Journal of Civil Aspects and Structural Engineering

www.case.reapress.com

Vol. 1, No. 1 (2024) 11–19.

Paper Type: Original Article

Management of Construction and Demolition Waste in Construction Projects: A Case Study

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Citation:

Received: 12 May 2023 *Revised: 25 July 2023* *Accepted:1 November 2023*	Edalatpanah., S. A., Gharib Jurkoohieh., F., & Rahimireskati, S. (2024). Management of construction and demolition waste in construction projects: A case study. *Journal of civil aspects and structural engineering,1* (1), 11-19.

Abstract

Waste production has been with humans since the first days of the formation of human society and concentration in a specific place, and also since the distant past, waste production and waste disposal methods have been problematic for humans, and this issue has caused that various methods for waste disposal are used. Since construction activities are among the most important economic parts of any society, this industry produces a large amount of waste every year, which is increasing with the increasing number of worn-out fabrics and construction in different levels of the country. In this study, by studying and researching the methods of disposal and management of construction and demolition waste, traditional and old methods should be left aside and a step should be taken in the direction of better management of time, economy and environment. Waste management is not discussed much in our country, although it is an important and vital topic in developed countries, because compliance with standards and using the right methods for its management in various fields will help people and the environment. The environment that should be addressed more than ever today and efforts should be made to preserve it because there is no substitute for it in case of any damage.

Keywords: Construction projects, Construction and demolition, Waste management, Construction waste.

1 | Introduction

Construction projects produce a large amount of garbage and waste that are usually abandoned or no longer used, and also with the increase of worn-out tissues, waste management is more and more important and finding a way to manage it. Waste during and after work is important in every way. In addition to saving in the economic sector, waste management preserves the environment, which is very important.

Waste production has been with man since the first days of the formation of human society and concentration in a specific place, and also since the distant past, waste production and waste disposal methods have been problematic for humans, and this issue has caused various methods to be used for waste disposal. At present,

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10.48314/jcase.v1i1.22

with the rapid growth of urbanization and the increase in the level of welfare and income of the society and the changing pattern of consumption, the quality and quantity of waste has also changed. There are also other problems at the level of city management, such as increasing costs, non-cooperation of people and other issues. Related to transportation and traffic, waste management has become one of the most important issues of the day [1]. Since construction activities are among the most important economic parts of any society, this industry produces a large amount of waste every year, which is increasing with the increasing number of worn-out fabrics and construction in different levels of the country. Wastes that are managed and controlled with proper and legal planning are not only harmful to the environment and economic issues, but if there is a targeted plan to control and manage this type of waste, it is possible to create appropriate productivity and from traditional practice (At present, waste management has become a fundamental and important problem due to the lack of free space and other environmental problems in the outskirts of cities) [2].

Huang et al. [3], in the article on the management of construction and demolition waste in China through the principle of R3, he believes that in general, although there is an awareness of the urgency to reduce construction and demolition waste, the current situation of construction and demolition waste it is not good in China and because the annual production of construction and demolition waste in China is more than 1.5 billion tons and it has led to severe environmental and social problems and is continuously growing at a high rate. In this article, the literature review and personal interviews have been conducted to analyze the existing barriers of construction and demolition waste management in China. The articles related to the treatment status of construction and demolition waste management and the existing obstacles in China to obtain primary information have been further investigated and it is emphasized that addressing this issue is of great importance and the most important identified challenges are lack of design standards. The building knows how to reduce construction and demolition waste, reduce construction and demolition waste disposal costs, and inappropriate urban planning.

Gómez-Meijide et al. [4], conducted a study that provides a suitable option for the asphalt manufacturing industry in cold mix asphalt: the evolutionary properties of using cold mix asphalt usually in financial and environmental savings, with this Now they need cooking time to reach their full potential. Considering the environmental and financial consequences, further improvement can be considered with 100% recycled materials from the production. In this paper, developmental properties in terms of hardness growth and water loss are investigated and the results are compared with conventional control mixtures.

Ossa et al. [5], in a study showed that recycled materials are a suitable alternative for the asphalt industry and the global production of construction waste has increased significantly over the past few decades, causing environmental problems. This environment is due to its uncontrolled disposal. The use of recycled materials is increasing primarily for sustainable development and environmental protection. The purpose of this work is to study the use of the production of recycled materials of construction waste to create hot mix asphalt for cities asphalt roads, which can be an alternative to reduce the environmental problems caused by inappropriate government and disposal of this type of waste. For this purpose, several tests were conducted to evaluate the sensitivity of asphalt samples to moisture damage and plastic deformation. Four different percentages of recycled grains were used to create asphalt samples. The test results of this study showed that it is possible to use up to 20% construction waste production materials for the asphalt of urban roads. Mistri et al. In Mistri et al. [6], pointed out in his article that the challenges presented in the use of recycled waste, high water absorption, the emergence of weak surface areas and the presence of small cracks in the surfaces are among the major drawbacks of this work. To minimize these disadvantages, the use of nano materials and pozzolan along with different methods of mixing and using cement can be a better and environmentally friendly way to improve the properties of recycled aggregates.

Zoran et al. [7], concluded in a study that using recycling, it was investigated that recycled concrete residues can be recycled and used in some construction projects such as road infrastructure, aggregates in concrete as well as can be used as a filler in some cases and concluded that due to the environmental problems that

threaten countries and considering the need for engineering training and recycling technology of concrete waste is felt more than ever.

Bolden et al. [8], in a study to investigate the environmental effects of recycling from the demolition of concrete structures. While reducing the harmful environmental effects of this industry, its application should be provided for sustainable development, and it was concluded that one of the solutions to minimize the harmful environmental effects of the concrete industry is to reduce concrete residues and finally recycle it.

Waste management is in the direction of proper productivity and environmental protection. The current research has studied this debate regionally in Tankabon city. Environmental crises threaten the entire system of nature and currently using old equipment, methods and technologies that were used in the past and cannot be the answer to the problems. How to plan and manage waste problems. It is one of the important issues of societies today. The management of these cases and the development and improvement of its performance depends on paying attention to elements such as collection, transportation, production control, storage, processing and disposal. and act based on sufficient and required knowledge and information about the existing situation in the target area, they can be effective and useful in the direction of improving waste management in the society.

2 | Research Method

One of the most important stages of any scientific research is choosing the right research method. It is the responsibility of the researcher to choose the appropriate research method and he must use the necessary sensitivity and precision in his choice and style of activity. The conducted research must have a complete set of methods and rules that are valid and with the help of which the unknown can be discovered. The choice of research method depends on the goals and possibilities of its implementation. In other words, the researcher must specify what method to choose to bring him to the answers and research questions as quickly, accurately, easily and cheaply as possible [9].

2.1 | Introduction of the Studied Area

In this research, the study area of Tankabon city is one of the cities of Mazandaran province. Its size was presented based on the latest country divisions in 2018, it is about 1740 square kilometers, and it is geographically located at 50 degrees and 88 minutes east and 36 degrees and 82 minutes north latitude and 20 meters below the level of the Azad Sea. According to the latest census conducted in the year 95, the population of Tankabon is 166,132 people.

2.2 | Classification of Existing Materials and Waste and Checking the Possibility of Separation at the Source and Reuse

One of the basic needs of human life is civil and construction activities. For these activities, on the one hand, there is a need to harvest natural resources, and on the other hand, things that are destroyed produce wastes that are disposed of in the environment, and in both cases, humans change their environment in this way. In order to reduce and control adverse environmental results, construction waste management needs to know the composition of construction waste, planning, control, how to collect, recycle, dispose, monitor and overcome the negative effects and problems caused by it. set of coherent and systematic regulations regarding economy, production control, storage, conservation of resources, transportation, processing and disposal of waste, aesthetics, collection in accordance with the best principles of public health and other environmental requirements that include complex relationships between sectors. It is interdisciplinary such as economics, urban and local planning, statistics and health, political science, sociology and environment. The main field of this type of management consists of functional elements and support elements. Functional elements include 8 elements: production and storage, processing and recycling, transportation, reduction from the source, disposal and post-disposal care, collection and financial support elements, support and procurement, management of equipment and tools, personnel, arrangements, public relations, launch, system and guide

lines are inventory taking, report writing, calculation of service rates and budgeting, and training and equipping of human resources. In waste management, the first step is to remove waste from the environment of human life, but due to finding valuable materials in it, the process of reusing materials that take the title of waste seems necessary. The second step in this management is waste processing, which consists of all chemical, mechanical, and biological processes that lead to ease in disposal operations [8].

Table 1. Example of the characteristics of construction waste resulting from demolition and renovation.

Source	Features
Construction	Healthy bricks, concrete stones, stone or concrete facades, tiles, ceramics, undamaged windows, wooden cabinets, counters, flooring, stairs, construction pipes, home electrical appliances.
Demolition and renovation	Broken bricks, concrete stones, stone or concrete facades and tiles, broken or undamaged glass, wooden beams, metal wall coverings, roofing materials, aluminum doors and windows.
Destruction of mechanical installations	Concrete, sand, ferrous metals, bricks, stone, wood products, miscellaneous waste.
Construction of passing roads	Asphalt, concrete, substrate material including soil, sand, and miscellaneous materials.
Cleaning the construction site	Construction materials, soil, steel, and other waste such as paper, plastic, brick.

Table 2. Different methods of separation of construction waste and their efficiency.

Process Type	Description	The Wasted Volume
Manual sorting	The waste is classified according to the type, the type of material is identified and separated into the appropriate size by the workers, and the remaining material is buried.	Up to 50%
Combined separation	The wastes are classified according to the type, identifiable materials are separated by trained workers and recycled in a depot with the help of conveyor belts.	25% - 50%
Automatic sorting	Wastes are classified according to type, materials are crushed by mechanical devices and separated mechanically based on physical characteristics such as specific weight, size, etc.	Less than 25%

2.3 | Obstacles to Avoid, Reduce and Recycle Construction and Demolition Waste

There are many obstacles to exploiting large amounts of materials from construction and demolition operations or recycling, reuse or reproduction as follows:

I. Lack of real information about the volume and composition of construction and demolition waste, especially at the regional level
II. Variable requirements, costs, and management between local levels of government and community custom.
III. Finding a cheap place to dispose of materials
IV. Taking illegal
V. Lack of recycling facilities
VI. Not enough space at the project site
VII. Cost of classification and lack of financial incentives
VIII. Time for classification and classification on site

IX. Lack of facilities

X. Planning needs

XI. Index products or standards

XII. Disposal costs

XIII. No need for classified materials or lack of a place to store them

Local construction projects are the most available market for reusing the contractors from construction projects. The lack or absence of the market depends on things like processing, transportation costs, consumption and storage of materials. Although some contractors may get permission or require from the beginning to reuse the waste from construction and demolition (For example, in the renovation of historical buildings), but the use of any type of materials other than first-hand materials for processing final products may be prohibited. The most important method that is included in the agenda of the recycling process all over the world is the separation operation at the source. So, the closer the separation of construction waste is to the place of production, the more efficient it will be in terms of time and economy. For this reason, we must send experts to the demolition sites to collect as much as possible the same and uniform materials and transfer them to the next places. It should also be kept in mind that the economic aspects of construction waste recycling are also important. Its technical issues are equally important.

2.4 | Strategy of Minimization of Construction Waste

The minimization of waste resulting from construction and demolition should be done through research and review of design and construction processes at regular time intervals, in the stage of pre-design, design and purchase, pre-fabrication and construction. All opportunities for waste minimization should be identified so that any waste that is produced is unavoidable and can be easily managed. Waste minimization provides an acceptable portion of benefits. Especially reducing waste has two main benefits:

I. Reducing the amount of materials introduced into the waste stream reduces the environmental effects of construction.

II. Reducing waste can lead to an acceptable reduction in costs.

There are also some other important benefits that, when combined, create a strong incentive to reduce waste, including 1) minimizing environmental damage, 2) preserving natural resources, 3) increased competitive differentiation, 4) response to public policy, and 5) reducing the emission of carbon dioxide gas.

2.5 | Plans to Reduce Soil Residues, Scum

In order to implement programs to reduce soil waste and sewage, the following measures can be taken: 1) use as a coating material, 2) use for filling holes and rehabilitating the land, 3) use in sand factories, 4) use for the production of prefabricated concrete, cement and asphalt, 5) gardening waste and tree leaves for production Compost and fertilizer, and 6) use as base and sub-base on roads.

Waste reduction methods at the place of production, processing, and reuse

I. Assigning the responsibility of site management to persons who have the necessary skills and expertise

II. Increasing construction waste management plans for each of the soil and waste projects

III. Communicating with project staff

IV. Developing delivery ways so that delivery is done on time

V. The correct management of projects through the selection and use of appropriate tools and equipment

VI. The safe and healthy storage and use of construction materials, because waste materials are usually considered as waste

VII. The use of closed materials Packaging instead of bulk materials

VIII. Proper and correct storage of material packages until the time of their use

IX. Processing the transfer of refuse

X. Demolition permit versus ultimate reuse or recycling

XI. Separation of waste and other items on site production

XII. Monitoring the stock of goods as a prevention of turning materials into unnecessary waste [8]

The important steps for evaluating production waste are 1) categorizing waste, 2) visiting facilities and activities, 3) documenting waste assessment and goals of waste assessment, 4) awareness of the goal of waste assessment, and 5) specifying the method.

There are three important factors for recycling soil and construction debris in different stages, which are are three crucial factors for recycling soil and construction debris in different stages, which are 1) stage of production of waste materials, 2) stage of recycling operation, and 3) stage of consumption of recycled materials.

2.6 | Creating Motivation Regarding the Recycling of Construction Waste

In order to create motivation for soil and garbage recycling, there are applicable methods that include:

I. High taxes can be used as a means to channelize the recycling of waste materials. Of course, it should be noted that taxes will affect the amount of profit.

II. In order to reuse recycled materials, which are of lower quality, it is necessary to find new applications.

III. The following information is required about recycled materials: 1) price of recycled materials, 2) amounts and composition of materials, 3) comparison of different methods of destruction, and 4) creating a market for the sale of recycled products is the best way to motivate the recycling of soil and construction debris. As far as it is technically possible, recycled soil, scum and crushed stone should be used in public projects. This also affects the private sector.

IV. Officials can prohibit the burial of dirt and refuse in the ground. If such a decision is taken, due care should be taken because there may not be other methods for disposing of soil and garbage, this may encourage illegal burial, and better control should be applied in this case.

V. In order to channelize waste materials and use recycled materials, new methods for destruction must be provided. In the first step, demolition permits must be issued for public operations and projects.

VI. Not being sure of the quality of recycled materials is considered a problem in the way of using such materials. Guaranteeing the quality of recycled materials by reliable and official organizations solves such problems.

VII. Creation of the recycling industry is the responsibility of the private sector. This makes recycling move towards economic activities and efficiency. In this way, the government will be able to increase the efficiency and improve the quality of recycling operations by motivating the separation of materials.

VIII. In recycling, direct subsidy is not an effective method. These materials must enter the market; But their price may be expensive.

2.7 | Reduction of Materials and Costs of the Disposal Stage by Reducing Ordered Materials and Waste Transported to Landfills.

According to the available statistics, most of the time for construction or renovation projects, materials are ordered more than the size required for the project, and there is always a deviation in the construction phase that causes incorrect use and discarding of a series of materials. Currently, our natural resources are severely decreasing and are facing new damages day by day. In recent decades, due to the increase in constructions and over-harvesting of national and natural resources, as well as the decrease in the useful life of buildings,

which leads to more destruction and the resulting waste, many problems have arisen in The lack of space and related costs, as well as creates many environmental problems, especially in the outskirts of cities. These cases have problems and obstacles such as increasing costs, problems in determining the quality of procurement, as well as concerns leading to incorrect forecasts, lack of effective management tools, problems in implementation, low financial incentives, lack of educational awareness, systems. The main complexity of contracting is management and time and expectations from the employer.

Table 3. Some advantages and disadvantages of sanitary burial of construction waste.

Disadvantages	Advantages
Lack of suitable land in many densely populated areas and economic benefits caused by transportation	In areas where there is accessible and suitable land, sanitary burial is considered the most economical method of disposal.
The proximity of the burial place to residential areas creates the possibility of public opposition.	The initial investment in this method is very low compared to other methods.
A burial site requires a schedule for filling and placing.	Hazardous waste can also be buried in the sanitary landfill.
A lot of land is needed for exploitation	There is the ability to develop and restore.
There is a possibility of groundwater contamination	This method can dispose of more waste with minimum staff and equipment.

A solution for waste management with the aim of reducing it in the pre-construction, construction and demolition stages. The pre-construction stage is one of the most important stages in construction projects, and what is achieved in this stage has a direct impact on other stages. It provides a good opportunity for the generation of waste and scum in projects. At this stage, there are two very important factors that must be taken into consideration:

I. Accurate and complete preliminary studies in the design stage

II. Planning.

Different organizations and people participate in the two mentioned factors, and there are different attitudes on their part to manage and reduce waste. Important and effective factors in the design phase include technical engineering design offices and design engineers, as well as the offices of consulting engineers and Architects and engineers in the planning and planning stage are three related and authorized agents (housing and urban development organization, engineering system organization and municipalities), employers and procurement.

According to the above, the following are the best solutions for the pre-construction phase: 1) necessity of very precise and accurate preliminary studies in the design stage of construction projects, 2) communication with research and development centers to improve the methods of planning, implementation and monitoring the efficiency of waste management systems in the urban construction industry, 3) communication between industry and university To improve the methods of implementation, planning and monitoring of the effectiveness of the waste management systems of the urban construction industry, 4) possessing the necessary legal powers for the integrated management of the transportation, production and disposal of municipal wastes, and 5) the influence of education and culture Social construction in reducing construction waste.

During the construction and implementation of construction projects, a large amount of waste is usually created for various reasons, and waste management is considered as control and monitoring measures, and people such as main contractors, subcontractors, executors and executive agents are involved with it. are.

According to the above, the following items play an important role in reducing waste during construction:

I. Using quality and environmentally friendly materials

II. Replacing unused materials with usable materials and avoiding waste in projects

III. Using people with technical skills and specialized and experienced experts for planning, implementation and monitoring on waste management

IV. Financial incentives and fines applied by employers to reduce construction debris

V. Project execution based on a predetermined schedule

VI. Positive changes in construction methods in the framework of applying new technologies and new techniques

VII. Having the executive team fully mastering the details of the plan and preventing redo work

3 | Conclusions

Construction wastes constitute a large part of urban solid waste materials that need to be properly managed. With the help of investigations, it was concluded that most of the construction wastes in Tankabon city are without relevant considerations and proper management of construction wastes. and destruction are discarded or abandoned in inappropriate places. The volume of production of waste from construction and demolition in our country and region is significant and has many ups and downs, therefore, planning and implementing a comprehensive program for the management of these wastes is a very difficult task, but it is necessary. And it was necessary. Traditional construction method, lack of local and regional laws and guidelines for waste management, low prices of raw materials and low disposal costs, not paying enough attention to the concepts of waste management and design, lack of new and reliable statistics. From the amount of production, the use of old and inefficient machinery is one of the most important problems and reasons for the delay in waste management.

The results of this study are:

I. A large amount of construction waste can be recycled or reused and can be used in different parts of the project.

II. Studies have shown that the use of suitable burial places saves on economic issues and also saves on raw materials.

III. The great importance of construction waste management in the whole world shows that the country of Iran and the city of Tankabon needs more studies in this matter.

IV. Due to the great importance of construction waste, one of the suitable methods for its management is locating their disposal site.

V. Due to the lack of possibility of recycling wastes from construction and demolition in Tonkabon city, it is recommended to use the initial stages of waste management such as reduction, separation and reuse.

VI. According to [9] of the executive regulations of the waste management law, the relevant regulations and guidelines regarding the separation, storage and transportation of construction waste must be followed.

VII. Preventing the accumulation of garbage resulting from construction and demolition inside and outside the city, along rivers, streets, etc.

VIII. In order to achieve sustainability in the construction industry, architects should try to use sustainable materials to reduce waste generation, optimal energy consumption and environmental protection.

Consent for Publication

The authors have given consent for the publication of this manuscript.

Ethics Approval and Consent to Participate

This study does not involve any research conducted on human participants or animals.

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