure 4. 17 Response on Durability and reliability

4. **Acceptability**

On the statement; shipping containers are likely to be accepted by the community if used as a residential unit, 34.7% (140) somewhat agree, 30.7% (124) strongly agree, 15.6% (63) Neutral, 11.1% (45) somewhat disagree and 7.9% (32) strongly disagree.

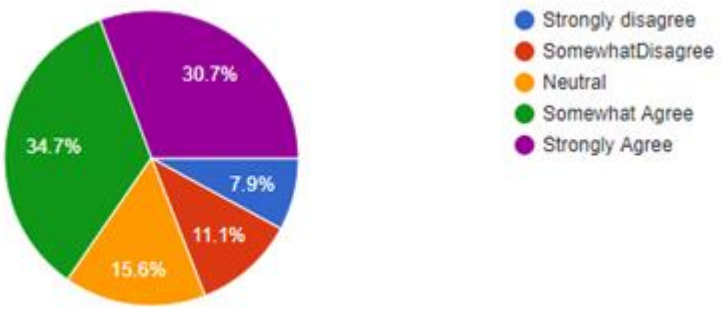


Figure 4. 18 Acceptability of respondents/ Technological factor.

ENVIRONMENTAL FACTOR

1. **Environment**

On the statement Shipping containers are environmentally friendly, 36.1% (146) strongly agree, 24.3% (98) somewhat agree, 15.8% (64) Neutral, 13.1% (53) somewhat disagree, and 10.6% (43) strongly disagree.

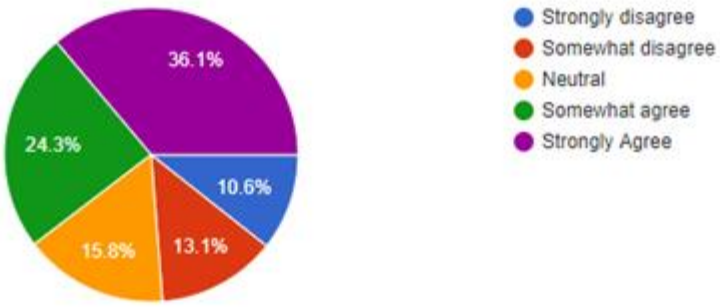


Figure 4. 19 Acceptability of respondents/ Environmental factor.

2. **Safety**

On the statement that states shipping container homes are safe as any other conventional home, 33.7% (136) strongly agree, 20.8% (84) neutral, 16.1% (65) Strongly agree, 16.1% (65) somewhat disagree, and 13.4% (54) strongly disagree.

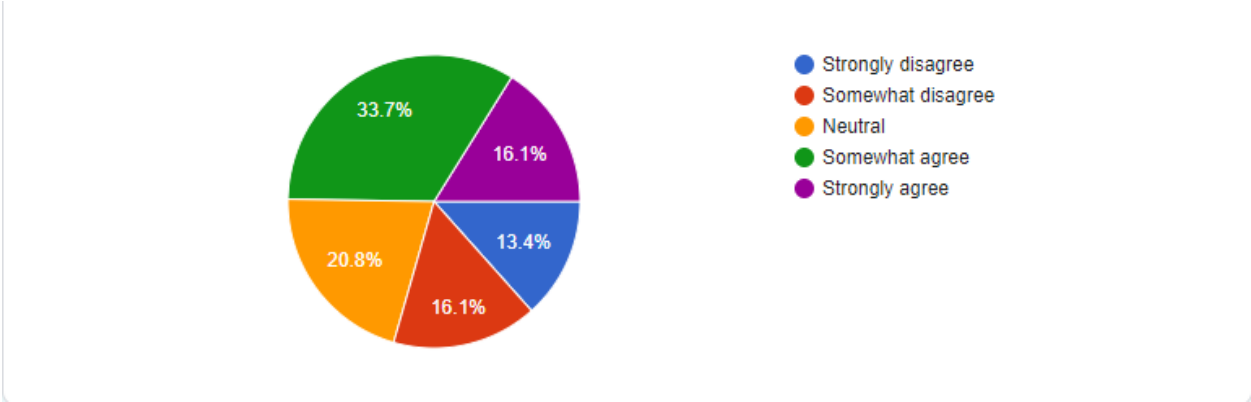


Figure 4. 20 Responses on safety of shipping container homes

3. Environmental aspect comparison

Giving the compared with other construction materials statement Using shipping container is a way to go for a healthy environment, 34.9% (136) strongly agree, 22.8% (84) somewhat agree, 19.8% (65) Neutral, 11.4% (65) somewhat disagree and 11.1% (54) strongly disagreed.

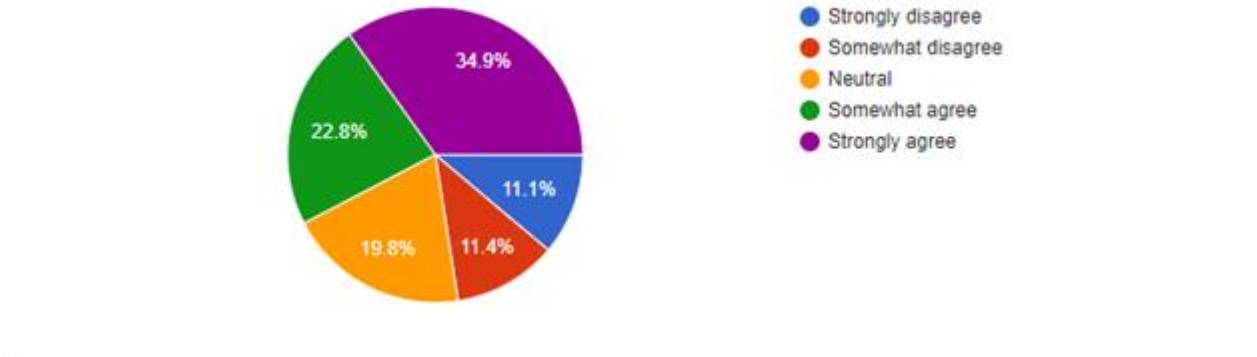


Figure 4. 21 Responses on safety of shipping container home

When participants are asked to make a general comment, recommendation, or give another opinion apart from what is in the questionnaire, the responses are as follows.

- Shipping container fast installation and flexible combination, time-saving in construction over transitional building techniques. Container houses good quality, cheap, and flexibility are all the positive features. But the question is, are container homes healthy compared to other homes
- I don’t think it’s possible because the containers are going to be returned to the issuing company.
- Since shipping containers are made of metals, it is (I believe) difficult to live in.

- Since shipping containers are made of metals, it is (I believe) difficult to live in.
- Considering shipping containers as an alternative option for residential issues 50% closer to fulfillment.
- It's a genius idea especially to solve the housing problem in AA as a low-cost home.

4.3 ANALYSING LIKERT SCALE QUESTIONNAIRE

4.3.1 RII (RELATIVE IMPORTANCE INDEX)

RII is the mean for a factor that gives weight to the respondent's perception. It summarizes the relative risk for the most advantaged group (at the top of the hierarchy) compared to the least advantaged group (at the bottom). This interpretation assumes that the variables scored so that higher scores are consistent with increased risk. Taking the surveying data result, the tables below show the RII value of each variable and their respective rankings in each classified factor.

S.A=	Strongly agreed
SW.A=	Somewhat agreed
N=	Neutral
SW.D=	Somewhat disagreed
S.D=	Strongly disagreed

SOCIO CULTURAL FACTORS	Response Ranking					Total	∑W	Mean	RII	Rank
	S.A=5	SW.A=4	N=3	SW.D=2	S.D=1	N		∑W/N		
If a shipping container houses fulfills all your choice in question number 5, It is likely for people to rent or buy such an apartment or house.	44	119	131	60	50	404	1259	3.12	0.623	1

Table 1 RII value and ranking of for socio culture factors variable.

In the socio-cultural factor section, the factor ranking value with its respective RII value ranked with an RII value of 62.3%. (if a shipping container house fulfills all your choice in question number 5, it is likely for people to rent or buy an apartment or house.).

ECONOMIC FACTOR	Response Ranking					Total	∑W	Mean	RII	Rank
	S.A=5	SW.A=4	N=3	SW.D=2	S.D=1	N		∑W/N		
1. There is enough resource available and is convenient to use shipping container as a residential unit	49	160	115	37	43	404	1347	3.33	0.667	**5**
2. Shipping container houses are suitable for my income type and social status.	143	170	42	24	25	404	1594	3.95	0.789	**2**
3. Shipping container houses are likely to solve house affordability	145	136	64	32	27	404	1552	3.84	0.768	**4**
4. Shipping container houses are likely to be more affordable than concrete houses	165	149	47	24	19	404	1629	4.03	0.806	**1**
5. If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one.	142	158	59	23	22	404	1587	3.93	0.786	**3**

Table 2 RII value and ranking of economical factor variables.

In the Economy factor section, the factors ranking value with their respective RII value is (Shipping container houses are likely to be more affordable than concrete houses) is ranked 1st with RII value 80.6%, (Shipping container houses are suitable for my income type and social status) ranked 2nd with RII value 78.9%, (If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one) ranked 3rd with RII value 78.6%, (Shipping container houses are likely to solve house affordability) ranked 4th with RII value 76.8) and (There is enough resource available and is convenient to use a shipping container as a residential unit) is ranked 5th with RII value 66.7%.

TECHNOLOGICAL FACTOR	Response Ranking					Total	∑W	Mean	RII	Rank
	S.A=5	SW.A=4	N=3	SW.D=2	S.D=1	N		∑W/N		
1. Using shipping Container as alternative housing solution is a feasible solution.	81	162	88	41	32	404	1431	3.54	0.708	**3**
2. Shipping Container houses are Strong enough to be used as construction material.	82	161	87	41	33	404	1430	3.54	0.708	**3**
3. Shipping Container houses are durable and reliable to use as residential unit.	124	140	63	45	32	404	1491	3.69	0.738	**1**
4. Shipping containers are likely to be accepted by the community if used as residential unit.	146	98	64	53	43	404	1463	3.62	0.724	**2**

Table 3 RII Value and ranking of Technological factor variables.

In the Technology factor section, the factors ranking value with their respective RII value is ranked 1st with RII value 73.8%; (Shipping Container houses are durable and reliable to use as a residential unit). (Shipping containers are likely to be accepted by the community if used as a residential unit.) is ranked 2nd with an RII value of 72.4% and (Using shipping Container as alternative housing solution is a feasible solution and Shipping Container houses are Strong enough to be used as construction material) both ranked 3rd with RII value 70.8%.

ENVIRONMENTAL FACTOR	Response Ranking					Total	∑W	Mean	RII	Rank
	S.A=5	SW.A=4	N=3	SW.D=2	S.D=1	N		∑W/N		
1. Shipping containers are environmental friendly.	65	136	84	65	54	404	1305	3.23	0.646	**3**
2. Shipping container homes are safe as any other conventional home.	141	92	80	46	45	404	1450	3.59	0.718	**2**
3. Using shipping container is a way to go for healthy environment compared with other construction materials.	122	154	72	20	36	404	1518	3.76	0.751	**1**

Table 4 RII and ranking of technological factor.

In the Environmental factor section, the factors ranking value with their respective RII value is 75.1%; (Using shipping container is a way to go for the healthy environment compared with other construction materials.). (Shipping container homes are safe as any other conventional home.) ranked 2nd with RII value 71.8%, and (Shipping container homes are safe as any other conventional home.) are ranked 3rd with RII value 64.6%.

4.3.2 MEAN AND STANDARD DEVIATION

The standard deviation is a measure of the amount of variation or dispersion of a set of values. A low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range. (en.wikipedia.org). Accordingly, the mean and standard deviation of the likert scaled data's from the questioner survey is estimated as follow:-

SOCIO CULTURAL FACTORS	Strongly Agree	Somewhat Agree	Neutrl	Somewhat disagree	Strongly disagree	Total	Mean	Mean2	Standard devation
1. If a shipping container houses fulfills all your choice in question number 5, It is likely for people to rent or buy such an apartment or house.	44	119	131	60	50	404	3.12	11.07	2.82

ECONOMIC FACTOR	Strongly Agree	Somewhat Agree	Neutrl	Somewhat disagree	Strongly disagree	Total	Mean	Mean2	Standard devation
1. There is enough resource available and is convenient to use shipping container as a residential unit?	49	160	115	37	43	404	3.33	12.40	3.01
2. Shipping container houses are suitable for my income type and social status.	143	170	42	24	25	404	3.95	16.82	3.59
3. Shipping container houses are likely to solve house affordability?	145	136	64	32	27	404	3.84	16.17	3.51
4. Shipping container houses are likely to be more affordable than concrete houses?	165	149	47	24	19	404	4.03	17.44	3.66
5. If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one.	142	158	59	23	22	404	3.93	16.64	3.57

Table 5 Mean and standard deviation of Economical factor variables.

TECHNOLOGICAL FACTOR	Strongly Agree	Somewhat Agree	Neutrl	Somewhat disagree	Strongly disagree	Total	Mean	Mean2	Standard devation
1. Using shipping Container as alternative housing solution is a feasible solution.	81	162	88	41	32	404	3.54	13.87	3.21
2. Shipping Container houses are Strong enough to be used as construction material.	82	161	87	41	33	404	3.54	13.88	3.22
3. Shipping Container houses are durable and reliable to use as residential unit.	124	140	63	45	32	404	3.69	15.15	3.38
4. Shipping containers are likely to be accepted by the community if used as residential unit.	146	98	64	53	43	404	3.62	14.97	3.37

Table 6 Mean and standard deviation of Technological factor variables.

ENVIRONMENTAL FACTOR	Strongly Agree	Somewhat Agree	Neutral	Somewhat disagree	Strongly disagree	Total	Mean	Mean2	Standard devation
1. Shipping containers are environmental friendly.	65	136	84	65	54	404	3.23	12.06	2.97
2. Shipping container homes are safe as any other conventional **home.**	141	92	80	46	45	404	3.59	14.72	3.34
3. Using shipping container is a way to go for healthy environment compared with other construction materials.	122	154	72	20	36	404	3.76	15.54	3.43

Table 7 Mean and standard deviation of Economical factor variables.

4.4 RELIABILITY ANALYSIS

Reliability test was also conducted using SPSS to determine internal consistency, Cronbach's alpha value of 0.858 was estimated from the test which suggests high internal consistency since >0.7 is acceptable.

- **ECONOMIC FACTOR**

Case Processiqng Suqmmary

		N	%
Case	Valid	404	100
	Excluded[a]	0	0
	Total	404	100

a. Listwise deletion based on all variables in the procedure.

Relibility Statistics

Cronbach's Alpha	N of Items
0.995	5

- **TECHNOLOGICAL FACTOR**

Case Processiqng Suqmmary

		N	%
Case	Valid	404	100
	Excluded[a]	0	0
	Total	404	100

a. Listwise deletion based on all variables in the

Relibility Statistics

Cronbach's Alpha	N of Items
0.936	4

- **ENVIRONMENTAL FACTOR**

Case Processiqng Suqmmary

		N	%
Case	Valid	404	100
	Excluded[a]	0	0
	Total	404	100

a. Listwise deletion based on all variables in the procedure.

Table 8 Reliability Analysis

Relibility Statistics

Cronbach's Alpha	N of Items
0.827	3

4.5 RESOURCE AVAILABILITY

On Maritime minister, Djibouti branch secretory office/ Hamle 2011 – Sene20 2012 incoming dry cargo container entrance and exported containers information summary report summarized as follows.

Month	Container through put Using marine transport TEU)	Container through put using Rail way transport	Wagon	Sum
July	18255	5644	2822	23899
August	16403	4934	2467	21337
September	17489	4992	2496	22481
October	15906	4336	2168	20242
November	14113	1156	578	15269
December	11368	5476	2738	16844
January	13641	4259	2195.5	17900
February	12503	3648	1824	16151
March	8916	3914	1959	12830
April	8088	2586	1320	10674
May	9744	2393	1271.5	12137
June	12775	3612	1805	16387
Sum	159201	46950	23644	206151

Table 9 Incoming dry cargo container entrance and export containers information summery report.

According to the data collected from Ethiopian shipping and logistic services enterprise (ESLSE), the container handled by the company from 2010 – 2012 is summarized as follows: -

Summary of Container Throughput for all Port and Terminal Branches from 2007-2012 EFY															
Branches	2010					2011					2012				
	Full In	Full Out	Empty In	Empty Out	Container Throughput (in TEU)	Full In	Full Out	Empty In	Empty Out	Container Throughput (in TEU)	Full In	Full Out	Empty In	Empty Out	Container Throughput (in TEU)
Modjo	130,747	132,042	128,696	128,682	**520,167**	128,791	125,859	127,391	125,735	**507,776**	133,020	132,751	140,267	135,364	**541,402**
Kality	18,707	18,677	18,267	18,296	**73,947**	23,131	21,672	21,953	21,380	**88,136**	18,803	20,482	17,578	18,081	**74,944**
Dire Dawa	4,432	4,233	3,946	4,001	**16,612**	3,852	3,769	3,502	3,495	**14,618**	3,294	3,572	4,505	4,448	**15,819**
Semera	1,851	1,791	1,786	1,801	**7,229**	2,379	2,039	1,826	1,782	**8,026**	1,959	2,326	1,960	1,780	**8,025**
Kombolcha	3,044	2,887	2,908	2,913	**11,752**	4,891	4,679	4,673	4,609	**18,852**	5,461	5,233	5,495	5,282	**21,471**
Mekelle	6,721	7,200	7,598	7,489	**29,008**	7,789	7,240	7,308	7,143	**29,480**	9,203	9,343	9,346	9,247	**37,139**
Gelan	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
Woreta	0	0	0	0		0	0	0	0	**0**	108	93	73	78	**352**
Grand Total	165,502	166,830	163,201	163,182	**658,715**	170,833	165,258	166,653	164,144	**666,888**	171,848	173,800	179,224	174,280	**699,152**

Table 10 summery of container throughput for all port and terminal branches.

Taking the above table of data between the years 2010-2012 annually, an average of 675,251.66 containers comes in and out of the country. Even though currently these containers are owned by the shipping lines, they can be purchased in fair amounts to be used further for the residential unit.

4.6 CORRELTION ANALYSIS

CALCULATING THE PROBABILITY OF HYPOTHESIS (P-VALUE)

Note: - Details of this could be found in Appendix 2

A cross-tabulation analysis of the questioner data was using IBM SPSS Statistics with the following condition where:

H0 = Null hypothesis = There is no significant relationship between variables

H1 = Alternative = There is significant relationship between variables.

Taking Age, education level, and Income level and cross-tabulated with Suitability, incentives or subsidy and Likely to buy or rent, where

- (Suitability) = Shipping container houses are suitable for my income type and social status.

- (Incentives or subsidy) = If the government puts incentives/subsidies on container houses renting, buying will be convenient for people to acquire one.

- (Likely to buy or rent) = If a shipping container house fulfills all your choice in question number 5, (on the economic factor), it is likely for people to rent or buy such an apartment or house.

SPEARMAN'S TEST

Interpreting a p-value

- P-value is a number between 0 and 1
- P values are expressed as decimals although they may be more easily understood if you convert them to a percentage (e.g. 0.1 = 10%).
- P-values are determined by the observed correlation R_s value and the sample size.
- Small p-values are strong evidence against the null hypothesis H_0.
- With a small p-value, we reject the null hypothesis H_0. The relationship between your data sets is significantly different than that stated in H_0.

P-value and evidence for rejecting the H_0 null hypothesis

P-value	P-value %	Evidence for rejecting H_0
More than 0.1	>10%	Very weak to none
Between 0.1 - 0.05	10%-5%	Weak
Between 0.05 - 0.01	5%-1%	Strong
Less than 0.01	<1%	Very strong

In geography, a p-value of 0.05 (5%) or less is typically considered statistically significant, as illustrated below:

The strength of a correlation

Value of coefficient R_s (positive or negative)	Meaning
0.00 to 0.19	A very weak correlation
0.20 to 0.39	A weak correlation
0.40 to 0.69	A moderate correlation
0.70 to 0.89	A strong correlation
0.90 to 1.00	A very strong correlation

P-VALUE AND CORRELATION INTERPRETATION

Variables	P- Value and Correlation Coefficient					
	Suitability		Incentives or subsidy		Likely to buy or rent	
	P	Correlation Coefficient R_s	P	Correlation Coefficient R_s	P	Correlation Coefficient R_s
Age	0.008	0.120	0.044	0.085	0.359	0.018
Education level	0.163	-0.049	0.207	0.041	0.346	0.020
Income Level	0.111	0.061	0.237	0.036	0.218	0.039

Table 11 Spearman's test

- The correlation between [Age × Shipping container houses are suitable for my income type and social status] and [Age × If the government puts incentives/subsidy on container houses renting and buying, it will be convenient for people to acquire one] indicates:- P-value less than 0.01, which signifies Very strong evidence of rejection of Ho, Ho is strong, and it is statically significant. Rs value for both relations is b/n 0.00 – 0.19, indicating a very weak correlation.
- The correlation between [Age × If a shipping container house fulfills all your choice in question number 5 (on the economic factor), It is likely for people to rent or buy such an apartment or house] indicates:- P-value more than 0.1, which signifies evidence of rejection, Ho is Very weak to none, and it is not statically significant. Rs value for the relation is b/n 0.00 – 0.19, which indicates a very weak correlation.
- The correlation between [Educational level ×Shipping container houses are suitable for my income type and social status], [Educational level × If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one], and [Educational level × If a shipping container house fulfills all your choice in question number 5 (on the economic factor)], It is likely for people to rent or buy such an apartment or house) relationship indicates P-value more than 0.1, which signifies evidence of rejection, Ho is Very weak to none, and it is not statically significant. Rs value for all three relations is b/n 0.00 – 0.19, which indicates a very weak correlation.

- [Income Level × If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one] and [Income Level * If a shipping container house fulfills all your choice in question number 5 (on the economic factor)], It is likely for people to rent or buy such an apartment or house) relationship indicates P-value more than 0.1, which signifies evidence of rejection, Ho is Very weak to none, and it is not statically significant. Rs value for all three relations is b/n 0.00 – 0.19, which indicates a very weak correlation.

4.7 COST COMPARISON

The cost comparison is on a building design with the same architectural building feature yet different construction material, concrete, and shipping container. The design future used is a G+2 Residential building as shown below:-

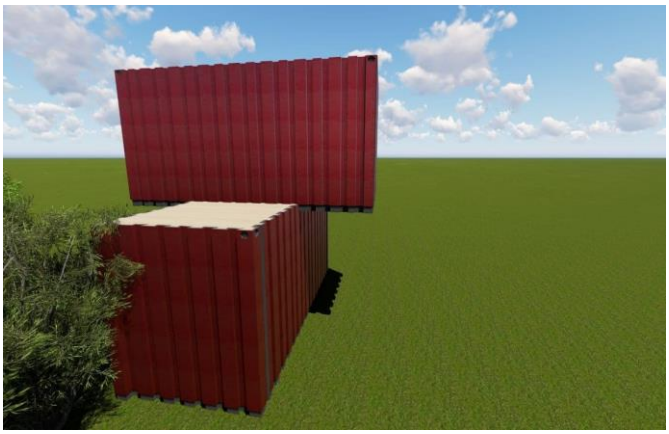


Figure 4. 22 G+2 Residential house design.

➢ SHIPPING CONTAINER BUILDING COST ESTIMATION

According to alibaba.com, the Factory price for a 40ft high Cube new shipping container with CSC Certification range b/n $900.00 - $3,500.00.

Taking the average price= $2,200

Taking the current currency= $2,200*42.7812= 94,118.64Birr

Taking the current Construction materials price from https://con.2merkato.com/ and Constructionethiopia.com/ Building items Engineering Estimates/Construction in Ethiopia, the cost estimation is summarizes as follow:-

- **CONCRETE BUILDING ESTIMATION**

Bill of Quantity, BOQ OF Concrete House

Item No.	*Description*	*Unit*	*Quantity*	*Unit Price*	*Total Amount*
	A. SUB-STRUCTURE				
	1. Excavation and Earth Work				
1.10	Clear site of all rubbish, bushes, shrubs, undergrowth hedges smaller trees, stubs, roots, etc..	m^2	61.12	25.00	1,528.00
1.20	Site clearing to remove top soil to an average depth of 20cm starting from NGL	m^2	61.12	30.00	1,833.60
1.30	Pit excavation	m^3	69.70	175.00	12,197.50
1.40	Cart away surplus excavated material	m^3	88.03	150.00	13,204.50
1.50	Back fill Select Material	m^3	10.77	395.00	4,254.15
1.60	Back fill Hard Core	m^2	47.47	200.00	9,494.00
TOTAL CARRIED TO SUMMARY					**42,511.75**
	2. CONCRETE WORKS				
1.10	50mm lean concrete quality C-5, with minimum cement content of 150kg/m^3 of concrete				-
	a) Under Footing Pad	m^2	17.28	163.86	2,831.50

	b) Under Masonry Foundation Wall	m^2	13.19	178.60	2,355.77
	c) Under Grade Beam	m^2	13.19	178.60	2,355.77
1.20	Provide, cut and fix in position sawn structural wood or steel formwork which ever is appropriate				-
	a) Footing Pad	m^2	70.56	310.00	21,873.60
	b) Ground floor Beam	m^2	50.78	310.00	15,741.80
1.30	Reinforced concrete quality C-25, 360kg of cement/m3 filled into formwork and vibrated around rod reinforcement (Formwork and Reinforcement measured separately) OPC cement				-
	a) Footing Pad	m^3	6.16	2,659.10	16,380.06
	b) Ground floor Beam	m^3	7.13	2,659.10	18,959.38
	c) Ground floor Slab 10cm thick	m^2	47.47	327.72	15,556.87
1.40	Mild steel reinforcement according to structural drawings. Price includes cutting, bending, placing in position and tying wire and concrete spacers				-
	b) Dia. 8mm deformed bar	Kg	139.18	65.00	9,046.70
	d) Dia. 12mm deformed bar	Kg	104.21	65.00	6,773.65
	e) Dia. 14mm deformed bar	Kg	416.10	65.00	27,046.50
TOTAL CARRIED TO SUMMARY					**138,921.59**

	2. MASONRY WORK				
2.10	Hard trachytic roughly dressed stone masonry foundation wall below ground level bedded in cement mortar (1:4)	m^3	13.17	1,175.80	15,485.29
TOTAL CARRIED TO SUMMARY					**15,485.29**
TOTAL SUB STRUCTURE SUMMARY					**196,918.63**
	B. SUPER-STRUCTURE				
	1. CONCRETE WORK				
1.10	Provide, cut and fix in position sawn structural wood or steel formwork whichever is appropriate				-
	a) Elevation column	m^2	139.18	310.00	43,145.80
	b) Floor Slab	m^2	104.21	330.00	34,389.30
	c) Floor Beam	m^2	416.10	330.00	137,313.00
1.20	Reinforced concrete quality C-25, 360kg of cement/m3 filled into formwork and vibrated around rod reinforcement (Formwork and Reinforcement measured separately) OPC cement				-
	a) Elevation column	m^3	5.18	2,710.00	14,037.80
	b) Solid Slab	m^3	7.12	2,710.00	19,295.20
	c) Floor Beam	m^3	14.26	2,710.00	38,644.60
1.03	Mild steel reinforcement according to structural drawings. Price includes cutting, bending, placing in position and tying wire and concrete spacers				-
	b) Dia. 8mm deformed bar	Kg			

			441.72	67.00	29,595.37
	d) Dia. 12mm deformed bar	Kg	883.17	67.00	59,172.23
	f) Dia. 16mm deformed bar	Kg	1,018.37	67.00	68,230.73
1.04	Spiral Stair	No.	1.00	21,390.00	21,390.00
	2. Finishing Work				-
2.01	Roof Work				-
	G30 Corrugated Galvanized Iron Sheet - Akakiu	m^2	47.48	294.30	13,973.36
	morale 5cmx7cmx400cm /Austria/	m	142.28	165.00	23,476.20
	morale 5cmx4cmx400cm /Austria/	m	32.00	165.00	5,280.00
2.02	HCB Work				-
	20×20×40	m^2	140.20	535.00	75,007.00
	15×20×40	m^2	49.28	516.00	25,428.48
2.03	Plastering				-
	External Plastering	m^2	282.58	153.86	43,477.76
	Internal Plastering	m^2			

			238.76	143.86	34,348.01
2.04	Gypsum				-
	Quartz External Gypsum work	m^2	282.58	181.67	51,336.31
	Internal Gypsum work	m^2	238.76	75.00	17,907.00
	Ceiling Gypsum work	m^2	46.50	230.00	10,695.00
2.05	Painting				-
	Internal Paint	m^2	238.76	54.00	12,893.04
	Ceiling Paint	m^2	47.47	54.00	2,563.38
2.06	Porcelain Ceramic				-
	Ceramic tile: 60cm x 60cm - 10mm thick	m^2	53.67	1,020.00	54,743.40
2.07	PVC skirting: 8cm high (Ethiopia)	m	85.45	140.00	11,963.00
2.08	Wall Ceramic				
	Ceramic tile: 30cm x 30cm - 7mm thick	m^2	23.22	535.00	12,422.70
2.09	Marble				-
	Window-Marble: 3cm thick white marble (Welega, Saba, Gojam)	m	13.2	400.00	5,280.00

	Door- Marble: 2cm thick white marble (Welega, Saba, Gojam)	m	12.94	400.00	5,176.00
2.10	Door				-
	(2.44×2.2)	No.	1.00	5,690.35	5,690.35
	(1.5 × 2.2)	No.	3.00	5,190.00	15,570.00
	(1.0 × 2.2)	No.	6.00	4,690.00	28,140.00
2.11	Window including 5mm thick clear glass				-
	(0.9 × 1.2)	No.	3.00	3,575.00	10,725.00
	(1.0 × 1.2)	No.	1.00	3,575.00	3,575.00
	(1.4 × 1.2)	No.	3.00	3,875.00	11,625.00
TOTAL CARRIED TO SUMMARY					**946,510.02**

Total= 1,143,428.65

VAT 15%= 171,514.30

Grand Total= 1,314,942.95

Table 12 Concrete building Cost estimation

- **SHIPPING CONTAINER BUILDING COST ESTIMATION**

Bill of Quantity, BOQ OF ContainerHouse

Item No.	*Description*	*Unit*	*Quantity*	*Unit Price*	*Total Amount*
	A. SUB-STRUCTURE				
	1. Excavation and Earth Work				
1.10	Clear site o all rubbish, bushes, shrubs, undergrowth hedges smaller trees, stubs, roots, etc..	m^2	61.12	25.00	1,528.00
1.20	Site clearing to remove top soil to an average depth of 20cm starting from NGL	m^2	61.12	30.00	1,833.60
1.30	Pit excavation	m^3	10.56	175.00	1,848.00
1.40	Cart away surplus excavated material	m^3	28.90	150.00	4,335.00
1.50	Back fill Select Material	m^3	4.18	395.00	1,651.10
1.60	Back fill Hard Core	m^2	1.73	200.00	346.00
1.70	Aggregate Placement	m^2	61.12	175.00	10,696.00
TOTAL CARRIED TO SUMMARY					**22,237.70**
	2. CONCRETE WORKS				
1.10	50mm lean concrete quality C-5, with minimum cement content of 150kg/m^3 of concrete				-
	a) Under Footing Pad	m^2	5.76	163.86	943.83
	b) Under grade beam	m^2	0.85	178.60	151.81

1.20	Provide, cut and fix in position sawn structural wood or steel formwork which ever is appropriate				-
	a) Footing Pad	m^2	23.52	310.00	7,291.20
	b) Pier foundation	m^2	10.00	310.00	3,100.00
	c) Grade Beam	m^2	11.36	310.00	3,521.60
1.30	Reinforced concrete quality C-25, 360kg of cement/m3 filled into formwork and vibrated around rod reinforcement (Formwork and Reinforcement measured separately) OPC cement				-
	a) Isolated Footing Pad	m^3	2.05	2,659.10	5,451.16
	b) Pier foundation	m^3	1.00	2,659.10	2,659.10
	c) Grade Beam	m^3	0.85	2,659.10	2,260.24
1.40	Mild steel reinforcement according to structural drawings. Price includes cutting, bending, placing in position and tying wire and concrete spacers				-
	a) Dia. 8mm deformed bar	Kg	10.42	65.00	677.30
	b) Dia. 10mm deformed bar	Kg	133.27	65.00	8,662.55
	d) Dia. 12mm deformed bar	Kg	34.74	65.00	2,258.10
	e) Dia. 14mm deformed bar	Kg	139.29	65.00	9,053.85
	e) Dia. 16mm deformed bar	Kg	61.01	65.00	3,965.65
TOTAL CARRIED TO SUMMARY					**49,996.39**
TOTAL SUB STRUCTURE SUMMARY					**72,234.09**

	B. SUPER-STRUCTURE				
	1. CONCRETE WORK				
1.10	Shipping Container		2.00	94,118.64	188,237.28
1.20	Provide, cut and fix in position sawn structural wood or steel formwork whichever is appropriate				-
	a) Elevation column	m^2	6.48	310.00	2,008.80
1.20	Reinforced concrete quality C-25, 360kg of cement/m3 filled into formwork and vibrated around rod reinforcement (Formwork and Reinforcement measured separately) OPC cement				-
	a) Elevation column	m^3	1.04	2,710.00	2,829.24
1.03	Mild steel reinforcement according to structural drawings. Price includes cutting, bending, placing in position and tying wire and concrete spacers				-
	b) Dia. 8mm deformed bar	Kg	125.14	67.00	8,384.38
	d) Dia. 12mm deformed bar	Kg	288.14	67.00	19,305.38
1.04	Spiral Stair	No.	1.00	21,390.00	21,390.00
1.05	Wilding and Grinding	No.	1	10,000.00	10,000.00
	2. Finishing Work				-
2.01	Roof Work				-
	G30 Corrugated Galvanized Iron Sheet - Akakiu	m^2	44.33	294.30	13,046.32
	morale 5cmx7cmx400cm /Austria/	m	142.28	165.00	23,476.20
	morale 5cmx4cmx400cm /Austria/	m	32.00	165.00	5,280.00

2.02	Plastering				-
	External Plastering on column	m^2	12.96	153.86	1,994.03
2.03	Gypsum				-
	Quartz on column	m^2	12.96	181.67	2,354.44
	Partition Gypsum Board	m^2	189.48	230.00	43,580.40
	Ceiling Gypsum work	m^2	47.47	230.00	10,918.10
2.04	Painting				-
	Internal Paint	m^2	238.76	54.00	12,893.04
	Ceiling Paint	m^2	47.47	54.00	2,563.38
2.05	Parque				-
		m^2	53.67	960.00	51,523.20
2.06	Wall PVC	m^2	52.25	280.00	14,630.00
2.07	Door				-
	(2.44×2.2)	No.	1.00	5,690.35	5,690.35
	(1.5 × 2.2)	No.	3.00	5,190.00	15,570.00
	(1.0 × 2.2)	No.	6.00	4,690.00	28,140.00
2.08	Window including 5mm thick clear glass				

					-
	(0.9 × 1.2)	No.	3.00	3,575.00	10,725.00
	(1.0 × 1.2)	No.	1.00	3,575.00	3,575.00
	(1.4 × 1.2)	No.	3.00	3,875.00	11,625.00
TOTAL CARRIED TO SUMMARY					**499,739.54**

Total= 581,973.62

VAT 15%= 87,296.043

Grand Total= 669,269.66

Table 13 Concrete building cost estimation..

- The result shows that the Container home building cost is estimated to be 669,269.66 Birr, and the concrete home building cost is estimated to be 1,314,942.95 Birr. It shows the container home is more affordable than the concrete building. And the container building is 1.96 times the cost of the concrete, which implies using containers as a building material could give an affordable solution.

4.3 DISCUSSION

The results show that majority of the respondent are between the ages of 21-29, live with others, and do not pay mortgage or rent. Their income level is between 5,000-10,000; they are mostly highly educated and are willing to accept shipping container housing as many fall between the low and lower-middle-income earners.

Looking into the participant's response, they are not familiar with the idea of; shipping container homes; since it is not in use in the city. While some of the respondents consider that shipping container is not appropriate as a residential unit, others take them as a choice of living considering their income level. Acceptance by the community is one of the main issues when it comes to; shipping container homes. Therefore, extensive enlightenment and practical experience are the main recommendations to make them comprehend that shipping container homes are as good as any home when properly constructed, made affordably, and considering the environmentally friendly aspects.

Most responses also agree with the community acceptance and convenience of the solution in the government putting some kind of incentives/subsidy on container houses renting and buying. Overall the community is concerned with affordability rather than any features related to buying or renting a house.

On the result from the statistical analysis in Table 8 of spearman's test,

- The correlation between [Age × Shipping container houses are suitable for my income type and social status (Suitability)] and [Age × If the government puts incentives/subsidy on container houses renting and buying will be convenient for people to acquire one (Incentives/subsidy)] shows:- the null hypothesis rejected, the alternative is true, there is no dependency b/n the variables, and the result is statistically significant.
- [Age × If a shipping container house fulfills all your choice in question number 5, it is likely for people to rent or buy such an apartment (economic factor)], [Educational level × Shipping container houses are suitable for my income type and social status (Suitability)], [Educational level × If the government puts incentives/subsidy on container houses renting and buying it will be convenient for people to acquire one], [Educational level × If the government puts incentives/subsidy, on container houses renting and buying, it will be convenient for people to acquire one (Incentives/subsidy)], [Income Level × Shipping container houses are suitable for my income type and social status (Suitability), [Income Level × If the government puts

incentives/subsidies on container houses renting and buying, will be convenient for people to acquire one (Incentives/subsidy)] and [Income Level × If a shipping container house fulfills all your choice in question number 5 (on the economic factor), it is likely for people to rent or buy such an apartment or house (Likely to buy, or rent)]. Relationship indicates that the null hypothesis is accepted, and there is dependency b/n the variables. And the result is not statistically significant.

On the comparison of the construction material between a shipping container and concrete homes, the result shows that not only container-homes could be an alternative solution, but also they can help with house affordability as well. It could answer the communities choice of the house concerning affordability which seems to be the issue of owning one.

In addition, the idea of shipping container homes should be investigated further concerning design issues and construction methods as well. The solution could be helpful in the construction industry and house affordability if used and more studied going forward.

CHAPTER FIVE: SUMMERY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter comprises four sections; a summary of findings, conclusions, limitations of the study, and recommendations. The chapter is required to summarize the components of the research report under the title organization of the study.

5.2 SUMMERY

The research is on the housing backlog and affordability problem in Ethiopia. The hypothesis was; introducing an alternative housing solution could help fill the gap, and changing the construction material could help change the affordability of a house. The study was in Addis Ababa, Ethiopia. A questioner survey and Material cost comparison; are used to evaluate the hypothesis.

The sample size was 400, and 404 respondents participated in the survey. The questioner was distributed using Google survey and manually throughout Addis Ababa in all sub-city.

The questionnaires were composed of questions on Socio-cultural factors, Economy factors, Technological factors, and environmental factors. The surveys show most of the respondents are from a low and middle-class family, live with others but don't pay any mortgage or rent, and are highly educated.

The Surveying data shows the following main points:-

- Affordability was the main; concern of people's choice on buying or renting a house.
- Most respondents agreed or somewhat agreed that it is likely for them to rent or buy such an apartment or house if shipping container house fulfills all their choices of housing: such as affordability, location, structural stability, quality of the house, closeness to service, size of the house, habitability, and neighborhood.
- Most respondents are not sure about the resource availability, which is a shipping container.
- Most respondents somewhat agree: that shipping container homes are suitable for their income level.

- Most respondents agree and somewhat agree that shipping container houses are likely to solve house affordability.
- Most respondents agree: Shipping container houses are most likely more affordable than concrete houses.
- When asked if the government puts incentives/subsidies on container house rental or purchase if it is convenient for people to acquire one, most respondents agreed that it is convenient for people to acquire one.
- Most respondents somewhat agreed with shipping Containers being an alternative housing solution is a feasible solution.
- Most respondents agreed that shipping Container houses are reliable, durable, and strong enough to be used as construction material.
- Most respondents agreed that shipping containers are likely to be accepted by the community if used as a residential unit.
- Most respondents agreed that shipping container houses are as environmentally friendly and safe as any other conventional home.
- The socio-cultural factor section (if a shipping container house fulfills all your choice in question number 5, it is likely for people to rent or buy an apartment or house) is ranked, with an RII value of 62.3%.

The Economy factor section (Shipping container houses are likely to be more affordable than concrete houses) is ranked 1st with an RII value of 80.6%. (Shipping container houses are suitable for my income type and social status) ranked 2nd with an RII value of 78.9%. (If the government puts incentives/subsidies on container houses, renting and buying will be convenient for people to acquire one) ranked 3rd with RII value 78.6%, (Shipping container houses are likely to solve house affordability) ranked 4th with RII value 76.8) and (There is enough resource available and is convenient to use a shipping container as a residential unit) is ranked 5th with RII value 66.7%.

In the Technology factor section, the factors ranking value with their respective RII value is (Shipping Container houses are durable and reliable to use as a residential unit) is ranked 1st with RII value 73.8%. (Shipping containers are likely to be accepted by the community if used as a residential unit.) is ranked 2nd with an RII value of 72.4% and (Using shipping Container as

alternative housing solution is a feasible solution and Shipping Container houses are Strong enough to be used as construction material) both ranked 3rd with RII value 70.8%.

In the Environmental factor section, the factors ranking value with their respective RII value is (Using shipping container is a way to go for the healthy environment compared with other construction materials.) ranked 1st with RII value 75.1%. (Shipping container homes are safe as any other conventional home.) ranked 2nd with RII value 71.8%, and (Shipping container homes are safe as any other convenient home.) are ranked 3rd with RII value 64.6%.

The data analysis is a cross-tabulation analysis of the questioner data by IBM SPSS Statistics, which shows that the null hypothesis is accepted (true). And there is no relationship between the variables, the correlation b/n the variables are mostly not significant.

Shipping container building and concrete building homes with the same Architectural design features used; to compare the cost estimation fare. The result shows that shipping container homes are more affordable than concrete buildings.

Using a reliability test to determine internal consistency for all findings: Cronbach‘s alpha value of 0.924 was estimated. The result suggests high internal consistency since >0.7 is acceptable.

5.3 CONCLUSIONS

- **The prospect of using shipping container as a residential unit.**

When we look at the possibility or likelihood of shipping container as a residential unit regarding affordability, based on the cost estimation and comparison between the container and concrete homes shows, container homes are more affordable than concrete homes. The survey result also shows; that it could be accepted and chosen if implemented. The result implies that the acceptability of shipping container homes as an alternative is not dependent on their educational background, age, or income level. It is more of on economics (affordability) and social status issues which are people's awareness and acceptance of things that are not commonly used by the community.

Therefore it can be concluded, the provision of container house as an alternative is viable as it is fast to construct and affordable to purchase.

- **The Challenges of using shipping container as a residential unit.**

Based on the findings, shipping container as a residential unit could be hard to implement due to resource availability and community awareness. To conclude, container houses should be an alternative when building residential units, and there should be further investigation on resources, government involvement, and the construction industry laws and involvements.

5.4 RECOMMENDATIONS

This report gives an insight into container houses as an affordable and alternative housing solution. Taking this into consideration, the following are some recommendations:-

-To make the alternative solution work, resource availability and access; should be further investigated. Design and construction futures, building construction code also should be prepared.

-One of the concerns to implement the solution is people's awareness and acceptance to make the idea reliable creating awareness throughout the community is necessary.

-The government has been helping with different housing subsidies, setting to help the community; acquire one. And it will be recommended if authorities develop a housing subsidy that supports container houses development.

-The idea of the study is new and has not been used practically. Due to this, it should be further explored and studied, especially the resource availability and future incentive ideas related to it.

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APPENDIX

APPENDIX1. QUESTIONNAIRE

ALTERNATIVE HOUSING SOLUTION

Introduction

This Survey is to measure and understand the communities' perspective of alternative housing solution specifically shipping container houses if presented as low cost and alternative housing solution, which could help in developing alternative housing solution in Ethiopia.

This survey should only take about 5minits to complete. The questioner is meant to be part of thesis for MBA program at St. Marry University.

Kindly fill this quick survey and you response will be treated confidentially.

Thank you in advance for your cooperation!

1. **Sub city_____**
2. **Gender?**

☐ Female

☐ Male

3. **Which category below includes your age?**

☐18 and above

☐18 – 20

☐21 – 29

☐30 – 39

☐40 – 49

☐50 – 60

☐60 and above

- **SOCIO CULTURAL FACTORS**

1. **Which of the following best describe your employment status?**

☐Employed

☐Unemployed

☐Entrepreneur

☐Retired

☐Others if any and please specify _____

2. What is the highest level of education you attended?

☐Primary education

☐Secondary education

☐10+1, 10+2, 10+3 and Diploma

☐Bachelor degree

☐Master's degree

☐PhD and above

3. Please signify your monthly income level?

☐2000 and below

☐2000 ≤ 5000

☐5000 ≤ 10000

☐10000 ≤ 2000

☐20000 ≤ 30000

☐30000 and above

4. Which of the following best describe your current living situation?

☐Rental

☐Living with others but not paying mortgage or rent

☐Living with others and paying mortgage or rent

☐Home owner

☐Others if any and please specify _____

5. Which of the following factors would you consider when renting or buying an apartment/ house or building your own house?

(You can check more than one)

☐Affordability

☐Location of house

☐Size of house

☐Beauty

☐Neighborhood

☐Quality of Facilities

☐Habitability

☐Closeness to services

☐Structural stability

☐Others if any and please specify _____

Description	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
6. If a shipping container houses fulfills all your choice in question number 5, It is likely for people to rent or buy such an apartment or house.	☐	☐	☐	☐	☐

- **ECONOMIC FACTOR ACCORDING TO THE COMMUNITIES PERSPECTIVE**

PLEASE MARK ONLY ONE CHOICE FOR THE FOLLOWING QUESTIONS

Description	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
1. There is enough resource available and is convenient to use shipping container as a residential unit?	☐	☐	☐	☐	☐
2. Shipping container houses are suitable for my income type and social status.	☐	☐	☐	☐	☐
3. Shipping container houses are likely to solve house affordability?	☐	☐	☐	☐	☐
4. Shipping container houses are likely to be more affordable than concrete houses?	☐	☐	☐	☐	☐
5. If the government puts incentives/ subsidy on container houses renting and buying it will be convenient for people to acquire one.	☐	☐	☐	☐	☐

- **TECHNOLOGICAL FACTOR ACCORDING TO THE COMMUNITIES PERSPECTIVE**
- **PLEASE MARK ONLY ONE CHOICE FOR THE FOLLOWING QUESTIONS**

Description	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
1. Using shipping Container as alternative housing solution is a feasible solution.	☐	☐	☐	☐	☐
2. Shipping Container houses are Strong enough to be used as construction material.	☐	☐	☐	☐	☐
3. Shipping Container houses are durable and reliable to use as residential unit.	☐	☐	☐	☐	☐
4. Shipping containers are likely to be accepted by the community if used as residential unit.	☐	☐	☐	☐	☐

- **ENVIRONMENTAL FACTOR**

Description	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
1. Shipping containers are environmental friendly.	☐	☐	☐	☐	☐
2. Shipping container homes are safe as any other conventional **home.**	☐	☐	☐	☐	☐
3. Using shipping container is a way to go for healthy environment compared with other construction materials.	☐	☐	☐	☐	☐

Any other comment or question pleases specify

Thank you for being part of this survey!

መጠየቅያ

አማራጭ የመኖነርያ ቤት መፍትሄ

ይህ የዳሰሳ ጥናት የሚካሄደዉ የህብረተሰቡን እይታ በአማራጭ የመኖርያ ቤት መፍትሄዎች በዋናነትም የካርጎ ኮንቴነር ቤት እንደአማራጭ የመኖርያ ቤት መፍትሄ በዝቅተኛ ዋጋ ቢቀርብ በሚለዉ ሀሳብ ላይ ይሆናል። ጥናቱ የተዘጋጀዉ የአማራጭ የመኖርያ ቤት መፍትሄ ይሆናል ብሎ በማሰብ ነዉ። የዳሰሳ ጥናቱ አምስት ደቂቃ ገደማ ሚወስድ ሲሆን መጠይቁ የተዘጋጀዉ በቅድስት ማሪያም የሚዘጋጀዉ የMBA ማስተርስ ዲግሪ ትምህርት ለጥናት ፅኑፍ ነዉ።

መጠይቁን በጥንቃቄ እየጠየቅን መልስዎ በሚስጥር እንደሚቀመጥ እናሳዉቃለን።

ለትብብርዎ በቅድሚያ እናመሰግናለን።

የካርጎ ኮንቴነር ቤትዎች ላይ እይታ ለመስጠት ያክል ከታች የተወሰኑ የኮንቴነር ቤትዎች ምስል አስቀምጠናል።

1. **ክፍለ ከተማ** _____
2. ***ፆታ***

   ☐ ሴት

   ☐ ወንድ

3. **የትኛዉ የእድሜ ክልል የእርስዎን ይገልዋል?**

   ☐ 8 እና ከዛ በላይ

   ☐18 – 20

   ☐21 – 29

   ☐30 – 39

   ☐40 – 49

   ☐50 – 60

   ☐60 እና ከዛ በላይ

➢ . **ማህበረሰባዊ እና ባህላዊ ተፅእኖ**

1. **የትኛዉ የስራ ሁኔታዎን ይገልፃል?**

   ☐ ተቀጣሪ

   ☐ስራ አጥ

☐የግል ስራ

☐ጡረተኛ

ሌላ ካለ እዚጋር ይግለፁ _____

2. የደረሱበት ትልቁ የትምርት ደረጃ?

☐ የመጀመርያ ደረጃ ትምህርት

☐ ሁለተኛ ደረጃ ትምህርት

☐ 10+1፣10+2፣10+3 እና ዲፕሎማ

☐ የመጀመርያ ዲግሪ

☐ ማስተርስ ዲግሪ

☐ PHD እና ከዛ በላይ

3. እባክዎን የወር ደሞዝ ልኬትዎን ይግለፁልን?

☐ 2000 እና ከዛ በላይ

☐ 2000 – 5000

☐ 5000 – 10000

☐ 10000 – 20000

☐ 20000 – 30000

☐ 30000 እና ከዛ በላይ

4. የትኛዉ የመኖርያ ሁኔታዎን ይገልፃል?

☐ ኪራይ ቤት

☐ የቤት ኪራይ ሳይከፍሉ ከሌሎች ጋር እየኖሩ

☐ የቤት ኪራይ እየከፈሉ ከሌሎች ጋር እየኖሩ

☐ በየግል መኖርያ ቤትዎ

ሌላ ካለ እዚጋር ይግለፁ _____

5. ቤት ሲከራዩ ወይም ሲገዙ የትኛን ቅድመ ሁኔታዎች ያያሉ?

(የሚመለከትዎትን ሁሉ ይምረጡ)

☐ የቤት ዋጋ

☐ የቤቱ መገኛ ቦታ

☐ የቤቱ ስፋት

☐ ቤቱ ዉበት

☐ የመኖርያ ቦታዉ የሰፈር ሁኔታ

☐ ያገልግሎት ጥራት

☐ የቤቱ አመቺነት

☐ ለአገልግሎት ማግኛ ቦታዎች ቅርብ መሆኑ

☐ የቤቱ ጥንካሬ

ሌላ ካለ እዚጋር ይግለፁ _____

ገለፃ	አጥብቄ እቃወማለዉ	በመጠኑ እቃወማለዉ	ከሁለቱም ሃሳብ ገለልተኛ	በመጠኑ ደግፋለዉ	አጥብቄ ደግፋለዉ
6. በጥያቄ ቁጥር 5 ላይ የመረጡትን ሁሉ ሚያሙዋላ የኮንቴነር ቤት ቢሰራ ቤቱን፤ ሰዎች ቤቱን የመከራየት ወይም የመግዛት ሁኔታ ይኖራል።	☐	☐	☐	☐	☐

➢ **ኢኮኖሚካል ተፅእኖ**

እባክዎ አንዱን ብቻ ይምረጡ

ገለፃ	አጥብቄ እቃወማለዉ	በመጠኑ እቃወማለዉ	ከሁለቱም ሃሳብ ገለልተኛ	በመጠኑ ደግፋለዉ	አጥብቄ ደግፋለዉ
1. ኮንቴነር ቤትን እንደ መኖርያ ቤት ለመጠቀም አመቺ የሆነን በቂ ጥሬ እቃ አለ።	☐	☐	☐	☐	☐
2. የኮንቴነር ቤት የወር ገቢዎን እና የኑሮዎን ሁኔታ ያገናዘበ ነዉ።	☐	☐	☐	☐	☐
3. የኮንቴነር ቤቶች የመኖርያ ቤት የመግዛት አቅም ችግርን ሊፈታ ይችላል።	☐	☐	☐	☐	☐

4. የኮንቴነር ቤቶች ከኮንክሪት ቤቶች የተሻለ አቅምን ያገናዘበ ነዉ።	☐	☐	☐	☐	☐
5. መንግስት በኮንቴነር የተሰሩ መኖርያ ቤቶች ግዢ ወይም ኪራይ ላይ ድጋፍ ቢያመቻች አገልግሎቱን ለመጠቀም ለሰዎች አመቺ ይሆናል።	☐	☐	☐	☐	☐

- ቴክኖሎጂካል ተፅእኖ

ገለፃ	አጥብቄ እቃወማለዉ	በመጠኑ እቃወማለዉ	ከሁለቱም ሃሳብ ገለልተኛ	በመጠኑ ደግፋለዉ	አጥብቄ ደግፋለዉ
1. ኮንቴነር ቤቶች ለአካባቢ ተስማሚ ናቸዉ።	☐	☐	☐	☐	☐
2. የኮንቴነር ቤቶች እንደመኖርያ ቤት መገንቢያ እቃነት ለመጠቀም በቂ ጥንካቄ አለዉ።	☐	☐	☐	☐	☐
3. የኮንቴነር ቤቶች ለብዙ ግዜ የሚያገለግል እና አስተማማኝ ነዉ።	☐	☐	☐	☐	☐
4. የኮንቴነር ቤት ከኮንክሪት ቤቶች የተሻለ አቅምን ያገናዘበ ነዉ።	☐	☐	☐	☐	☐
5. ኮንቴነር ለቤትነት ጥቅም ቢዉል በህብረተሰቡ ተቀባይነት ያገኛል።	☐	☐	☐	☐	☐

- ማህበረሰባዊ ተፅእኖ

ገለፃ	አጥብቄ እቃወማለዉ	በመጠኑ እቃወማለዉ	ከሁለቱም ሃሳብ ገለልተኛ	በመጠኑ ደግፋለዉ	አጥብቄ ደግፋለዉ
1. ኮንቴነር ቤቶች ለአካባቢ ተስማሚ ናቸዉ።	☐	☐	☐	☐	☐

2. የኮንቴነር ቤቶች እንደሌላ የመኖርያ ቤቶች አስተማማኝ ናቸዉ።።	☐	☐	☐	☐	☐
3. የኮንቴነር ቤቶች ከሌላ የመገንቢያ እቃዎች በተሻለ ለአካባቢ ተመራጭ ነዉ።።	☐	☐	☐	☐	☐

የዳሰሳ ጥናቱ አካል ስለሆኑ እናመሰግናለን!

APPENDIX2. CALCULATING THE PROBABILITY OF HYPOTHESIS (P-VALUE) (IBM SPSS STATISTICS ANALYSIS)

Nonparametric Correlations

Correlations

			Age	Suitability
Spearman's rho	Age	Correlation Coefficient	1.000	.120**
		Sig. (1-tailed)	.	.008
		N	404	404
	Suitability	Correlation Coefficient	.120**	1.000
		Sig. (1-tailed)	.008	.
		N	404	404

**. Correlation is significant at the 0.01 level (1-tailed).

Nonparametric Correlations

Correlations

			Age	Incentive or subsidy
Spearman's rho	Age	Correlation Coefficient	1.000	.085*
		Sig. (1-tailed)	.	.044
		N	404	404
	Incentive or subsidy	Correlation Coefficient	.085*	1.000
		Sig. (1-tailed)	.044	.
		N	404	404

*. Correlation is significant at the 0.05 level (1-tailed).

Nonparametric Correlations

Correlations

			Age	Likely to buy or rent
Spearman's rho	Age	Correlation Coefficient	1.000	.018
		Sig. (1-tailed)	.	.359
		N	404	404
	Likely to buy or rent	Correlation Coefficient	.018	1.000
		Sig. (1-tailed)	.359	.
		N	404	404

Nonparametric Correlations

Correlations

			Income level	Suitability
Spearman's rho	Income level	Correlation Coefficient	1.000	.061
		Sig. (1-tailed)	.	.111
		N	404	404
	Suitability	Correlation Coefficient	.061	1.000
		Sig. (1-tailed)	.111	.
		N	404	404

Nonparametric Correlations

Correlations

			Income level	Incentive or subsidy
Spearman's rho	Income level	Correlation Coefficient	1.000	.036
		Sig. (1-tailed)	.	.237
		N	404	404
	Incentive or subsidy	Correlation Coefficient	.036	1.000
		Sig. (1-tailed)	.237	.
		N	404	404

Nonparametric Correlations

Correlations

			Income level	Likely to buy or rent
Spearman's rho	Income level	Correlation Coefficient	1.000	.039
		Sig. (1-tailed)	.	.218
		N	404	404
	Likely to buy or rent	Correlation Coefficient	.039	1.000
		Sig. (1-tailed)	.218	.
		N	404	404

Nonparametric Correlations

Correlations

			Education level	Suitability
Spearman's rho	Education level	Correlation Coefficient	1.000	-.049
		Sig. (1-tailed)	.	.163
		N	404	404
	Suitability	Correlation Coefficient	-.049	1.000

	Sig. (1-tailed)	.163	.
	N	404	404

Nonparametric Correlations

Correlations

			Education level	Incentive or subsidy
Spearman's rho	Education level	Correlation Coefficient	1.000	.041
		Sig. (1-tailed)	.	.207
		N	404	404
	Incentive or subsidy	Correlation Coefficient	.041	1.000
		Sig. (1-tailed)	.207	.
		N	404	404

Nonparametric Correlations

Correlations

			Education level	Likely to buy or rent
Spearman's rho	Education level	Correlation Coefficient	1.000	.020
		Sig. (1-tailed)	.	.346
		N	404	404
	Likely to buy or rent	Correlation Coefficient	.020	1.000
		Sig. (1-tailed)	.346	.
		N	404	404

APPENDIX3. BUILDING DESIGN AND QUANTITY ESTIMATION

Pier Foundation:

Pier foundations are the most popular choice for shipping container homes for numerous reasons. They are relatively inexpensive, and quick to construct, a pier foundation is comprised of concrete blocks. Each concrete block, or pier, is generally 50 cm X 50 cm X 50 cm and containers reinforcing steel inside to improve the concretes strength in tension.

With shipping container homes, the concrete piers are generally laid at each corner of the container. And, with the with larger 40-foot containers, an additional two piers can be placed midway down each side of the container.

You save a lot of time and money with pier foundations because you don't need to excavate a lot of earth at all. You only need to excavate the ground for the piers, which are generally 50 cm X 50 cm X 50 cm. Compare this to a slab foundation where you will need to excavate basically the entire area under the container. Another great reason to use a pier foundation is that other foundations, such as pile foundations, require expensive specialized equipment.

DESIGN OF SLAB

Durability and fire resistance

Nominal cover for very moderate conditions of Exposure = 25mm

Nominal cover for 1.5 hours fire resistance =20 mm

Since 25>20, provide nominal cover 25mm

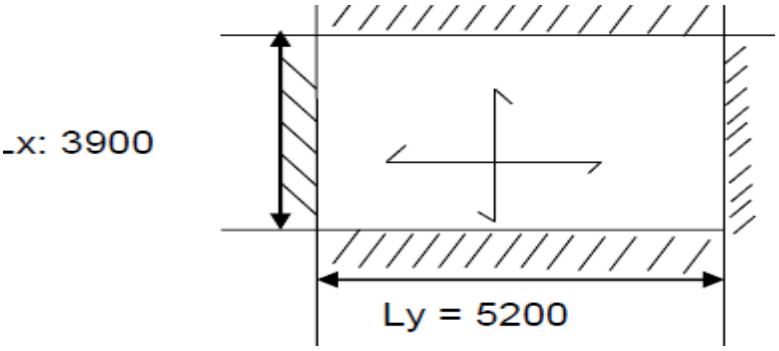
Preliminary sizing of slab

$lx40 \leq ho \leq lx25 = 3.9040 \leq h \leq 3.9025\ 9.75 \leq h \leq 15.60$

Taken h = 15cm

Effective depth in all direction of the slab

ho = 15cm – 2.5cm = 12.5cm



Ly = 5200mm

Lx= 3900 mm

λ= Ly/Lx= 5200/3900= 1.33 < 2

Hence slab is designed as two ways span with four edges continuous.

Loading

Self weight of slab

1.40*0.15*1*1*24= 5.04KN/m2

-Finishes =1.40*1.5=2.1KN/m2

Total dead load =5.04KN/m2 + 2.10 KN/m2

= 7.14 KN/m2

Design live load for residential house = 1.60*1.50KN/m2 = 2.40kN/m2

Design load (n) = 7.14KN/m2 + 2.40kN/m2=9.54KN/m2

For a 1m width, n=9.54 KN (n=Total distributed load on the slab panel)

Bending moment in simply slab supported slab

According to the moment coefficients related to the design of slabs ,

λ = Ly = 5.20 = 1.33 ~ 1.30

Lx 3.90

For the panel with four fixed sides(continuous edges);

Msx = ∝ sx * n Lx2

Mx- = 0.062 * 9.54 * 3.90 * 3.90 = 9.00 KNm

Mx+ = 0.027 * 9.54 * 3.90 * 3.90 = 3.92 KNm

Msy = ∝ sx * n Lx2

Mx- = 0.037 * 9.54 * 3.90 * 3.90 = 5.37 KNm

Mx+ = 0.016 * 9.54 * 3.90 * 3.90 = 2.32 KNm

Conclusion

Negative Mmax = 9.00KN/m (For to used in design of the required steel reinforcement at the top of slab

Positive Mmax : 3.92KNm (For to use in design of the required steel reinforcement the bottom of the slab)

Reinforcement Analysis

Effective depth = ho = 15cm -2.5 cm = 12.50 cm

a. Required steel at the top

$\propto m$ = Mmax = 9.00KNm x 100 = 0.041

Rb* b * ho2 1.40*100*(12.50)2

≅ 0.039 available in the table

$\propto m$ = 0.0.39 ξ = 0.04; = n = 0.980 (see table of coefficients relative to the design of members subjected to bending moment)

Ās= Mmax = 9.00*100 = 1.837cm2

n * Rs * ho 0.980*40*12.5

Ās = 1.66 cm2 =2 ø 12 = 2.26 cm2 (not suffiscient)

Taken 5 ø12/m provide ø12/20cm. In general the minimum bars required per meter the slab is taken as 5 bars ø 12

Required Steel at the bottom

∝m = Mmax = 3.92 x 100 = 0.018

Rb* b*ho2 1.40 *100*(12.5)2

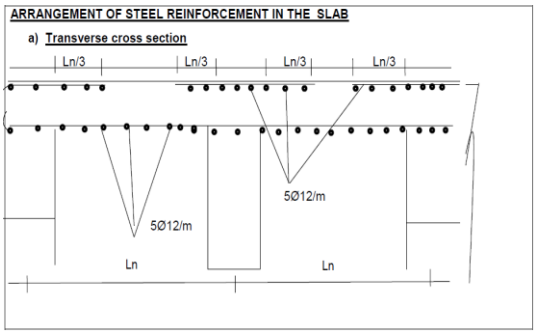
$\propto m$ = 0.031 ξ = 0.03; n= 0.985 Singly reinforced section

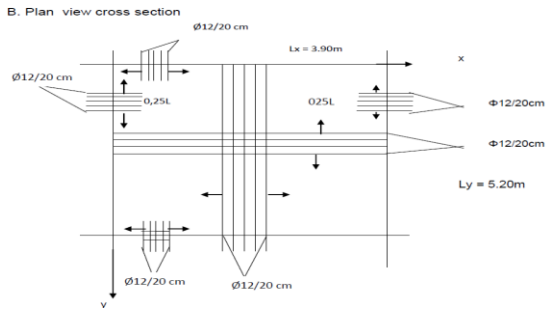
As+ = Mmax = 3.92 * 100 =0.792 cm2

n*RS*ho 0.990*40*12.5

As+= 1.010 cm2 ~ = 2 ø 8 (not sufficient)

Taken 5ø12/m provide ø 12/20cm (5 bars min / m in slab)





DESIGN OF TYPICAL BEAM

The total height (ht) of the beam has to be in the range below :

ℓy/15 < ht < ℓy /8=520 /15< ht < 520/ 8= 34.67 < ht < 65

Taken ht = 50 cm

The Breadth of the section (bw) of the beam has to be in the range below :

0.50 <bw/ht < 1 = 0.50 = bw/50 = b = 25 cm

Taken : bw = 30 cm

The flange (bf') of the beam has to be the lesser of

a) ℓy/3= 520 /3= 173.33cm ~ 175cm

b) ℓx/2 = 390/2 = 195 cm

c) 12hf+b = (12 * 15) + 25 = 205 cm

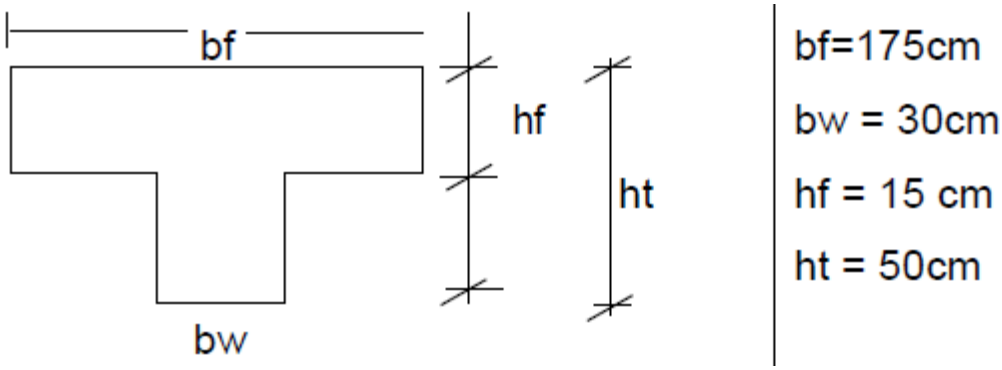
d) Taken bf' = 175 cm

therefore using ht : 50 cm

bw = 30 cm

bf' = 180 cm

Dimensions of the beam (T. section) Sketch



Maximum hogging moment = Maximum at support = Mmax- = 45.40 KN.m

Maximum sagging moment = Maximum at midspan = Mmax+ = 69.15 KN .m

Maximum shear force = Vmax = 76.67KN

Required steel reinforcement in the beam type

 Effective depth (ho) = 50 cm – 3.00 cm = 47.00 cm

a) Required steel at the top or support reinforcement

$\propto m$ = Mmax/(Rb * b * ho^2) = 45.40 x 100/(1.40 * 30 * 47 * 47) = 0.049

$\propto m$ = 0.049 ξ = 0.04 and η = 0.980

ξ = 0.03 < ξ R = 0.559 The T section is singly reinforced

Thus x = ξ * ho = 0.03 x 47 < 29 cm = ($ht-hf$) = 0.47- 0.15)

Where hf is the thickness of the flange of the T section. For that the compression area is reinforced, we have :

As- = Mmax /(n x RS x ho) = 45.40 x 100 (0.980 x 40 x 47) = 2.464 cm2

Because of the minimum bar in the beam is Ø 12, we must use Ø16

Provide = 3 Ø 16 = 6.03 cm2

b) Required steel at the bottom or mid span reinforcement

$\propto m$= Mmax+ /($Rb*bf*$ ho^ 2)= 69.15 * 100 (1.40 * 175 * 47 * 47) = 0.079

$\propto m$ = 0.77 ξ = 0.08 and n = 0.960

ξ = 0.01 < ξ R = 0.559 The T section is singly reinforced

Thus x = ξ x ho = 0.01 x 47.00 < ($hf-hf$= 15 cm) ; The compression area is reinforced

As = 69.15 x 100

0.960 x 40 x 47

Taken 3 Ø 14 = 4.62 cm 2

c) Design of stirrups or shear reinforcement

Vmax (Maximum shear force) = 76.67 KN

qsw = shear force carried by stirrups

qsw = (Vmax)^2 /4φbf x Rbt x bw x ho2

Where φbf = 1.50

Rbt = 0.09 KN/cm2

qsw = (76.67)^2/(4 *1.50 *0.09*30*47*47)=5878.2889/35785.80=0.164 KN/Cm2

Set us use stirrups of Ø 8 Asw = 50.3 mm2 = 0.503 cm2

Rsw = 0.8 x Rs = 0.8 x 40 KN / cm2 = 3.20 KN / cm2

Distance between stirrups (S)

S = Rsw x Asw x n /,qsw, where n = number of legs for stirrup

S = 0.8 x 40 KN/cm2 x 0.503 cm2 x 2 /0.164 KN/Cm2

Note: The distance between stirrups must be lesser than the three following values

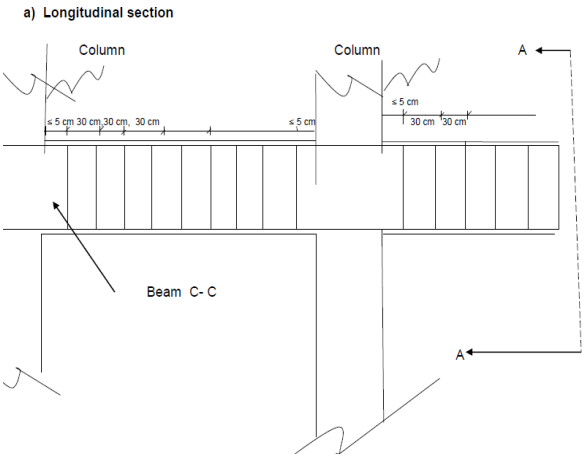
1) Smax = (0.75 φbf x Rbt x b x *h*o2)/Vmax

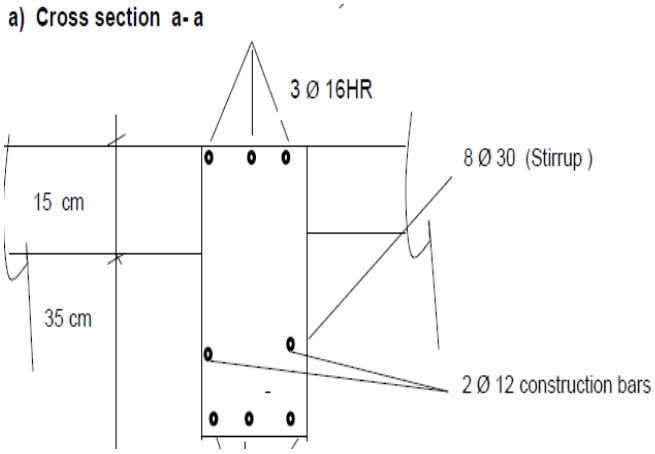
= (0.75 x 1.50 x 0.09 x 30 x (47)^2)/Vmax = 6709.84 /76.67= 87.52 cm

2) The width of the beam web = bw =30 cm

3) 30 cm

Thus S = Min 87.52cm; 30 cm; 30 cm = 30 cm Taken : Ø 8 @30 cm





COLUMN DESIGN ANALYSIS

Clear height of ground floor column = 300 cm

End conditions

Condition at top of the column

End of column is connected monolithically to beams on either side and are at least as deep at the overall

Condition at bottom of the column

End of column is connected monolithically to beams or to footing on either side and are at least as deep as the overall

Dimension of the column (minimum cross section of column AB = 25 * 25 cm

a= 250 mm b = 250 mm

β = 0.7 (braced column)

H = Total height of column

Effective height of column = $\ell o = \beta * H$

ℓo = 0.70 * 3.0m = 210 cm

λ (slenderness ratio) : $\ell o/a$ = 210 cm/25cm = 8.40≈ 8

φ = 0.91 if λ = 8 (page 25 on table of φ values in RCDI)

Hence column is to be designed as short braced axially loaded column (short column)

Let us do design analysis of one internal column type.

Design analysis of column

Loads on the column

a) Column loading area = (2.10/2 x 4.10/2) + (2.10/2 x 5.10/2) + (5.10/2 x 3.80/2) + (3.80/2 x 4.10/2) = 13.58m2

b) Slab (permanent load) = 1.40 * 0.15m * 24KN/m3 * 13.58m2= 68.44KN

c) Live load from the slab = 1.50 KN / m2 x 1.60 m2 * 13.68m2= 32.59 KN

d) Load from beam 1.40*0.300* 0.375* 7.55 * 24 = 28.54KN

e) Load from the wall maconery = 1.40*0.20*3.00*5*18=75.60KN

S/total 28.54 KN + 75.60 KN = 104.14 KN

f) On floor of column = 1.40 x 0.25 x 0.25 x 3.00 x 24 = 6.30 KN

g) Load from the light roof ≅ Permanent load from slab/2 = 68.44KN/2 = 34.22KN

4.3.2. Ground floor part of the column

N1 = [(68.44KN + 32.59KN + 104.14KN) x 1 +(6.30KN * 2)] + 34.22KN

N1 = 205.17 KN + 12.60KN+34.22KN = 251.99KN ~ 252.00KN

4.3.3. Required steel reinforcement

ℓo = 0.7 * 3.00 = 2.10

λ = 2.10/0.25 = 8.40 < 14.3 short column

If $\lambda = 8.40 \approx 8$ $\varphi = 0.91$

AS = (N1 /φ -Rb * Ab)/ RS = (252.00KN/0.91 – 1.40 * 625) /40

AS = (276.92 – 875)/40= - 14.95 cm2

Negative sign indicate that compression steel reinforcement is not required because AS < 0

Therefore the theory assumes that the minimum percentage of steel reinforcement must be evaluated as follows

Asmin = 0.004 Ab

Asmin = 0.004 x 25 x 25 = 2.5 cm2

Token = 4 Ø 12 = 3.14 cm2

But, because of the minimum diameter of bar in the column is assumed as Ø 12, we must use 4 Ø12

Thus we arrange the same steel up to the top floor

□□Smin = distance between stirrups = 1 / 4 * 12 mm = 3mm

□□Smax = 12 * Ø max = 12 * 12 = 144 mm ~ 15 cm

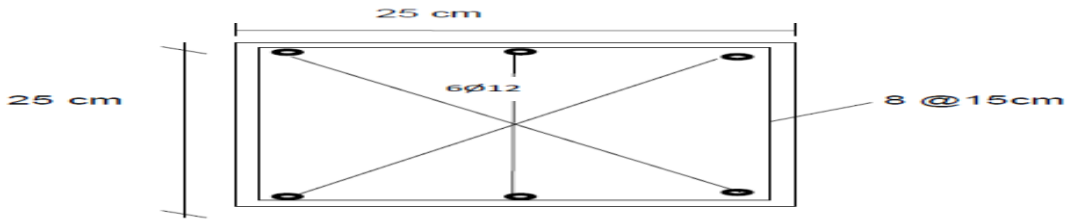
□□S= 300mm

Taken 15 cm

Token S = 15 cm

Thus we use Ø 8 @ 15 cm

CROSS SECTION OF THE COLUMN C22



DESIGN OF PAD FOUNDATION footing nº 22

(see page 115 in B.S)

Soil bearing capacity

We assume that PS = 200 KN /m2

Characteristic load transmitted to the foundation

NC =[(68.44/1.40 + 32.59/1.60 + 104.14/1.40)] x 1 + 6.30/1.40* 2 + 34.22/1.40

NC = (48.89 + 20.37 +74.39) * 1 + 24.44 + 9.00

NC = 143.65 + 24.44 +9.00

NC = 177.09KN

4.4.3. Weight of the foundation

NC = 177.09 KN = 17.71 KN

10 10

4.4.4. Foundation base dimensions

Af = Area of footing = NC + NC / 10 = 177.09 + 17.71KN

PS 200

Af = 0.974cm2

af x bf = √0.98cm2 = 0.99 cm ~ 1.00 m

af = bf =0.99m Af = 1.00m2

Because of seismic zone provide 1.20m * 1.20m

4.4.5. Checking of the punching shear

□□Condition of no punching shear:

Qf = Nf - Δq ≤ Rbt X Ab

Where : Qf : Punching shear force

N1 = Nf = load transmitted by the column to the foundation

Δq = Balanced soil pressure

Ab = Average lateral area of the punching pyramid

Um : Average perimeter of the punching pyramid

Rbt = Concrete tensile design strength = (0,09 KN / cm2)

P = pressure = Force = F = N1 = 252.00 KN=

Area A Af 14400 cm2

P = 0.018 KN/ cm2

af = bf = sides of footing

ac = bc = dimensions of cross section of column

ho = Effective depth of footing

□□Let us take hf = 30 cm $ho = hf$ - 5 cm(it is recommended to take minimum value of hf with respect the equilibrium of QF formula below

ho = 30 cm – 5 cm = 35 cm

Um = 2 (ac+bc+2 ho) = 2 (25+25+2 x 25)

Um = 200 cm

$Ab = Um\ x\ ho$= 200 cm x 25 cm = 5000 cm2

Δq = (+2 ho)(bc+2 ho)

Δq = 0.013 $KN/cm2$ (25+2 x20) (25 + 2 x 25)

Δq = 0.013 x 75 x 75

Δq = 73.13 KN

Thus : $Qf = Nf -$ Δq ≤ $Rbt\ x\ Ab$

Qf = 252.00 KN−73.13 KN ≤0.9 x 5000

Qf=178.87 KN < 4500 KN

The condition is satisfaction ; thus No punching shear

4.4.6. Required steel reinforcement for the foundation

Maf=Mbf = ($P\ x\ af2$) ($bf - bc2$)2

Where: : Bending moment about side af of the

Footing

: Bending moment about side bf of the footing

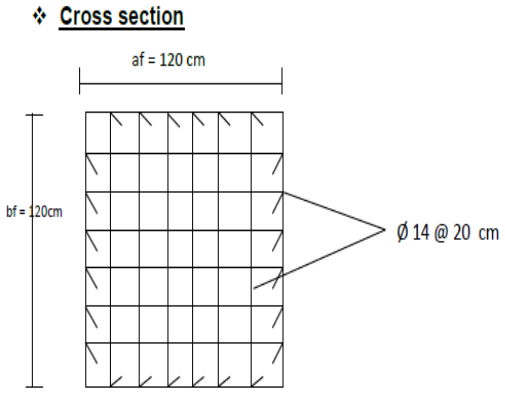
Thus : $Maf = Mbf$ = 0,013 x 1202 120− 252

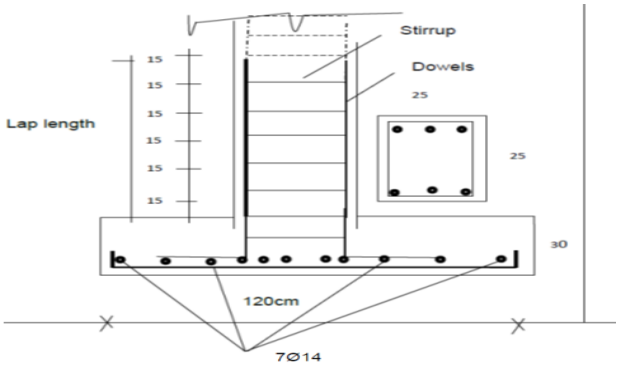
= 0.78 x 2256.25 = 1759.88 KN.cm

As = $Mmax$0.9 $x\ Rs\ x\ ho$= 1759.875 $KN.cm$0.90 x 40 x 25 = 1.96 cm2

As = 1.96 cm2 because of seismic zone

provide 7Ø14/m provide Ø14@ 20cm





DESIGN OF STAIR CASE (Reinforced concrete)

Durability and fire resistance

Nominal cover for very moderate condition of exposure = 25mm

Nominal cover for 1.5 hours fire resistance =20mm

Since 25>20,provide nominal cover =25mm

Therefore durability and fire resistance are satisfactory

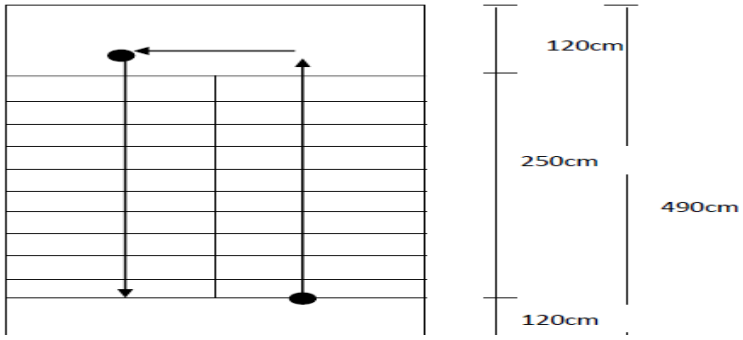
Preliminary sizing of staircase members

Height from ground floor slab to first floor

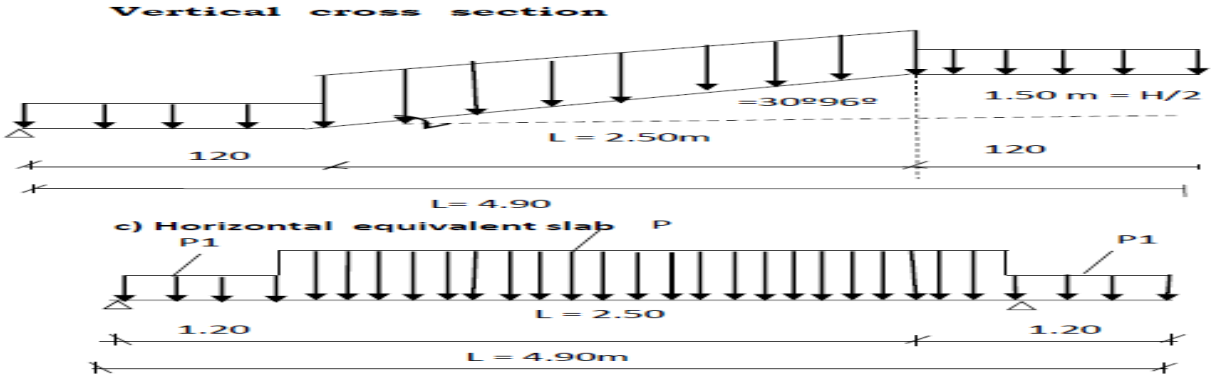
slab=3000mm

Height from ground floor landing=3000/2=1500mm 7Ø14

a) Plan view



b) Vertical cross



Calculation of load P

Tg∝ = (H/2)/L=150/250 = 0.600 ∝ = 30º 96

Thickness of horizontal equivalent slab

h= dℓ Cos∝+ 2 3*H* 1 = 18 /0.85749 + (2 x 18.33)/3 = 33.21 cm

Where dl = thickness of slab of stair case and h = waist of slab of stair case and H1 = rise of stair

Self load = 1.40 * 0.332m *1m * 24KN/m^3 = 11.16 KN/m

Finishes = 1.40 * 1.50 = 2.10 KN /m

Live load = 1.60 * 3KN/m^2*1m = 4.80KN/m

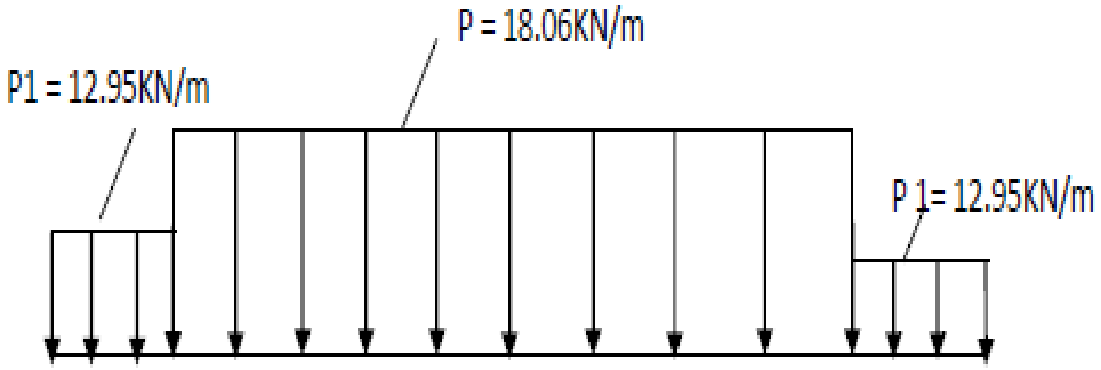
Calculation of load P = 11.16 + 2.10 + 4.8 = 18.06 KN /m

Self weight = 1.40 * 0.18 * 1 * 1 * 24 KN/m3 = 6.05 KN/m

Finishes = 1.40 x 1.50 = 2.1 KN/m

Live load = 1.60 x 3 = 4.80 KN/m

Total load P1 = 6.05KN/m + 2.10KN/m + 4.80 KN/m = 12.95 KN/m



calculation of steel reinforcement in the stairs

Ho = h -2.5cm = 33.21cm – 2.50cm = 30.71cm

∝m= Total Mmax = 50.03 x100 = 0.038

Rb x b xh2o 1.40 x100 x 30.71x 30.71

From the table of coefficients related to the design of members subjected to bending moment

∝m = 0.038 n = 0.980

Main steel reinforcement

AsM = Total Mmax = 50.03 x 100 = 4.16cm/m = 3Ø14

n x ho x Rs 0.980 x 30.71 x 40

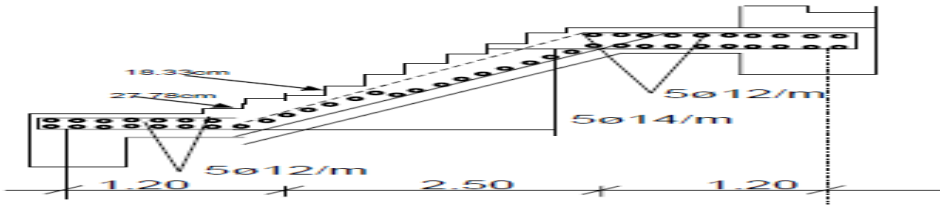
Because of we have to use at least 5 Φ 14/ m in the slab, therefore we take the minimum Provide 1 Φ14 @ 20cm as main steel reinforcement, it means 1 Ø14@20cm Distribution steel reinforcement

Provide 1 Φ14@20cm as main steel reinforcement

Distribution steel reinforcement

AsD = AsM * ⅕ = 7.70cm2÷⅕ = 1.54cm2

For the same reason, we choose the minimum such as 5 Φ 12 = 5. 65 cm2, thus, Provide 1Φ12 @ 20cm as distribution steel reinforcement



R= Rise = 18.33cm
T= Tread = 27.78 cm
W = Waist slab = 33.21cm
Dl = Thickness of slab = 18 cm

The Quantity breakdown is estimated to be as follow

A. Sub- structure		
	Description	
Excavation and earth work	Clear site of all rubbish, bushes etc..	61.12 m^2
	Site Clearance	61.12 m^2
	Pit Excavation	10.56 m^3
	02 Aggregate placement	61.12 m^2
Back Fill	Select Material	4.18 m^3 => 1 Biyajo
	Hard Core	1.73 m^3 = > 1 Biyajo
Cart Away		28.90 m^3
C-5 Concrete	Lean Concrete under Footing Pad	5.76 m^2
	Under Grade Beam	0.85 m^2
Foundation (Pier foundation) (C-25)	Footing Rebar	160ø10 = 1.35 m => 30Berga
	Form work	10 m^2
	Concrete	1.0 m^3
Foundation (Footing Pad) (C-25)	Footing Rebar	48 ø14 = 2.4m => 29Berga---139.28
	Column Starter Rebar	24ø12 = 1.63m => 11Berga---34.74
	Column Starter Stirrup	22 ø8 = 1.2m => 54Berga---10.42
	Form work	23.52 m

	Concrete	2.05 m^2
Grade Beam (C-25)	Rebar	6 ⌀ 16 = 3.64m => 3Berga
		6 ⌀ 16 = 2.80m => 2Berga---61.01
	Form work	11.36 m^2
	Concrete	0.85 m^3
B. Supper- structure		
	Description	
Shipping Container		2pcs
Ground Floor Column (C-25)	Rebar	24 ⌀ 12= 3.38m => 8Berga
		72 ⌀ 8= 1.1m => 8Berga
	Form work	6.48 m^2
	Concrete	1.05 m^3
Stair Case	Spiral Stair	1pcs
Finishing Work		
Roof Work	**CIG G-28**	44.33 m^2
	0.4mm thick, girth 65cm	142.28m
	G-28 Flat steel Sheet Copping	26 m
Plastering	External on column	12.96 m^2
Gypsum	Quartz on column	12.96 m^2
	Gypsum Board	89.48 m^2
	Roof	47.47 m^2
Painting	External Steal paint	282.58 m^2
	Internal	238.76 m^2
	Roof	47.47 m^2
Parquet Tid	Per m^2	53.67 m^2
Skirting	(0.1×0.6)	85.45 m
Wall PVC	Per m^2	52.25 m^2
Door	(2.44×2.2)	1 pcs
	(1.5 × 2.2)	3 pcs
	(1.0 × 2.2)	6 Pcs
Window with Glazing	(0.9 × 1.2)	3 pcs
	(1.0 × 1.2)	1 pcs
	(1.4 × 1.2)	3 pcs

Table 5 shipping container building quantity breakdown

- **CONCRETE BUILDING COST ESTIMATION**

The Quantity breakdown is estimated to be as follow

A. Sub- structure		
	Description	
Excavation	Clear site of all rubbish, bushes etc..	61.12 m^2
	Site Clearance	61.12 m^2
	Pit Excavation	69.70 m^3

Back Fill	Select Material	10.767 m^3 => 1 Biyajo
	Hard Core	47.47 m^3 = > 1 Biyajo
Cart Away		88.03 m^3
C-5 Concrete	Lean Concrete under Footing Pad	17.28 m^2
	Under Masonry Foundation Wall	13.49 m^2
	Under Grade Beam	13.49 m^2
Foundation (Footing Pad) (C-25)	Footing Rebar	144⌀14 = 2.4m => 29Berga
	Column Starter Rebar	72⌀12 = 1.63m => 11Berga
	Column Starter Stirrup	64⌀8 = 1.2m => 54Berga
	Form work	70.56 m
	Concrete	6.16 m^2
Grade Beam (C-25)	Rebar	12 ⌀ 16 = 12.00m => 12Berga
		3 ⌀ 16 = 3.64m => 0Berga
		3 ⌀ 16 = 2.80m => 0Berga
		24 ⌀ 16 = 6.64m => 24Berga
		8 ⌀ 12 = 12.00m => 8Berga
	Form work	50.78 m^2
	Concrete	7.13 m^3
Masonry		13.17 m^3
Ground Floor Slab (C-25)	Rebar	34 ⌀ 8= 4.22m => 17Berga
		52 ⌀ 8= 2.54m => 13Berga
	Concrete (10cm thick)	47.47 m^2
B. Supper- structure		
	Description	
Ground Floor Column (C-25)	Rebar	72 ⌀ 12= 3.38m => 24Berga
		216 ⌀ 8= 1.1m => 22Berga
	Form work	34.56 m^2
	Concrete	2.59 m^3
Stair Case	Spiral Stair	1pcs
First Floor Beam (C-25)	Rebar	12 ⌀ 16 = 12.00m => 12Berga
		3 ⌀ 16 = 3.64m => 0Berga
		3 ⌀ 16 = 2.80m => 0Berga
		24 ⌀ 16 = 6.64m => 24Berga
		8 ⌀ 12 = 12.00m => 8Berga
	Form work	63.08 m^2
	Concrete	7.13 m^3
First Floor Slab (C-25)	Rebar	36 ⌀ 12= 2.50m => 9Berga
		36 ⌀ 12= 6.38 m => 36Berga
		36 ⌀ 12= 9.32m => 36Berga
	Concrete (15cm thick)	7.12 m^3

	Form Work	47.47m^2
First Floor Column (C-25)	Rebar	72 ⌀ 12= 3.38m => 24Berga
		216 ⌀ 8= 1.1m => 22Berga
	Form work	34.56 m^2
	Concrete	2.59 m^3
Roof Floor Beam (C-25)	Rebar	12 ⌀ 16 = 12.00m => 12Berga
		3 ⌀ 16 = 3.64m => 0Berga
		3 ⌀ 16 = 2.80m => 0Berga
		24 ⌀ 16 = 6.64m => 24Berga
		8 ⌀ 12 = 12.00m => 8Berga
	Form work	63.08 m^2
	Concrete	7.13 m^3
Finishing Work		
Roof Work	**CIG G-28**	44.33 m^2
	0.4mm thick, girth 65cm	142.28m
	G-28 Flat steel Sheet Copping	26 m
HCB Work	20×20×40	140.20 m^2
	15×20×40	49.28 m^2
Plastering	External	282.58 m^2
	Internal	238.76 m^2
Gypsum	External	282.58 m^2
	Internal	238.76 m^2
	Roof	47.47 m^2
Painting	External	282.58 m^2
	Internal	238.76 m^2
	Roof	47.47 m^2
Porcelain Ceramic	(60×60)	53.67 m^2
Skirting	(0.1×0.6)	85.45 m
Wall Ceramic	(0.45×0.3)	23.22 m^2
Marble	(1.5×0.15)	10pcs
Door	(2.44×2.2)	1 pcs
	(1.5 × 2.2)	3 pcs
	(1.0 × 2.2)	6 Pcs
Window with Glazing	(0.9 × 1.2)	3 pcs
	(1.0 × 1.2)	1 pcs
	(1.4 × 1.2)	3 pcs

Table 6 Concrete building quantity breakdown