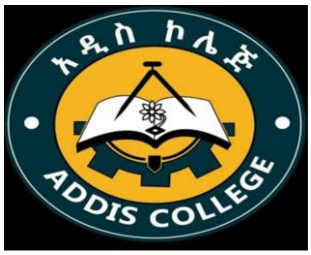

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

ASSESSMENT OF CONSTRUCTION WASTE MANAGEMENT STRATEGIES. THE CASE OF GIFT REAL ESTATE BUILDING CONSTRUCTION PROJECT

BY

Bezawit Mesfin

A Thesis Submitted to School of Graduate Studies in Partial fulfillment of the requirements for the Degree of Master of Science in Civil Engineering (Construction Technology and Management Engineering)

Advisor-Mr Biruk Tibebu

August, 2023

Addis Ababa, Ethiopia

ADDIS COLLEGE

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

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BY

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DECLARATION

I, Bezawit Mesfin, declare that this research project entitles" ASSESSMENT OF CONSTRUCTION WASTE MANAGEMENT STRATEGIES IN THE CASE OF GIFT REAL ESTATE BUILDING CONSTRUCTION PROJECT". Is the outcome of my own effort and study also that all sources of materials used for this study have been acknowledge I have produced it independently with the guidance and suggestion of my research advisor.

This research study has not been submitted for any degree in this university or any other university. It is submitted for the partial fulfilment of the degree of masters of Science in Construction Technology and Management.

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ENDORSEMENT

This thesis has been submitted to Addis College, department of construction technology and management for examination with my approval as a university advisor.

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Addis College, Addis Ababa

August, 2023

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Bezawit Mesfin Kifle

August 2023

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LIST OF ABBREVIATIONS

3Rs – Reduce, Reuse and Recycle

AAHCPO – Addis Ababa Housing Construction Project Office

C & D – Construction and Demolition

CWM & DS – Construction Waste Management and Disposal Strategies

EPA – Environmental Protection Authority

EPCP – Environmental Pollution Control Proclamation

GDP – Gross Domestic Product

MoUDC – Ministry of Urban Development and Construction

RII – Relative Importance Index

SPSS – Statistical Package for Social Science

SWMP – Solid Waste Management Proclamation

UNEP – United Nation Environmental Protection

ASSESSMENT OF CONSTRUCTION WASTE MANAGEMENT STRATEGIES IN THE CASE OF GIFT REAL ESTATE BUILDING CONSTRUCTION PROJECT

ABSTRACT

In Ethiopia construction industry significantly increase especially in Addis Ababa. In our capital city at this time there are huge construction projects because of this a huge construction material needs for construction process and In property usage of this material or other reasons there are a high amount of construction waste in the site so this waste polluted our environment on account of this waste must be change to use by waste management plan. Therefore, the aim of this study was to assessing of building construction waste management strategies of gift real estate building project. The significance of this study, the organization was to identify its problems and revise its waste management strategies in order to improve systematic waste management plan. The Employees of Gift Real Estate Company were the target study population. Descriptive Research design was used in this study. The sampling technique was purposive non-probability sampling used, study was utilized both primary and secondary data was collected through qualitative and quantitative method. The researcher was used questionnaire, interview and observation. The collected data was analysis by frequency and mean item score. The research found out reinforcement bar & timber were extremely generated construction waste in Gift Real Estate and also lack of proper waste management plan & control was extremely significant sources of construction waste. Gift Real Estate current practices of construction waste management was mostly landfilled and disposal. Therefore, from assessing result current waste management practice is poor organization should improve its waste management plan.

Keywords: - Construction Waste, Sources of Construction Waste, Construction Waste Management Strategy

CHAPTER ONE: -INTRODUCTION

1.1. Background of the study

The construction industry is one of the main contributors towards the development of nations. Providing the necessary infrastructure and physical structures for activities such as commerce, services and utilities. The generates employment opportunities and injects money into a nation to global warming, environmental pollution and degradation.

With a large population, rising urbanization, and a rapidly expanding economy, Ethiopia is one of the least developed countries. With more over 110 million people, it is the second-most populated country in Sub-Saharan Africa after Nigeria (World Bank, 2021a). The rates of growth for both the total population and the urban population are as high as 2.5% and 4.7%, respectively (World Bank, 2021b). Since 2010, the nation's economy has grown by 9.4% on average, and it is committed to reaching a low-middle income by 2025 (World Bank, 2015, 2021b).

Ethiopia's building industry is still expanding, which helps the nation's economy and provides for the country's infrastructure needs. Addis Ababa is on a fast track of development. An enormous number of construction projects are running envisioning the future of Addis Ababa. The construction sector is the second most important sector in the Ethiopian economy in terms of workforce and 9.5 percent of GDP in 2016. Based on the above premise, it’s logical to consider the construction sector as the dominant economic force in the development process of Addis Ababa. Housing is among the major demands in Addis Ababa. In the past 15 years, the city administration has been trying to fulfill the housing need through the mass construction of condominium houses. And other side appreciate investor to invest in real estate business in order to decrease housing needs, (Teka, E., 2023).

Addis Ababa population grows, more new homes must be built, which has caused the real estate market to emerge as a substitute method of satisfying demand. Numerous real estate companies operate in the sector of real estate. Construction industry is responsible for one of the single largest waste streams in the country and Construction waste can affect human economy, environmental

health if it is not managed and disposal properly. Hence proper construction waste management and disposal system is necessary for sustainable and healthy environment. Waste management is evolving into a pressing issue that affects the life of the population (Hirpe, L., & Yeom, C., 2021).

The terrible recent deaths of hundreds of waste collectors and neighborhood residents as a result of the accumulation of waste collapsing in the official dumpsite in the capital, Addis Ababa, may be indicative of the gravity of the problem with waste management in the nation. Construction-related waste includes scrap, ruined or broken materials, temporary and disposable tools and supplies, aids that aren't part of the completed project, packaging materials, and employee waste, (Baird, J.-A., 2016)

When constructing a new building or structure, as well as when restoring or destroying an existing building or structure, construction and demolition materials are produced. These are typically bulky, heavy materials like concrete, steel, wood, asphalt, and gypsum that are employed in modern building. It is well known that a sizable amount of the materials is wasted at the sites for a variety of causes (Abdulsemee M.& Halahla, M., 2019).

Sustainable construction must include responsible waste management. Managing waste in this context entails reducing waste when it is practical, eliminating waste whenever possible, and repurposing things that could otherwise end up in the waste. Reducing, recycling, and reusing waste has been acknowledged by solid waste management techniques as being crucial for resource management that is sustainable.

Multiple stages of development are involved in the building waste management system's transition to sustainability (African Clean Cities Platform Secretariat, 2019). It achieves waste reduction, initiates a circular economy that transforms waste management into a comprehensive resource management system explained by the 3Rs, and ensures sanitary conditions to protect public health through efficient waste collection, controlled disposal, and waste reduction (Wilson et al., 2013). While developing countries struggle to achieve the first two stages, waste collection and controlled disposal, developed countries have been performing better in this regard due to institutional, policy, and legal methods and the implementation of construction waste management strategies based on waste management hierarchy (UNEP, 2016). In accordance with concerns for the economy, human health, and the environment, an effort is being made to prevent and limit construction waste. In order to prevent trash, reuse it, and properly dispose of it, there are a number

of measures to take into account. Administrative, policy, and legal procedures are required for the attempt to manage construction waste properly. The majority of research conducted in underdeveloped nations show that there are no efficient construction management solutions used in the construction process (Guerrero, 2014). Along with Ethiopia, other nations have experienced a growth in the building sector. Construction waste management, both generally and in the residential sector especially, falls short of expectations. A country's management style is significantly influenced by its economic, social, and political situation. Construction waste management entails waste minimization, prevention, and disposal. Effective waste management provides major economic benefits and guards against harm to the environment and human health. This study endeavors to examine the situation of waste management of the real estate through an assessment of waste management strategies of Gift Real-estate.

The study aims to identify the construction waste management strategies implemented, its problems and roots with a view to understand and contribute in finding solutions. With this in mind, it exposes and discusses the findings of the study and forwards appropriate recommendations.

It also provides an overview of the concept of construction waste and management strategies, economic, human and environmental impacts of waste management, experiences of other countries on construction waste management and other related concepts.

1.2. Statement of the problem

Management of construction waste has a substantial impact on the economy, the environment, and human health. In order to cut costs, avoid health issues, and lessen environmental harm, proper waste management is essential. Ethiopia has seen a sharp rise in development over the past two decades, but there are currently no systems in place to effectively manage the growing amount of construction debris. Gift Real estate company’s also no effective system used to managed their waste.

A large part of waste entering the ground comes from the construction industry. According to estimates by Abukhader. M (2015), construction and demolition waste account for 15–30% of the total volume of waste dumped to landfills worldwide. Historically, the construction sector has been unfriendly to the environment. This due to lack of effective waste management. Trade contractors

are rewarded for speed rather than their care for the environmental impact of their job, which is a construction cultural practice that contributes to waste (Kofoworola, 2009). Construction waste has a detrimental environmental impact in Ethiopia since there is no efficient waste management system in place. Moreover, waste levels are exceedingly high in the majority of Addis Ababa real estate and condominium (Getachew, 2009).

Waste can occur at any stage of construction not only because of construction activities but also due to external factors such as theft and vandalism (O.O. Fadiya, 2014). The construction waste if that not properly managed cause cost overrun and time overrun of each construction activities and that affect total project success. In Gift Real Estate also cost overrun and time overrun happened that the one reason Gift Real Estate project completion time and budget run from expected schedule. Therefore, development of construction waste management in Ethiopia construction needed. It is crucial to manage construction waste if you want the sector to perform better in terms of sustainability and economic quality. Reducing waste at every level of the construction process is one method to meet this goal. Managing construction waste may speed up the building process, save time, and promote sustainability. The amount of construction waste on site cannot be overlooked. This study decided filled the gap in identifying the types and source of construction waste and assess the gift real estate construction waste management practice. Purpose of the study is clearly identifying construction waste and assessing and improving construction waste management strategies in gift real estate building construction project.

1.3. Objective of study

The aim of this research is to assess the construction waste management strategies at gift real estate building project. In order to achieve this aim, the following objectives must be achieved in prior.

1.3.1. General objective

To assess building construction waste management strategies of gift real estate building project.

1.4.2. Specific objective

The study focuses mainly on the following elements

1. To identify the sources of construction waste in gift real estate building construction project.
2. To assess types of construction waste management strategies applied in Gift Real Estate building construction project.
3. To formulate frame work to improving construction waste management strategies of gift Real Estate building construction project.

1.4. Research Question

This research aims to answer the following questions:

1. What are sources of construction waste in Gift Real Estate building construction project?
2. What is the practice implemented for managing waste in the Gift Real Estate building construction project?
3. How to improve the construction waste management strategies of gift real estate Company?

1.5. Significant of the study

The researcher believes that the findings of this study may help to overcome the challenges on the construction waste management strategies of the study area. The study introduce new concepts, plans and strategies construction waste management, which may help individuals and entities to properly manage waste in construction. By indicating the problems in construction waste management. It is significant as it possibly leads to an in-depth study of the situation of construction waste management and motivates administrative legal and policy measures. For the organization to identify its problems and revise its waste management strategies in order to improve systematic waste management and disposal plan. The study also be useful as a reference and stepping stone for academic and practical research on construction waste management.

1.6. Scope of study`

This research was limited to an assessment of construction waste management strategies in Gift real estate building construction at Addis Ababa different project. It may however provide a useful insight regarding the situation of other real estate sites, which practice a similar waste management strategy. Substance wise the research was limited to construction waste management system

relating to the construction process of buildings at the site also impact of waste at real estate buyer village at health and environmental impacts. It mainly focuses on assessing the management of construction waste resulting in during construction. It does not provide in-depth expose of construction material management techniques applicable before construction such as those relating to the production and manufacturing of materials employed as mechanisms of waste prevention. Therefore, for this study considered on Gift Real estate building construction projects. And the case study only considers the construction waste. Also, different literature review was carried out on material wastage in building sites with a main focus of prior research work. Moreover, the researcher was working in real estate building project and had the experience to the source of construction waste the problem of housing development projects.

1.7. Limitation of the study

There was lack regarding data on the specific health, environmental and economic impacts. The research would have been more elaborate and informative with a broader scope. The respondent somewhat careless as they responded and low interest to fill. However, financial and time constraints limited its scope to the Gift real estate Project. While this is true, it was provided useful insight about the main problems in other sites and its recommendations has been helpful.

1.8. Operational definitions

Construction Waste management – An efficient material handling, reduction, reuse, recycling and disposal of construction waste materials.

Construction Waste - Wasted or damaged materials generated from construction site which need to be transported elsewhere to the construction sites or used within the construction site itself for the purpose of land filling, incineration, recycling, reusing, or composting rather than the intended specific purpose of the project due to material change, excess nonuse, or noncompliance with the specifications or being a byproduct of the construction process.

Construction Waste Disposal – The land filling, incineration, recycling, reusing, or composting of construction waste materials.

Waste Management Strategies- An all-encompassing strategy to effectively utilize construction resources, with the view to reducing the quantity of waste and utilizing the generated waste in the

most effective manner constituting avoiding waste, re-using and recycling waste materials. Avoiding waste refers to any practice to avoid or minimize waste at source. Re-using and recycling refer to the re-using and recycling of waste materials

1.9. Organization of the study

The Organization of the study is divided in different chapters, as follows:

Chapter 1. Introduction: This section provides a background of the topic researched in this study. The main idea of this chapter is to explain the background of the problem, the objectives and the contribution made by this project.

Chapter 2. Literature Review: This chapter contains information on the main topics of thesis, including the types and sources of construction waste on building construction projects as well as practical advice on how to better manage and reduce construction waste on buildings construction project. Additionally, this chapter will provide a theoretical framework by formulating a few assertions that serve as the cornerstone of the methodology research.

Chapter 3. Methodology: - This chapter provides the plan of the research. In other words, this section explains the research paradigm, approaches, strategies and data collection methods.

Chapter 4. Analysis and Discussions: - this section was providing the results from the questionnaire & interview and analysis to makes a comparison with the existing literature. In addition, these results are used in this section to see the way in which they help confirm or reject the hypotheses. On the other hand, this chapter also provides a critical evaluation of this work including the limitations of the research.

Chapter 5. Conclusions and Recommendations: This section will be summarizing the main issues of this dissertation and it provides an overview of the main findings. It also concludes if the project met the proposed objectives and the way in which this dissertation was useful to confirm or reject the hypothesis.

CHAPTER TWO: LITERATURE REIVEW

2.1. Theoretical Literature Review

2.1.1. Definition of Construction Waste

A construction project is "an economic activity directed to the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature, and other such engineering constructions as roads, bridges, dams, and so forth," according to the United Nations Statistics Division. It is a procedure that involves creating or putting together infrastructure in the areas of architecture and civil engineering. It includes the construction of new structures, which includes site preparation, as well as the augmentation and alterations of existing ones. It also includes the upkeep, fixing, and enhancement of these structures. It involves building structure to real estate (Center for Statistics, 2008/2009).

The practice of controlling materials is very new in the building sector. Contractors and designers are primarily focused on cost control at the moment, with no attention paid to waste reduction methods. The cost of materials is generally acknowledged to have contributed significantly to the overall cost of construction projects. Therefore, it is anticipated that careful material management and effective construction management will lower building project costs.

General contractors, major construction (such as motorways, airports, and utility systems), and construction by specialized trades are all included in the construction business. Companies that work on preparing sites for new construction and splitting land for building sites are also featured. New work, additions, alterations, maintenance work, and repairs all fall under the category of construction work.

The success of a project is greatly influenced by the vital role that materials management plays in building projects. Lack of storage space, supply delays, pricing changes, damage and waste, and material shortages all make managing supplies for building projects difficult. The management of materials is a crucial task for increasing productivity in building projects.

The management of materials should consider at all the phases of the construction process and throughout the construction and production periods. This is because poor materials management

can often affect the overall construction time, quality and budget. The important for planning and controlling of materials to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at a reasonable cost, and are available when needed. Many construction projects apply manual methods, not only for the tracking of materials, but also for materials management as a whole and this involves paper-based techniques and is problematic with many human errors (Narimah, K., 2013).

Researchers and authors have different views as to what constitutes construction waste and provided various definitions in relevant literature. Construction waste as the by-product generated and removed from construction, renovation and demolition workplaces or sites of building and civil engineering structures.

Waste is defined as something that does not offer value to the consumer, client, or end-user, according to (Mossman, A., 2009). Accidents, waiting times, rework, damaged or over ordered materials, repeated handlings of those materials, "making do," multiple insurances, etc. Poor payment procedures, competitive bidding, and cost-based facility procurement are all examples of wastes.

Construction waste is a significant global problem that can harm a project's overall success as well as the city and environment, Nagapan, S. et al. (2012) pointed out in their study. It can be brought on by a number of things. The waste produced results in material, time, and financial expenses being wasted. Industrial trash from construction projects, including metal debris, concrete remnants, and collapsed concrete, among other things, results in substantial physical harm.

Construction material wastages can be defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials transferred elsewhere, in which unnecessary cost and time may be incurred by materials wastage (Maghani, M.D., 2011)

Waste has been considered as a major problem in the construction industry. Waste in construction is not only focused on the quantity of waste of materials on site, but also related to time waste. Waste in the construction industry has been the subject of several research projects around the world in recent years. Some of them have focused on the environmental damage those results from

the generation of material waste. On the other hand, there have been a number of studies mostly concerned with the economic aspect of waste in the construction industry (Agyerum, S., 2012).

One of the major issues facing the building sector is waste. There are a lot of useless actions during the design and building process, according to several experts and professionals.

One of the core ideas of the lean production philosophy is waste. The new production philosophy states that waste should be understood as any inefficiency that causes the use of more tools, materials, labor, or capital than are thought to be necessary for the product. Waste is the occurrence of material losses as well as the performance of superfluous effort, which results in increased costs without improving the product.

According to Wahab and Nawal, (2011), waste is produced at several stages of building, including the design, estimating, and construction stages. Additionally, waste develops during the design, operation, procurement, and material handling processes. The bulk of these take up time and effort without offering the client anything in return, which results in material losses, time delays, and the completion of pointless work. Waste directly affects productivity, material loss, and project completion time, which results in severe revenue loss. Construction trash accounts for 13-26% of the physical waste that ends up in landfills, which highlights the necessity for an organized and effective waste minimization strategy to regulate waste production at all levels.

According to Hwang, B. G., & Yeo, Z. B. (2011), the construction industry generates a significant quantity of waste, four times that produced by households, with more than half of it ending up in landfills. Therefore, it is necessary to identify the primary sources of the waste in order to prevent waste formation. There are many different sources that contribute to the production of building trash. This paper's goal was to analyze the different types and sources of building waste during the entire construction process. Construction waste is different from municipal waste and typically comes from renovation, construction, modification and demolition of roads, buildings, and other built facilities (Thailand pollution control department, 2018).

Researchers have varying opinions about what constitutes construction waste. Debris from building and demolition can be used to define construction waste, according to (Augustine, S., 2011). Construction waste specifically denotes solid waste without liquids and hazardous

materials, primarily inert waste, generated during the construction of various types of buildings, including both residential and non-residential buildings, roads, and bridges.

Construction and demolition (C & D) debris is waste produced in the process of construction, renovation, or demolition of structures. Components of C & D debris include concrete, asphalt, wood, metals, gypsum wallboard, and roofing (Franklin Associates, 2017).

Waste in construction is not only focused on the quantity of waste of materials on-site, but also related to several activities such as overproduction, waiting time, material handling, processing, inventories and movement of workers (Agyerum. S, 2012).

Caron., V. (2010) defined construction waste as a by-product produced and removed from building and civil engineering construction, restoration, and demolition sites. Construction wastes are often divided into three categories: objects, labor, and equipment waste, with the majority of the trash coming from non-renewable sources

2.1.2. Classification of Construction Waste

Waste from construction and demolition is considered high volume when compared with other types of waste, and causes environmental and social problems. The composition of construction waste is often unique because it depends on the construction techniques, building types, countries, and other factors. Construction techniques and varying building technologies cause difficulties in determining the type of waste from construction and demolition. However, there is an ongoing effort to determine the type or classification of Construction waste.

Waste in construction can be classified into two main types; construction time waste and construction materials waste, (Asmare. S. 2015):

1. Construction Time Waste

The time waste is from the concept that the duration of construction tasks consists of process (and reprocess or rework) time, inspection time, move time, and wait time from which only process time is considered value adding activity. The value adding activity is defined as the activity that converts material and/or information towards that which is required by the customer; non value adding activity (also called waste) as the activity that takes time, resources or space but does not

add value. However, all value adding time belongs to process time, not all process time is value adding. Processes are also subject to wastes resulting from overproduction, wrong construction method, defects, and poor optimization in performance tasks, (Asmare. S. 2015).

Wasted time is understood as the time that is perceived by the skilled workers as useless, or as wastes use of time. The most common reasons for occurrence of time waste are: shortage of labor, unskilled or unproductive workers, the indecisiveness of clients, accidents on site, the conflict between sub-contractors, poor work flow layout, shortage of materials and inclement weather (Terji, B., 2010).Time is unnecessarily wasted due to reordering, re-delivery, waiting and handling of additional material which cause will lower productivity, delay completion of time, raise labor & machinery cost and bring overhead cost and hence reduce profit.

Time waste is related to delay of construction project as a whole. There is different cause of time waste occur in different stage of construction. The time waste (delay) over all affects the project success by delay and cost overrun.

2. Construction Material waste

Construction material wastes refer to materials from construction sites that are unusable for the purpose of construction and have to be discarded for whatever reason. Construction material waste is defined as any material apart from earth materials, which needs to be transported elsewhere from the construction site or used on the site itself other than the intended specific purpose of the project due to damage, excess or non-use or which cannot be used due to non-compliance with the specifications, or which is a by-product of the construction process (Agyerum. S, 2012).

Construction material wastes refer to materials from construction sites that are unusable for the purpose of construction and have to be discarded for whatever reason.

According to (Gov.hk., 2018), Construction waste was divided into two categories: 1. Inert construction waste- which makes up the majority and is made up of building supplies like soil, asphalt, and concrete that can be used to reposition the construction site; and 2. non-inert construction waste- which made up 20% of all construction waste and is made up of organic materials like bamboo, wood, and packaging. While some parts were discarded and taken to a landfill, others could be recycled. Waste from construction includes a variety of items that can't be reused, leftover resources, and materials damaged during or after construction.

According by Ramaswamy et. al., (2009) Classified waste in construction into four: - 1) material, 2) Quality, 3) labor, and 4) equipment

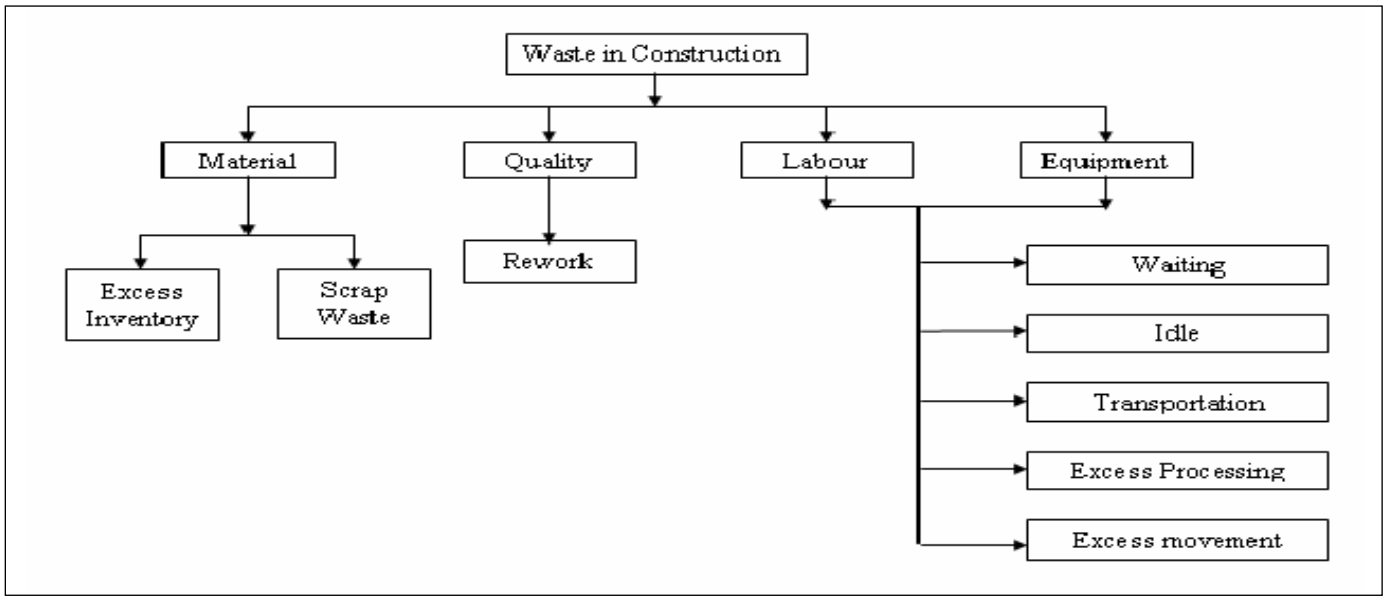

Figure 2.1:- classification of construction waste, Ramaswamy, et.al.

After a systematic review of previous researches on waste, (Viana, D. D., et.al 2012) divided into three categories namely construction material waste (physical waste); non-value-adding activities (process waste) and specific waste (such as accidents and rework). Construction Waste Categories Besides a clear understanding of the general concept of waste, it is helpful to use a classification of waste in different categories, in order to understand the wide range of possible corrective actions related to its prevention.

According to resource consumed, waste can be categorized into physical and financial waste. This classification includes (Augustine. S, 2011):

Physical waste of materials: Additional number of materials relative to those specified in the project.

Physical Waste of man-hours: Man, hours increased by delay in the arrival of materials and overproduction.

Physical Waste of Equipment: Equipment hours increased in function of the problem quoted for the manpower.

Financial waste as a result of physical waste: Determine the costs associated with physical waste.

Financial waste in result of material purchase: Relative additional cost for the use of material with superior value to the specified one.

According to its nature, waste is also categorized in to two as (Augustine, S. (2011); Asmare, S. (2015)).:

Direct Waste

Include damaged material which could not be repaired and subsequently used, or which were lost during the building process: -

Deliveries waste: comprises all losses in transit to the site, unloading and placing into the initial storage.

Site Storage and Internal site transit waste: comprise losses due to bad stacking and initial storage, including movement and unloading around the site, to stack at the workplace or placing into position.

Conversion waste: comprises losses due to cutting uneconomical shapes, e.g., timber, sheeted goods.

Fixing waste: comprises materials dropped, spoiled or discarded during the fixing operation.

Cutting waste: include losses caused by cutting materials to size and to irregular shapes.

Application waste: includes materials such as mortar for brickwork and paint spilled or dropped during application, similarly, materials left in containers or can which are sealed and mixed materials like mortar and plaster left to harden at the end of the day.

Waste due to the uneconomical use of the plant: this covers plant running when not in use, or not employed to its optimal use.

Management waste: includes losses arising from an incorrect decision and not related to anything other than poor organization or lack of supervision

Waste caused by other trades: This includes losses arising from events such as “borrowing” by trades for purposes other than work, and not returning the plant or material or damage by succeeding trades.

Criminal waste: covers pilfering, theft from the site and vandalism.

Waste due to incorrect type or quality of materials: This includes waste stemming from materials wrongly specified and waste due to errors, particularly in the bills of quantities and specification.

Learning Waste: Waste that is usually caused by apprentices, unskilled tradesmen, and tradesmen on new operation

Indirect waste

Represents monetary losses only and not the physical loss of material. Such loses arise principally from substitution of materials, unnecessary use of costlier material, excess use of material than estimated and allowed under the contract, from errors etc. Indirect waste classified as:

Substitution: where materials are used for purposes other than those specified

Production waste: where materials are used in excess of those indicated or not clearly defined in contract documents, e.g., additional concrete in trenches, which are extracted wider than designed because no appropriately sized digger bucket was available.

Operational waste: where materials are used for temporary site work for which no quantity or other allowances have been made in the contract documentation, e.g., tower crane bases, site paths, and temporary protection.

Negligent waste: where materials are used in addition to the amount required by the physical waste financial waste materials man-hour Equipment material purchase due physical waste. Waste according to the type of resource consumed contract, owing to the construction contractor’s own negligence.

” Indirect Waste” is distinguished from “direct waste” in that the materials are not usually lost physically, but the payment for part or whole of the value is lost. This is the waste, which can be prevented, and involves the actual loss. Table below summarizes the various forms in which direct and indirect waste can occur.

According to (Lee Chin, F. 2013). Here further various classification or types of construction waste materials:

Building Materials

Among the most common kinds of materials used in construction are building materials. The types of construction projects are numerous. Building materials will always be used, whether it be for simple construction, demolition, repair, or remodeling operations, and with that comes building material waste. Nails, wiring, insulation, rebar, wood, plaster, scrap metal, cement, and bricks are a few of the items that are used most frequently in construction. Often, it is due of deterioration that these materials end up in waste.

In some cases, though, it's because they were simply unused. The good news about these materials is that a lot of them can be recycled. A specific material that can be reused in many ways is wood. Any time there is wood waste, it can be recovered to be reused for new building projects. Disposal for these kinds of waste is usually pretty basic, but they still need to be disposed of in proper ways. Cement, plaster, and bricks are generally crushed down and can be used in future building projects. As long of the material is contained in a proper dumpster, a recycling or waste management company will come to collect it (Lee Chin, F. 2013).

Dredging Materials

Dredging materials are described as materials that get removed through the preparation of a demolition or construction site. To put it simply, these are parts of nature such as trees, tree stumps, rocks, dirt, and sometimes rubble. These are generally not materials that are considered hazardous, but they should be collected by a waste management company that can provide the proper waste disposal and trash removal for dredging materials. Specific materials that can be reused from this waste such as wood from uprooted trees can be taken to a plant for recycling. Proper recycling and disposal of natural resources are some of the most important aspects of the disposal of dredging materials.

Hazardous Waste

Hazardous waste is one of the most important types of construction waste materials you must be able to identify and handle. Not only can this kind of waste be dangerous to those working around

and handling it, but it can also present dangers to the general public if not managed properly. Hazardous waste can be produced at sites of construction, demolition, restoration, and remodeling projects. Much of the waste can come from the common material used for building. Some of the most prominent examples of the hazardous waste that comes out of construction are lead, asbestos, plasterboard, paint thinners, strippers, mercury, fluorescent bulbs, and aerosol cans. The proper disposal of these hazardous materials is an area where environmental cleanup companies come in handy. Hazardous material disposal is regulated under strict state and federal laws.

Demolition Waste Materials

There are specific types of waste that are prevalent in demolition projects. Due to this, they tend to get broken down into a few sub-types. Asbestos and insulation are major types of demolition waste, and they are also very hazardous materials. Asbestos can increase the risk of lung disease and cancers.

This is because asbestos can produce very fine flakes that can be easily inhaled. However, there is insolation that is not made entirely out of asbestos. The problem is that even if the insolation contains a small amount of asbestos, it' still incredibly hazardous. Another sub-type of demolition waste is non-asbestos- containing materials like concrete, bricks, tiles, and ceramics. Reinforced concrete is very valuable to recycle, as it can be reused to make new concrete.

This kind of material can be crushed up on the site of the project it is being used for. This will keep the costs of transport low as there will be less need for vehicle use. Wood, glass, and plastic fall under a third sub-type of demolition waste materials. Wood from these sites can be disposed of the same way as mentioned above.

Plastic is a major source of the volume of waste created on demolition and construction projects. Part of this is because plastic is mixed into many materials that are used to construct buildings. Many of the plastics that require proper disposal are Styrofoam, PVC siding, and PEX pipes.

2.1.3. Sources of Construction Waste

Construction waste arises from design, logistics, and physical construction processes. In the context of this study, construction wastes are some of the materials delivered to site which have been damaged and meant for disposal, reuse, or recycling. Studies indicate that waste of materials

is usually higher than normal figures assumed by construction companies in their estimates. However, while some level of construction waste is unavoidable, the potential benefit of preventing waste generation on site can be substantial. Furthermore, among the objectives of sustainable development is waste reduction which incorporates both reduction at source and recycling so as to reduce quantities and risks there in (Fadiya, O.O. 2014).

The complex waste stream known as "construction and demolition waste" results from a variety of construction activities during both design and construction phase such as land excavation or formation, civil and building construction, site clearance, demolition activities, roadworks, and building renovation. It is made up of a wide range of materials including building debris, rubble, earth, concrete, steel, timber, and mixed site clearance materials. Instances of labor and energy waste during construction projects are also included. However, it is now well acknowledged that material waste is a significant issue in the construction sector with significant ramifications for both the effectiveness of the sector and the environmental impact of construction projects, (Sawant, S.B., et.al., 2016).

According to Nagappan, S., (2011), His study conducted on causative factors of construction waste existing in construction field activities. The causes of construction waste are matrix and found that 63 wastes factors existed in construction activities. The waste causes were grouped into seven categories: Design, Handling, Worker, Management, Site condition, Procurement and External. In this research the sources which cause waste on site were identified after a review of the literature, and placed in seven major categories. Design, Procurement, Handling and storage, Operation, Weather, Vandalism & Others

According to Mahesh, M., (2011), in some sites the sources of waste were organized into

Overproduction; - Related to the production of a quantity greater than required or earlier than necessary. This may cause waste of materials, man-hours or equipment usage. It usually produces inventories of unfinished products or even their total loss, in the case of materials that can deteriorate. An example of this kind of waste is the overproduction of mortar that cannot be used on time.

Substitution: - Related to the substitution of a material by a more expensive one (with an unnecessary better performance); the execution of simple tasks by an overqualified worker; or the use of highly sophisticated equipment where a much simpler one would be enough.

Waiting time: - Related to the idle time caused by lack of synchronization and leveling of material flows, and pace of work by different groups or equipment. One example is the idle time caused by the lack of material or by lack of work place available for a gang.

Transportation: - Concerned with the internal movement of materials on site. Excessive handling, the use of inadequate equipment or bad conditions of pathways can cause this kind of waste. It is usually related to poor layout, and the lack of planning of material flows. Its main consequences are: waste of man hours, waste of energy, waste of space on site, and the possibility of material waste during transportation.

Processing - Related to the nature of the processing (conversion) activity, which could only be avoided by changing the construction technology. For instance, a percentage of mortar is usually wasted when a ceiling is being plastered.

Inventories: - Related to excessive or unnecessary inventories which lead to material waste (by deterioration, losses due to inadequate stock conditions on site, robbery, vandalism), and monetary losses due to the capital that is tied up. It might be a result of lack of resource planning or uncertainty on the estimation of quantities.

Movement: - Concerned with unnecessary or inefficient movements made by workers during their job. This might be caused by inadequate equipment, ineffective work methods, or poor arrangement of the working place.

Production of defective products: - It occurs when the final or intermediate product does not fit the quality of specifications. This may lead to rework or to the incorporation of unnecessary materials to the building (indirect waste), such as the excessive thickness of plastering. It can be caused by a wide range of reasons: poor design and specification, lack of planning and control, poor qualification of the team work, lack of integration between design and production, etc.

Others: - Waste of any nature different from the previous ones, such as burglary, vandalism, inclement weather, accidents, etc.

Table 2.1 - Sources of Construction Waste

Design	**Management construction process**	**Material management**	**Operation**	**Others**
Incompatible market standard sizes	Ordering errors	Material supplied	Use of incorrect material thus requiring replacement	Theft
Lack of attention paid to dimensional coordination of products	Use of incorrect material requiring replacement	Damages while transporting	Damage to work done due subsequent trades	Lack of material control on site
Lack of knowledge about standard size available in market	Purchases not complying with specifications	Unfriendly attitudes of project team and worker	Delays in providing information to contractors regarding types and sizes of products to be used	Natural disasters
Design changes while construction is in progress	Lack of possibility to order small quantity	In appropriate site storage	Required quantity unclear due to improper planning	Lack of waste management plan
Designers' unfamiliarity with alternative products	Design changes while construction is in progress	Lack of environmental awareness of employees on site	Accidents due to negligence	Inclement weather
Complexity of drawings	Quality products selection of low	Lack of technical direction for workers on site	Errors by trades persons or laborers malfunctioning of equipment	

Source: - researchers analysis (2017)

2.1.4. Concept of Lean Construction

Lean construction is about designing and operating the right process and having the right system, resources and measures to deliver things right first time. Essential to this is the elimination of waste- activities and processes that absorb resources but create no value.

A widely used definition is that Lean Construction is a "way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value," (Koskela et. al,'2002). Lean construction is not just another specific approach to construction, but rather a challenger of the conventional understanding and practice of construction. Lean construction aims to embody the benefits of the Master Builder concept. Essentially, Lean Construction recognizes that desired ends affect the means to achieve these ends, and that available means will affect realized ends (Lichtig, W., 2005).

Lean construction aims to maximize value in construction industry by reducing wastes. “Waste elimination is a by-product of lean process, lean design and lean production management. Viewing it as the raison, focus or purpose for lean is itself wasteful” (Mossman, A., 2009). Seven wastes in production are focused upon so as to maximize its reduction (known in Japanese as ‘Muda’.) They are: Over Production, Over Processing, Wait, Motion, Inventory, Defects, Inventory

Lean construction allows us to be able to "prevent illnesses" rather than just 'treating illnesses''. Lean construction is concerned with turning the construction site into an assembly location rather than a fabrication one in its most basic, though not uncomplicated, form. Basically, the efficiency of the construction will increase as we build more off-site. The use of panelized construction, structural insulated panels, pre-cast concrete, structure steel, raised-access floors, movable walls, etc., are examples of systems that enable this vision. It is important to recognize that in order to gain the cost savings from off-site fabrication, the following must happen:

The entire supply chain has to be coordinated and aligned, which can be achieved by using what we know about Lean Design and Lean Supply practices.

Workflow on site must be reliable, which we can be only achieved by having site practices devoid of waste (muda in lean production) and using the Last Planner System.

Lean construction practices mainly effective when increasing number of construction academics and professionals have been storming the ramparts of conventional construction management in an effort to deliver better value to owners while making real profits (Jang et al. 2007). As a result,

lean-based tools have emerged and have been successfully applied to simple and complex construction projects. These tools are briefly described below. A lean approach to manage construction projects is different from the traditional method. (Howell .1994) describes lean construction as having the following essential features:

Continuous improvement: Lean construction is based on the principle of continuous improvement. This means that construction projects are constantly being reviewed and improved to identify and eliminate waste.

Respect for people: Lean construction recognizes the importance of the human element in construction. It emphasizes the need to create a culture of respect for all workers, regardless of their position or role.

Value stream mapping: Lean construction uses value stream mapping to identify and eliminate waste in the construction process. Value stream mapping is a visual tool that helps to map the flow of materials, information, and money through a construction project.

Pull system: Lean construction uses a pull system to control the flow of materials and information on a construction site. A pull system means that materials and information are only supplied when they are needed, rather than being delivered in advance.

Takt time: Takt time is the rate at which a product or service must be produced to meet customer demand. Lean construction uses takt time to set production goals and to ensure that projects are completed on time and within budget.

Concept of lean construction mainly governed concept of construction waste management techniques.

2.1.5. Concept of construction waste management strategies

Waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The practice is typically conducted to lessen the impact of the materials created by human activities on health, the environment, or aesthetics. Different waste management procedures apply in established and developing countries, urban and rural areas, and for producers in the residential and industrial sectors. (MOU Ka-Yan., 2008).

Sustainable construction must include responsible waste management. Managing waste in this context refers to reducing waste whenever practical, eliminating waste whenever practicable, and reusing things that would otherwise go to trash. Construction waste management practices have long recognized the need of waste reduction, recycling, and use in resource management, (Sawant, S.B; et.al, 2016).

The reduction of construction waste and its management are now major and difficult environmental issues in developing cities all over the world. Due to the growing amount of demolition debris, the ongoing lack of disposal locations, the rise in transportation and disposal costs, and, most importantly, the growing concern about pollution and environmental deterioration, the management of construction and demolition waste is a major concern. Due to its high level of pollution and heterogeneity, construction debris is difficult to recycle and reuse once it has been produced. As a result, project management's scope gives emphasis to its prevention and mitigation. Some detrimental effects of development and demolition include depletion of natural resources, rising pollution, a lack of disposal sites, loss of the ecosystem and habitat resulting in ecological imbalance, etc.

There are several approaches to construction waste management. The process of managing construction waste goes far beyond the disposal of the wastes itself. It is an all-encompassing strategy to effectively utilize construction resources, with the view to reducing the quantity of waste and also utilizing the generated waste in the most effective manner. The most common approach to management of construction waste is dumping in landfill sites. However, decreasing landfill space has led to increasing costs of landfill disposal to the contractor. Also, a relatively large number of materials is being wasted because of poor material control on building sites. The need for alternatives to waste prevention and the three R's of construction waste management initiatives to reduce, reuse, and/or recycle waste produced have resulted from this, (Dania, A.A., Kehinde, J.O. and Bala, K.).

Current waste management strategies are commonly based on what is known as the ‘waste hierarchy approach’. The waste hierarchy is a framework which has been used in construction industry. The concept is simple, with waste prevention at the top of the waste hierarchy (the preferred option) and disposal at the bottom (the worst option). In between, in order of preference,

is preparing for reuse, recycling and recovery. There are standard definitions within legislation on what constitutes each activity under the waste hierarchy, (Katherine Adam, 2022).

Waste Prevention: Reducing waste generation, dangerous substance content, and negative effects on the environment and human health are all examples of waste prevention strategies. Waste minimization, elimination, and reduction are examples of other phrases. The bulk of the time, waste avoidance is concerned with things like resources, products, and components before they (confusingly) end up in the trash. Examples of waste prevention include good storage of materials to avoid damage; avoiding over ordering of materials, eliminating excess packaging, designing out waste and extending the lifetime of products. For a building/structure, waste prevention may include build nothing, build less, extending the life of a building (thereby not creating demolition waste); designing for adaptability, being more material efficient in the design, and using systems that may create less waste such as modern methods of construction).

Reuse: Reuse is any process that involves using leftover goods or parts for new purposes. A product or component of a product that has become waste can be checked, cleaned, or repaired so they can be utilized again without undergoing any additional pre-processing. Remanufacture, refurbishment, repair, and reclamation/salvage are other words that refer to reuse. Examples include reclaimed bricks, the reuse of steel beams and reusable packaging systems. Examples of remanufacture can be found for lighting. Reclamation/salvage is often used for reusing architectural items. At a building level, the refurbishment of a building is reuse. Often, reuse is conflated with recycling, but they are two different activities. Reuse may be seen as a waste prevention activity.

Recycling: is any recovery process in which waste items are transformed into new goods, materials, or substances for the same or other uses. Two categories of recycling exist: Closed-loop recycling is the practice of turning waste materials back into the same or a closely related product (such as recycling used plasterboard into new plasterboard). Closed-loop recycling typically yields greater advantages; for instance, studies have shown that it is preferable to use recovered glass to make new glass as opposed to using it as a construction aggregate. Open loop recycling is the practice of turning waste materials into new products. Examples include turning container glass into fiber glass insulation and plastic bottles into pipes. Repurposing materials, such as utilizing scaffolding boards as furniture, may also be considered a form of recycling. Recycled materials

are used in the manufacturing operations of many companies that produce construction products. Due to the growing popularity of the circular economy concept, which strives to maintain products, components, and materials at their highest usability and value, terms like "down cycling" and "upcycling" are being used more frequently. As the terms imply, upcycling involves increasing value whereas down cycling involves some value being lost, as in the case of crushed concrete used in fill applications.

Other Recovery Methods: Include anaerobic digestion and composting (both used for organic waste), incineration with energy recovery, gasification, and pyrolysis (used for organic waste), which all provide energy. Construction and demolition trash, such as plastic and wood, will be sent for energy recovery in some cases. Backfilling is a recovery method that involves using inert materials, primarily from C&D waste, to reclaim previously excavated ground or for engineering uses in landscaping. The garbage must replace non-waste items and be fit for the intended use. 'Recycling' and 'recovery' are words that are sometimes used synonymously.

Disposal: Waste management practices include burning of waste without the recovery of energy and the landfilling of waste. Sometimes it may be required to landfill rubbish, such as asbestos or other hazardous material. In areas where there are planning requirements, inert trash may be disposed of, for instance, to repair quarries. Reversion

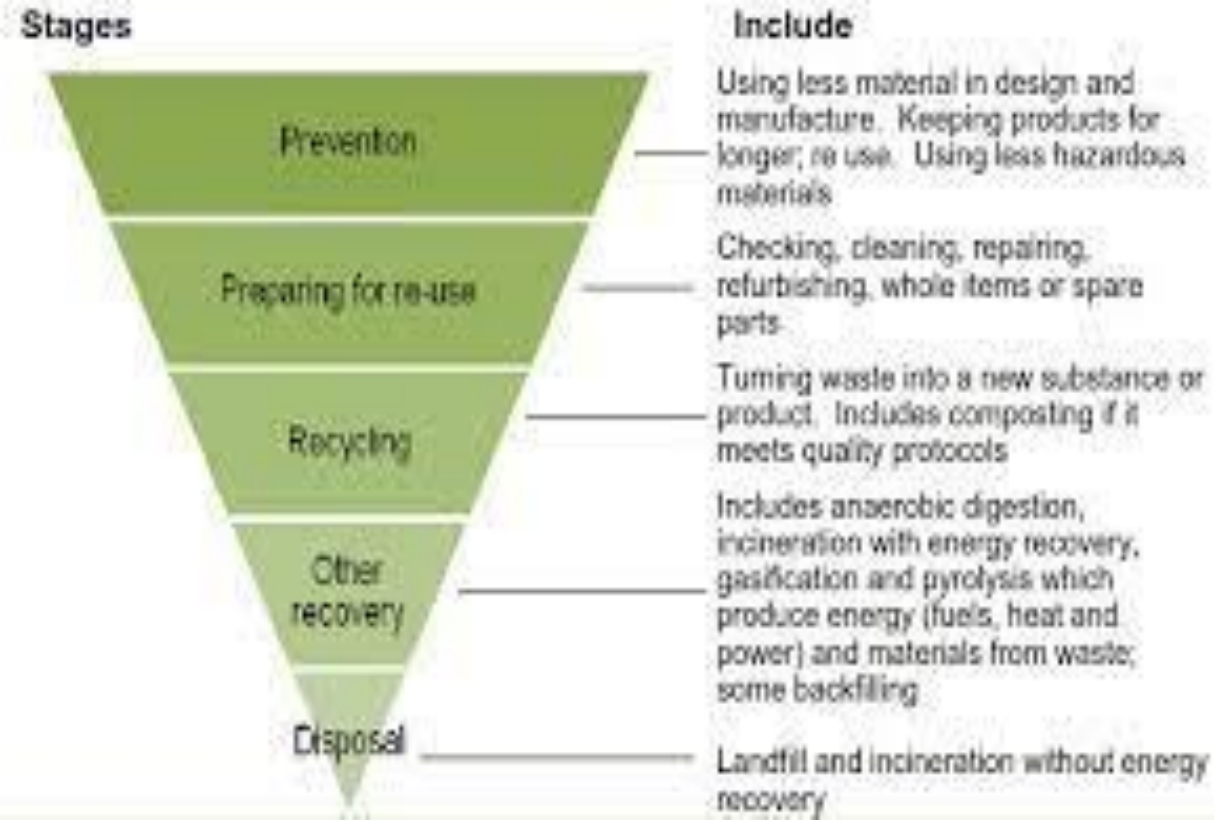

Figure 2.2: Waste Reduction Hierarchy

In general figure shows disposal is the last and worst option in waste management plan and also preventing of construction waste is most desirable best option highest priority when in strategies of construction waste management are avoiding waste, re-using and recycling waste materials.

An effective waste management system that can regulate waste at its source and manage trash at every step or phase of a construction project is required for waste management. Additionally, there are many strategies to control construction waste, including (Sawant, S.B.,et.al., 2016): Using Waste Management System on Project, Planning Project Activities at Every Stage by Every Construction Personnel, Who Are Involved in Minimizing the Overall Waste Generation at Project, Practicing Attitude Towards Zero Wastage, Proper Decisions at Design Stage, Site Management, Proper Standardization of Construction Materials, and Codification of the Same.

Local practices in the management and disposal of construction and demolition wastes are frequently influenced by factors such as the accessibility of appropriate disposal sites, economic conditions, societal priorities, the availability of markets for recycling and reuse, transportation

options, and the capacity of local workforces and construction businesses to modify demolition processes for waste management (Napier, T., 2012).

People altering their wasteful behavior makes a big contribution to waste reduction in the construction business. Waste is an unavoidable by-product of the building industry, and managing it is a low priority project for which there aren't enough resources or incentives bolster it. The most important factors influencing waste reduction behavior on projects are local infrastructure accessibility and top management support (Agyerum, S., 2012). Some of the waste minimization techniques are included in Table 2.2.

Table 2.2. Methods for Materials Waste managing and Minimization

No	Method for material waste managing and minimization technique
1	Adoption of proper site management techniques
2	Good coordination between store and construction personnel to avoid over ordering
3	Purchasing raw materials that are just sufficient.
4	Accurate and good specifications of materials avoid wrong ordering.
5	Training of construction personnel
6	Proper storage of materials on site
7	Checking materials supplied for right quantities and volumes
8	Employment of skilled workmen
9	Minimizing design changes
10	Change of attitude of workers towards the handling of materials
11	Mixing, transporting and placing concrete at the appropriate time
12	Vigilance of supervisors
13	Just in time operations
14	Careful handling of tools and equipment on site
15	Recycling of some waste materials on site
16	Minimizing design changes
17	Access to latest information about types of materials on the market
18	Accurate measurement of materials during batching

Sources: - Agyerum, (2012)

2.1.5. Benefit of construction waste management

With the intention of protecting the environment and the understanding that wastes from construction and demolition works considerably contribute to the pollution of the environment, the practice of waste management for construction activities has been pushed. Waste management has become a crucial component of construction project management as a result of growing awareness of the environmental effects of construction wastes, (Dania, A.A., Kehinde, J.O., Bala, K.).

According to Asmare, S, (2015); Sawant, S.B., et.al., (2016) Waste Management in Construction activities has been promoted for the aim of increasing profit from project and protecting the environment. There are two fundamental reasons for waste management: the economic advantages, and the environmental advantages.

Environmental Advantages include: Reduced quantity of waste generated and hence, minimized amount of wastes disposed of at landfills, which therefore extend the life span of landfills; Reduced Environmental effects as a result of disposal, e.g. noise, pollution, and decreased global warming; Minimization of the risk of immediate and future environmental pollution and harm to human health. Conserving natural resources due to reduced demand for virgin materials due to recycled packaging.

Economic Advantages include: Reduced Transportation cost, Less Disposal Cost, Minimized Purchase quantity and raw materials. Reduced Purchase price of new materials (when considering reuse and recycling), Increased returns achieved by selling waste materials to be reused and recycled.

Other Advantages: Enhanced Work Efficiency and Productivity, Improved Profit Margin, Improved image of the company, Competitiveness and Client Satisfaction, Increased site safety.

2.1.6. Challenge of construction Waste Management

Barriers for widespread adoption of waste management (Reduce, reuse and recycle) system in India as stated by Jain, M., (2012) are the following:

Lack of Awareness in the Industry: The main obstacle in the industry is the ignorance of waste management procedures and approaches among local contractors, laborers, and architects. The

majority of trash generated during the construction process is typically the consequence of careless handling and procedures.

Clients' lack of interest: Clients' disregard for incorporating waste management and reduction practices into projects is another major factor contributing to the ignorance of the sector. Customers do not support initiatives that do not directly benefit them. Projects have not yet willingly incorporated any potential large cost savings, and scheduling is given top priority.

Inadequate education and training: Lack of contractor federations and professional organizations that might greatly increase customer and contractor awareness of potential economic benefits and social implications.

Lack of skilled labor: A large share of the industry's labor force is unskilled. Because of this, appropriate waste treatment techniques are not used. Therefore, it is crucial for contractors and subcontractors to become knowledgeable about and skilled in the labor that is largely illiterate.

Lack of market competition: The above-mentioned barriers make the industry as a whole to be fragmented and fail to extract benefits from the much evident aspects. This leads to lack of competition among contractors, for e.g., if one contractor makes good cost savings from a project and increases their profit margins. Eventually this should then incentivize other contractors to get involved with waste minimization and management techniques. But mostly from a contractor’s viewpoint, taking up waste minimization and management is more of ex ante issue where risks are associated with the contractor to bear the cost implications. This will become widespread only after taking project initiative and then benefiting from them.

Lack of Government Interventions: Government regional, national policies and regulations are limited and are not implemented appropriately. Regulations like landfill tax or tax incentives to incorporate this approach in the project might enforce industry to explore cost savings seriously.

Lack of waste reduction approach by architects: Usually architects do not give preference to waste minimization approach during design and planning stage. Designing as per standard minimum sizes will eliminate wastage on sites.

In general:

To permit appropriate provisions for good waste management and a sequence of operations to sort and separate materials, a waste management strategy must be created early on in a project. Augustine, S., (2011) Transportation related to the movement of garbage and materials should also be taken into account.

Without dependable and consistent garbage collection and suitable disposal systems, clean and healthy living conditions in cities and towns cannot be accomplished (MoUDC. 2012).

It is not sustainable to not recycle, reuse, and decrease social waste. It makes sense that efficient and effective waste reduction, material reuse, and elimination are crucial components of design and construction activity (Napier, T., 2012).

Creativity, persistence, knowledge of available markets and business, and understanding of applicable regulations are important skills for design and construction professional (Napier, T., 2012).

2.1.7. Materials Management Issues in Construction Projects

With completion on schedule, within budget, in line with specifications, and to the satisfaction of all parties involved, the construction industry is the largest sector of the economy. The act of physically erecting a project and installing the essential tools, materials, supplies, monitoring, and administration is known as construction. There are numerous organizations involved in complicated construction projects, including customers or owners, architects, engineers, contractors, suppliers, and vendors (sellers). This involves the varied and frequently challenging process of creating distinctive, substantial, and immovable goods from a supply of resources (cash, tools, materials, and labor).

Materials management becomes more challenging as projects get bigger and more complex, frequently necessitating the use of the right tools and methods to guarantee, among other things, that materials are delivered on time, stock levels are well managed, the construction schedule is not jeopardized, and wastage is kept to a minimum. For large and complicated projects that call for advanced tools and processes, materials management is particularly challenging. Due to the many components involved and the significance of the project, the management of materials in

complex construction projects requires proper thought. On construction sites, incorrect material handling and management have the potential to significantly worsen project performance. The total project cost and time will be impacted by the inappropriate handling and management of materials on site during the construction process, (kasim 2013).

This study focuses on waste produced during the construction process and lifecycle of the study sides and excludes indirect waste such as those relating to manufacturing, production and transport.

2.2. Empirical Literature Review

The minimization approach was also used in several nations to reduce waste from both operations. Large amounts of material waste are created all throughout the construction process, but notably near the conclusion of a building's useful life. Some developed nations have undergone a full rethink due to the growing issues with construction and demolition waste. According to David. N. et.al., (2006), wastes are increasingly being seen as resources or by-products that can be transformed into new goods and used for a range of beneficial purposes. This is due to the fact that a substantial amount of the waste generated on building sites can be recovered for reuse and recycling.

2.2.1. Experience from Australia

Several Australian states have 'towards zero' waste plan documents, including Victoria, South Australia, and Western Australia. According to Chris and Emily (2013), the plans establish statewide goals for reducing waste, recovering resources, and littering. Before approving a development, many local authorities need waste management plans. Usually, they call for the builder or designer to make an educated guess as to the overall volume of garbage generated by both demolition and new construction. Additionally, specify the disposal method, such as the recycler, the recycling facility, or the landfill location. It is frequently necessary to include waste storage facilities on the site during construction as well as a delivery or pickup schedule in the site plan. The following main building materials are frequently recycled in Germany.

The effort and money spent on creating a waste plan are typically repaid through savings on waste disposal fees or dividends from the sale of commodities that can be salvaged. The possibilities for recycling and reusing in Australia.

2.2.2. Experiences from Nigerian

Indicated four major types of construction materials waste. These include cutting waste, transit waste, theft and vandalism waste, and application waste. The studies concluded that the identified construction materials under cutting waste indicated that reinforcement bars had highest percentage of wastages of 19.03%, followed by wires and cables with wastage of 17.26%, roofing sheets and pipes both have 15.70% wastage. Moreover, the identified construction materials under transit waste indicated that tiles had highest percentage of wastages of 21.38%, followed by window glazing and ceramic sanitary appliances with percentage wastages of 14.73% and 14.72% respectively (Babatunde, 2012). In addition, the studies in Nigeria identified construction materials under theft and vandalism waste revealed that reinforcement bars, timber (hardwood and softwood) and cement had the highest percentage of wastages of 18.64%, 18.64% and 18.44% respectively Furthermore, the identified construction materials under application waste showed that POP (Plaster of Paris) ceiling had the highest percentage of wastage of 15.70%, followed by mortar (through screeding) with wastage of 14.91% and concrete (through columns, beams, lintels and walls) had percentage wastages of 14.13%. Moreover, the study concluded that theft and vandalism waste had the highest average level of 16.58% followed by cutting waste with 15.44%. Application waste and transit waste had the least overall average wastage of 14.16 % and 14.89% respectively. The study finally concluded that construction materials wastage accounted for an average of 15.32% in the Nigerian construction sites. Therefore, the study recommended 15-20% allowance for construction materials waste in Nigeria (Babatunde, S.O.,2012).

2.2.3. Experience from South Africa

The C&DW stream in South Africa (SA) alone is estimated at around 5-8 million tons. This shows that there is a massive opportunity for growth in the recycling industry worldwide as well as in SA with regards to the recycling of C&DW. SA still has vast open spaces and natural aggregate resources are still available, therefore it is not surprising that SA is lagging behind in terms of its development of measures to promote the recycling of C&DW. However, as the available area for landfill sites are reduced, natural resources that are depleting and the pressures from global markets increase, such as with the need for ISO 9000 and ISO 14000 requiring more companies to have

quality environmental management systems, SA might soon see the need for effective recycling of Construction waste management.

2.2.4. The Practice of Construction Waste management strategies in Ethiopia

Even giving a brief highlight of the situation of construction waste management in Ethiopia is a trying task because it is largely unstudied and there is serious lack of data. However, considering government initiatives, research on Ethiopia's solid waste management, the country's building sector, and pertinent studies on developing and African nations at a comparable level of development, one might infer about the practice and its difficulties. The management of construction waste is characterized by the following;

Landfilling is the most frequent method of managing construction waste - Since there aren't enough landfills to handle solid waste, landfilling is the most popular method. For the disposal of all sorts of solid waste, there is just one open dumpsite in Addis Ababa. It is referred to as "Rappi" or "Koshe" It is becoming overcrowded, surrounded by residential neighborhoods and educational facilities, and poses a health risk to those who live nearby.

Most of the time, contracts are used to dispose of construction waste, including waste generated during the construction of residential homes. Construction companies have a legal obligation to the AAHCPO, for instance, while building condominiums, to dispose of excavated materials like soil and to generally clean up the site thereafter. Waste must be disposed of up to five kilometers away from project sites in order to meet the contractual responsibility to dispose of excavated materials, such as soil. Where and how it should be disposed of are not specified in the provision. Additionally, contractors are not required to dispose of waste in a safe and healthy manner for the environment. Enforcing contractual duties is difficult, and there are some situations where contractors fail to dispose of building waste in accordance with them.

Metal, wood, and electrical components are recyclable resources found in building waste. However, due to infrastructure and technological issues, recycling is not commonly used. Sound waste reuse and recycling cannot be accomplished with the infrastructure and facilities already in place. Information on the amounts and composition of construction waste, technical, institutional,

and organizational capabilities, prevalent attitudes, and access to technology and funding are not readily available.

2.2.5. Review from Research document

Assessment of construction waste management and disposal techniques is the name of the study. Endale Teferi (2017) investigated the condominium construction project site in Gelan.to determine the trash management and disposal tactics used in the Addis Ababa, Ethiopia, Gelan condominium construction projects. The evaluation of waste management and disposal practices for building construction was the major goal of the study. Its goal is to evaluate the CWM&DS's effects on the economy, human health, and the environment. It is important since it outlines the problems with the CWM&DS and suggests strategies to avoid their unfavorable effects. Primary and secondary data gathered using qualitative and quantitative techniques were used in the study. Through survey questions, in-person interviews, and field surveys, data was gathered. According to the research, the CWM&DS at the Gelan Project site is ineffectual and lacks a plan and strategy. Inadequate storage facilities, improper handling, deterioration, and theft are just a few of the problems. Waste is being disposed of slowly and in a way that is bad for the environment and public health. Major issues include ineffective procurement, bad storage, improper handling of materials, a lack of proper CWM&DS, insufficient managerial focus, lax law enforcement, theft, and a lack of knowledge of CWM&DS. The report advises stakeholders and policy makers to strengthen legal enforcement, increase supervision, security, and storage, as well as CWM&DS training and planning. The conclusions and suggestions are anticipated to act as a benchmark for future knowledge and as an input to improve the CWM&DS of AAHCPO.

A study titled Managing and Minimizing Wastage of Construction Materials on Selected Public Building Projects in Addis Ababa was carried out by Asmara Seyoum, (2015) to evaluate how construction materials are currently managed and wasted as little as possible in Addis Ababa on a few specific public building construction projects. Based on the findings of the paper, recommendations will be made about the handling of construction materials. When evaluating earlier attempts to investigate and examine the reasons and sources of construction material waste on building construction projects, the researcher used questionnaires, interviews, and site visits.

According to the study's findings, the respondents (Contractors, Consultants, and Clients) had varying opinions about the extent to which waste sources contributed to the generation of waste. According to the analysis' findings, which were ranked from first to fifth by contractors, consultants, and owners, the following factors are the most important ones that contribute to construction waste on building construction projects: factors affecting site supervision, materials handling and storage, design and documentation, site management and practices, and operations.

According to the report, a new construction waste department should be created in order to create waste management regulations and an efficient plan to reduce construction waste. The study advised the owners to use the contractors' prior experience with waste management as a criterion when awarding contracts. According to the study, consultants should focus on avoiding design and planning errors during the design and planning phases. The study also recommended the contractors to assign qualification staff and workforce in construction projects and to prepare waste management plan.

2.2.6. Policy and regulation in Ethiopia

There is no specific policy that pertains to construction waste management in Ethiopia but constitutional policy provisions and national environmental policies indirectly deal it.

Articles 92.1 and 92.2 of the Constitution of the Federal Democratic Republic of Ethiopia provide that “Government shall endeavor to ensure that all Ethiopians live in a clean and healthy environment” and that “Government and citizens shall have the duty to protect the environment” respectively. These provisions relate to and are applicable to construction waste and its management from the perspective of environmental protection.

The Environmental Policy of Ethiopia issued by Environmental Protection Authority (EPA) also contains provisions that directly and indirectly deal with construction waste management.

Article 3.7 that deals with matters related to human settlement, urban environment and environmental health.

Article 3.8 that relate to the control of hazardous materials and pollution from waste

Article 3.8 of the policy has detailed provisions dealing with many issues including the review and development guidelines for waste disposal and issuance of regulations, the establishment of safe limits for the location of sanitary landfill sites, formulation and implementation of national strategy and guidelines on the management of wastes, the promotion of waste minimization processes, efficient recycling of waste materials.

Article 3.9 that deals with atmosphere pollution and climate change are worth mentioning. Particularly

Solid Waste Management Proclamation (SWMP) No. 513 of 2007 is a significant declaration that covers solid waste management, including the management of construction waste. The declaration seeks to strengthen the ability to avert any negative effects and turn solid waste into assets that will benefit society and the economy. Two articles of the proclamation specifically address the handling of solid building waste.

Article 12 that deals with urban authorities to take on or enter into arrangements with construction companies to refill solid waste disposal sites, quarry pits with pebbles or gravel from demolished structures or with excavated earth. Deals with construction debris and demolition trash. Additionally, it states that building contractors shall only be granted construction licenses following the submission of a bond that is legally acceptable or other documentation that guarantees the environmentally responsible disposal of construction waste or excavated earth. Additionally, it states that before beginning any residential house development, metropolitan authorities should guarantee the availability of sufficient facilities for an environmentally sound solid waste management.

Article 14, another article that deals with construction of solid waste disposal sites provides that; urban administration should ensure that solid waste disposal sites are constructed and properly used in conformity with the relevant federal environmental standard, solid waste disposal are subjected to environmental auditing, environmental impact assessment should be carried out for new solid waste disposal sites.

The proclamation also incorporates several provisions regarding obligations of administrative organs and citizens, solid waste management planning, collection & storage, transportation, treatment, disposal, incineration, recycling, and hazardous waste, civil and penal provisions.

Environmental Pollution Control Proclamation (EPCP) No.300/2002 is another related proclamation. The proclamation mandates urban administrations to devise and implement safe and effective mechanisms to handle, transport, and store municipal waste.

The proclamation under article 5 (Management of Municipal Waste) deems that urban administrations should ensure the collection, transportation, and as appropriate, the recycling, treatment or safe disposal of municipal waste through an integrated municipal waste management system. It also mandates them to monitor and evaluate the adequacy of municipal waste management systems and ensure their effectiveness.

2.3. Summary of the literature review

Generally, Construction, remodeling, and demolition of buildings, roads, bridges, flyovers, subways, runways, factories, and other similar institutions frequently accompany the expansion of infrastructural facilities. The majority of the world's building industry uses a tremendous number of natural resources and frequently produces a lot of waste. An Unwanted material created by the construction industry, either directly or indirectly, constitute construction trash. This includes garbage from the site as well as inert and non-biodegradable construction materials such concrete, plaster, wood, metal, broken tiles, bricks, and masonry, insulation, nails, and electrical wiring. These wastes are bulky, heavy, and frequently require a large amount of storage space. In general, it is believed that the waste level in building is extremely high.

Studies have revealed that not all materials ordered and delivered to sites are used for the intended objectives and end up being wasted for a variety of reasons. Previous research has shown that material waste has a significant impact on the financial success of construction projects. In addition, managing waste from construction materials can increase productivity, save time, and improve safety, but disposing of excess garbage requires additional time and resources and could impede construction progress. Construction waste comes from a variety of sources during the whole implementation of a construction project as a result of one or a number of different causes. In order to understand the causes and elements that contribute to material waste in construction projects, numerous studies have been conducted globally. This is due to the fact that it is necessary to identify the primary sources and types of waste in order to limit the amount of building waste.

Therefore, stakeholders in the construction sector can prevent excessive waste from being generated on construction sites by recognizing the major causes. Any method used to prevent or reduce waste at its source is referred to as waste avoidance. Reusing and recycling are the processes of reusing and recycling waste products, which reduces the amount of waste that must be disposed of in landfills. The prevention or reduction of trash at the source is given top priority since it is always more cost-effective to reduce waste creation at the source than to create methods for handling or treating the waste. Therefore, stakeholders in the construction sector can prevent excessive trash from being generated on construction sites by identifying the primary source. There are also numerous studies on the impact of recycling and reusing as part of a strategy to minimize material waste on construction projects. Different gaps were found in each evaluation of the literature on building waste minimization.

Critical information gaps regarding the types and sources of building waste as well as the waste management strategy for gift real estate projects are revealed by these investigations. Construction waste is caused by inadequate planning (scheduling), design revisions, rework, documentation, etc. construction debris that was actually discarded on site was not appropriately identified as construction waste. However, because the construction sector uses a lot of raw materials, a waste management plan demands careful thought and analysis. The development of an effective construction waste management practice that outlines processes to close the aforementioned knowledge gaps is therefore required.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

The aim of research is to study the construction waste management strategies at gift real estate and recommend strategies frame work of waste management plan for gift real estate Company. Research methodology decisions depends on the nature of the research question. Methodology was derived with intention to go through the research objectives and finally to obtain the aim of the research. In this study, interviews, structured questionnaire and site visits were used in the gathering of data. The interviews were adapted to collect detailed information about respondent's experiences and impressions about Construction wastage on projects. It also uses to collect preliminary information to help in structuring the questionnaires. The questionnaire survey also adapts to get feedback on opinions of respondents about construction wastage in Gift Real Estate Company. The site visits involved observations where the researcher sought to find out how materials were store and handled and also to provide a compendium on high waste generating real estate. The researcher spent time in building construction sites and observed the flow activities and flow of materials (handling and storage).

3.2. Study area

The study area was gift real estate building Construction Company. Gift Real Estate is engaged in real estate development business in Ethiopia. We are a part of gift Group (holding company). Gift Real Estate have three projects in the eastern part of Addis Ababa. It is about 10 or 12 kilometers away from the center. Company are developing villa houses, townhouses, and different types of apartment houses. Study specific area for this study was from three project of company select one project at around Hayat 49 branch project area.

3.3. Research designs

To meet the objectives of the study, both quantitative and qualitative (mixed) research approach is adopted. The advantage of using a mixed approach is to cover the weakness of each approach with the strength of the other approach (Mark, S., 2009). Quantitative research approach count things, data statistically and quotes results in numeric forms. This approach is used to find facts based on evidence or records. The method relies on experiments and surveys to collect measurable data.

Therefore, a quantitative research approach is adopted to rank the types wastage, to identify the major sources of waste in the main construction materials during construction operations and to find out measures taken for minimizing construction material wastage.

As a research design, descriptive design was selected based on the research questions. According to Naoum, S.G., (2007), descriptive research is used to describe a specific population or a phenomenon and to answer the "what" question. As it is stated earlier, the objectives of this study are mainly to identify the wastage contributing factors, identify the types and major sources of construction waste during construction operations and to find out measures taken for minimizing construction wastage. So, the reason behind using the descriptive design is because all the research questions are towards answering the "what" and are explaining or describing the construction material wastage phenomenon.

As a research strategy, a survey was used to answer the study questions. The survey strategies were used to assess the construction material wastage in Gift Real Estate building construction projects. As stated by Naoum, S.G., (2007), surveys are used to obtain data from a large number of samples within a short period of time. Thus, when data is collected from a defined sample, a generalized result can be obtained. The sampling frame in this study was employees of Gift Real Estate Company, who are currently working as construction professionals such as project managers, site engineers, and office engineers The total number of the sample for this study is 63. As a result, to obtain data from this number of samples within a limited time, a survey was chosen as an applicable research strategy. In addition, Mark, S., (2009), stated that a survey strategy is usually used and allows the researcher to collect quantitative data. As it is stated above, this study has a mixed method approach followed by descriptive design and to obtain data from a number of samples, a survey strategy is used.

The study preferred to use purposive sampling to focus on units that provide most information about waste management strategies at gift real estate site from professionals and staff members with relevant knowledge and expertise. The research was be collected data by structured questionnaires and interviews.

The structured questionnaire is probably the most widely used data collection technique for conducting surveys to find out facts, opinions and views. Interviews can be classified according to the degree to which they are structured. In an unstructured or nondirective type of interview the interviewer asks questions as they come to mind. On the other hand, in the structured or directive interview the questions are specified in advance (Agyerum, S., 2012).

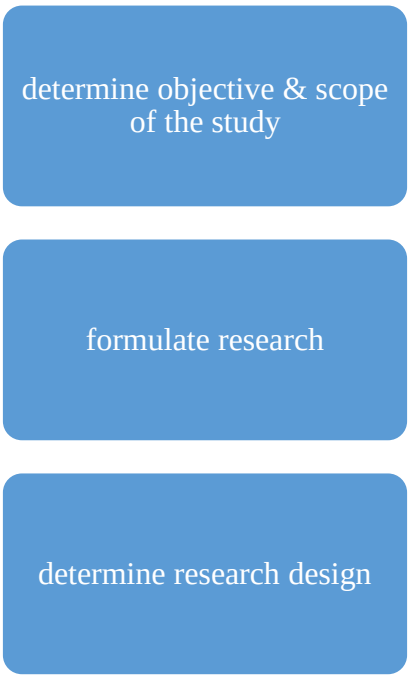

Figure 3.1:- process of this research.

3.4. Population and sampling techniques

3.4.1. Research population

Population is a group of items that a sample will draw. A sample, on the other hand, refers to a set of individuals selected from an identified population with the intent of generalizing the findings to the entire population. The research population of this study was Gift Real Estate Building Construction Company branch project, the researcher first identified major entities involved in the

Gift Real Estate building construction branch project based on their respective tasks and responsibility. The gift real Estate Company is constructing village by own as a client and a contractor and there is a supervisor to control quality of work. The sample for this study was draw from staff and personnel of these entities using their roles and involvement in the construction process at the target site as a sample criterion. It was composed of individuals directly involved and responsible for the construction work, material and construction waste management.

So, target population for this research is people who worked in gift real estate project central head, professionals, skilled labor and subcontractor.

3.4.2. Sample size

Sampling is the process of selecting representative units of a construction parties for the study in research investigation. The advantage of using a sample is that it is more practical and less costly than collecting data from the construction parties. The risk is that the selected sample might not adequately reflect the behaviors, traits, symptoms, or beliefs of the participate (Al-Moghany, 2006)

Purposive non-probability sampling is the method of sampling used. Deliberate or criteria sampling are other names for purposeful sampling. It is a method that is frequently used in qualitative research to identify and choose examples with a wealth of information in order to make the best use of scarce resources. The strategy entails locating and choosing individuals or groups of individuals who have particular expertise in or experience with an interest phenomenon (Creswell & Plano Clark, 2011).

The study shall prefer purposive sampling to focus on units that are most likely to provide the most information about construction waste management at the Gift real estate sites from professionals and staff members with relevant knowledge and expertise.

In this study sample size is 63 people from the total population. The sample includes all department heads from gift real estate offices, all storekeepers and office managers who work on the construction site, all subcontractors and their foreman. The total population of this research include this member state in above and also sample select from that.

3.5. Data collection tools

The method of sampling was a non-probability purposive sampling. Purposive sampling is also known as deliberate or criterion sampling. It is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources. The method involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Creswell & Plano Clark, 2011). The study preferred to use purposive sampling to focus on units that are most likely to provide the most information about construction waste management at the real estate sites from professionals and staff members with relevant knowledge and expertise.

The technique was use in data collection is through reviewing relevant documents, observations, that means use of multiple data collection techniques and sources strengths the credibility of outcomes and enables different interpretations and meaning to be include in data analysis.

The study was use both primary and secondary data sources. Primary data, both qualitative and quantitative was collect through observation, questionnaires and interview. The study was use both open and close-ended questionnaires for employee and interview with top level manager. Study also acquires secondary data from books, published and unpublished research papers for theoretical and empirical concept formulation.

3.5.1. Questionnaire

According to Saunders, M., et.al (2016), a questionnaire is the most popular way for conducting surveys. Because the respondents were asked to answer the identical questions, as the authors proposed, this will give an efficient way to gather responses from a sizable sample before the study begins.

The process of quantitative analysis. Due to the sample size and quantitative nature of the study, a questionnaire was utilized as a data collecting instrument to gather the required information. The sample population was surveyed using a formal English questionnaire in order to get first-hand information. The questionnaire was created with the goal of evaluating the level of construction waste management at the Gift real estate building construction site as well as its efficiency. The question was constructed using the Likert scale. The respondent was asked to rank the extremely

one to not significant. The questionnaire will arrange professional and employee knowledge of waste management concerns and practices depending on the research purpose.

3.5.2. Face to Face Interviews

The purpose of the in-depth interview questionnaire is to collect data on the issues it focuses on. The interview was designed to complement the questionnaire and improve the validity of the information gathered through the questionnaire. Interviews were conducted by the researcher with employees of the gift real estate Company, consulting firms, and sub-contractor of the gift real estate.

3.5.3. Observations

A researcher physically observes what is happening and what is there at the site or location of interest using the observation method. The researcher's intended study subjects' behaviors or physical characteristics at the study site may constitute the observable phenomenon. If the observations are behaviors that aren't visible to the naked eye, they can be reported or made into images using cameras. In order to evaluate the state of construction waste management at the study site, the researcher visited the study site repeatedly, conducted observations, recorded his findings, and took pictures with a camera.

3.6. Data collection process

The researcher determined on the content, organization, and format of the data gathering instruments utilized in this study after settling on the data collection procedures. As a result, a questionnaire was created in accordance with the study's research questions. The questionnaire's information was arranged as previously mentioned.

The research was conducted through the collection of data using structured questionnaire and interview survey approach for the assessment of construction waste management strategies of Gift Real Estate building construction project. A total of 63 questionnaires were distributed in to the determined sample size of purposively selected respondents.

3.6.1. Questionnaire approach

In this study, a structured questionnaire and interview was used to assess current practice construction waste management strategies of the Gift Real Estate building construction project.

3.6.2. Steps of conducting this research

1. Literatures are reviewed

Literature was reviewed and questionnaire variables was identified. On the process of literature review, it was assessed the back ground of construction waste, construction waste management and construction waste management practices.

2. Design of questionnaires and interviews

Structured questionnaires and interviews were designed in a way to achieve the research objectives. Copies of these questionnaires and interviews was attached in the appendix part of this paper.

3. Distribution of questionnaires

The data for this research was collected by distributing a formulated structured questionnaire and Interviews were asked in a structured way.

4. Analyze the responses from questionnaires and interviews

The data that was collected from questionnaires and interview was analyzed both qualitatively and quantitatively. Tables and graphs were employed for elaborating and discussing the data.

5. Conclusion and Recommendation

After the analysis made, Conclusion was drawn from the bases of the analysis and recommendation was forwarded to the user of this research regarding to construction waste management strategies.

3.7. Method of data analysis and presentation

Firstly, the data was prepared where the aim is to convert raw data into something meaningful and readable. Since the research design used to meet the objectives is descriptive, descriptive statistics that involve both measures of central tendency (mean, median, and mode) and measures of

dispersion (standard deviation) were used to analyze the data using SPSS software. At last, the Data was analyzed by calculating frequencies and Mean Item Score (MIS) using Statistical Package for Social Science (SPSS) software.

3.8. Validity and Reliability

3.8.1. Validity

According to Saunders, M. et al. (2016), "validity" essentially relates to the suitability of the measures utilized, the accuracy of the analysis of the data, and the generalizability of the conclusions. According to the writers, a questionnaire's validity relates to its capacity to measure the things it was designed to test.

Content validity is one of the numerous types of validity that demonstrates whether or not the instrument covers the questions under investigation. Before disseminating the questionnaire, a pilot study of 10 participants was conducted to achieve this. The procedure is distributing the questionnaire to a selection of responders with expertise in that field so they can provide feedback. Ten seasoned professionals who are actively employed in the academic and construction sectors were given the questionnaire and its purpose and research questions in order to test its content validity. The questionnaire was then circulated to the target populations after being amended in light of the feedback.

3.8.2. Reliability

According to Saunders, M., (2016), dependability is defined as "replication and consistency," which implies a study is considered reliable if it can be repeated using an earlier design and produces the same outcomes.

The authors claim that Cronbach's alpha, which has a value between 0 and 1, is used to gauge internal consistency by determining whether or not the items in the data collection tool assess the same concepts. This coefficient was employed in this study to evaluate the questionnaire's dependability. A reliability test of Cronbach's Alpha was made for the liker scale type questions on SPSS Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the

extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency (Goforth, C., 2015).

Table 3.1. Cronbach alpha coefficient interpretation

Cronbach alpha coefficient	0.9 and above	0.8 - 0.89	0.7 – 0.79	0.6 – 0.69	0.5 – 0.59	Below 0.5
Internal consistency	Excellent	Good	Acceptable	Questionable	Poor	Unacceptable

The pilot study was done to test questionnaire was relevant to the study, the respondent easily understands the question and respond with reliable data.

Table 3.2. Reliability result

Case Processing Summary		
	N	%
Cases	10	100.0
Excluded	0	.0
Total	10	100.0

a. List wise deletion based on all variables in the procedure.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.953	0.952	86

Sources: - spss result

From reliability result we can conclude that the Cronbach alpha coefficient for questionnaire is 0.953 which indicates internal consistency of questionnaire is excellent reliable. Hence, it can be said that the questionnaire is valid and reliable.

3.9. Ethical considerations

The rights of study volunteers are subject to a variety of significant ethical difficulties, according to Leedy et al. (2005). These include the rights to honesty, privacy, informed consent, and protection from harm. In order to comply with the principle of informed consent, respondents must be fully informed about the research before their assent to participate is requested. The study's participants must provide thorough written and verbal information regarding the study's purpose. The questionnaire informed the respondents that their participation was voluntary and explained the purpose and nature of the study. The participants requested for interviews were also orally informed about the nature of the study and that their participation was voluntary and consensual.

Participants were also made aware of their right to anonymity by the researcher. Confidentiality suggests that a subject's privacy and dignity should be protected. Participants were made aware that any information they provided would be kept private and only the researcher would have access to it. The final study was not included any of the subjects' names or other identifying information because they were not compelled to do so, however some participants were okay with have their personal information published.

CHAPTER- FOUR: ANALYSIS AND DISCUSSION

4.1. Introduction

The analysis, presentation, and interpretation of the study's findings are included in chapter four. Data analysis and interpretation are done in two stages. The first section, which deals with a quantitative analysis of data, is based on the questionnaire's results. The results of interviews are interpreted qualitatively in the second section. Frequency percentages were applied to the data obtained from the questionnaire. The maximum frequency of occurrence (that is, the number of times a specific response occurs) was determined by adding the answers to each individual question. These responses to the questions, which are quantified, are then presented in percentage forms. Tabular format is used to present this analysis. The demographics of the respondents are covered in the first section of the chapter, and their survey responses are covered in the second. The third portion examines the findings from in-person interviews.

4.2.Responses Rate

The questionnaire was distributed to the selected 63 focus group. Out of the total 63 questionnaires distribute 53 of the questionnaires are filled and returned. From the respondents are 16 high level management and different position of office engineers, 31 field engineers & other employee related to material and 6 sub-contractors. Accordingly, 53 questionnaires filled and returned, 79.15% was collected. 5 were doesn't filled and returned, 3 were uncompleted response and 2 were incorrect response.

Table 4.1. Respondent Rate of the questionnaire

Respondent	Questionnaire Distributed (N)	In Rate (%)	Filled and returned	Response Rate (%)
High level managers & Engineers at Office	18	100	16	88.89
Engineer at Site & other employee related to material case and supervisors	35	100	31	88.57
sub-contractor	10	100	6	60
Total	63	100	53	79.15

Source- spss result

Others parts interview questions. Interview question consists of coordinator, project manager and sub-contractor interviewed only (3) respondents were interviewed. This was due to the busy schedules of the respondents and absence of time. The numbers were determined on the basis of the available Engineers employed by Gift Real Estate building construction project.

4.3. Characteristics of the respondents

The demographic characteristics of the responders it's surveyed in this research include respondent position, academic qualification, educational background and period of experience.

4.3.1. Respondent position

Table 4.2. Respondent position

Respondent position	Frequency	Percent
high level managers &engineers at office	16	30.2 %
engineer at site &other employee related to material case and supervisors	31	58.5 %
sub-contractor	6	11.3%
Total	53	100 %

Source- Own Survey and SPSS result

The questionnaires were received from 53 professionals who are working in different position within Gift Real Estate building construction project. As shown in Table 4.2 The respondent's position illustrated that 58.5% of the respondents were Project Managers, site engineers and other employee worked at material example store keeper. This illustrates that since project managers are well experienced, the data collected from them will be more reliable and the site engineers & other worker related in material works more in to the action so they have practical experience on waste so collected data from those experienced site engineers will be more reliable.

4.3.2. Academic qualification

Table 4.3. Academic Qualification

Educational qualification	Frequency	Percent (%)
Certificate	3	5.7 %
Diploma	17	32.1 %
first degree	25	47.2 %
post graduate	8	15.1 %
Total	53	100.0 %

Source- Own Survey and SPSS result

Data regarding academic qualification of survey are a total of 53 respondent 47.2% of them had receive a Degree, 32.1% of them had completed Diploma, 15.1% of them had receive a Masters and 5.7% of them had completed certificate. This has influence on quality of building construction.

4.3.3. Educational Background

Table 4.4. Educational background

Educational Background	Frequency	Percent
Resource management	3	5.7 %
Engineering	25	47.2 %
Management	8	15.1 %
Construction Management	9	17.0 %
Economics	1	1.9 %
Accounting and purchasing	7	13.2 %
Total	53	100 %

Source- Own Survey and SPSS result

Most of our respondents are engineering by its educational background. A total of 53 respondent 47.2% of them had engineering, 17% of them had construction management, 15.1% management, 13.2% of them had accounting and purchaser, 5.7% of them had resource management (store keeper) and 1.9% of them had an economics. Regarding from data most of our respondent Engineers closely related knowledge about main sources and its management strategies of construction waste at the site.

4.3.4. Period of Experience

Table 4.5. Respondent experience

Period of experience	Frequency	Percent
1-3	17	32.1 %
4-7	18	34 %
more than 7	18	34 %
Total	53	100 %

Source- Own Survey and SPSS result

The data regarding the respondent's period of experience in Gift Real Estate Construction Company from 53 respondent 18 are more than 7 years that is 34% of respondent, 18 are between 4-7 years that is 34% while 17 are between 1-3 years of experience that is 32.1% of respondent experiences in Real Estate projects. Generally, the respondents can be identified as experienced employees and sub-contractors. Experience of respondent used to help identified the main source of construction waste and improvement strategies of construction waste management.

4.4. Technical questions

4.4.1. Analysis Types of construction waste generate in construction project

In this section, respondent answered question which types of construction waste generated at that projects. The respondents were given to choose from common types of building construction waste identified in relevant literature.

This objective was examined through the research question indicated below using Likert Scaling. The ranking was to be made from 1 - 5, from not occur to extremely occur able with multiple options possible.

Table 4.6. Types of construction waste

Types of construction waste	N	Mean	Std. Deviation	Rank
Process construction waste				
Time	53	3.70	1.102	3rd
Manpower	53	3.64	1.058	4th
Material construction waste				
Concrete	53	3.09	1.148	18th
Reinforcement bar	53	4.11	1.086	1st
Mortal for HCB	53	3.23	1.012	14th
Piece of brick	53	2.94	1.082	20th
Glass	53	2.75	1.399	21th
Gypsum powder board	53	3.47	1.030	9th
Masonry rubble	53	3.11	1.251	17th
Plastic	53	3.47	1.187	10th
Soil, sand & gravel	53	3.21	1.405	15th

Aluminum	53	2.43	1.337	22th
Cardboard and paper	53	3.21	1.645	15th
Pvc	53	3.55	1.030	7th
Timber	53	3.91	1.043	2nd
Tile ceramic	53	3.08	1.016	19th
Plywood	53	3.58	1.100	6th
Dry cement	53	3.55	1.066	8th
Paint	53	3.42	1.167	12th
Electric wire & lighting fixture	53	3.43	1.118	11th
Plumbing fixture	53	3.62	1.130	5th
Excavated soil and select material	53	3.30	1.636	13th

Sources: spss result

Table 4.6. Shows respondent rank types of construction waste that mostly occur in construction site. Response indicate that top five type of construction waste generated at site; Reinforcement bar waste the first ranked extremely occur able construction waste in site, Timber waste second ranked extremely occur able construction waste in site, time waste is third ranked construction waste extremely occur able in site, Man power waste fourth level ranked extremely occur able construction waste in site and plumbing fixture waste fifth ranked extremely occur able construction waste in site and the least generated types of construction wastes are Concrete, Piece of brick, Glass, Aluminum, Tile ceramic respectively generated in Gift Real Estate building construction project. This ranking waste identified by respondent personal knowledge and observation.

From the above data we can conclude that the top five types of waste generated at site mainly cause due to unskilled workmanship and lack of clear schedule of work flow. Gift Real Estate building construction project should improve construction management & supervision and waste management plan.

4.4.2. Sources of construction waste

In this section, respondent answered question two identify sources of construction waste. The respondents were given to choose from common sources of building construction waste identified in relevant literature.

Objective one: To identify the sources of construction waste in gift real estate building construction project.

This objective was examined through the research question indicated below using Likert Scaling. The ranking was to be made from 1 - 5, from not significant to extremely significant with multiple options possible.

Table 4.7. Identify sources of construction waste

Sources of construction waste	N	Mean	Std. Deviation	Rank
Design such as change to design and contract document errors	53	2.94	1.231	5th
Procurement Such as ordering error and supplier's error due to inaccurate data	53	3.08	1.567	3rd
Purchased material that don't comply with specification	53	3.11	1.683	2nd
Materials handling such as damage during transportation, off-loading, on-site distribution	53	2.42	1.278	17th
Conversion waste from cutting uneconomical shapes	53	2.55	1.294	13th
Rework due to incorrect material and worker mistakes	53	2.55	1.576	14th
Poor workmanship and skilled labor	53	2.38	1.496	19th
Over production/ production of a quantity greater than required or earlier than necessary	53	2.70	1.218	9th

Choice of wrong construction method	53	2.75	0.830	7th
Wrong handling of material and insufficient instruction about handling	53	2.30	1.234	20th
Wrong improper storage of construction material	53	2.58	1.151	12th
Shortage of tools and equipment's required	53	2.53	1.324	15th
Damage due to weather such as temperature and humidity	53	2.87	1.127	6th
Security such as damage on construction site due to vandalism	53	2.96	1.208	4th
Residual such as off-cuts from cutting materials to length and packaging	53	2.72	0.818	8th
Materials misplacement on site	53	2.42	1.379	17th
Lack of proper waste management plan and control	53	3.19	1.618	1st
Lack of a quality management system aimed at waste minimization	53	2.62	1.701	11th
Poor coordination and communication between parties involved in the project	53	2.43	1.264	16th
Lack of supervision and delay of inspections	53	2.68	1.370	10th

Source- spss result

The participants were asked to rank the source of construction waste at the site as shown in Table 4.7. The sources are common sources of building construction waste selected and adopted from relevant literature. The respondents identified the sources of construction waste the top five major sources of construction waste stated respectively; Lack of proper waste management plan and control, Purchased material that don't comply with specification, Procurement Such as ordering error and supplier's error due to inaccurate data, Security such as damage on construction site due

to vandalism, Design such as change to design and contract document errors and the least significant sources of construction waste Poor coordination and communication between parties involved in the project, Materials handling such as damage during transportation, off-loading, on-site distribution, Materials misplacement on site, Poor workmanship and skilled labor, Wrong handling of material and insufficient instruction about handling are identified as the least sources of waste at the site.

Generally, from the finding we can conclude that, lack of proper waste management plan & its controlling mechanism and material purchased not feat to specification those reason cause construction waste. So, Gift Real Estate building construction project should upgrade the construction waste management plan and material & any work precede depend on design and specification in order to prevent rework.

4.4.3. Is there any waste management department in your company?

In this section, respondent answered question three to assess types of construction waste management strategies applies in Gift Real Estate building construction project identify current practices of company in this 4.4.3 section used to know company waste management department available or not.

Objective two: To assess types of construction waste management strategies applies in Gift Real Estate building construction project.

This objective was examined through the research question indicated below using yes, no question.

Table 4.8. Is there waste management department in your Company?

	Frequency	%
Yes	6	11.3 %
No	47	88.7%
Total	53	100 %

Sources: spss result

Regarding to the above table 4.8 show that participant that is 88.7% of respondent “No” and 6 participant that is 11.3% of respondent” yes” so this indicate that there is no waste management department at Gift Real Estate building construction project.

From this we can conclude that waste management department established in project is very useful to managed and monitor construction waste plan. Regarding response there is no waste management department in Gift Real Estate building construction project so there is huge gap to implement and control an effective construction waste management at that project. So, company should establish waste management department.

4.4.4. Is there any construction waste management plan in your site

In this section, respondent answered question three to assess types of construction waste management strategies applies in Gift Real Estate building construction project identify current practices of company in this 4.4.4 section used to know company waste management plan available or not.

Objective two: To assess types of construction waste management strategies applies in Gift Real Estate building construction project.

This objective was examined through the research question indicated below using Yes, No question.

Table 4.9. Is there waste management plan

	Frequency	%
Yes	40	75.5 %
No	13	24.5 %
Total	53	100 %

Source- Spss Result

According to above table 4.9, 40 respondent that means 75.5% of the respondent “yes” and 13 respondent that means 24.5% of the respondent “No” so this indicate that there is waste management plan in Gift Real Estate company.

From this we can conclude Gift Real Estate begun to applies construction waste management plan but from our observation in that project. It is not sufficient waste management plan so organization should set effective waste management plan and upgrade previous waste management plan.

4.4.5. In which construction stage it implemented

In this section, respondent answered question three to assess types of construction waste management strategies applies in Gift Real Estate building construction project identify current practices of company in this 4.4.5 section used to know in which construction stage waste management plan implement.

Objective two: To assess types of construction waste management strategies applies in Gift Real Estate building construction project.

This objective was examined through the research question indicated below using specific stage of construction.

Table 4.10. In which construction stage it implemented

	Frequency	%
pre-construction	23	43.4 %
during construction	30	56.6 %
Total	53	100 %

Source- Spss Result

The respondents were asked about in which stage of construction is the waste management plan implement then majority of the respondent, 30 that means 56.6% choose “during construction” and others 23 that means 43.4% choose “pre-construction”.

From this we can conclude that most of the construction waste management plan implement in Gift Real Estate Company during construction stage. Planning before every work isn’t exercise in Gift Real Estate so the company should apply waste management plan before any work start that means implement in preconstruction stage.

4.4.6. Construction waste management plan practice usually used on your site

In this section, respondent answered question to assess types of construction waste management strategies applies in Gift Real Estate building construction project identify current practices of

company in this 4.4.6 section used to know for which type of construction waste material managed by what waste management plan.

Objective two: To assess types of construction waste management strategies applies in Gift Real Estate building construction project.

This objective was examined through the research question indicated below using table construction waste material with its waste management practice.

Table 4.11. Waste and management practice in Gift Real Estate

	Prevent %	Reduce %	Reuse %	Recycle %	Landfill %	Disposal %	Waste management practice
Time	52.8	35.8	9.4	1.9	0	0	Prevent
Manpower	28.3	60.4	9.4	1.9	0	0	Reduce
Concrete	1.9	7.5	32.1	3.8	45.3	9.4	Landfilled
Reinforcement bar	3.8	0	60.4	35.8	0	0	Reuse
Mortal HCB	0	3.8	30.2	11.3	47.2	7.5	Landfilled
Brick	0	1.9	35.8	7.5	54.7	0	Landfilled
Glass	1.9	5.7	5.7	9.4	1.9	75.5	Disposal
Gypsum	0	0	39.6	0	47.2	13.2	Landfilled
Masonry and bubble	0	7.5	9.4	15.1	62.3	5.7	Landfilled
Plastic	0	11.3	60.4	11.3	0	17	Reuse
Soil, sand & gravel	0	1.9	3.8	3.8	84.9	5.7	Landfilled
Aluminum	17	22.6	37.7	20.8	0	1.9	Reuse
Cupboard and paper	0	5.7	7.5	15.1	0	71.7	Disposal
Pvc	0	3.8	32.1	15.1	0	49.1	Disposal
Timber	0	7.5	69.8	15.1	0	7.5	Reuse
Tree stumps, dirty rock	0	1.9	0	1.9	56.6	39.6	Landfilled

Tile, ceramic	5.7	1.9	5.7	9.4	35.8	30.2	Landfilled
Plywood	0	0	84.9	11.3	0	3.8	Reuse
Dry cement	0	0	0	5.7	66	28.3	Landfilled
Paint	5.7	0	9.4	1.9	5.7	77.4	Disposal
Electric wire and lighting fixture	3.8	5.7	24.5	5.7	0	60.4	Disposal
Plumbing fixture	7.5	5.7	26.4	5.7	0	54.7	Disposal
Excavated soil and select material	1.9	0	5.7	5.7	73.6	13.2	Landfilled

Source- spss result

According to the above table, the respondent responds on different types of construction waste managing strategies practices on study project. Types of construction waste taken from above table 4.6. Survey question.

Regarding from respondent data, Highly generated waste at that site was Reinforcement bar 60.4% managed by reused, timber 69.8% managed by reused, time 52.8% managed by prevent, manpower 60.4% managed by reduce, Plumbing fixture 54.7% managed by disposal, plywood 84.9% managed by reuse, PVC 49.1% managed by disposal, dry cement 66% managed by landfilled, gypsum power & board 47.2% landfilled, plastic 60.4% managed by reuse, tree stumps & dirty rock 56.6% managed by landfilled, electric wire & lighting 60.4% managed by disposal, paint 77.4% managed by disposal, excavation soil & select material 73.6% managed by landfilled, mortal HCB 47.2% managed by landfilled, card board & paper 71.7% managed by disposal, soil sand& gravel 84.9% managed by landfilled, masonry rubble 62.3% managed by landfilled, concrete 45.3% managed by landfilled, tile ceramic 35.8% managed by landfilled, pieces of brick 54.7% managed by landfilled and glass 75.5% managed by disposal above respond percent indicate waste with its strategies respectively. From above respondent data identified there are different waste management practice for different types of construction waste

Table 4.12. Summary of construction waste management current practices

Construction waste generated in site	Construction waste management practice
Time	Prevent
Manpower	Reduce
Reinforcement bar, Plastic, Aluminum, Timber, Plywood	Reuse
Concrete, Mortal HCB, Brick, Gypsum, Masonry and bubble, Soil, sand & gravel, Tree stumps & dirty rock, Tile ceramic, Dry cement, Excavated soil and select material	Landfilled
Glass, Cupboard and paper, Pvc, Paint, Electric wire and lighting fixture, Plumbing fixture	Disposal

Sources- own survey

Generally, from respondent ranked there are five waste management practices applied in site. The respondent answer It is good beginning of waste management exercise use for some waste Reuse but their huge gap because the majority for construction waste generated in Gift Real Estate building construction project managed by landfilled and disposal.

From this we can conclude that Gift Real Estate Company should improve strategies in order to upgrade eliminate, reduce and recycling method of construction waste at site because those methods more advantageous due to decrease cost overrun & time overrun than others.

4.4.7. Do you believe gift real estate waste management strategies good experience compare to other construction company?

In this section, respondent answered question which technique used to improving construction waste management strategies of gift Real Estate building construction project. 4.4.7. Section used to know Gift Real Estate Building Construction good experience in waste management practice or not.

Objective three: To formulate frame work to improving construction waste management strategies of gift Real Estate building construction project.

This objective was examined through the research question indicated below using Yes, No questions.

Table 4.13. Do you believe good experience in waste management practice?

	Frequency	%
Yes	15	28.3 %
No	38	71.7 %
Total	53	100 %

Source- spss result

From above respondent data 28.3% of them “yes” Gift Real Estate good experienced and 71.7% of them “No” Gift Real Estate not good waste management experience. From this we conclude that Gift Real Estate Company was not good construction waste management practice. The Organization should improve waste management plan. In order attain the profit margin.

4.4.8. Techniques to improve waste management strategies of gift real estate.

In this section, respondent answered question which technique used to improving construction waste management strategies of gift Real Estate building construction project. This section 4.4.8. Used to know choose from improvement method of building construction waste management identified in relevant literature.

Objective three: To formulate frame work to improving construction waste management strategies of gift Real Estate building construction project.

This objective was examined through the research question indicated below using Likert Scaling. The ranking was to be made from 1 - 5, from strongly disagree to strongly agree with multiple options possible.

Table 4.14. Technique to improve waste management strategies

	N	Mean	Std. Deviation	Rank
Promoting adequate communication among company member	53	3.91	0.883	11th
Before commencement of work asses needed material and locate	53	3.91	0.861	10th
Order supplier material should respect sizing needed	53	4.04	1.018	7th
Make sure storage area are secure and weatherproof	53	3.98	0.772	9th
Plan accordingly before start project	53	4.02	0.99	8th
Material inspection on arrival site	53	4.17	1.069	3rd
Documentation of material in and outflow	53	4.13	0.878	4th
Reuse and recycle salvageable material	53	4.13	1.127	5th
Option for deconstruction instead of demolition	53	3.75	1.239	13th
Material quality check	53	4.38	0.945	2nd
Training of storekeeper	53	4.06	0.886	6th
Improve knowledge by orientation about material handling worker	53	4.42	0.929	1st
Use different construction technology in order to prevent rework	53	3.87	1.001	12th

Source- spss result

The research project made an effort to isolate parameters that might affect how well construction waste is managed on site. Several elements that are generally acknowledged as having a beneficial impact on the effectiveness of the framework for managing construction material waste were included in the questionnaire.

The questionnaire's requirements were stated, and the respondents were asked whether they believed they played a role in improving the site's waste management system and how important they thought each factor was in that regard. The respondents ranked the waste minimization techniques from top to bottom to attract management attention, as indicated in Table 4.14 which

shows the distribution of responses; Improve knowledge by orientation about material handling worker 1st technique, Material quality check 2nd technique, Material inspection on arrival site 3rd technique, Documentation of material in and outflow 4th technique, Reuse and recycle salvageable material 5th technique, Training of storekeeper 6th technique, Order supplier material should respect sizing needed 7th technique, Plan accordingly before start project 8th technique, Make sure storage area are secure and weatherproof 9th technique, Before commencement of work asses needed material and locate 10th technique, Promoting adequate communication among company member11th technique, Use different construction technology in order to prevent rework 12th technique and Option for deconstruction instead of demolition 13th last technique,

Generally, from this we can conclude that, the most top five highly preferable technique to improve construction waste management respectively Improve knowledge by orientation about material handling worker, Material quality check, Material inspection on arrival site, Documentation of material in and outflow, Reuse and recycle salvageable material. So, organization should focus on material handling giving training for worker about how to use and handle materials without waste and also inspect the process. And others material quality check purchase material should attain the standard specification also salvageable material should use reuse and recycle methods.

4.4.9. Formulate strategic frame work to improving construction waste management

In this section to formulate strategic frame work to improve construction waste management in Gift Real Estate building construction project.

From above response indicate that there are different types of construction waste and also sources of construction waste and its practices. Regarding response implies indicate improvement mechanisms of construction waste management. So, this all information gathers from respondent combined interoperate by input process output frame work. Below figure indicate input output process of construction waste management.

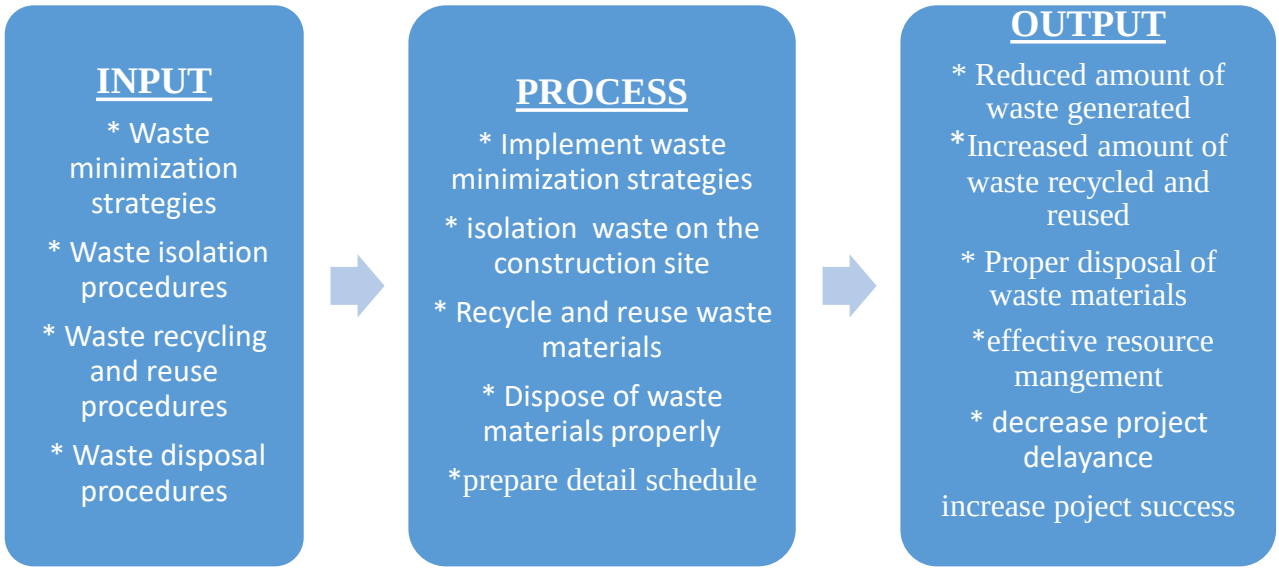

Figure 4.1 : strategical frame work input process out of construction waste management

Here is a more detailed explanation of the inputs, processes, and outputs of the construction waste management plan:

1. Inputs

Waste minimization strategies: These strategies are designed to reduce the amount of waste generated during construction. Some examples of waste minimization strategies include using sustainable materials, designing buildings that are easier to deconstruct, and implementing waste-prevention practices on the construction site.

Waste isolation procedures: These procedures are used to isolate waste on the construction site. This will help to ensure that waste is disposed of properly and that recyclable materials are not contaminated.

Waste recycling and reuse procedures: These procedures are used to recycle and reuse waste materials on the construction site. This will help to reduce the amount of waste that goes to landfills.

Waste disposal procedures: These procedures are used to dispose of waste materials that cannot be recycled or reused. This will ensure that waste is disposed of properly and that it does not pollute the environment.

2. Process

The process of construction waste management involves implementing the waste minimization strategies, isolating waste on the construction site, recycling and reusing waste materials, disposing of waste materials properly and prepare detail scheduling.

3. Outputs

The outputs of the construction waste management plan are a reduced amount of waste generated, an increased amount of waste recycled and reused, proper disposal of waste materials, decrease project delayanse and increase project success.

By following this framework, we can develop a comprehensive and effective construction waste management plan that will help to protect the environment and reduce the cost of construction projects.

4.5.Face to face interview results concerning construction waste management strategies at Gift Real Estate Company

4.5.1. Types, sources, management and improvement strategies

Other part of data collection system is Interview question. Interview respondent consists of coordinator, project manager and sub-contractor interviewed only (3) respondents were interviewed. This was due to the busy schedules of the respondents and absence of time.

According to the interviewees with project manager and sub-contractor, there are different types of waste material interviewees state some waste mostly occurred such as manpower, reinforcement bar, wooden materials, excavated soil, gravel, sand, gypsum material and cement are some of them. Extremely occur able waste was reinforcement bar. From respondents there was many sources of

construction waste. Some of them mentioned poor workmanship, lack of supervision, rework, wrong material handling and procured material without specification. Regarding construction waste management the interviewees given definition of waste monitoring mechanisms such as plan before work start, material quality check, material inspection arrival on site & reuse recycles salvageable material, training of worker & storekeepers handling of material and need detail inspection of work avoid rework. According to the interviewees there were different waste management mechanism practically implement in respondent site area. They mentioned different waste management strategies such as reduce, reuse, landfill and disposal. For sand, gravel, soil this kind of waste material managed by landfilled. Therefore, depending on the type of waste there was various management mechanism of waste in site but most waste material managed by landfilled & disposal there is a gap by using recycle & reuse management plan in site. Interviewee's responses including identified improvement method of waste management strategies. They stated some methods such as plan is mandatory before every work begin in order to prevent or reduce waste, order to purchase or supplier material based on needed specification, check material quality, improve skill by training about material handling of workers and finally waste happen use salvageable material by reuse, recycle and landfilled. Sub-contractor said material purchasing done by client that means Gift Real Estate company so material purchased are need fulfill design specification and also it must be use quality material.

According to the interviewees with coordinator, from the interviewee there are different types and sources of waste majority he response similar with questionnaire and other interviewees finding. The most serious issue he states there was no waste management department at office. Waste management department responsible for identifying, quantifying and estimating any construction waste generated at that site so company should build one department for construction waste at office. Also, he notices sub-contractor are contractually under obliged to reduce waste and also managed waste properly so sub-contractor employee skilled worker and managed the work properly in order to decrease rework. And also, in order to decrease waste of time and manpower use detail schedule for all project flow of work by that detail schedule do each activity during construction stage.

Regarding to interviewees response and also majority questionnaire response implies that material storage area of Gift Real Estate was good status so construction waste happened at storage area was minimum.

Generally from interviewees response we can conclude that company waste management practice not upgrading due to different reason so interviewee indicate improvement mechanism such us prepare effective waste management planning and control, prepare good teamwork, prepare good project management, prepare good communication between parties, standardized construction elements should be promoted to reduce amount material waste on construction site and subcontractor responsible for their waste lack of enforcement of law a side of sub-contractor in case of violation of obligations of waste properly managing.

4.6. Observation

The observation method is used by a researcher to actually observe what is occurring and what is present at the site or location of interest. The observed phenomena might be the actions or physical traits of the study participants as desired by the researcher. If the observed behaviors aren't evident to the naked eye, cameras can be used to record the observations or convert them into visuals. To assess the quality of construction waste management site.

Figure 4.2. improper damping excavated soil

The above Figure 4.2 indicate that there is poor disposal system and excavated soil don't dispose on time. This happens due to lack of proper waste management plan & control and Poor coordination and communication between parties involved in the project.

Figure 4.3. improper handling of reinforcement bar

From the above figure 4.3. indicate that reinforcement bar extremely occurs able waste in site that cause due to unskilled workmanship and Renovation waste from cutting uneconomical shapes & size Gift Real Estate building construction project should improve workmanship skill by training and daily supervision.

4.7.Triangulating data sources

The triangulation of data from the questionnaire, interviews and observations exposes the following finding for types and sources of construction waste and current practices of Gift Real Estate company and also improvement mechanism of construction waste.

- Types of waste generated in site mostly waste was reinforcement bar, timber, manpower and excavated soil.
- The main significant sources of construction waste in study area are lack of proper waste management plan, poor workmanship, lack of supervision, wrong material handling poor workmanship, and procured material without specification.

- In Gift Real Estate there is no waste management department established in the company. it's mainly affected waste management plan and controlling system. So, Company should develop waste management department in office.
- In Gift Real Estate there was waste management plan but not perfect should be upgrade.
- There was different waste management current practice in Gift Real Estate but most of construction waste generated in site managed by landfilled and disposal.
- There was different improvement technique from different data sources: Improve knowledge by orientation about material handling worker, Material quality check, Material inspection on arrival site, Reuse and recycle salvageable material, plan is mandatory before every work begin in order to prevent or reduce waste and sub-contractor are contractually under obliged to reduce waste and also managed waste properly so sub-contractor employee skilled worker and managed the work properly in order to decrease rework.

Chapter five: Conclusion and Recommendation

5.1. Conclusion

Construction waste management is required for a country to develop in a sustainable manner. It helps to address issues related to environmental, social and economy. Once the root sources of waste generation are notified, it can either be avoided or minimize to benefit the world for better future.

From this point of view, the purpose of this study was to know types and sources of construction waste by their contribution and a management plan. It is good to assessing the source of the construction waste to create better world.

The study gives the following conclusion to address based on results gain.

1. The first objective was to identify the sources of construction waste in gift real estate building construction project.
   - The study site generates several types of waste from respondent data ranking identifies mostly generated types of waste such us Reinforcement bar, Timber, Time, Manpower, excavated soil and least generated waste in site was Concrete, Piece of brick, Glass, Aluminum, Tile ceramic.
   - The analysis result show that the significant source of construction waste in site: The first, second and third contributors of construction waste are Lack of proper waste management plan and control, purchased material that don't comply with specification and Procurement Such as ordering error, supplier's error due to inaccurate data and sub-contractor not properly managed their waste as shown in the analysis.
2. The second objective was to assess types of construction waste management strategies applies in Gift Real Estate building construction project.
   - The analysis result indicates the construction waste management practices applied on sites is not good experiences. From this study majority of construction waste collected in Gift Real Estate project managed by landfilled and disposal. Huge gape on application of recycling and reusing of construction waste.

- Regarding analysis there is no waste management department in office. It implies gap for implementation of waste management. And also lack of enforcement of law a side of sub-contractor in case of violation of obligations of waste properly managing.

3. The third objective was to formulate frame work to improving construction waste management strategies of gift Real Estate building construction project.
   - According to study attempted to identify mechanism that may have improve on the effectiveness of construction waste management at the site: : Improve knowledge by orientation about material handling worker, Material quality check, Material inspection on arrival site, Reuse and recycle salvageable material, plan is mandatory before every work begin in order to prevent or reduce waste and sub-contractor are contractually under obliged to reduce waste and also managed waste properly so sub-contractor employee skilled worker and managed the work properly in order to decrease rework. Use different construction technology in order to prevent rework those are the improvement mechanism used to upgrade waste management plan.

5.2. Recommendations

On the basis of the above-mentioned findings the following point are recommendations to minimize and managing the construction waste for stakeholder in that project.

5.2.1. Gift Real Estate Construction Company

- Should established construction waste management department in company office then department should prepared and monitor acceptable waste management plan matching with the nature of the project.
- Creating new job: Since waste can make a good profit from salvaged building parts this will become a vital branch of the building parts, branches of the building industry offering many new jobs firm the sorting and transporting of construction waste.
- Management teams Should Provide waste reduction training to site staff to raise their environmental awareness and improve working procedures to reduce waste generation in construction projects.
- Should set enforcement law for sub-contractor working in Gift Real Estate in case of violation of obligations of waste properly managing.
- Should prepare modern construction method for instance off site fabrication & in site fixing method

5.2.2. Employer of Gift Real Estate Company

- Zero Preventable Waste in construction means preventing waste being generated at every stage of a project's lifecycle. Especially in this study finding reinforcement bar mostly generate construction waste so skilled labor of Gift Real Estate should prevent Adaptation waste from cutting uneconomical shapes.
- Should control material quality check when arrive at site before fix.

5.2.3. Supervisor

- Site supervision and management should be done regularly & frequently, the lack of supervision may result in mistakes, reworks, and poor workmanship; Coordination among parties is a key to reducing waste.
- Prepare accurate design and specification update immediate if there is any change before any work start.
- Prepare accurate detail time and resource schedule before work begin.

5.2.4. Sub-Contractors

- Should assign qualified staff and skilled workmanship in construction projects activities in order to prevent rework or demolition work.
- Should work based on design, specification and schedule.
- Should fulfill their responsibility managed waste properly.

5.3. Future research

- It required the research of new technology of recycling waste and managing mechanism for applying to construction companies in Ethiopia, especially in Addis Ababa.
- It is necessary to repeat this research every three years to observe the new trends of contractors.

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APPENDIX – A

Questionnaire survey for thesis paper on

Assessment of construction waste management strategies in case of gift real estate building construction project

ADDIS COLLEGE

SCHOOL OF GRADUATE STUDIES

DEPARTEMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Survey questions for Gift Real Estate Engineering team, Management team. Sub-contractor and skilled labor staff.

Dear respondents,

The purpose of this research is conducted to collect information on construction waste management strategies system at Gift real estate building construction project in order to identify problems and provide alternative solution of waste management as a requirement for the completion of Master of Science Degree of Construction Technology and Management at Addis College, School of Graduate Studies.

Your volunteer participation in providing accurate information is vital for the successful completion of this research. The information provided will be used for academic purpose only and will be kept confidential.

Thank You for your participation

Bezawit Mesfin

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Part I. Demographic Characteristics

1. Name of institution /agency /company_____

2. Position_____

3. Academic qualification –

Certificate ☐ Diploma ☐ First Degree ☐ Post Graduate ☐ Doctoral ☐

Other ☐

4. Educational Background

Resource management ☐ Engineering ☐ Management ☐ Construction Management ☐

Economics ☐ Accounting and purchasing ☐ other ☐

5. Period of Experience in years

1- 3 ☐ 4-7 ☐ more than 7 years ☐

Part II. Technical Questions

1. Type of construction waste at the site The given table below are types of construction waste Mostly generated on building construction in gift real estate. Please indicate [√] at which percentage Range waste type are mostly occur able on your site.

5 = extremely occur [81% - 100%] 4 = very occur [61% - 80%]

3 = moderately occur [41% - 60%] 2 = slightly occur [21% - 40%]

1 = not occur [0% - 20%]

No	Waste type	1	2	3	4	5
1	Time					
2	Manpower					
3	Concrete					
4	Reinforcement bar					
5	Mortal HCB					
6	Piece of Brick, block					
7	Glass					
8	Gypsum powder, board					
9	Masonry and rubble					
10	Plastic					
11	Soil, sand & gravel					

12	Aluminum					
13	Cardboard and paper					
14	Pvc					
15	Timber					
16	Tree stumps, dirty rock					
17	Tile, ceramic					
18	Plywood					
19	Dry cement					
20	Paint					
21	Electric wire, lighting fixture					
22	Plumbing fixture					

Please specify if there are any other type of construction waste in your site

_____

_____

2. Source of construction waste

The given below are numbers of Sources of construction materials waste on building construction sites in gift real estate. Please indicate percentage range the significance of each factor by ticking [√] the appropriate boxes.

5 = extremely significant [81% - 100%] 4 = very significant [61% - 80%]

3 = moderately significant [41% - 60%] 2 = slightly significant [21% - 40%]

1 = not significant [0% - 20%]

Source of construction waste	1	2	3	4	5
Design such as change to design and contract document errors					
Procurement Such as ordering error and supplier's error due to inaccurate data					
Purchased material that don't comply with specification					
Materials handling such as damage during transportation, off-loading, on-site distribution					
Conversion waste from cutting uneconomical shapes					
Rework due to incorrect material and worker mistakes					
Poor workmanship and skilled labor					
Over production/ production of a quantity greater than required or earlier than necessary					
Choice of wrong construction method					

Wrong handling of material and insufficient instruction about handling						
Wrong storage of material						
Shortage of tools and equipment's required						
Damage due to weather such as temperature and humidity						
Security such as damage on construction site due to vandalism						
Residual such as off-cuts from cutting materials to length and packaging						
Materials misplacement on site						
Lack of proper waste management plan and control						
Lack of a quality management system aimed at waste minimization						
Poor coordination and communication between parties involved in the project						
Lack of supervision and delay of inspections						

Please specify if there are any other possible source in your site

_____

_____

3. Is there any waste management department in your company?

   Yes ☐ No ☐

4. Is there any construction waste management plan in your site?

   Yes ☐ No ☐

5. If you answer question 4 "Yes" In which construction stage it implemented

   - Pre-construction ☐

   -During construction ☐

   -Post construction ☐

6. Marke (√) on which type Construction waste management plan usually used on your site

No	Material type	Construction waste management strategies					
		Prevent	reduce	Reuse	Recycle	Landfill	Disposal
1	Time						
2	Manpower						
3	Concrete						
4	Reinforcement bar						
5	Mortal HCB						

6	Brick						
7	Glass						
8	Gypsum						
9	Masonry and bubble						
10	Plastic						
11	Soil, sand & gravel						
12	Aluminum						
13	Cupboard and paper						
14	Pvc						
15	Timber						
16	Tree stumps, dirty rock						
17	Tile, ceramic						
18	Plywood						
19	Dry cement						
20	Paint						
21	Electric wire and lighting fixture						
22	Plumbing fixture						
23	Excavated soil and select material						

Please specify if there is other type of construction waste management strategies that could have significant contribution in material waste reduction in you site

_____

_____

7. Do you believe gift real estate waste management strategies good experience compare to other construction company?

Yes ☐ No ☐

8. If you answer for question no 7 “No” what techniques to improve waste management strategies of gift real estate.

Please tick mark [√] on the appropriate column where good technique of waste management strategies for your company. For the level of good technique use this level

1= Strongly Disagree, 2= Disagree, 3= Neutral,

4= Agree, 5= Strongly Agree

number	Improvement technique waste management strategies on in your site	1	2	3	4	5
1	promoting adequate communication among company member project designers and construction team					

2	Before commencement of construction works, asses needed materials and make an effort to locate and acquire used materials beforehand, whenever possible;					
3	Orders to suppliers of materials should respect sizing needs so that size adjustments can be avoided during construction;					
4	Make sure storage areas are secure and weatherproof (where required);					
5	Plan accordingly before starting the project					
6	material inspections on arrival on sites					
7	documentation of materials in and outflows					
8	Reuse and recycle salvageable materials					
9	Option for deconstruction instead of demolition					
10	Material quality check					
11	Training of storekeepers/site personnel					
12	Improve knowledge by orientation about material handling of workers					
13	Use different construction technology in order to prevent rework					

Please specify if there is other techniques to improve construction waste management strategies that recommend at your site

_____
_____
_____
_____
_____
_____

9. Finally please forward any opinion, suggestion or recommendation regarding the waste management system at the site

_____
_____

APPENDIX – B

Face-to-face interview questions for thesis paper on

Assessment of construction waste management strategies in case of gift real estate building construction project

Face-to-face interview questions for gift real estate management members heads and staff.

Dear respondents,

The purpose of this research is conducted to collect information on construction waste management strategies system at Gift real estate building construction site in order to identify problems and provide alternative solution of waste management as a requirement of MSc degree in construction technology management from Addis College.

Your volunteer participation in providing accurate information is vital for the successful completion of this research. The information provided will be used for academic purpose only and will be kept confidential.

Thank You for your participation

Bezawit Mesfin

Tel. 0978 10 34 58

Email: bezawitmesfin13@gmail.com

1. Do you have a knowledge about construction waste management strategies?

2. Do you know what kinds of construction wastes and from what source waste generate on the site?

3. Are the construction waste management applicable in your site and what challenges you facing to implement this strategies?

4. Do you think your company waste management policy is satisfactory?

5. State some point to improvement waste management strategies of gift real estate company policy?

6. Please forward any opinion, suggestion and recommendations on your site regarding to construction waste management strategies?

APPENDIX – C

Observation picture

Assessment of construction waste management strategies in case of gift real estate building construction project