T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

RECYCLE CONSTRUCTION AND DEMOLITION WASTE IN IRAQ BETWEEN POSSIBILITIES AND CHALLENGES

MASTER'S THESIS

Yaseen Qasim MOHAMMAD

Engineering Management Department

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Thesis Advisor: Assoc. Prof. Dr. Redvan GHASEMLOUNIA

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LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ MÜDÜRLÜĞÜ

Yüksek Lisans Tez Onay Belgesi

Enstitümüz, Engineering Management Department İngilizce Tezli Yüksek Lisans Programı (191281833) numaralı öğrencisi Yaseen Qasim Mohammad'in "Recycle Construction and Demolition Waste in Iraq Between Possibilities and Challenges" adlı tez çalışması Enstitümüz Yönetim Kurulunun 17/08/2022 tarihinde oluşturulan jüri tarafından *Oy Birliği* ile *Yüksek Lisans* tezi olarak edilmiştir.

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DECLARATION

I, Yaseen Qasim Mohammad, do hereby declare that this thesis titled "Recycle Construction and Demolition Waste In Iraq Between Possibilities And Challenges" is original work done by me for the award of the master's degree in the Faculty of Engineering Management. I also declare that this thesis or any part of it has not been submitted and presented for any other degree or research paper in any other university or institution. (17/08/2022)

Yaseen Qasim MOHAMMAD

DEDICATION

Praise be to God, who has blessed me with joy and happiness, and who has blessed me with success in my life in my academic career. I dedicate my graduation to my honorable family, my friends, my teacher and mentor, Abdul Rahman Al-Ahmad, to the Sheikh Abdullah Al-Nouri Association, and to the Zia Endowment for Development and Education

PREFACE

The Almighty said (And whoever is grateful, he is thankful for himself) And the Messenger of God, may God's prayers and peace be upon him, said: "Whoever does not thank people does not thank God Almighty " Praise be to God Almighty, a great, good, and blessed praise, filling the heavens and the earth, for what He has honored me by completing this study, which I hope you will be pleased with.

Then I would like to extend my thanks and great gratitude to Dr. Radwan for his continuous support to complete this thesis and to everyone who helped me by word or deed, to my dear mother and my family who was with me all the time.

Special thanks to IALD Academy for Leadership and Development, which has supported and continues supporting students in various disciplines to reach a better reality for all

August 2022 Yaseen Qasim MOHAMMAD

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ABBREVIATIONS

C & D : Construction and Demolition
UK : United State
PVC : Plastic Pipe Recycling
UNEP's : United Nations Environment Program

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RECYCLE CONSTRUCTION AND DEMOLITION WASTE IN IRAQ BETWEEN POSSIBILITIES AND CHALLENGES

ABSTRACT

Construction activity requires large amounts of inert materials (such as gravel and sand), and laws and regulations encourage the reuse of construction and demolition. Waste is generated by continuous urban redevelopment. The reuse of building waste is a new issue for Iraq and the use of recycling in general for waste and sewage treatment is still somewhat behind in Iraq. Construction and demolition waste forms a large part of the solid waste management system it continues to rise due to the booming housing and construction industry all over the world.

The results showed that the management of construction waste in Iraq requires high efforts from the authorities to develop a national program with clear plans and goals to advance the reality of construction waste. The municipality must cooperate with experienced and specialized engineers and plan with them to sort waste that can be recycled, establish landfills for waste that cannot be recycled, and provide researchers who want to use waste in their research with the mentioned materials. According to qualitative research, construction waste is used to fill low lands and water swamps in some areas to reclaim land for residential or commercial construction. Additionally, the municipality uses traditional methods of building waste disposal, and modern methods of recycling and benefiting from them are not used, there is no sorting of construction waste, and it is dumped in random dumps outside the city. Therefore, the municipality must cooperate with experienced and specialized engineers and plan with them to sort waste that can be recycled, establish landfills for waste that cannot be recycled, and provide researchers who want to use waste in their research with the mentioned materials.

Modern methods must be introduced by burying chemicals etc. to take advantage of obtaining gases and investing in construction waste as they are still present in large quantities in city, modern methods must be introduced by burying chemicals, etc. to take advantage of obtaining gases and investing in construction waste as they are still present in large quantities they.

Quantitative research showed that most respondents believe that construction and demolition waste affect the environment, representing 93% of all respondents, Also, more than half of the respondents confirmed that there is no interest from the municipality in their city in the issue of construction and demolition waste, as they represent 61% of the total respondents.

52 percent of all respondents strongly agreed to support the creation of a construction and demolition waste recycling plant in their city, and 35 percent agreed with this thought, as well as the use of recycled building materials in engineering applications such as roads and sidewalks. The reuse of materials from demolished buildings and other construction projects is economically beneficial to their city. Only 14% of total respondents think that waste from construction and demolition is carried to a sorting

or recycling facility after being discarded; 43% of respondents believe that the waste is taken nowhere, and 43% believe that it is sent to a random dump in their city.

Because it stimulates the reuse of resources, protects the environment, and is seen as a step toward a more sustainable environment, the adoption of the idea of recycling building and demolition waste will result in a considerable improvement in waste

Keywords: *C & D Waste, Recycling, Construction, Waste management*

IRAK'TA İNŞAAT VE YIKIM ATIKLARININ OLANAKLAR VE ZORLUKLAR ARASINDA GERİ DÖNÜŞÜMÜ

ÖZET

İnşaat faaliyeti büyük miktarda atıl malzeme (çakıl ve kum gibi) gerektirir ve kanunlar ve yönetmelikler inşaat ve yıkımın yeniden kullanımını teşvik eder. Atık, sürekli kentsel yeniden yapılanma ile üretilir. Bina atıklarının yeniden kullanımı Irak için yeni bir konu ve atık ve kanalizasyon arıtma için genel olarak geri dönüşümün kullanımı Irak'ta hala biraz geride. İnşaat ve yıkım atıkları, tüm dünyada hızla gelişen konut ve inşaat sektörü nedeniyle yükselmeye devam ettiği katı atık yönetim sisteminin büyük bir bölümünü oluşturmaktadır.

Sonuçlar, Irak'ta inşaat atıklarının yönetiminin, inşaat atıkları gerçeğini ilerletmek için net planlar ve hedefler içeren ulusal bir program geliştirmek için yetkililerin yüksek çaba göstermesini gerektirdiğini gösterdi. Belediyenin deneyimli ve uzman mühendislerle iş birliği içinde olması ve geri dönüştürülebilen atıkların ayrıştırılması, geri dönüştürülemeyen atıklar için düzenli depolama sahaları kurulması ve atık araştırmalarında kullanmak isteyen araştırmacılara söz konusu malzemelerle birlikte plan yapılması gerekmektedir. Nitel araştırmalara göre, inşaat atıkları, arazileri konut veya ticari inşaat için geri kazanmak amacıyla bazı bölgelerdeki alçak arazileri ve su bataklıklarını doldurmak için kullanılmaktadır. Ayrıca belediye bina atıkları bertarafında geleneksel yöntemler kullanmakta, modern geri dönüşüm ve bunlardan yararlanma yöntemleri kullanılmamakta, inşaat atıkları ayrıştırılmamakta ve şehir dışındaki rastgele çöplüklere dökülmektedir. Bu nedenle belediyenin deneyimli ve uzman mühendislerle iş birliği içinde olması ve atıkların geri dönüştürülebilecekleri ayrıştırması, geri dönüştürülemeyen atıklar için düzenli depolama sahaları oluşturması ve araştırmalarında atık kullanmak isteyen araştırmacılara söz konusu malzemeleri sağlaması gerekmektedir.

Gazların elde edilmesinden yararlanmak ve inşaat atıklarına yatırım yapmak için kimyasallar vb. gömerek modern yöntemler uygulanmalı, çünkü bunlar şehirde hala büyük miktarlarda bulunduğundan, gaz elde etme avantajından yararlanmak için kimyasalları gömerek vb. modern yöntemler tanıtılmalıdır. hala büyük miktarlarda bulundukları için inşaat atıklarına yatırım yapıyorlar.

Nicel araştırmalar göstermiştir ki, çoğu inşaat ve yıkım atıklarının çevreyi etkilediğine inanmaktadır, tüm payın %93'ü, Ayrıca, yarısından fazlasını temsil eden, belediyelerin inşaat ve yıkım atıkları konusunda şehirlerine ilgi göstermediğini doğrulamıştır, çünkü toplamın %61'ini temsil ediyorlar. Ankete katılanların yüzde 52'si şehirlerinde bir inşaat ve yıkım atığı geri dönüşüm tesisi kurulmasını desteklemeye şiddetle katılıyor ve yüzde 35'i bu düşünceye ve ayrıca yollar ve kaldırımlar gibi mühendislik uygulamalarında geri dönüştürülmüş yapı malzemelerinin kullanılmasına katılıyor. Yıkılan binalardan ve diğer inşaat projelerinden gelen malzemelerin yeniden kullanımı, şehirleri için ekonomik olarak faydalıdır. Toplam yanıt verenlerin yalnızca %14'ü inşaat ve yıkımdan

kaynaklanan atıkların atıldıktan sonra bir ayrıştırma veya geri dönüşüm tesisine taşındığını düşünüyor; Ankete katılanların %43'ü atıkların hiçbir yere götürülmediğine ve %43'ü şehirlerindeki rastgele bir çöplüğe gönderildiğine inanıyor.

Kaynakların yeniden kullanımını teşvik ettiğinden, çevreyi koruduğundan ve daha sürdürülebilir bir çevreye doğru bir adım olarak görüldüğünden, bina ve yıkım atıklarının geri dönüştürülmesi fikrinin benimsenmesi, atıklarda önemli bir iyileşme ile sonuçlanacaktır.

Anahtar Kelimeler: *C&D Atıkları, Geri Dönüşüm, İnşaat, Atık yönetimi*

1. INTRODUCTION

1.1 Background

The reuse of materials from buildings and demolitions is encouraged by laws and regulations. Construction and demolition need huge volumes of inert materials (such as gravel and sand), which may be recycled. waste that is produced as a result of ongoing urban redevelopment. Reusing old construction materials is a relatively new concept in Iraq, and the country is currently playing catch-up when it comes to recycling in general, both for the treatment of waste and sewage.

As a result of rapid urbanization and the construction boom that occurred almost everywhere in the world during the 20th century, an increase in the amount of C&D waste that was generated occurred, and it started to rise to uncontrollable levels. Construction and demolition waste are not a new topic anywhere in the world, but they have started to flourish with the increase in population. As a result of this, people's housing needs have increased, which has led to an increase in the amount of C&D waste that has been generated.

It is becoming more important to reuse or recycle construction and demolition debris, particularly given the depletion of natural resources that is causing (Sally M.) a problem that affects all nations. Eliza, Salah M. El-Haggar, and Khaled Nassar (2016).

Concrete is an important construction material that is used all over the globe, particularly in the Middle East. The formation of concrete is accomplished by combining cement, gravel, sand, and water. This combination triggers a chemical reaction that binds the components together, producing a substance that is robust, long-lasting, and economical. During the 17th century, Roman cement had a considerable amount of popularity.

The global construction industry has seen phenomenal expansion over the last couple of centuries as a direct result of the immense demand for a wide variety of building projects, including those in the residential, industrial, and infrastructure sectors. It is

possible to finish megaprojects by employing a broad variety of concrete materials, which will result in the use of vast quantities of natural resources and will have effects both environmentally and socially on the populations that they affect.

Habitat suffers from the presence of 7-8 million tons of debris, especially in the old city on the banks of the Tigris River. The Circular Solution Initiative "The Circular Solution" addresses the rubble of Mosul and the residential area (The Second International Symposium 2021).

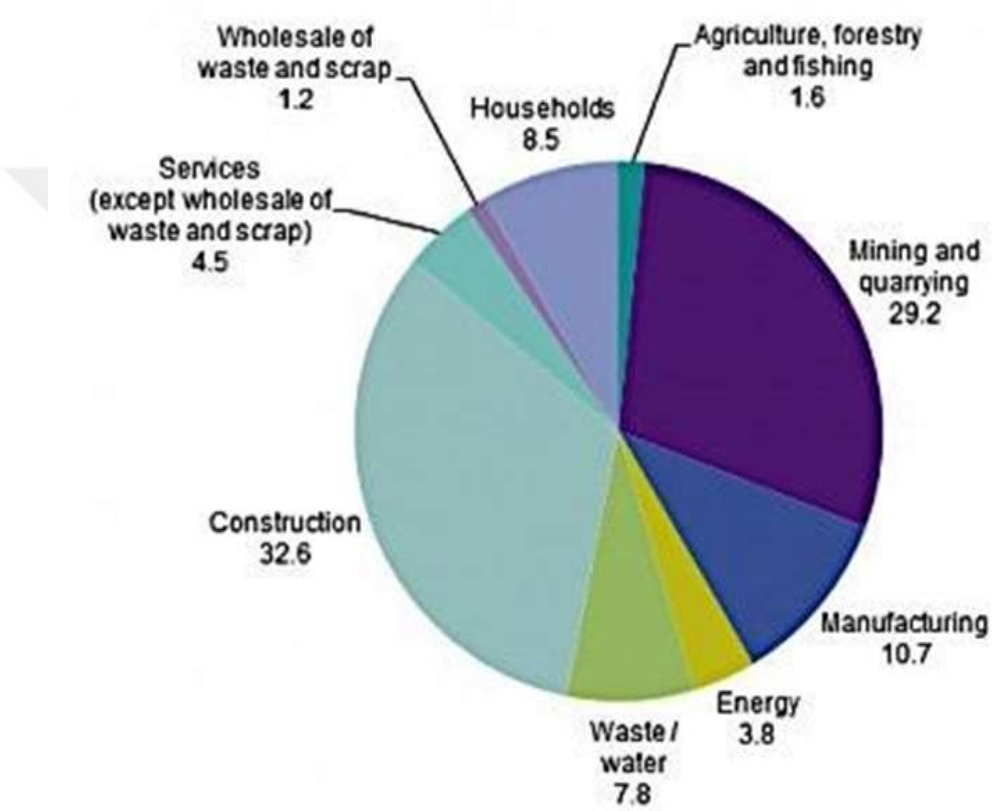

Figure 1.1: Waste Generation By Economic Activities and Households

In contrast to the standard procedure, which entails the haphazard removal and disposal of debris, the primary emphasis of this new project will be on the reuse of recycled rubble in the restoration process. Gary Lewis, Director of the UNEP's Disaster and Conflict Branch, stated that the results of laboratory tests for construction materials confirm that the recycled rubble complies with Iraqi standards for road design. This will allow Iraq to recover from crises more quickly by rebuilding more effectively.

Several campaigns have been launched to remove hundreds of thousands of tons of street debris, open them up and allow residents to reach their homes and businesses,

and enable the rehabilitation of critical infrastructure such as hospitals, schools, and water treatment plants.

Due to the absence of designated areas for the disposal of rubble, however, the debris was frequently discarded haphazardly and scattered along the sides of the roads. This led to several cities experiencing a severe lack of available land due to their rapid urbanization.

Since the beginning of the crisis in 2014, Japan has contributed more than $50 million worth of humanitarian aid to those impacted by it. In addition, Japan has decided to provide a new aid package to Iraq in the form of an amnesty this year. The aid package will include this project that is being implemented by the United Nations Environment Program, and the initiative of the United Nations Environment Program in cooperation with the International Organization for Migration on recycling rubble, which improves the urban environment and produces materials for road construction as well as creates job opportunities for youth. In addition, Japan has decided to provide a new aid package to Iraq for $50 (Loutrophoroi 2021).

The fighting that broke out between ISIS and Iraq's second-largest city, Baghdad, led to the destruction of these millions of tons of cargo. The United Nations Program of the United Nations and the International Organization for Migration are partnering with the Iraqi municipality, with the help of Japan, and the city debris recycling center to deal with the United Nations and solve this problem.

This initiative contributes to reconstruction by attempting to address rubble, establishing business opportunities for the unemployed, and cleaning up the urban climate so that they jointly contribute to humanitarian issues and the achievement of sustainable development principles. Jasim Hammadi 2021, Prohibited Technical Agent, Health Technical Undersecretary of the Ministry of Health and Environment: "This initiative contributes to reconstruction by attempting to address rubble, starting business opportunities for the unemployed, and cleaning up the urban climate."

1.2 Field of Study

This section contains information about Iraq, the nation that served as the primary focus of the study that was carried out here. One of the nations in the far eastern part of the Arab world, Iraq is located between Turkey in the east and Turkey to the north. , which includes Syria and Jordan, the southern region of Saudi Arabia, and Kuwait, stretches between the latitudes of 29 and 27 north, as well as between the longitudes of 38 and 48 east (2018, Central Statistical Organization).

Figure 1.2: Map of Iraq

1.3 The importance of Studying

Waste from construction and demolition is created whenever there is new building construction, as well as whenever there is renovation or demolition work done on an existing structure. The term "construction and demolition waste" refers to the non-polluting solid waste that is produced during the building, re-design, repair, and destruction of non-polluting facilities, roadways, and other infrastructure.

Every single year, around 1.3 billion tons of solid trash are produced by the world's cities. According to research that was published in 2012 by the World Bank, its amount is forecasted to increase to 2.2 billion tons by the year 2025. Materials used in construction account for about half of all materials used and approximately half of the world's solid waste production. Because of this, construction and demolition debris may be a rich supply of building materials.

Because of the potential for all of these issues to become even more severe if adequate action is not taken to address them, the study on recycling construction and demolition debris in Iraq that is reported in this article was conducted there.

1.4 Research Objectives

The objective of this study focuses on:

To measure the level of awareness about the concepts of sustainability for practitioners in this field. To investigate the recycling of building materials Review the efforts of the Iraqi municipality, its shortcomings, and the problems that lie behind the weak waste management and recycling. Before you begin, provide a two-stage C&D waste reduction approach.

The design work comes first, followed by the classification of the models as a basis for determining the building work. Building sites might benefit from improved waste management practices, which would also have a lower impact on agricultural land.

1.5 Methodology of Research

This study was carried out as a conclusion to the literature review by reviewing the most current journals and reports and researching any literature that was linked to the subject using a mix of group research procedures and literature.

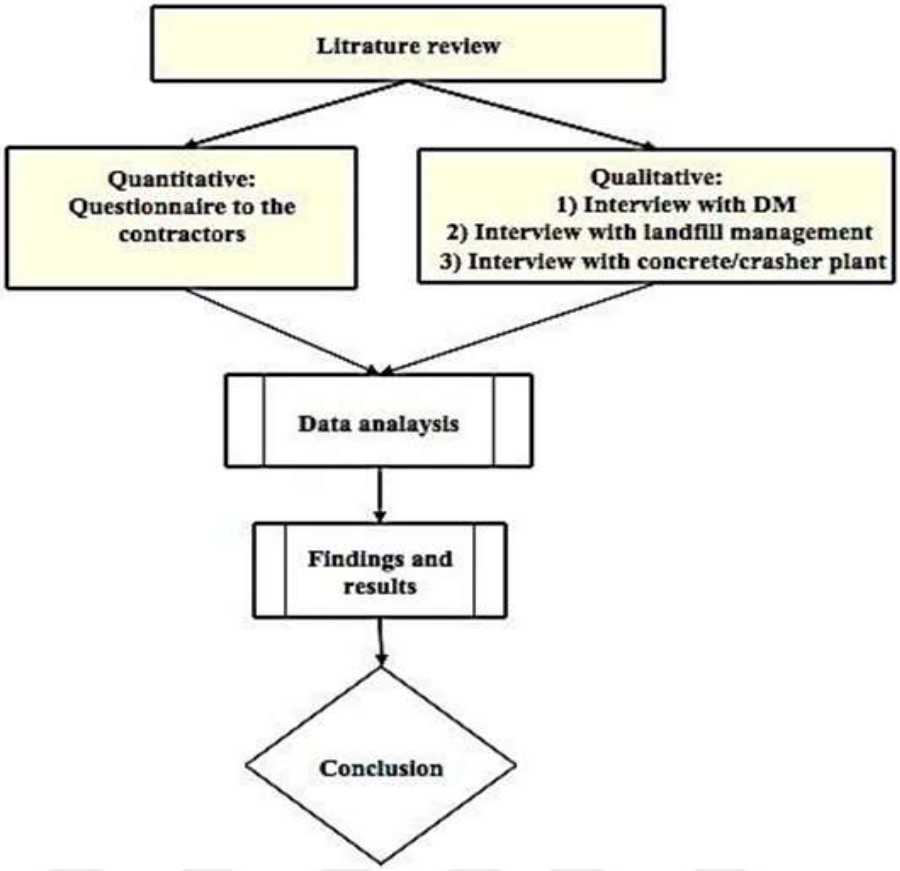

Figure 1.3: Research Methodology Diagram

1.6 Research Question

What is the difference between possibilities and challenges in recycling construction and demolition waste in Iraq between possibilities and challenges? Does knowing the current correspond to the current of the current capital in Iraq? An assessment of the current situation Previous data collection in Iraq? What is the role of the city municipality in managing construction waste? What should the Mosul municipality do with construction waste? Submitting proposals for the construction debris management system?

1.7 Iraq's C&D waste problem

The issue of construction and demolition waste in Iraq is unique compared to that in any other nation for the following reasons:

When it comes to urbanization, Iraq is the country most at risk of being destroyed. Because of this, a significant amount of C&D waste is produced. Because urban

development accounts for around 50 percent of the total at the level of take-off and conductor, the province may now provide more rapid preventative offers.

The towns, and Mosul in particular, suffer from a dearth of written materials and documents.

The society of Iraq is made up of more than one religious group, and there are people from more than ten different countries living there at the same time. The proportion of tourists who are foreigners is highest in Anbar and Mosul. In the past, legislation mandating environmental regulations in the building sector was successfully implemented.

2. LITERATURE REVIEW

2.1 Definitions of "C&D waste"

"Trash from whence it is created" is how the Environmental Protection Agency (EPA) defines construction and demolition waste. Construct, rebuild, repair, and destroy structures such as residential and commercial buildings, as well as roads and bridges. " Concrete, asphalt, building goods, and lumber are the primary components of C&D trash. Metal, plastic, insulation, paper, and cardboard are all included in this category. (Meyer and Walsh, 1996).

According to the definition provided by Chromanols et al. (1977), construction and demolition waste is described as follows: "Waste from demolished structures and other buildings is classed as demolition waste." Individual homes, commercial structures, and other types of facilities are included in the definition of "construction trash," which includes debris from building renovations as well (Thabang's, G., Theisen, H., and Eliasson, R. (1977)).

In most cases, these types of waste result from the demolition of existing structures, which may be done intentionally, as in the case of restoration and rebuilding, or unintentionally, due to natural disasters such as earthquakes, floods, etc. Demolition waste is a heterogeneous mixture of building materials such as aggregates, wood, and metals. In addition, demolition waste is a result of the demolition of existing structures. S. El Haggar (2007).

It has been concluded, based on an in-depth analysis of the relevant literature, that trash from road construction and infrastructure projects is in addition to that there are occasions when it is counted as part of the trash from building and demolition, and other instances when it is counted independently. Garbage that is produced either during the construction phase of a building or as a consequence of its destruction is referred to as C&D waste.

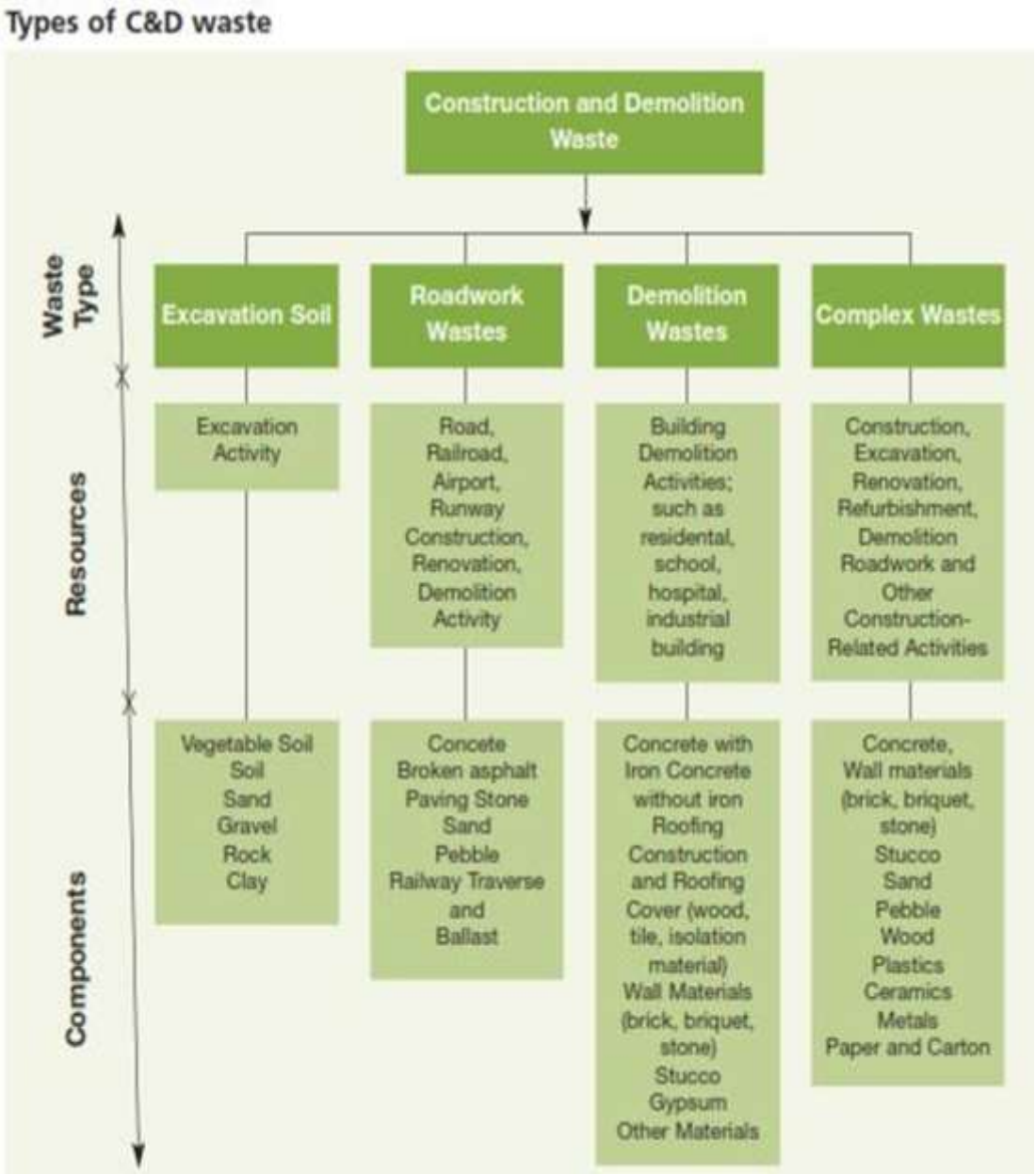

Figure 2.1: Types of C & D Waste

Source: (Centre for Science and Environment Report).

2.2 C&D Waste Classification

The fact is that garbage from construction and demolition (C&D) accounts for one of the biggest proportions of overall waste in the solid waste stream.

A danger to every nation on the planet. Spivey (1974) was one of the first people to take an interest in the categorization of garbage from building projects. (Spivey, D.A. (1974)) suggests categorizing the most common waste components on construction and demolition sites based on where they originated.

Waste from demolition (i.e., concrete, brick, etc.)

Packaging waste (i.e., paper, cardboard, plastic, etc.)

Waste made of wood

3. Concrete-based waste

Asphalt Waste products such as garbage and sewage discarded pieces of scrap metal.

A mixture of rubber and glass pesticides and non-pesticide containers.

Symonds Group Ltd. (1999), who argued that building and demolition trash might vary widely from one site to another and separated it into three sorts of garbage, coming from (Symonds Group Ltd (1999)): (Symonds Group Ltd (1999)); (Symonds Group Ltd (1999)); (Symonds Group Ltd (1999)); (Symonds Group Ltd (1999)); (Symonds Group Ltd (1999)): (Sy

A brand new building. renewal demolish.

Demolition waste, renovation waste, and construction waste are the three categories shown in Figure (2.2) to represent the C&D trash that is generated in the member states of the EU.

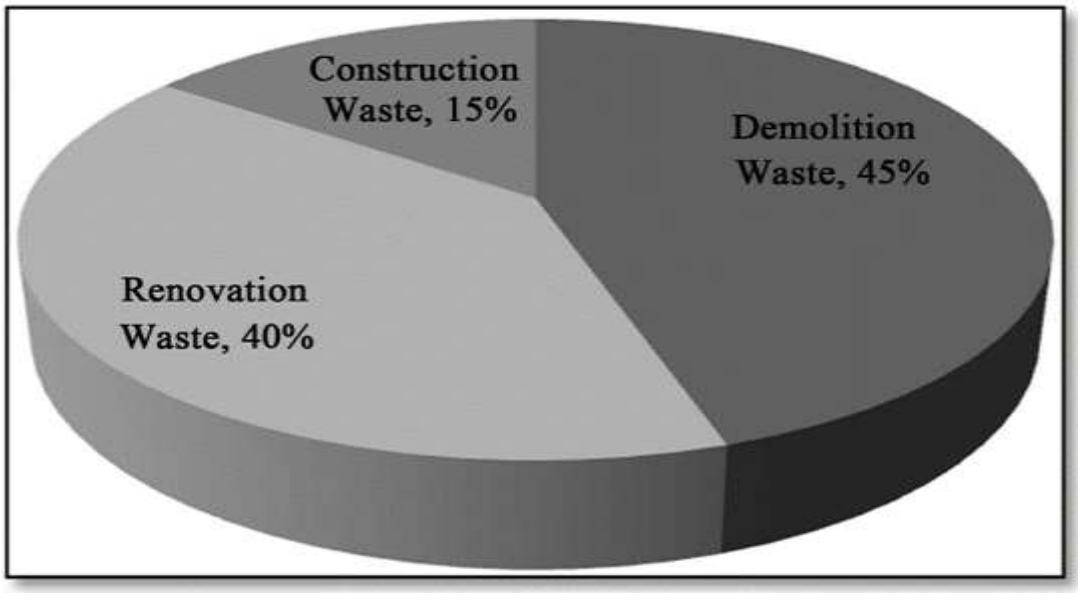

Figure 2.2: C & D Waste in the EU Countries

Source: (Symonds Group Ltd (1999)

The origin of construction debris, as well as the characteristics of the trash itself, are two of the criteria that may be used to categorize it. The many origins of garbage from building projects are broken down below in Figure (2.3). Every aspect of

construction Figure (2.3) demonstrates that waste may be classified into one of two categories: sources created by humans or sources that occur naturally.

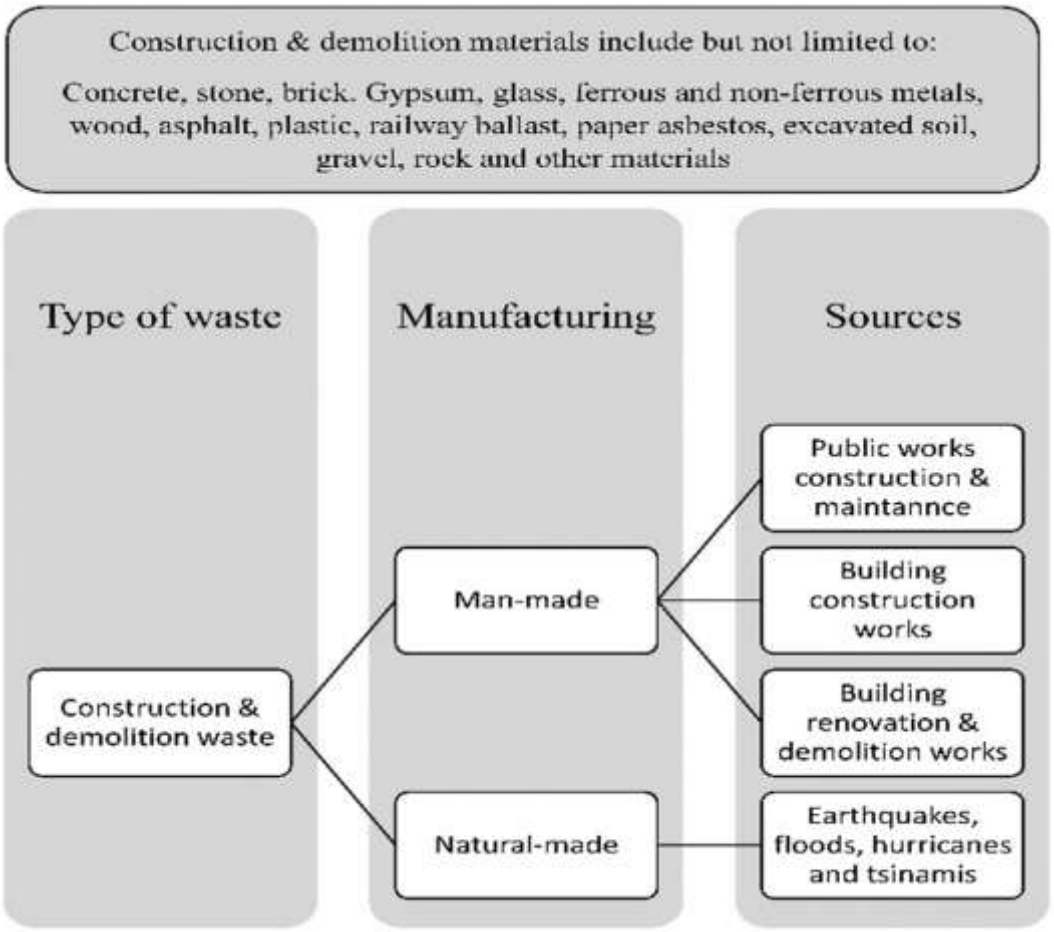

Figure 2.3: Construction Waste

2.3 Source and Types of Solid Waste

Regarding the origins of solid waste, municipal solid waste can be broken down into the following categories: residential (household) refuse; institutional waste; street sweepings; waste from commercial areas; and debris from construction and demolition. In developing countries, municipal solid waste also contains varying amounts of industrial waste from small-scale industries. Many different kinds of solid waste can be found in these sources.

The following is a list of the numerous sources that contribute to the generation of municipal solid waste:

Household garbage: This category includes wastes generated by household activities such as food preparation, sweeping, cleaning, fuel combustion, and gardening

wastes. Residential refuse, also known as domestic waste, can be generated from single-family and multi-family dwellings, as well as low-, medium-, and high-density apartments. In addition, it consists of discarded items such as clothes, furniture, and appliances, as well as reading material and packaging (Medina Martin 2002).

2.3.1 Commercial garbage or refuse

This category includes trash generated by stores, offices, hotels, store offices, fuel service stations, warehouses, restaurants, packaging materials, office supplies, and food waste. Other categories include waste generated by gasoline service stations, warehouses, and warehouse offices. In nations still on the path to economic development, markets may be responsible for the majority of the rubbish generated by these waste categories.

2.3.2 Waste in institutions

This category comprises garbage from educational institutions, medical facilities, and clinics, as well as government offices, police stations, barracks, religious structures, and military sites, among other places. In addition to that, it includes trash from hospitals and therapeutic settings, which might be contagious and contain harmful elements. The waste products produced by the institution are comparable to those produced by homes. Residents, for example, are involved, as is the case in camps.

2.3.3. Municipal services

This waste is generated from street waste, landscaping, and recreational areas, and it includes paper, cardboard, plastic, dirt, dust, leaves, and other vegetable matter that are collected from streets, walkways, alleys, parks, and vacant plots. It also includes waste that is generated from street waste, landscaping, and recreational areas.

2.3.4 Debris from construction and demolition

This includes certain quantities of the major components of the construction materials such as cement, bricks, cement plaster, steel, rubble, stone, timber, and plastic iron pipes that are left out as waste during construction and demolition. Residential solid waste, which is sometimes referred to as household waste, typically forms the largest proportion of municipal waste (the combined solid waste in an urban area).

2.3.5 Household waste

The dwellings in which people reside are among the most significant contributors to the generation of solid waste. Food trash, plastic, paper, glass, cardboard, metals, debris from demolition, ash, and special waste such as major home objects such as electronics, tires, batteries, old mattresses, and used lubricants are all included in the rubbish produced by these locations. The majority of houses are equipped with garbage cans in which residents can dispose of solid waste; after this step, the can is emptied by the local government or a private firm, and the trash is collected before being sent to a landfill or a facility that processes recyclables.

2.3.6 Waste from industry

These industries produce solid waste in the form of housekeeping wastes, food wastes, packaging wastes, ashes, construction and demolition materials, special wastes, medical wastes, and other hazardous wastes. Industries are known as one of the largest contributors to the treatment of solid waste. This category includes light and heavy manufacturing industries; construction sites; manufacturing plants; canning plants; and chemical plants.

2.3.7 Biomedical

These industries produce solid waste in the form of housekeeping wastes, food wastes, packaging wastes, ashes, construction and demolition materials, special wastes, medical wastes, and other hazardous wastes. Industries are known as one of the largest contributors to the treatment of solid waste. This category includes light and heavy manufacturing industries; construction sites; manufacturing plants; canning plants; and chemical plants.

2.4 Recycling of Construction and Demolition Waste

Urban growth and construction activities are major contributors to pollution on a global scale. These contributors include not only the environmental component but also social and economic factors. This information was gathered to develop the idea of sustainability in building toys, which refers to the possibility that human actions would continue in order to sum and resources for future generations.

Concrete is the material that is used the second most often after water, and it serves the most vital purpose when it comes to the construction of our surroundings. Up to 60 percent of all construction and demolition debris is composed of trash-concrete, making up the vast majority of this kind of garbage. If done properly, recycling has the potential to be a very fruitful course of action. Waste is recycled on a massive scale by C&D in every region of the globe (Bashan et al., 2015).

It has been determined what materials make up building and demolition debris around the globe, and that information has been compiled into a list. Several major components, such as concrete, wood, metal ferrous (steel) and metal non-ferrous (copper, aluminum), masonry (bricks and mortar), plastic (PVC pipes, plastic films for packaging, wall coverings), can be expected to some extent in the wastewater in the majority of construction projects. Glass, ceramic tiles insulation material (mineral wool insulation, Styrofoam), drywall/gypsum board insulation material

The elements that make up C&D waste may be categorized according to The level of difficulty associated with recycling may vary from one to five, with one being the most difficult level and five representing the most difficult level. Table (2.1) demonstrates how much simpler it is.

Table 2.1: Different Waste Materials and Their Rankings Based on Their Ease of Recycling

Score	Waste material
4	Concrete
3	Wood
5	Ferrous
4	Non Ferrous
3	Masonry
3	Plastic
4	Glass
4	Ceramic Wool
2	Mineral Wool
2	Styrofoam
2	Drywall
3	Filling material
5	Paper
3	Marble

Table 2.1 makes it abundantly evident that ferrous metals, non-ferrous metals, and paper or cardboard are the materials that are the simplest to recycle, provided that effective recycling procedures are used to generate products with a value comparable to the original material. Because of their ability to be recycled, concrete, glass, and ceramic tiles are the next materials on the list. It has not yet been improved, and there are still issues with its recycling in terms of the technology involved, the efficiency of the process, and the cost. When crushed, masonry, filling materials, and marble generate a significant quantity of powder or fine materials that, for the most part, cannot be recycled. This poses a dilemma. It is not yet completely developed in terms of cost-effectiveness and quality of recycled products for gypsum board and Styrofoam. Mineral wool insulation has a strong potential to be utilized in other processes through their recycling technologies.

2.5 Review of Previous Studies

With a study on construction waste, researchers Priyadarshini Sawant and Smersina Alone (2010) came up with the following findings: "source selection, quantity, and the characteristics of their products management about building housing developments" in the building business, to identify the various waste management systems that are currently in use.

According to the findings of the research, construction operations create a significant quantity of construction and demolition trash. With a study on construction waste, researchers Priyadarshini Sawant and Smersina Alone (2010) came up with the following findings: "source selection, quantity, and the characteristics of their products management about building housing developments" in the building business, to identify the various waste management systems that are currently in use.

According to the findings of the research, construction operations create a significant quantity of construction and demolition trash, which, in the end, is deposited in landfills and dumping yards and accounts for thirty percent of the entire volume of garbage received. It was determined that the typical amount of waste is 4.7 percent of the quantity that was calculated, which is a much higher percentage than the management had anticipated.

A study titled "Construction and demolition trash" is now being conducted by Rohan S. Shetty (2013), who is a researcher. An overview of the construction business in India: "To examine the amount of construction trash that is being created and practices for dealing with waste to suggest environmentally friendly construction methods, given the recent surge in the number of building demolitions and construction projects, respectively."

According to the findings of the research, efforts should be made both to minimize the quantity of trash produced during construction and to avoid the formation of garbage altogether. Contractors are required to organize the construction process such that leftovers are eliminated or reduced. They need to take responsibility for lowering the cost. The volume that is produced at the location, the use of the recovered materials in the production process, and the effect that this has on the trash that is produced by working with unsatisfactory materials

The researchers B. Kourampanis, A. Papadopoulos, M. Stylianou, and M. Loizidou (2008) published a paper titled "Preliminary study for the management of building and demolition trash." The study discusses an issue with C & D, including the quantity and content of C & D trash in EU nations; variances in the characteristics of this waste depending on the source; as well as the group and management strategies that are used.

According to the findings of the research, the problem of properly managing C&D waste is quite challenging. It is a matter that should get the attention of everyone, from experts and authorities to average folks. It is abundantly evident that the selection of the optimum management strategy for C&D waste presents a difficult decision-making process challenge for several different reasons.

Anantha Rama and Lokeshwari M., researchers, published their findings in 2010 under the title "Management of Construction and Demolition Waste." It brings to light the opportunity to make use of recycled aggregate. There is a need for more investigation.

According to the findings of the research, a tenfold improvement in the industry's productivity of its physical resources would be achieved by being able to design and construct structural members with a lifespan of 500 years or more, rather than 50

years. a requirement that calls for the replacement of natural resources with recycled materials. The resource has the potential to undergo considerable enhancement.

The study, "Mapping Approach for Examining Waste Management on Construction Sites," was conducted by researchers L. Y. Shen, Vivian Tam, and D. Drew (2004). Raising public awareness of the environmental consequences, which resulted in the establishment of the construction waste payment job management function project management.

An investigation shows that different site management practices share different waste management procedures, even though they have common weaknesses and share some good practices. However, the differences and experiences among the various practices received little attention among professionals, according to the findings of the study, which indicate that investigation.

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2.6 C&D Waste in Iraqi Countryside

In recent decades, there has been an increase in the quantity of building activity, which has led to an increase in the amount of waste generated from construction.

This increase in garbage production is a direct outcome of the growth in building activity. The combination of this development and the fact that there is a shortage of landfill space, particularly in metropolitan areas, has proven to be a significant burden on the environment. 1,2. The activities of the construction industry have a wide range of effects on the environment, one of which is the production of waste. Even though the construction industry plays an essential part in increasing the value of the built environment, the activities of the industry have a broad range of effects on the environment. The world's cities are responsible for producing around 1.3 billion metric tons of waste each year that is related to structures. It is estimated that by the year 2025, this quantity will have climbed to 2.2 billion tons from its current level. It is anticipated that the quantity of rubbish produced in emerging countries will increase by more than three times its current level. This suggests that there was a considerable rise in the amount of waste produced per capita during the last fifteen years, from 1.2 to 1.42 kg per person per day. However, worldwide averages are simply near estimates because they vary significantly by region, country, city, and even within cities themselves. This is why global averages can only be considered close approximations. Even within the same city, there may be huge differences. In 2008, the European Commission gathered figures that indicated the entire quantity of rubbish created by construction and demolition, often known as C&D waste, was around 890 million tons. 4. Recycling and reuse of C&DW waste are so tightly controlled in developed countries by bare law and policy that recycling and reuse proportions in these countries have significantly exceeded 90%.7. Singapore has stated that their ideal reuse percentage is zero, but Japan's reusing rate was 99.5 percent in 2012.Over 90 percent of such waste was repurposed or recycled in Australia, making it the country with the world's best reuse rate. It came to everyone's attention that Malaysia's C& D retrieval percentage was nowhere near attaining the benchmark of 50 percent. 8.2 In the past, there have been a few studies conducted on how waste management should be handled in construction projects in Iraq. The purpose of these investigations was to determine how much waste resulting from building and demolition might be discovered on development sites. Even though the activity has moved into the decay stage at this point, because of the economic downturn and the variation in the progression of the construction, it is essential to address and consider in depth the difficulties that were instigated by such waste, or more reasonably, by its supervision. Even though the activity has moved

into the decay stage at this point, it is essential to address and consider in depth the difficulties that were instigated by such waste.

The difficulty of managing trash in Iraq has worsened as a result of several factors, including a rapidly expanding economy, a growing population, rising individual wages, and a variety of violent conflicts. All of these factors have contributed to an increase in the size of Iraq's trash problem. Every day, Iraq is expected to generate 31,000 tons of solid trash and junk from construction, with each citizen producing 1.4 kilos of waste. In addition, multiple illegal landfills for the disposal of trash, including waste from building and demolition, have been found. These landfills were used to dump the nk. The fast growth in garbage generation is placing a tremendous burden on Iraq's waste management institutions, which have been badly damaged over the past several years as a consequence of fighting and poor administration. This is causing the institutions to experience large amounts of stress. Even though there is almost no concern for the health of either individuals or the environment, the vast majority of Iraq's garbage is kept in landfills that have not been permitted all around the nation. This is even though there is practically no concern for the health of humans. This is because Iraq does not have a waste management and transfer system that is both contemporary and functional. In this manner, Iraqi landfills have been characterized by spontaneous fires, contamination of groundwater and surface water, and a growth in greenhouse gas emissions. In addition, there has been an increase in the number of landfills in Iraq. As a consequence of this, building supplies have been wasted, the deadline for completing the project has been pushed back, and operations have been inefficient. Because of the potential for all of these issues to become considerably more severe if they are not appropriately managed, the study presented in this article offers an exhaustive examination of the waste that is produced by construction projects in Iraq. As part of this process, a number of the most recent and important research articles, as well as official and non-official internet blogs, were also reviewed in order to inform and ion that is as up to date as possible about the subject matter. This review study comes to a conclusion and examines the following subjects in an up-to-date and thorough manner: building waste; its types; its sources; its preparation and dissolution; and its. Certification a concessions were made and supplied based on the information that was investigated in this work. More than that, however, some future study that will be valuable to the

beginner subject area was also ignored in this work. shows that there have been a total of 597 landfills as of the year 2017, with 163 landfills that were deemed ecologically unacceptable in the year 2015 and 73 landfills that were deemed environmentally acceptable in the same year. However, a treelined tendency may be seen in 2017 as compared to the year 2016 for landfills that have been permitted as well as those that have not been permitted. If this is true, there is a real possibility that waste management in Iraq is becoming worse. This is a really bad situation. On the other hand, the current circumstances unequivocally reveal that there has been a significant enhancement in the administration of waste for both regular and non-regular transforming stations. It is mostly due to the absence of studies, research, and the establishment of coding standards connected to the ecologically cleaning services industry in order to boost management satetoad dition. The total land area of the cities, as well as their horizontal growth, does not correspond to the amount of effort, equipment, and personnel that are now available. The hurdles that are provided by building debris put Iraq in jeopardy, despite the fact that Ireven thought. These problems have resulted in the production of unlawful waste, which adds to the deterioration of the environment and raises the overall cost of the project. The activities of design, transportation, materials handling, and storage are the most important contributors to the production of waste in the construction sector (15). Design, transportation, and materials handling are also among the most significant contributors.

These operations would require a significant investment of time and labor on the part of the customer without yielding any tangible benefits for that customer.

Table 2.2: Environmental Statistics for Iraq-Municipal Services 2015, 2016, 2017

No. of Landfill	Year	Environmentally Approved	Environmental-ly Unapproved	Regular Transformational Stations	Non-Regular Transformer Stations	Random Dump Locations
236	2015	73	163	30	78	235
156	2016	112	44	42	23	34
205	2017	57	148	59	23	53

2.6.1 Means of disposal of building waste in Iraqi cities

Construction trash is typically disposed of by collecting it at the job site in phases and transporting it to the following locations using tractors or transport vehicles:

- Open dumps.
- Space is plotted by land.
- Cities' outskirts
- The canal and drain edges The means of disposal of these wastes represent one of the sources of environmental pollution through the spread of rodents and insects. In addition to their continuous accumulation, transporting wastes also causes pollution to the streets through the accumulation of dust and waste in them.

2.6.2 Building waste patterns in Iraq

The types of building waste can be summarized in the following elements:

Sand NS is left over from the pouring process of regular and reinforced concrete, as well as unusable sand (sand blocks). asphalt and aggregates that are not suitable for use in regular and reinforced concrete.

Breaking bricks resulting from construction operations.-Wasted and leftover mortar from various sorts of internal and exterior bleaching operations.

Tiles, pottery, and flooring material remnants

Changes in design procedures, such as eliminating walls and altering floors, generate waste. Figures (2.4) depict models of construction trash, while Figure (2.5) depicts one method of transferring garbage away from the building site.

Figure 2.4: Represent Models of the Waste Resulting from the Construction Process

Figure 2.5: One of the Means of Transporting Waste Outside the Site

2.7 Effects of C&D Waste on the Environment

Many environmental issues, including soil and groundwater pollution, and waste accumulation in landfills with limited space, which results in less stringent environmental protection regulations, are commonly attributed to construction sites. These issues include dust, noise, and vibration, as well as soil and groundwater pollution. Control the activities of backfilling, Furthermore, the biodegradation of garbage in landfills is a major contributor to the myriad of health and environmental issues that result. Early examinations carried out in the United States concluded that just 0.4 percent of the country's building waste contains According to the United States Environmental Protection Agency and the United States Department of Agriculture (1995), the garbage that is thrown away in landfills is classified hazardous waste.

2.8 Benefits of Recycling of Construction Materials

If people continue to mismanage and misuse our natural resources, we will ultimately run out of them. Therefore, the advantages will be achieved through the three pillars of sustainability, which are the economy, the society in which we live, and the environment. Khao, S.H., et al. (2021). The use of recycled construction materials comes with several advantages, including the following: Environmental benefits:

Maximizing the capacity to recycle and reuse construction waste will result in less waste going to landfills, thus extending the life of landfill sites and future use. The

common use of chemical additives in building materials intensifies pollution at landfill sites.

Increased use of recycled materials will therefore reduce the transportation requirements of this waste from the construction site to the landfill, thus reducing the overall contribution of carbon dioxide emissions.

- Economic benefits:

There is an argument that eliminating the use of landfills will lead to the loss of employment of workers in the industry. However, this loss can be balanced. by creating new opportunities using recycled materials. This is due to deviation. From recycled materials from reused materials, meaning that, unlike recycled materials where they are still in their original form, the recycled materials will undergo some form of modification process to improve the by-product while maintaining the physical characteristics to enable the material or product to serve its purpose in the building. Such as operations, which incorporate skill sets, thus providing an employment opportunity. This will contribute to the economy by providing such opportunities, with the help of

- This causes fewer negative impacts on our environment.
- Societal benefits

The need for land development is expected to rise as a result of continuing population expansion. An increase in the recycling of materials in the building sector will lead to a reduction in the amount of land that is transformed into landfills. As a result, more high-quality land will be available for the development of subdivisions in order to satisfy housing demand. Toxic materials from building sites that are dumped in landfills or natural rivers and streams may also be a source of trouble. These difficulties can arise from the disposal of these items. These unmanaged circumstances have the potential to cause damage to organisms that are already present in the surrounding environment, which may ultimately lead to a compromise in the health of humans living in society. In addition, unpleasant scents may be produced by landfills, which can create difficulties for the town that is located nearby since it is easy for strong winds to carry them there.

2.9 Sustanable Construction Waste Management

The problem of garbage from construction is one that affects the whole world and calls for significant attention. Adopting environmentally responsible building practices, such as sustainable construction, is one of the most efficient ways to reduce the amount of trash generated during construction. It places an emphasis not just on concerns pertaining to the natural world but also on those about the economy and society.

Because of this, it is essential to implement environmentally friendly methods of waste management to carry out the entire treatment plan indicated above in steps. It is possible that the building waste might be seen as a more desired accomplishment. This is appropriate in light of the circumstances and quality of waste generation. As may be seen in Figure (2.6), this may also be organized in a hierarchy that is used for trash management.

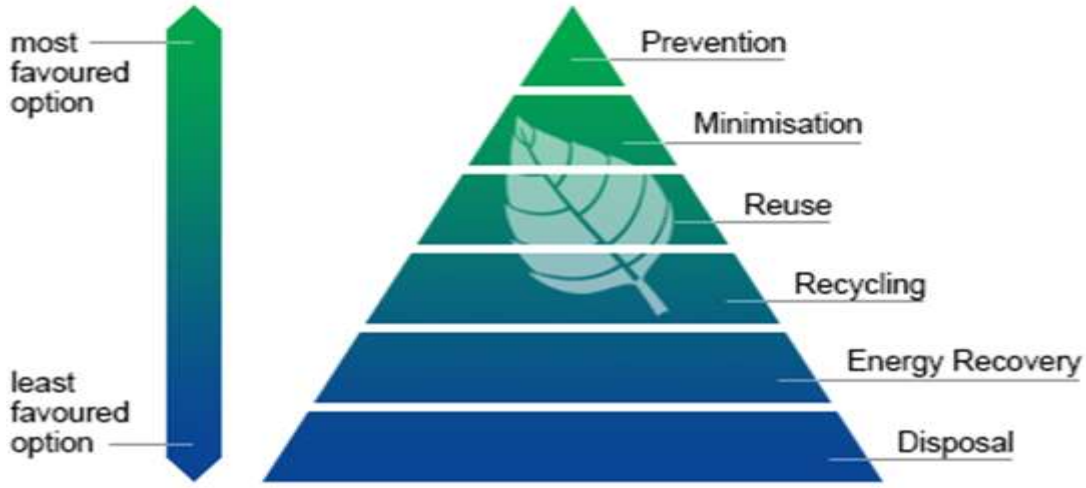

Figure 2.6: Sustainable Waste Management Hierarchy

2.9.1 Prevention

It is also applicable to waste reduction and avoidance, which are the two most effective waste management strategies. However, there are a few challenges that must be conquered by the practitioners, particularly during the pre-construction phase of the project. During the design phase, architects and engineers need to take into account specific technical details about each step of the building process in order to avoid construction errors.

However, preventing waste throughout the building process involves meticulous coordination on the part of all parties involved. Therefore, in order to prevent any miscommunication or unwelcome situations, it is essential that you have a very excellent relationship and connection with and within the construction community, i.e., contractors, consultants, and customers. According to research by S. Makieva et al. (2018), a lack of communication and debate may lead to incomprehension and the gene.

2.9.2. Minimization

When it comes to the management of construction waste, the reduction and elimination of waste is the second most ideal technique. The construction sector might stand to benefit from a reduction in the elements that contribute to waste creation. These methods reduce environmental harm and building expenses. (S. Nagappan et al., 2007) suggests cutting down on the number of resources used to start new projects and on the amount of labor required for transportation. As a result, the reduction of waste is an essential component of sustainable practice. This situation is analogous to what takes place in Singapore, where there is a severe lack of available land. The authorities in charge of building the nation need to support this sustainable initiative and play their best part in promoting it. The country's construction authorities are using the minimization approach to achieve sustainability and minimize land consumption. (Court of Appeal Circa 2007).

2.9.3 Reuse

Within the framework of waste management, waste reuse occupies the fourth and last position. Some emerging nations, like Germany and Hong Kong, are taking actions that are like these in order to decrease the amount of garbage that is disposed of in landfills. The German government has done an excellent job of managing the recycling process. In addition, the policies of the Korean government demand the use of recycled aggregates in the building industry. Government regulatory incentives offer minimum standards for the utilization of recycled materials and aggregate in construction projects (Adeyemi et al. 2017).

2.9.4 Recovery

Recovery may be defined as the process of extracting materials or components from a waste stream in some fashion. It is made in the same manner as it was used before, so it keeps its authentic and recycled character. The quantity of rubbish that might be sent to a landfill even after recovery has been performed. Burning aid is provided in Germany. recycling of used metals and metal scraps. This recovery technique may reduce dangerous heavy metals by one ton, which is equivalent to between two and three kilos, once the distillation and burning processes have been completed. As a result, from taking up space to contributing to waste, this strategy is successful. Find a solution to the issue. Nevertheless, the government ought to back up this process. A reimbursement will be provided for the establishment of a laboratory.(S. Nagapan et al. 2012).

2.9.5 Disposal

The last choice is disposal, and there are baseline requirements that must be met for environmentally responsible garbage management. However, many nations dispose of garbage from building projects by dumping it in landfills. For instance, research conducted on waste management in Malaysia by the Solid National Circle found that the nation of the United States had around 289 landfills.

In addition, the Foundation for Solid Trash Management and Public Disinfection (PPSPPA) and the Construction Industry Development Board (CIDB) are continuing their efforts to limit the amount of waste that is dumped in landfills by promoting recycling and industrialization of building systems (IBS). On the other hand, the method for getting rid of them is not a fantastic choice. Because minimizing waste management is one of the primary functions of sustainable waste management, (O. C. Aja and H. Al-Kayiem (2013)).

2.10 Research Deficit

The process of recycling used materials In addition, activities are carried out in a more effective manner at construction sites in Iraq. The study reveals a gap between the economic potential of carpentry, recycling, waste separation, and recycling, all of which are rarely practiced, and the real reasons behind the absence of long-term recycling and recycling. To put it correctly, the issues that are now being faced are

huge. Cut down on and bring attention to waste in Iraq and concentrate your efforts right now on the gaps that presently exist in future projects; the waste that exists right now; the waiting time; and the need for an immediate solution.

3. METHODOLOGY OF RESEARCH

3.1 Introduction

The research presented in this chapter aims to re-emphasize the focus of the study objectives. The research method will be explained to ensure the selection of an accurate research method, in addition to the advantages and disadvantages of the techniques chosen for the chosen method, which will be discussed, as well as the sample size and size of the study, as well as the reliability of the tools used in the study. A review of the benefits and drawbacks of the approach strategies that were selected in order to enhance the data gathering tool will serve as the chapter's conclusion.

3.2. Research Plan

The researcher was able to gather qualitative and quantitative data for this study since it was based on a design that allowed for several methods of research to be used. It is generally agreed that a researcher is better able to validate their findings when they use methods from both the qualitative and quantitative schools of research. It's possible that using a mix of qualitative and quantitative research methods can help shed some light on the situation.

The depth and variety of a certain event may be better understood from several vantage points thanks to this kind of research. In addition, the hybrid approach makes use of both open-ended and closed-ended questions, as well as questions that are both spontaneously generated and pre-determined. The methodology and interpretation of both qualitative and quantitative data (Carruth, 2013), The researcher made the decision to employ a combination design as the approach because it explains and analyzes the data; complements the power of one design and overcomes the limitations of the other designs; and the dual design takes a single theoretical stance and approaches it from many levels of analysis.

Research conducted in academic settings often makes use of methodologies that integrate quantitative and qualitative methods, as well as blended techniques. The researcher has the opportunity to choose the method by taking into account a wide range of factors, including the kind of study that is being carried out, the information that is already accessible, the subject matter and general aims of the research, and so on. Not only will the quality of the results improve if the right methodology is used, but the overall value of the research or study that was carried out will also rise if this is the case.

3.3 Population & Sample Size

The demographic that you are interested in studying is known as the target population, and it is this group that you want to research or address. When it comes to studying the full population of interest, research projects are often improper or fruitless. The investigator will conduct research on a representative cross-section of the population in order to compile his findings. The purpose of this research is to generalize the findings of the study from the sample to the population that is being looked at. Providing a description of the demographics, which should include age, gender, socioeconomic position, and educational level, is also very significant.

224 male and female respondents between the ages of 18 and over 45, graduates of master's and doctoral studies, university and high school graduates, government employees, self-employed workers, and housewives made up the population of this study. The graduates of master's and doctoral studies ranged in education level from master's to doctoral. In addition, they came from all of Iraq's governorates, provided a variety of responses to the questionnaire's questions, and there were a total of five people who responded to the interview's invitation. A number of individuals who are considered to be authorities on the subject of solid waste, such as university professors, government officials, and representatives of private businesses, were interviewed. They were given a number of questions to answer, and those answers were acquired. Based on the responses provided by them, an analysis will be performed on them, and the specifics of their findings will be reported in Chapter 4 (Van den Breck J, Sandy IF, Brest off JR. (2013)).

3.4 Research Methods

Explain the methodology of this research in a clear and detailed manner that can be divided into the following sections:

- Quantitative combination (Belamy, 2012).
- Each of these sections is essential and important to make the work take place in the required manner and achieve satisfactory results.

3.4.1 The quantitative method

It is possible for the quantitative method to provide statistical and numerical data that can be studied, such as the perspectives of a group of individuals on a specific issue. However, this is only the case if the group of individuals in question shares a common relationship with the research area. It is a strong tool that may be used to evaluate ideas, analyze changes or gains in performance, and transform opinions into numerical numbers. Among its other applications, it can be used to: The collection of numerical data for the aim of putting theoretical objectives to the test is a primary focus of the quantitative methodology, which places a strong emphasis on this step.

Examining quantitative data via the lens of statistical techniques might include the use of anything from simple graphs to intricate cluster analyses in order to highlight links, differences, or similarities between various objects or groups. This is something that may be accomplished via the use of statistical tools (Aliaga and Gunderson, 2006).

3.4.2 Qualitative approach

I needed to "dig deeper" in this research in order to acquire a complete grasp of the issue from the point of view of the players in the construction and demolition waste management industry. It is not enough to draw conclusions based on statistics in order to see the whole picture. Estimating the number of people requires not only the collection but also the examination of qualitative data (Blanche et al., 2006).

There is a connection between the qualitative technique and the macro-inductive models. Instead of focusing on groups of variables and subsequent causal relationships that are part of the entirety of the business or business-related phenomenon that is being studied, comprehensive inductive models allow

researchers to study (business) phenomena in their totality and complexity. This is possible because comprehensive inductive models are comprehensive. Researchers use this approach to get an insider's understanding of the business phenomenon (Gayle R. Jennings, 2005). The sampling procedures used by these researchers will not be random or probabilistic.

3.4.3 The mixed method

The mixed research methodology combines qualitative and quantitative research methodologies; numerical and textual data may be obtained and analyzed in order to re-confirm the conclusion that was made regarding the study issue. This methodology is often regarded as a compromise between qualitative and quantitative procedures; hence, it frequently produces conclusions that are superior to those generated by the other two methodologies (Aliaga and Gunderson (2006)).

Table 3.1: The Aliaga and Gunderson Differences between the Three Research Methods (6 and Bellamy, 2012)

Quantitative Methods	**Mixed Methods**	**Qualitative Methods**
Pre – determined	Both predetermined and emerging methods	Emerging methods
Instrument based questions	Both open – and closed ended questons	Open – ended questions
Preforance data, attitude data, observational data, and census data	Multiple forms of data drawing on all possibilities	Interview data, observation data, document data, and audiovisual data
Statistical analysis	Statistical and text analysis	Text and image analysis
Statistical interpretatio	Across databases interpretanion	Themes, patterns interpretion

3.5 Data Collection Methods

3.5.1 Questionnaire

The questions on the questionnaire are structured to elicit closed answers, which can be an efficient instrument for measuring certain parameters among the community of contractors and engineers in Iraq. The questionnaire has a total of 16 questions, with the first covering the engineering category, the second covering the contractor category, and the third covering the construction workers in Iraq. The engineering category of the questionnaire has 16 questions.

The statements presented narrower and more specific terms for the recycling of tangible waste, and it was in the language of these statements that they were simplified as much as possible to encourage the respondents to fully understand and complete the referendum. The statements showed broader environmental concepts than narrower and more specific terms for the recycling of tangible waste.

A significant portion of the research that was evaluated centered on how ineffective the current system of waste disposal is. The questionnaire was designed specifically to assess the availability and, if available, the C&D waste management plan at construction sites in Iraq, as well as how closely it is being followed; the answers in this section will also indicate whether or not the literature has been reviewed, and whether or not its relevant proposals apply. The questionnaire was designed specifically to assess the availability and, if available, the C&D waste management plan at construction sites in Iraq. The questionnaire was designed specifically to make the connection to the waste management issue in Iraq.

The survey questions are grouped as below:

From Q1 to Q4 are demographic questions. From Q5 to Q9 are Yes/No questions that are nominal questions. Then from Q10 to Q13 are scale questions (from 1 strongly disagree to 5 strongly agree). Q14 is a nominal question.

The Cronbach Alpha test of reliability for the scale questions from Q10 to Q13 is not applicable to the other nominal questions.

Since the research is descriptive and has several variables, no validity test was done as only the opinion of respondents was investigated, not their behavior.

3.5.2 Interviews

In the field of social sciences, one of the methods of data collection that is most often used is the interview. Because of their potency, they are used in a variety of contexts. Interviewing is a technique of research that may be used to get a variety of information and insights that are not included in quantitative data. Only recently have interviewing methodologists begun to realize this, despite the growing pressure to encourage new ways of thinking about research methodology. "We cannot raise interview results from the contexts in which they were collected and claim that they are objective data without constraints" (Robson, C. (2011)).

They presented several questions and answers were obtained from them. They will be analyzed, and the specifics of their findings will be presented in Chapter 4. Interviews were conducted with a number of experts in the field of solid waste, and the total number of those involved was five. These experts include university professors, government officials, and private companies.

3.6 Validity and Reliability of the Instrument

Reliability can be defined as the extent to which measurements can be repeated when multiple people measure on different occasions, under different circumstances, and it is assumed using alternative tools that assess the construction of skill. In other words, reliability refers to how well measurements can be repeated. In addition to this, it refers to the degree to which the building scale may be relied upon. For instance, if many different people guess your weight, the figure that they come up with could not be accurate since it clashes with the actual amount, which would render the measurement unreliable. If a large number of people use the same scale to determine their weight, you will almost certainly get the same result each time a measurement is taken; hence, this measurement is reliable.

The term "construct" refers to the ability, knowledge, trait, or position that a researcher is researching. Reliability and validity constitute the psychometric properties of measurement scales that are very important in assessing measures of adequacy and accuracy in scientific research. The term "the extent to which a scale adequately provides the basic structure it is meant to measure," the term "construct" refers to the skill, knowledge, trait, or position that a researcher is researching.

The dependability of the data obtained from the research instruments is affected by two sorts of mistakes: random error and systematic error. Both types of error might occur when a researcher conducts an investigation under certain circumstances. Error at random is attributed to a variety of uncontrollable external circumstances that have an impact on a selection of observations chosen at random.

The degree to which an instrument provides an accurate assessment of validity is referred to as the validity of the instrument. "Validity" is an explanation that seeks to justify why the search results are accurate. Is one's intellect, for example, able to be determined by an IQ test? When evaluating validity, both theoretical and

experimental evidence are taken into consideration. A group of arbitrators or university professors may conduct a theoretical examination in order to translate the concept of a building into something tangible. A quantitative investigation that makes use of statistical methods must be performed in order to determine the validity of any component (Zohaib, M. (2013); Drost, E., A. (2011). Therefore, it is necessary to evaluate the appropriateness of each component.

3.7 Information Processing

The quantitative data from the questionnaire had been examined; the data had been gathered; the data had been reviewed and prepared to be put into the main paper using the SPSS software; and the data had been collected. , and the researcher made use of statistical tools in the study. Simple percentage analysis, where the percentages of each answer are calculated based on the other answers, and descriptive statistics, where the mean and standard deviation are used to summarize and describe the answers based on the responses, in order to analyze the responses and discuss the results of the study.

The qualitative data was analyzed based on the interviews; the data was collected, the researcher reviewed the data, and it was analyzed. Additionally, the points of intersection between the respondents were monitored, and a discussion of the results was carried out based on the literature review and the data from the reviewed document.

4. DELIBERATIONS AND ANALYSIS

4.1 Introduction

This chapter includes the analysis that was done on the data that was collected. It includes the simple percentage analysis, which shows the respondent's distribution and percentages for each question of the survey, in addition to the mean and standard deviation that are related to those percentages.

4.2 Analysis of Simple Percentages

A back percentage analysis was carried out in order to have a deeper understanding of the responses obtained from the people who were targeted. The following formula is used to construct this kind of analysis, which offers an aggregated summary of the respondent's responses based on the frequency distribution of the data gathered:

The percentage is equal to the number of respondents multiplied by 100 and divided by the total number of respondents.

A summary of the replies may be obtained using this method of analysis, which is based on the frequency distribution of the data that was acquired. 224 replies in their entirety were gathered throughout the survey. The first section of this research project is made up of quantitative questions that only allow for predetermined answers. There are a total of 14 questions like this, and the explanations and results that are descriptive of these questions may be found in the following:

Table 4.1: Q01, Your Gender

	Frequency	**Percent**	**Cumulative Percent**
Male	122	54.5%	54.5%
Female	102	45.5%	100.0%
Total	224	100.0%	

Almost half of the respondents are male representing 55% of the total respondents, and the other half are females representing 45% of the total respondents

Table 4.2: Q02, Your Educational Level

	Frequency	Percent	Cumulative Percent
Baccalaureate	46	20.5%	20.5%
Bachler	74	33.0%	53.6%
Master / PhD	104	46.4%	100.0%
Total	224	100.0%	

Less than half of the respondents have a master's or Ph.D. degree they represent 46% of the total respondents, and 33% of the total respondents have a Bachler degree.

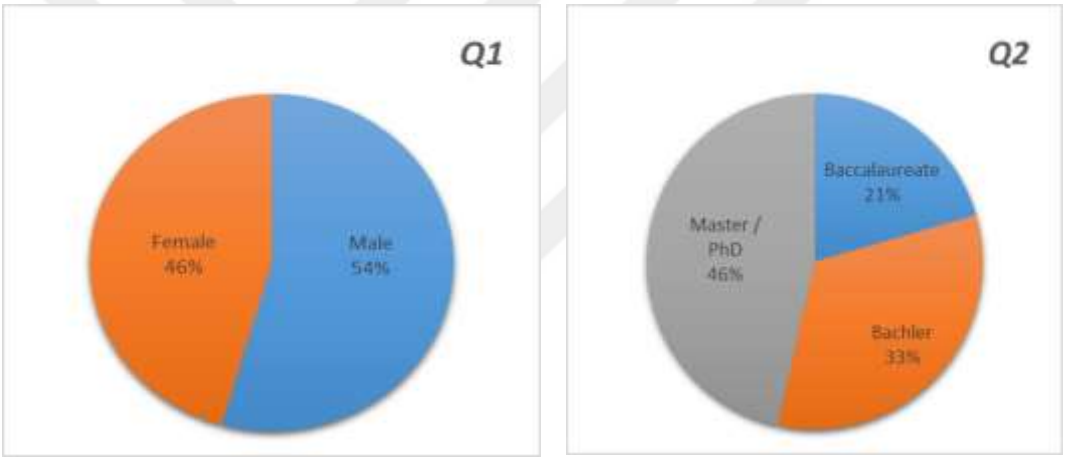

Figure 4.1: Distance Learning Questions Q1 and Q2

Table 4.3: Q03, Your Age

	Frequency	Percent	Cumulative Percent
18 – 25 years or less	85	37.9%	37.9%
26 – 35 years	89	39.7%	77.7%
36 – 45 years	36	16.1%	93.8%
Above 45 years	14	6.3%	100.0%
Total	224	100.0%	

Less than half of the respondents are from 26 to 35 years old they represent 40% of the total respondents, and 38% of the total respondents are from 18 to 25 years old or less.

Table 4.4: Q04, Your Profession

	Frequency	Percent	Cumulative Percent
Student	112	50.0%	50.0%
Employee	70	31.3%	81.3%
Free business	35	15.6%	96.9%
Housewife	7	3.1%	100.0%
Total	224	100.0%	

Half of the respondents are students, they represent 50% of the total respondents, and 31% of the total respondents are employees.

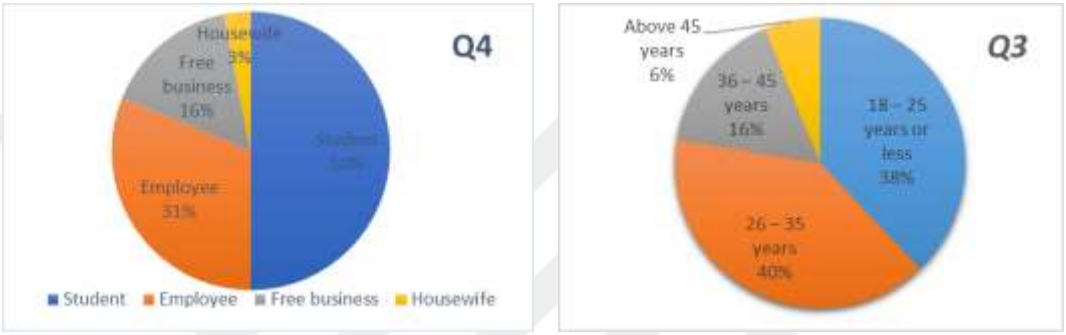

Figure 4.2: Distance Learning Questions Q3 and Q4

Table 4.5: Q05, do You Agree With The Recycling of Construction and Demolition Waste?

	Frequency	Percent	Cumulative Percent
Yes	209	93.3%	93.3%
No	15	6.7%	100.0%
Total	224	100.0%	

Almost all of the respondents agree with the concept of recycling construction and demolition waste, they represent 93% of the total respondents.

Table 4.6: Q06, in Your Opinion, Do Construction and Demolition Waste Affect the Environment?

	Frequency	Percent	Cumulative Percent
Yes	209	93.3	93.3%
No	15	6.7	100.0%
Total	224	100.0%	

Also, almost all of the respondents think that construction and demolition waste affect the environment, they represent 93% of the total respondents.

Question 5 and question 6 have the same distribution of the answers but after reviewing the responses of these two questions it was found that the detailed responses are different however the total results are the same.

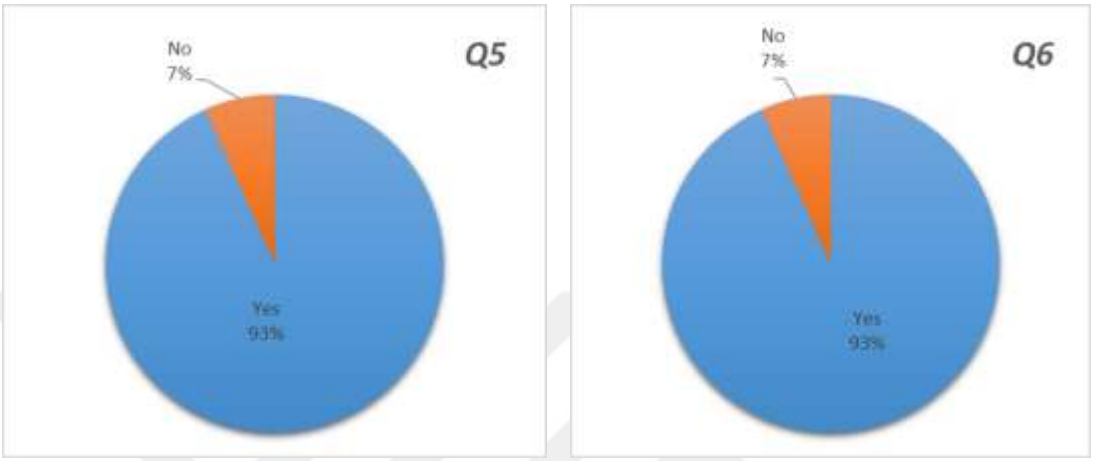

Figure 4.3: Distance learning questions Q5 and Q6

Table 4.7: Q07, Is There Demolition and Construction Waste in Your City?

	Frequency	**Percent**	**Cumulative Percent**
Yes	175	78.1%	78.1%
No	49	21.9%	100.0%
Total	224	100.0%	

Most of the respondents say that there is demolition and construction waste in their city. They represent 78% of the total respondents.

Table 4.8: Q08, Is There Interest From the Municipality in Your City in the Issue of Construction and Demolition Waste?

	Frequency	**Percent**	**Cumulative Percent**
Yes	88	39.3%	39.3%
No	136	60.7%	100.0%
Total	224	100.0%	

More than half of the respondents say that there is no interest from the municipality in their city in the issue of construction and demolition waste, they represent 61% of the total respondents.

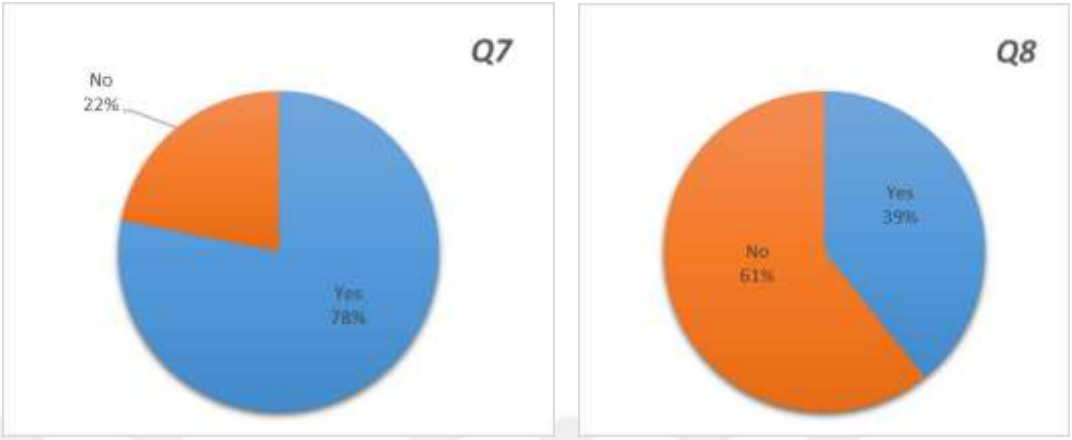

Figure 4.4: Distance Learning Questions Q7 and Q8

Table 4.9: Q09, Are You Ready to Cooperate With the Municipality To Recycle Construction And Demolition Waste?

	Frequency	**Percent**	**Cumulative Percent**
Yes	192	85.7%	85.7%
No	32	14.3%	100.0%
Total	224	100.0%	

Most of the respondents say that it is ready to cooperate with the municipality to recycle construction and demolition waste, they represent 86% of the total respondents.

4.3 Reliability Assessment (Cronbach Alpha Test)

Reliability analysis represented by Cronbach alpha test is used when determining the quality of measuring scale. The Cronbach alpha test, which "shows how closely related a collection of items are as a group" and "is an internal consistency metric," is one method of evaluating reliability.

The reliability value should be more than 0.70 but usually a value more than 0.60 is accepted.

The reliability test results of each variable of this study are shown below:

Table 4.10: Reliability Assessment (Cronbach Alpha Test)

	Cronbach's Alpha	Results
Q10 to Q13	0.69	Accepted reliability

Table 4.11: Q10, Do You Support the Establishment of A Factory to Recycle Construction and Demolition Waste in Your City?

	Frequency	Percent	Cumulative Percent
Strongly disagree	1	.4%	.4%
Disagree	4	1.8%	2.2%
Neutral	24	10.7%	12.9%
Agree	78	34.8%	47.8%
Strongly agree	117	52.2%	100.0%
Total	224	100.0%	

Half of the respondents strongly agreed with the support of the establishment of a factory to recycle construction and demolition waste in their city, they represent 52% of the total respondents, and 35% agreed with such an idea.

The mean of this question is 4.37 which indicates an agreed response to this question, and the standard deviation of this question is 0.781.

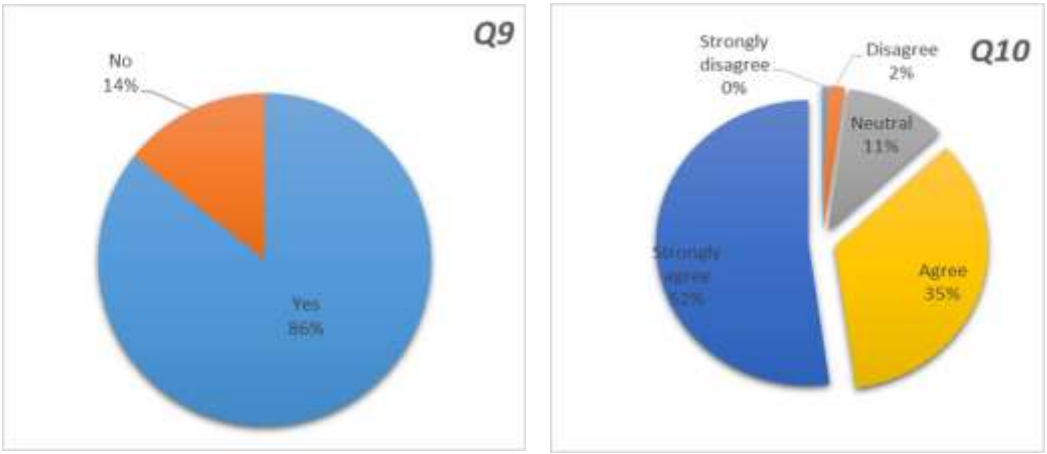

Figure 4.5: Distance Learning Questions Q9 and Q10

Table 4.12: Q11, Do You Agree With the Use of Recycled Construction Materials in Engineering Applications Such As Roads and Sidewalks?

	Frequency	Percent	Cumulative Percent
Strongly disagree	8	3.6%	3.6%
Disagree	9	4.0%	7.6%
Neutral	21	9.4%	17.0%
Agree	87	38.8%	55.8%
Strongly agree	99	44.2%	100.0%
Total	224	100.0%	

Less than half of the respondents strongly agree with the use of recycled construction materials in engineering applications such as roads and sidewalks, they represent 44% of the total respondents, and 39% agreed with such an idea.

The mean of this question is 4.16 which indicates an agreed response to this question, and the standard deviation of this question is 0.998

Table 4.13: Q12, Does the Municipality in Your City Have Sufficient Resources and Machinery to Transport Construction and Demolition Waste?

	Frequency	Percent	Cumulative Percent
Strongly disagree	15	6.7%	6.7%
Disagree	48	21.4%	28.1%
Neutral	92	41.1%	69.2%
Agree	50	22.3%	91.5%
Strongly agree	19	8.5%	100.0%
Total	224	100.0%	

Less than half of the respondents are neutral about if the municipality in their city sufficient resources and machinery has to transport construction and demolition waste or not, they represent 41% of the total respondents, and 22% agreed with such an idea.

The mean of this question is 3.04 which indicates a neutral response to this question, and the standard deviation of this question is 1.023

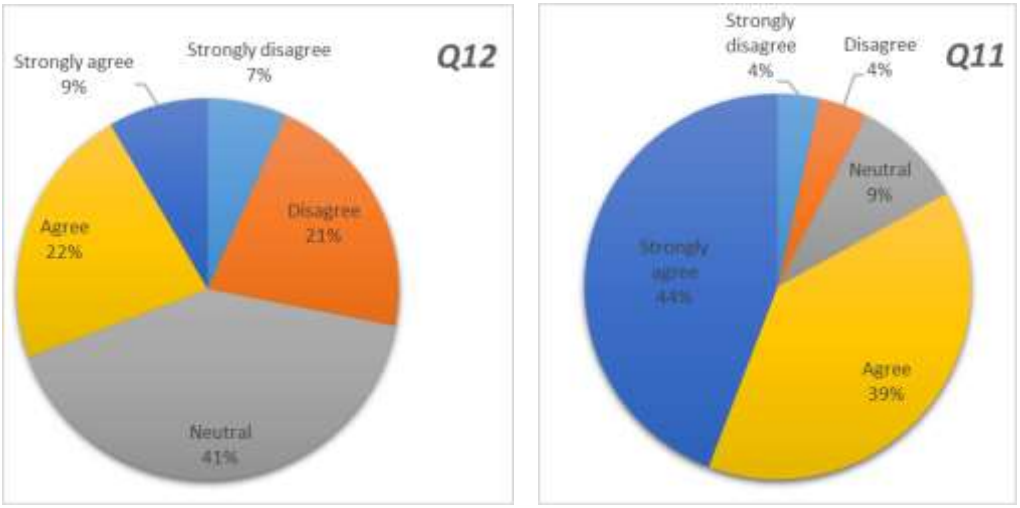

Figure 4.6: Distance Learning Questions Q11 and Q12

Table 4.14: Q13, Does Recycling Construction and Demolition Waste Have Economic Returns For Your City?

	Frequency	**Percent**	**Cumulative Percent**
Strongly disagree	4	1.8%	1.8%
Disagree	22	9.8%	11.6%
Neutral	34	15.2%	26.8%
Agree	94	42.0%	68.8%
Strongly agree	70	31.3%	100.0%
Total	224	100.0%	

Less than half of the respondents agreed that recycling construction and demolition waste has economic returns for their city, they represent 42% of the total respondents, and 31% strongly agreed with such an idea.

The mean of this question is 3.91 which indicates an agreed response to this question, and the standard deviation of this question is 1.007

Table 4.15: Q14, Where Do You Think Construction and Demolition Waste Is Taken in Your City?

	Frequency	Percent	Cumulative Percent
Random dump	97	43.3%	43.3%
Sorting or recycling plant	31	13.8%	57.1%
It is not transferred anywhere	96	42.9%	100.0%
Total	224	100.0%	

Less than half of the respondents think that construction and demolition waste is taken in their city to the random dump, they represent 43% of the total respondents, also, 43% think that they are is not transferred anywhere, finally, only 14% think that they are taken to sorting or recycling plan.

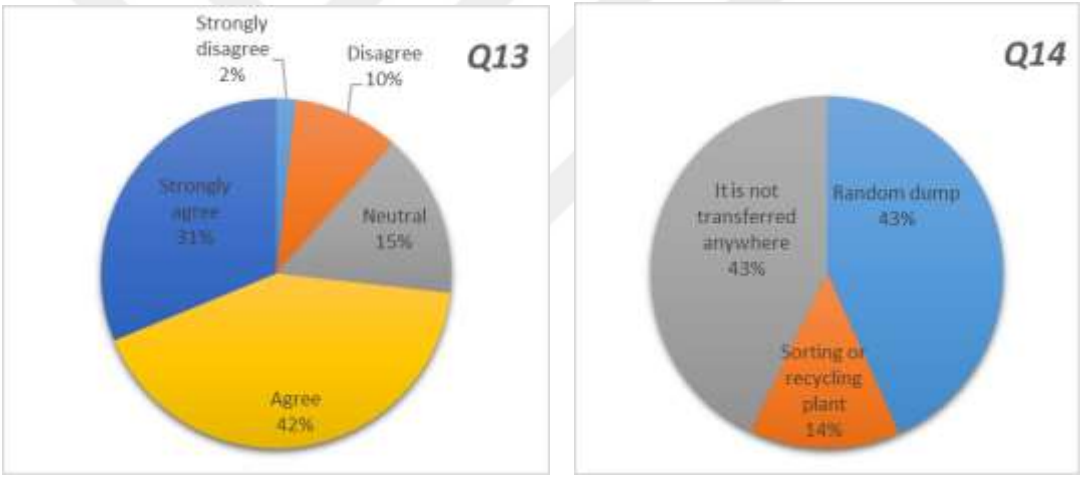

Figure 4.7: Distance Learning Questions Q13 and Q14

The second part of this analysis represents qualitative open-ended questions, they are questioning their summarized answers are shown below:

The purpose of the interview is to identify issues related to the recycling of construction waste that would contribute to the development of a tool suitable for the quantitative stage.

Three axes emerged from the interview analysis, which are waste transportation and landfill sites, the role of the municipality in management, and recyclable elements.

The qualitative responses to this research from academics and engineers approximately 5 questions to them, and their answers were taken and analyzed, not the richness of the research.

4.3.1 Waste track and landfill sites

The following responses were given by the respondents in response to a question that was posed regarding how garbage may be transported by the municipality and to dump sites:

One of the respondents, a civil engineer from the University of Baghdad, said the following: " The remaining construction waste is taken by transferring it to designated places by those who transport it, sometimes in low places, to settle the lands for disposal first and establish some investment projects for commercial purposes such as building some shops or malls, especially on both sides of the roads, or secondly, or filling in some water swamps for reclamation, the land for a residuary purpose." This was one of the

The following quotations from additional respondents provide more evidence in favor of the position presented previously: "It is gathered and deposited in disused locations and returned from the city." "Yes, it is disposed of in suitable places since it is outside the city."

"It is transported to a sanitary landfill location, which is a site that is appropriate and is located far away from the city. I am unable to provide exact facts; yet, this is a pretty conventional approach. I believe that they dispose of rubbish in the open air.

4.3.2 The role of the municipality in managing construction waste

The following is a list of responses supplied by respondents in response to a question on the role of the municipality in the management of garbage from building projects:

One of the interviewees, a civil engineer from the University of Anbar, indicated that the municipality is installing huge containers in the remaining garbage collection yards in addition to transporting waste beyond the city to dedicated areas for disposal.

Another responder, a civil engineer from the University of Mosul, said the following: "The municipality is at a stage of clear and continuous growth and is trying to invest

everything feasible in this sector, and it is the first accountable for managing this file entirely."

The following are excerpts from responses given by other people: "It cooperates with experienced and specialized engineers and plans with them to sort waste that can be recycled, make landfills for waste that cannot be recycled, and provides researchers who want to use waste in their research with the mentioned materials." (Citation needed)

"It must introduce modern methods by burying chemicals and other such things to take advantage of obtaining gases and invest in construction waste as well as it is still present in large quantities in the city," the report states. "It must introduce modern methods by burying chemicals and other such things."

4.3.3 Sortable construction waste items

The following is what the respondents had to say in response to a question about the items that can be separated out of construction waste: "The majority of them need to be separated as building materials such as concrete, which can be used under the foundations of buildings and the foundation layers of roads, in addition to the chemicals that can be used as chemical fertilizers."

"Concrete, iron, bricks, broken bricks, and plastic pipes, if any." "Items that can be recycled, such as glass, plastic, types of iron and wood, as well as residual electrical materials and residuals, doors and windows, and some construction materials used from the remnants of construction waste." "Items that can be recycled, such as glass, plastic, types of iron, and wood, as well as residual electrical materials and residuals, as well as some construction materials used from the remnants of"

4.4 Research Findings

Based on the findings of a qualitative study, it was discovered that in some regions, building waste is used to fill lowlands and water marshes in order to recover land for the purpose of residential or commercial development. There is no sorting of construction trash, and it is thrown at random dumps outside the city. Additionally, the municipality relies on conventional methods for the disposal of building waste. Modern recycling techniques and the benefits that may be derived from them are not

used. Therefore, the municipality is obligated to work together with skilled and knowledgeable engineers and plan with them to sort waste that can be recycled, establish landfills for waste that cannot be recycled, and provide the aforementioned materials to researchers who want to use waste in their research.

It is necessary to use contemporary practices such as burying chemicals and other waste products in order to make the most of opportunities to get gases and invest in building waste, both of which are still present in the city in significant amounts.

Quantitative research showed that:

Almost all respondents agreed with the concept of recycling construction and demolition waste, they represent 93% of all respondents. Almost all of the respondents think that construction and demolition waste affect the environment, they represent 93% of the total respondents. More than half of the respondents say that there is no interest from the municipality in their city in the issue of construction and demolition waste, they represent 61% of the total respondents. Half of the respondents strongly agreed with the support of the establishment of a factory to recycle construction and demolition waste in their city, they represent 52% of the total respondents, and 35% agreed with such an idea. Less than half of the respondents strongly agree with the use of recycled construction materials in engineering applications such as roads and sidewalks, they represent 44% of the total respondents, and 39% agreed with such an idea Less than half of the respondents agreed that recycling construction and demolition waste have economic returns for their city, they represent 42% of the total respondents, and 31% strongly agreed with such an idea. Most of the respondents say that it is ready to cooperate with the municipality to recycle construction and demolition waste, they represent 86% of the total respondents. Less than half of the respondents think that construction and demolition waste is taken in their city to the random dumps, they represent 43% of the total respondents, also, 43% think that they are not transferred anywhere, finally, only 14% think that they are taken to sorting or recycling plan. Less than half of the respondents are neutral about if the municipality in their city sufficient resources and machinery has to transport construction and demolition waste or not, they represent 41% of the total respondents, and 22% agreed with such an idea.

4.5 Limitations

1. There were many restrictions from the most important
2. lack of sources in this field.
3. The receipt of demolition rates and preliminary information about the study.
4. Time constraint.
5. No experience in Iraq helps me to quote from her knowledge.
6. Difficulty in delivering the questionnaire to the required category.
7. Direct questions and field research.

5. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

The findings indicate that the authorities in charge of the management of construction waste in Iraq need to make significant efforts in order to build a national program that includes distinct aims and objectives in order to progress the reality of construction waste.

The town is obligated to work with skilled and knowledgeable engineers to devise a strategy for sorting garbage that can be recycled, establishing landfills for waste that cannot be recycled, and providing the aforementioned materials to researchers who wish to utilize waste in their work.

It is necessary to use contemporary practices such as burying chemicals and other waste products in order to make the most of opportunities to get gases and invest in building waste, both of which are still present in the city in significant amounts.

The vast majority of respondents, which accounts for 93% of the total, are of the opinion that garbage from building and demolition has an impact on the environment. In addition, more than half of those who responded said unequivocally that there is no concern shown by the local government in their city about the problem of garbage from building and demolition, and these individuals make up 61 percent of the total respondents.

They made up 52% of all respondents and were unanimous in their support for the establishment of a construction and demolition waste recycling plant in their city. Furthermore, 35% agreed with this concept as well as the use of recycled building materials in engineering applications such as roads and sidewalks. Their city can see economic benefits from recycling debris from building and demolition projects.

They have to get rid of construction and demolition waste that is transported in their city to a random landfill because it makes up 43% of the total respondents.

Additionally, 43% of the respondents believe that the waste is not transported anywhere, and 14% believe that it is transferred to a sorting or recycling plan.

5.2 Recommendations

1. The work of special factories to sort construction waste and make maximum use of this waste by recycling it.
2. Allocating suitable places to dispose of construction waste that are not suitable for recycling away from residential areas or using them to fill in lowlands and reclaim them to build on them.
3. Launching a program to encourage the private sector to work in waste recycling by providing some financial and procedural facilities to owners of small and medium enterprises.
4. Transporting waste to places outside the cities and far from the population to avoid dust and environmental pollution.
5. The municipality needs good financial resources to purchase advanced machinery and locate special places for transporting this waste to it.
6. The municipality should cooperate with experienced and specialized engineers and plan with them to sort out the waste that can be recycled, establish landfills for the waste that cannot be recycled, and provide the researchers who want to use the waste in their research the mentioned materials.
7. Use of recycled building materials in engineering applications such as roads and sidewalks.

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APPENDIX

AppenSurdix-1: Survey and Interviews questions

Survey questions:

1. Do you agree with the recycling of construction and demolition waste?
2. In your opinion, does construction and demolition waste affect the environment?
3. Is there demolition and construction waste in your city?
4. Is there interest from the municipality in your city in the issue of construction and demolition waste?
5. 5, Are you ready to cooperate with the municipality to recycle construction and demolition waste?
6. Do you support the establishment of a factory to recycle construction and demolition waste in your city?
7. Do you agree with the use of recycled construction materials in engineering applications such as roads and sidewalks?
8. Does the municipality in your city have sufficient resources and machinery to transport construction and demolition waste?
9. In your opinion, does recycling construction and demolition waste have economic returns for your city?
10. Where do you think construction and demolition waste is taken in your city?
11. What is your suggestion to recycle construction and demolition waste in your city?

Interview questions:

1. Where is construction waste taken in your city (is it disposed of in acceptable places? How is it disposed of?
2. What is the role of the city municipality in managing construction waste?

3. What should the city municipality do in managing construction waste?
4. What items of construction waste do you think should be sorted for recycling?
5. What is your proposal for the development of construction waste management in Iraq?

RESUME

EDUCATION

- **Bachelor :** 2017 Graduated From The University of Technology In Baghdad, Bulding And Constraction Department, Branch Of CAD/CAM Engineering.
- **Master:** Master Degree In Engineering Management From Istanbul Gedik University 2022