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Review of Waste Management in Construction Industry

Hüseyin Gökçekuş[1], Youssef Kassem[1, 2], Albaraa Harahsheh[1]

[1] Department of Civil Engineering, Civil and Environmental Engineering Faculty, Near East University, 99138 Nicosia (via Mersin 10, Turkey), Cyprus

[2] Department of Mechanical Engineering, Engineering Faculty, Near East University, 99138 Nicosia (via Mersin 10, Turkey), Cyprus
***** Correspondence: albaraaharahsheh@gmail.com (A. Harahsheh); Tel.: +962772119116

Abstract: ***The world is facing a rapid development in the field of construction due to a very large increase in human numbers, and the construction industry is one of the most important modern industries, because of the large increase in urban development, it produces from this process waste as a result of demolition and construction operations, and the environment is considered the largest negatively affected. This paper aims to do a comprehensive review of the demolition, construction, and waste management processes such as asphalt, brick, concrete, ferrous metals, glass, non-ferrous metals, paper, cardboard, plastic, and wood . to reduce the cost and the negative impact of these wastes on the environment by studying practices that contribute to reducing these impacts by recycling Waste and use again.***

1. Introduction

These days' people live in a world where every day is lost the amount of building waste due to the inefficiency of the procedures in the process of waste management

The environment has been impacted by building waste, despite this negative impact, the construction industry is an important factor in building local economies, as it contributes significantly to the gross domestic product and provides many jobs and contributes strongly to supporting the national economy.

Building activities consist of many activities, including construction, road works, bridges, tunnels, and airports. At the same time, unfortunately, there is a neglect of the environmental side and the negative impact of these activities on the environment.

Annually, the construction industry is produced millions of tons of waste, most of which are geared towards infrastructure, as infrastructure is an essential element in achieving development. Many countries of the world suffer from difficulties in getting rid of the waste resulting from the construction and demolition process due to the huge quantities of this waste, the quality and quantity of waste from the demolition and construction process are the most important factors contributing to this problem.

The world today needs an effective and integrated system to address this global problem, by reviewing the current behaviors that contribute to reducing this problem, the waste management and reduction process were applying in the third world, there is an urgent need to develop policies, laws, and regulations related to the process of managing the demolition and construction waste.

The large increase in the number of construction projects in recent years has led to an increase in the negative impact of this process and its impact on the environment, As it caused pollution of water and air, the destruction of the ecosystem, and the risks that were reflected in public health, and all this was due to the poor process of managing demolition and construction waste So it is possible to recycling, reuse, or disposal of it.

The large increase in the amount of waste is a global phenomenon and therefore must be dealt with, as most waste is produced specifically from construction activities, To reduce this issue and its negative impacts, countries must enact effective and more aggressive waste management laws, and force companies operating in the construction industry to reduce the quantities of waste that is produced. This paper provides a review of the construction industry waste management literature in terms of identifying gaps in current practices and behaviors.

2. Literature Survey

2.1 A Spanish model for quantification and management of construction waste

Demolition and construction waste is a global issue at all levels of government and construction companies. A new decree organizing waste management was issued in 2008 in Spain, and the waste management process is carried out through the alcores model and was implemented in the city of Seville, and this model works by estimating the amount of waste resulting from the demolition process, this model was developed by studying 100 residential projects.

2.2 Alternative construction and demolition (C&D) waste characterization method proposal

Most of the waste from the demolition and construction process is a solid waste in Brazilian cities, this study came to support project managers in diagnosing this process, this study suggested the use of qualitative characterization in the field by using indicators that generate waste in the demolition process.

2.3 A Review of Construction Waste Management and Initiatives in Malaysia

The construction industry is one of the most important industries that generate money and wealth. The lack of implementation in the project waste management process leads to many environmental and illegal dumping problems.

2.4 Critical Review on Construction Waste Control Practices: Legislative and Waste Management Perspective

Waste coming out from construction sites is a major concern because of its negative effects on the environment. Construction waste production must be controlled and managed by stakeholders.

This paper reviews construction practices adopted by the responsible parties in Hong Kong and Malaysia in order to reduce negative impacts on the environment.

2.5 Implementation of waste management and minimization in the construction industry of Malaysia
Because of the significant negative impacts of construction waste and with the increasing demand for infrastructure projects and commercial buildings, waste minimization is an important area in the construction management process.

This study provides empirical evidence for the contribution of the waste minimization practice by following the weighted average and minimization model. The results of the analysis indicate the most important and least important factors in reducing waste.

2.6 Attitude and behavioral factors in waste management in the construction industry of Malaysia

Building waste management is a very important matter. The construction industry in Malaysia is witnessing a great labor momentum. This study aims to provide insights into the impact of contractor behaviors on waste management. A questionnaire was implemented and the results showed that the contractor's attitudes and behaviors differ depending on the contractor size.

2.7 Disaster waste management: A review article

Depending on the nature and severity of disasters, these disasters will create a lot of debris and waste. If the waste is managed, it is possible to turn the waste into an investment opportunity. This paper provides an overview of waste management in disaster situations, on the waste management process, temporary storage, recycling, and early disposal. The options are decided upon after the disaster.

2.8 Waste Management in the Construction Industry

This paper is based on a detailed study of the application of waste management to several million dollars in a housing project in Queensland. This study includes an evaluation of the site's waste management operations plan and a questionnaire with which construction workers participated.

2.9 A study conducted to reduce construction waste generation in Turkey

During the life cycle of buildings, waste is generated in the construction, modification, and demolition stages. These waste have become environmental problems in many countries, including Turkey. The main environmental goal is to prevent the generation of waste or reduce it, the main objective of this study is to provide suggestions on reducing waste production in Turkey.

2.10 The effectiveness of Hong Kong's Construction Waste Disposal Charging Scheme

The Hong Kong government introduced a construction waste shipping plan in 2005 to ensure waste disposal. This plan aims to provide an economic incentive for contractors and developers to reduce waste and to encourage reuse and recycling. Daily waste areas were collected from landfills, and the results showed a 60% decrease in waste.

2.11 A Glance on Construction Solid Waste Management in Khartoum

Waste is generated at construction sites and waste varies depending on the type of building structure and construction technology. The problem is that these wastes need large areas to store. The waste services department in Khartoum does not deal with the rapid urban expansion seriously. Construction waste is still managed with municipal waste, and effective means must be used to dispose of construction waste and preserve the environment.
The aim of this study is to reduce the volume of waste in Khartoum.

2.12 A novel methodology to estimate the evolution of construction waste in construction sites

The accumulation of construction waste resulting from the building construction process. A special methodology has been developed in which the waste flow and the amount and components of waste can be predicted. Construction sites were monitored from 7,000 square meters to 320000 square meters. The waste accumulates exponentially, meaning that smaller quantities are generated in the early stages and large quantities at the end of the project.

2.13 Improving solid waste reduction and recycling performance using goal-setting and feedback

A multi-line trial evaluation across waste streams was used to determine the effectiveness of the goal in achieving the improvement of solid waste management performance at the Australian Sports Stadium construction site. The desktop method was used to measure the volume of wood, two indicators were calculated for recycling. The performance was measured every two weeks and official targets were set. The intervention was effective in reducing the volume of waste. This indicates that solid waste has been reduced or reused.

2.14 Construction waste management policies and their effectiveness in Hong Kong: A longitudinal review

It produces solid waste from construction activities and is considered dangerous for the economy in many fields and has a negative impact on the environment and the overall aesthetic view. Many methods must be used, from reducing waste from the source to recycling or reuse.

2.15 Strategies for successful construction and demolition waste recycling operations

Building a successful process for building and recycling building and recycling waste in the United States is a challenge today.
Especially because the secondary materials markets have not yet matured to put the state's recycling operations under strict supervision.

2.16 On the effectiveness of implementing a waste-management-plan method in construction

Increased awareness of building and demolition waste management concerns has led to the development of waste management as an important function in the project management process. The Hong Kong government has begun the waste management plan method) WMP) for all construction projects in 2003 during the trial period. This paper examines the effectiveness of the current implementation of (WMP) method In the construction industry in Hong Kong. The results showed the suggestion of ways to reuse materials on-site to reduce waste.

2.17 A systems analysis tool for construction and demolition wastes management

The demolition and construction waste management process face great challenges due to the reduced capacity of many municipalities to dispose of waste.

To overcome these challenges, the Massachusetts Department of Environmental Protection proposed a landfill restriction policy for the disposal of some waste if it is not treated.

This research aims to study the potential economic impact of this restriction on building contractors and waste treatment.

A spreadsheet-based systems analysis model has been developed to help evaluate the cost and benefit of various building and demolition waste management scenarios.

2.18 The recent progress of recycled steel fiber reinforced concrete

The world is heading towards sustainable construction, the use of reinforced concrete using steel fibers because of its high pressure bearing properties and providing more ductility, the environmental impact always gives a lot of attention, the process of recycling the steel fibers preserves the environment by reducing gas emissions during the production of steel fibers This paper provides an overview of the properties of recycled steel and the properties of concrete in terms of porosity, bulk density, and volumetric stability, and discuss the mechanical properties of cement systems such as compressive strength, flexion, tensile strength, toughness, and resistance to Effects and durability .

2.19 Durability of Recycled Steel Fiber Reinforced Concrete in Chloride Environment

Structural elements exposed to chloride environments have an important aspect in the recycling of reinforced concrete with steel fibers. A pilot program has been implemented to assess the long effects of chloride attack on post-cracking behavior through tensile and split procedures and round plate tests.

2.20 Re-Use Potential of Steel in Building Construction

The results of this research are based on the end of the life of the research project for steel construction in the Netherlands, the United Kingdom, and Sweden. The study found that at the end of the life of the project 83% From steel construction products it is recycled,14% Reusable, and just 3% Be buried . The possibility of reusing steel products in buildings is evident through the principles of modular construction, dismantling and rebuilding of steel structure buildings and interior wall systems transported in offices.

2.21 Recycled Concrete as Aggregate for Structural Concrete Production

In this paper, an analysis and comparison of experimental results of the properties of fresh and hardened concrete were presented when replacing a quantity of recycled coarse aggregate in a concrete mixture. Recycled aggregates were made by crushing concrete waste cubes of test cubes, then testing three types of concrete mixtures, aggregate concrete Natural, concrete made from recycled aggregates by one hundred percent, and made from recycled aggregates by fifty percent. It was concluded that the recycled aggregate concrete, regardless of the replacement ratios, had a good performance compared to that which did not differ significantly from the performance of the control concrete in this experimental study.

2.22 Repair of Deteriorating Pavement Using Recycled Concrete Materials

The demand for recycled materials increases, this research was carried out to upgrade recycled concrete materials. Polyethylene was reused as a substitute for coarse aggregate. The study found that the optimum ratios are in the range of ten percent to thirty percent.

2.23 Use of recycled aggregates in molded concrete bricks and blocks

This study aims to develop a technique for producing bricks and paving blocks using recycled aggregates from demolition and construction waste. Experiments were conducted on recycled aggregates and their usability, and the results showed that replacing recycled aggregates at a rate ranging between twenty-five and fifty percent had little impact on compressive strength

2.24 Using Recycled Concrete Aggregates in New Zealand Ready-Mix Concrete Production

The most important motives for using recycled concrete is to preserve the environment by taking advantage of the increased flow of waste and energy saving, this study was conducted in New Zealand and the study included conducting research on the feasibility of using recycled concrete aggregates as an alternative to natural aggregate in the production of concrete mixtures, and study indications that the aggregates Recycled concrete is a viable alternative to natural aggregate production

2.25 Practical recycling applications of crushed waste glass in construction materials: A review

Getting rid of glass waste is a difficult environmental challenge that many countries suffer from. The reuse of glass waste reduces the consumption of natural resources. Over the past sixty years, many researchers have studied the possibility of using crushed glass waste. This paper provides an overview of previous studies carried out to restore. The use of glass waste in concrete mixtures, and we can conclude from the study that glass waste can be used in building materials.

2.26 Recycling Wood Waste from Construction and Demolition to Produce Particleboards

Wood recycling is a very important process, raw materials are obtained from wood waste recycling, as they are divided into four types (medium density fiberboard),)medium density particleboard(), plywood and timber, and wood waste showed that it can be used as a raw material in Particleboard.

2.27 Sustainable management of excavated soil and rock in urban areas e A literature review

The construction process in urban areas includes the use of building materials from quarries and soil digging operations. There are benefits to using soil and rocks in building materials. This paper aims to describe the flow of materials and management practices in soil digging processes in urban areas. It was concluded that there is a lack of knowledge of the quantities And the fate of soil and rocks dug in urban areas.

2.28 A review of the use of recycled solid waste materials in asphalt pavements

The process of building and maintaining roads in the United Kingdom drains large quantities of aggregate produced from quarries, the recycling process helps reduce the pressure on the landfills and reduce the demand for extraction. This paper reviews the standards and literature for technical requirements, as well as the performance of asphalt pavements that were created using recycled materials.

2.29 Plastic waste management in construction: Technological and institutional issues

The most important goal of waste management is to protect human health, safety and welfare, from options for waste management, landfill, incineration, and recycling, the process of recycling plastic waste need an integrated infrastructure that facilitates the collection and effective technology for recycling and a marketing process for products from the recycling process, extensive research and studies have been to produce a high-performance composite material.

3. Construction Waste Management

3.1 Steel Fibers recycling

One of the most important ways of steel recycling is to convert it into steel fibers that are used as additional material in reinforced concrete and to resist the fissures that can be generated, and steel fibers are obtained from various sources. The process of recycling synthetic fibers contains many sources through which fibers can be obtained, and these fibers are similar in mechanical and physical properties despite the different sources of obtaining them, due to the fact that they consist of the same raw material. One of the most practical solutions for improving the quality of hard concrete mixtures is the use of steel fibers, Steel fibers are considered one of the most important fibers because they are primitive and easy to handle, and contribute significantly to improving the performance of concrete mixtures against loads, The process of applying steel fibers on an industrial scale leads to some environmental concerns related to carbon emissions.

This study concluded that the process of tire recycling and the use of the resulting fibers is a sustainable and environmentally friendly process. The rubber particles that are on the surface of the fibers negatively affect the performance of the fibers, It was also concluded that the process of affecting recycled steel fibers on compressive strength is not yet clear and needs further study, Studies have shown that recycled steel fibers, when added to the concrete mixture in ideal conditions, do not significantly affect the properties of concrete in terms of workability and some other properties. Finally, recycled steel fibers are environmentally friendly and have a positive impact as they reduce costs.

Reuse steel

By **ECSC**, the quantity and pollutant environmental emissions of all stages of the life cycle of the number of steel construction products in the Netherlands, Sweden, the United Kingdom, and Sweden were examined and determined, and they were divided into five stages, starting with steel production, through its use, ending with the end of the steel product life cycle. In these stages, the focus was on the primary energy consumption process, carbon dioxide emissions, waste generation process, and emissions of organic compounds.

At the end of the life of the project, as the materials are useful and can be reused, buildings and structures are dismantled through demolition and dismantling, and through demolition and dismantling, an attempt is made to obtain any parts that can be reused again. Improving the effectiveness of the process of reusing steel materials is an important factor in improving the efficiency of the use of other materials such as concrete, brick, and wood, and the process of using steel can

solve the problem of study found an increase in the recycling rates for steel demolishing products as they are recycled 83%, reused 14% and also buried 3%, Based on these numbers, steel can be defined as a substance with a semi-closed life cycle and that the properties of steel materials are preserved in the process of recycling and reuse, It can also increase the rates of re-use of steel products.

3.2 Concrete

Recycled concrete is used again as a component in new concrete mixtures, where certain amounts of natural aggregates are replaced by recycled aggregates, recycled concrete is obtained by crushing concrete cubes that have been used for testing, The process of producing concrete from recycled aggregates differs from the method of producing concrete from natural aggregates, as recycled aggregates absorb more wate0r to saturate before mixing and during mixing, Where initially concrete was produced using natural aggregates 100%, The second time, recycled aggregates were used 50% The third time, recycled aggregates were used 100%, Many concrete properties were studied, such as workability, bulk density of hardened concrete, erosion resistance, compressive strength, and many other characteristics, The water absorption behavior was studied when using recycled aggregates in the concrete mixture.

The study found that the main changes in the volume of water absorbed occur in the first thirty minutes and that the bulk density of concrete depends on the amount and type of recycled aggregates, the process of preparing the recycled aggregates affects the workability of concrete, The bulk density of the concrete containing recycled aggregates decreases as the amount of recycled aggregates increases, and the amount of water absorbed depends on the porosity of the recycled aggregate and that if recycled aggregates are used it is obtained from concrete with a high-quality braking force and will not affect the compressive strength, Finally, it was concluded that it is not recommended to use concrete that contains recycled aggregate in structural elements subject to major deformations.

Concrete wastes generated from demolition and construction are subjected to mechanical crushing and sieving, so fine and coarse aggregates are produced and the resulting aggregates are treated in laboratories, It was the maximum volume of recycled coarse aggregate 15mm.

Recycled aggregates are collected and contain some impurities such as wood, natural stone, and minerals, The aggregate was recycled according to the British method (w15-2x) ,A set of tests were conducted to find out some characteristics such as density, strength, and transverse strength. Recycled aggregates were used in the production of concrete bricks and pavement blocks, the experiments were carried out in three stages, whereby certain proportions of the natural aggregates were replaced by recycled aggregates.

The study concluded that the results of replacing recycled aggregates instead of natural aggregates by a ratio between 25% to 50% had little effect on the brick compression strength and that the lateral strength of the samples increased as the percentage of replacement increased.

3.3 Glass

Glass is one of the most important elements in the construction industry, as it is widely used in this industry, Glass has many properties such as transparency, chemical inactivity and low permeability of gases, Large quantities of glass are produced annually, so the handling of glass waste is very important, The quantities of glass waste are collected, crushed and classified according to the volume of aggregates resulting from crushing operations. The glass is also classified into three types based on its chemical composition, such as soda-lime glass (used in construction and automobile manufacturing) and pyrex glass (used in household appliances that are exposed to high temperatures And a leaded glass (used to make cups). Waste glass is sifted and passed through a sieve 5 mm, We point out here that this study was conducted in Hong Kong.

The glass waste is used after going through all these processes as a substitute for the aggregate in the floor tiles, where it gives aesthetic to the floors because of the beautiful glass colors. It was found in this study that works must be done to expand the process of glass recycling and work to find new practical ways to recycle glass waste such as architectural cement and concrete pavement blocks, The process of using glass waste in cement products not only reduces waste but also improves the properties of mortar and pavement blocks. The use of waste glass also reduces shrinkage and increases workability due to non-absorbent glass properties for water, It also improves concrete resistance to high temperatures and chloride ion penetration.

3.4 Wood

Wood is used in the construction process in many cases, and as a result of this use of wood, waste is produced before and after this use. In this study, wood waste was used to produce **PARTICLEBOARDS**, This study was conducted in an area within the Brazilian capital, Cardboard sheets were produced and materials were divided into four categories according to the origin of these materials. MDF, MDP, Wood chips, and wood. These materials are collected, processed and crushed, then materials are sieved, Moisture must be 3%, Six types of planks are produced, one for each category of original waste and one mix for the remainder of the waste with 25% from each one.

The urea-formaldehyde resin was applied within 8% based on the dry weight of the furnace, Also has been added 1% Of ammonium sulfate and 1% Of paraffin wax emulsion To reduce moisture absorption and the required density was 0.75g per cm^3 and the boards were 1.5m*0.5m*0.5m. The study concluded that the wood contained in the demolition because it is a good bonding ability, and it is recommended that more studies be taken into account in order to consider other process variables in order, to improve mechanical properties in static curvature.

3.5 Plastic

The main goal of the solid waste management process is to

effectively protect the public and maintain public health and safety, the waste management process involves several options, including reuse, recycling, or burial. The plastic recycling process is very important, and for the success of the waste plastic recycling process, the appropriate infrastructure must be available for the collection of plastic waste, providing effective technology that contributes to the process of recycling waste and converting it into new useful products, and establishing markets that contribute to the marketing of these products. This research aims to use the basis of resins with recycled polyethylene to produce a high-performance compound material which is polyester concrete, and the resins provide when used with polyethylene at a low cost. Chemical modification or de-polymerization is an effective way to recycle plastic waste, There are two methods of analyzing de- polymerization, hydrolysis, and pyrolysis, For example, polyethylene can be chemically modified to produce unsaturated polyester that is typically used in bathtubs, glass panels, boat, and car hulls.

After discussing the various issues involved in the process of plastic waste management, the study concluded that a focus should be placed on recycling in the construction industry and it was concluded that recycled polyethylene could be modified to produce unsaturated polyester, However, the use of recycled plastic waste in the construction industry must be evaluated in order to achieve the most efficient options on the market and then be used in applications that do not involve health risks and maintain the safety of performance.

3.6 Asphalt

Road construction and maintenance require large amounts of aggregate extracted from quarries, The process of using recycled materials instead of natural materials contributes to reducing the demand for material extraction. This study was conducted in the UK. waste glass, steel slag, plastic, tires, etc. were chosen to be used in the asphalt pavements. The upper layer in the roads, which consists of the asphalt mixture is an important layer because it will bear the pressure of the tires located on it and contains the most expensive materials and is characterized by many characteristics including friction, strength, noise and the ability to drain surface water.

And it resulted from this study that there is a difference in the use of recycled materials in the roads because of the difference in reaching the appropriate natural aggregate and the ability of landfills to receive waste, away from the problems and technical obstacles that exist, Asphalt has been replaced with crushed glass and the ratio between 10% to 15% from fine aggregate In the surface layers, the crushed glass particles do not affect on the safety level, Fine aggregates are also used in small quantities, Steel slag should be used instead of aggregate in the surface asphalt layers to achieve the best possible result of mechanical strength and slip resistance, one of the resulting defects in the high specific gravity of steel slag, and it is not recommended to use slag in structures subject to volumetric expansion.

3.7 Soil and rocks

The construction process in urban areas includes the use of building materials from quarries and soil and rocks digging, mostly the soil and rocks resulting from the construction industry process are disposed of in landfills, and the recycling rate in high-quality works is low. Therefore, the use of soil waste and rocks as materials in the construction process must be expanded. Waste from rocks and drilling operations can be reused in the same location, and this leads to reduced excavation and transportation to landfills, as well as reduced demand for materials from quarries. Also, waste from other projects can be used by transporting this waste to other projects. The abundance of construction sites in the same drilling area makes it easy to transfer materials to them, in order to reduce time and cost. Soils and rocks are classified as waste and then transported to recycling facilities where there is a process for treatment to use.

Through this study, a deficiency in the perspective of drilling and rock drilling in urban areas was found, and the main focus is on the recycling process and its benefits. It was not possible to know the quantities of rocks and soil dug in urban areas, and there is a need for further research on the subject of the flow of soil and rock wastes. The recycling of soil and rock waste reduces the emission of carbon dioxide 14kg per ton, Recycling this waste can save 85% Of material handling costs.

4. Conclusion

Waste management is a process of great importance, and the study concluded that the waste management process is considered to have a positive impact permanently on the environment, whether the waste has been reused, recycled, or properly disposed of, with regard to the economic aspect in some cases, the cost may increase or decrease in light of the lack of developing methods Recycling and use of waste. The study also concluded that research should be developed in the field of waste management because of its great impact, as this field still needs more and more development.

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