

MANAGEMENT AND ORGANIZATION OF WASTES RESULTING FROM CONSTRUCTION ACTIVITIES

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Abstract:-

A large volume of construction wastes are generated in most countries of the world for various reasons. But the production as well as management of these wastes are different in various countries. Attention to the waste management causes to the sustainable development of that country in addition to cost savings. Besides the above, environmental issues resulting from the disposal of these wastes double the need to manage and organize these wastes. In this article, we attempted to familiar with different management and organization strategies of the waste.

Keywords:- Management and organization of wastes, Construction activities, Sustainable development.



1- INTRODUCTION

Implementation of development planning is inevitable in any society and amount of performing these activities has a direct relationship with economic status. In other words, the more development projects are carried out in a society with favorable situation. In general, constructions activities can be divided into two categories of demolish and build activities [1].

With the rapid expansion of cities and development of the urban development activities, a huge amount of raw substances and materials are annually consumed in each country and generated a huge volume of construction wastes that all of these cases are added on problems of the city and the costs of transportation and disposal of these wastes, and its adverse effects on the environment and human health can be observed. Wastes from human development activities takes years to get back to the nature. That's why experts are trying to optimally restore it to nature without disrupting the crucial order, while they use these benefits favourably. Thus, management programs and wastes recycling and construction wastes can lead to reducing the costs, increasing the productivity of building materials in the construction industry, sustainable development and preventing the environmental pollution, if they are studied and implemented. For this reason, not only the lack of reusing the construction wastes is a waste of extractable resources, but also is considered a waste of the national capitals [2]. So, we need to investigate the recycling methods of construction wastes which have the lowest environmental problems.

2- Wastes resulting from construction activities

Construction wastes are building and waste materials remained as a result of the construction, demolition, restoration (repair), digging or excavation of the construction activities [3]. Wastes resulting from construction activities consist of two parts:

2-1- Grits: Wastes resulting from (waste products derived from) the destruction of buildings, also known as demolition waste, are called construction wastes. These wastes are a result of the construction operations such as internal changes, repair or demolition of buildings, roads and other structures or these wastes (grits) may be also caused by accidents and natural disasters such as hurricanes, floods, earthquakes and fires in large volumes. These wastes are also known as grits.

2-2- Tails: Materials which have no particular application during the consumption and practically considered as discarded materials are called construction waste (tails) or Perth materials during the performance. Construction wastes include the wastes caused by the construction, reconstruction and repair of residential, commercial structures and other infrastructures such as roads, bridges, dams and etc. More than three billion tons of raw materials are used around the world each year for the production of building materials and its products [4]. It is about 40-50% of the entire global economy [5]. Also, the researches carried out in the world show that the volume of construction wastes among other wastes is 13 to 29 percent. In 1996, it was estimated that 136 million tons of construction wastes from demolition and renovation related to the building were produced in the United States in which 43% is in residential resources and 57% is derived from non-residential resources. In addition, construction wastes of 48 percent of the total include 44% of reconstruction and 9% of new construction. Unfortunately, similar estimates for construction wastes resulting from the construction of non-residential and commercial centers and physical destruction of centers including concrete structures, steel bridges, road infrastructure and cleanup of the site will not be available. It is estimated that not building construction wastes are 2 pounds/per person in a day. With a population of 280 million, the equivalent amount of not building construction wastes in the United States is about 100 million tons per year. The volume of construction waste for repairs and reconstruction of roads in America is about 91 million tons and recycled concrete from 1992 to 1997 was 26 to 100 million tons. Also in California America, wastes constitute about 12 percent of the landfills that make up about 25 percent of the total volume of them. The average weight of construction waste in this state is more than 4 million tons per year. Although America has the greatest waste production in the world, the highest annual per capita waste production belongs to the city of Bombay with 875 kg and New York is in second ranking with 720 kg per capita. In 1996, the total amount of waste for the construction and demolition has been reported 215 million tons in Europe. In 2006, the same production rates of construction waste resulting from demolition of buildings was 970 million tons in Europe [6].

3- Consequences and unpleasant impacts of lacking the management and organization of waste (production and uncontrolled disposal of construction wastes)

3-1- Decrease of existing lands for waste disposal

3-2- Environmental pollution

3-3- Incurring additional costs for governments to prepare the new disposal center

3-4- Allocating the useful lands to disposal centers which have no added value

3-5- Reduce in sources of the new materials especially sources with long return period

3-6- Loss and waste of sources and project costs without adding value or useful output

3-7- Encourage a culture of construction consumption without responsibility

4- Necessities and reasons for considering the management and organization of wastes

Attention to waste recycling is necessary and essential because of various reasons including environmental problems, waste disposal sites, shortage of raw materials, creating an inappropriate prospect, social and political issues, countries' sustainable and economic development, reduction costs, increase of population, and reduction of energy consumption.

5- The positive effects of construction waste management

- 5-1- Environmental development (intelligent use of natural resources, efficiency in energy consumption, limiting environmental pollutants)
- 5-2- Economic development (high efficiency, low costs and higher profits through the utilization of scrap)
- 5-3- Social development (increasing employment level, improving public health) 5-4- increase the efficiency of construction process

6- Identification of factors influencing the construction wastes

Factors affecting the construction wastes will be examined in three influencing factors on creating, an increase in volume and reduce the volume of construction wastes.

The factors affecting in creating the construction wastes:

There is a need for the special division in the course of identifying several factors which led to the creation of waste in construction projects. Relationship of the desired factor with loss of certain types of building materials can be used as a division indicator. Accordingly, effective factors in creating and emerging the construction tails are divided into two categories.

- (A) General factors: refers to the factors that their influence in creating tails has no a special connection with a particular building material and its effect range includes all of the building materials. Some of these factors include neglecting in providing standard materials, lack of program in the construction industry, the use of old technologies, low information and abilities of workers, inappropriate transport, decaying and devastating of plants, excess order of building materials.
- (B) Specific factors: refers to the factors that have a direct relationship with one or more special building materials in creating tails and is not necessarily effective in the loss of other building materials. For example, improper cutting of scrap iron which leads to wasting the variety of profiles and steel plates.

Effective factors on increasing the volume of construction waste:

Several factors are influential in increasing the volume of waste construction which some of them are briefly mentioned:

- 1- The rate of population growth and the increasing need for new residence
- 2- The structure of existing building and demand of the present generation
- 3- Economic factors of people (construction booms more in some areas of the city due to appropriate economic situation of the people)
- 4- Structure of cities are damaged by natural disasters such as earthquake, flood, storm etc. and the high volume of tails is created.
- 5- The low level of public awareness: The main reason for the increased levels of waste and the reluctance of people to recycle is the lack of awareness of public towards environmental issues. The problem of waste disposal and lack of attention to their recycling is much worse in industrial and commercial sectors. Unfortunately, industries are not still realized the economic and environmental benefits of waste recycling.
- 6- Simplicity and cheapness of landfill: Landfill is considered as the first and least painful solution to eliminate the problem of waste accumulation. The landfill has increased rapidly within a few years ago.

This method is much cheaper in Ireland compared to other European countries.

Important factor in reducing the volume of construction waste:

The factors can be effective in reducing the volume of wastes include:

- 1- Procurement of recyclable, durable, and maintainable materials in order to prevent the frequent switching
- 2- Specify the local source suppliers to reduce costs and transport distance
- 3- Check and strict control of incoming and outgoing materials to the warehouse (right warehousing) 4- Appropriate and right transport.

7- Current rules and regulations in the management of building and construction wastes

- 7-1- Note 4 paragraph 2 Article 55 of Municipal Law (Amendment approved 07/08/1973)
- 7-2- Islamic Penal Code, Article 688 (Amendment approved 30/07/1997)
- 7-3- Article 7 of the Law on Amending the safety of Roads and railway
- 7-4- Law of solid waste management
- 7-5- Executive regulations of solid waste management

8- The major producers of development and construction wastes

All natural and legal persons whose efforts permanently or temporarily lead to the production of more than 5 cubic meters development and construction waste per day are referred to a major producer of development and construction waste that we can mention examples including the owners of old buildings, owners of lands ready to build, water and sewage company, electricity supply and distribution company, telecommunications company, gas company, police and armed forces, civil contractors of public and government agencies, building contractors (natural and legal persons).

Methods of waste management

8-1- Management of tails during the performance

8-1-1- Prevention methods

Some prevention methods include public education and comprehensive awareness to reduce and optimize in this part through academic books and advertising programs, industrializing the buildings and attention to the production and consumption standards of building materials, increased skills and experience of master craftsmen, design of space dimensions according to the look at the size of tiles and ceramic in the country.

8-1-2- Recycling methods during the construction

Some methods include the optimization of construction, the use of 3D panels in the walls of building, and so on.

8-2- Debris resulting from the destruction

8-2-1- Prevention methods (policy-making)

- One of the prevention methods includes public education and comprehensive awareness to reduce and optimize in this part through academic books and advertising programs, industrializing the buildings and attention to the production and consumption standards of building materials.
- Each area of the city can have a temporary station for waste discharge. In this method, they can agree to private contractors by putting temporary boxes for waste dump in the city, so that each number of needed boxes in the city should be kept in these areas.
- One of the methods is to develop the effective legislation on the use of biocompatible construction materials and use of these materials in the construction industry. For example, the use of bamboo as a natural material can be noted in parts of the building.
- Apply the encouragement and punishment techniques in order to protect the environment
- By order of the judicial system, vehicles which attempts to illegally discharge waste and causes discomfort for citizens should be confiscated in a specified period to prevent the repetition of such violations.
- Providing information of agencies active on debris transport to citizens in times of licensing, seriousness in the control of debris to determine the framework of practice in the form of system, devoting a proportion of licensing tolls known as special account to account of waste management organization, carrying out agreements between waste management organization with agency owners to deliver temporary stations of waste discharge to the private contractor, so that the waste management organization attempts to transfer debris to the permanent landfill after completing the capacity of temporary stations, preventing the violation of offenders who discharge wastes in virgin land available in different parts of the city.
- Formation of dirt and debris committee consisting of urban services deputy, expert of technical office, expert of renovation organization and repair the old textures, expert of Municipality's waste management, experts of cleanliness headquarters
- Designing a place for the disposal of construction debris, then obtaining necessary approvals
- Establishing laws and regulations for transport and disposal of construction debris and organization of employees in this profession.
- Assessing the volume and type of debris entering the landfill for recycling planning, as well as conducting research on methods of reducing the volume of waste at source and also recycling of production waste.
- Before the destruction, it is necessary that the following steps to be implemented:

Completing the destruction form and submit to the municipality should be sent for city Engineering System Organization, the Environmental Protection Agency and Cultural Heritage Organization at least one month before the destruction. If a particular view was not presented by the three organizations within one month, municipality acts the issuing permits of destruction after reviewing on the ground.

Accordingly, the following steps should be performed by the landowner.

- + Selecting an engineer supervisor to monitor the process of destruction
- + Selecting a contractor for the destruction
- + Selecting a contractor for debris disposal
- + Permission from the municipality for the destruction
- + Informing the surrounding neighbors and shopkeepers of timing and duration of the destruction
- + Beginning the destruction operations with coordinated conditions

If a certain opinion was presented by one of the above organizations, the subject is reviewed in a committee comprised of representatives of the above organizations and implements based on the decisions made.

- Issuance of necessary permits for vehicles to transport and disposal of building and construction wastes, and reviewing routes of vehicles carrying the building and construction wastes, recyclable wastes and sewage, and stopping the cars if they had no necessary licenses and guiding vehicles carrying a variety of building and construction wastes, sewage and sludge into authorized evacuation centers and avoiding the evacuation at unauthorized sites and preventing

violations in each stage of excavation and loading operations; transportation and unloading of dirt and debris are identified and industries and all waste producers are introduced to the organization in order to conclude a mutual contract based on carrying and health and authorized discharge in a designated area

- Creating and building good roads for easy access to places of allowable unloading
- Implementing the recycling plans and transforming construction materials and construction and development wastes
- Issuance of licenses for operations of excavation, loading, transportation and permitted unloading for all kinds of vehicles and handling the violations
- Continuous patrolling and constant control of the main axes, ring roads, bottlenecks in city entrances by special vehicles in cooperation with the enforcement forces of Municipality and the Traffic to identify and stop vehicles active in various stages of dirt and debris, waste, and residues disposal which have no respective licenses. GPS is installed on patrol cars and special trucks for transport trash and patrolling officers control and monitor the city highways by using available cameras in order to monitor and prevent unauthorized discharge of some trespassing truckers based on Memorandum of Understanding between this organization and the traffic control organization. - Increase the useful life of buildings in Iran

9-2-2- Recycling methods during the destruction

In this section, we can work by using the manual destruction for more accurate separation of building materials and step by step destruction of structural components, especially the wall for compliance with safety tips of lacking the reduction and lower damage to the building materials (destruction with minimal damage to building materials). All materials and equipment inside the building should be exited of the building before the start of destruction operations and kept elsewhere. Through using doors, metal corrugated sheets and other components that can be used to separate spaces, a suitable isolated place should be considered for storing debris. Such a way that transmission and removing the debris in them is not difficult. The necessary measures should be taken to avoid mixing building materials and water penetration in these spaces. Building materials which are obtained during the destruction, should be separately (depending on type) distinguished, stored and sent outside of the building at the appropriate time. If this is not possible that all building materials resulting from the destruction are collected in one place due to space limitations and transferred to the building at the end of destruction, the building materials and separated debris can be moved to the recycling place step by step.

9-2-3- Recycling methods after the destruction

Some recycling methods after the destruction are as follows:

- Recycling the concrete debris by using concrete recycled façade
- The use of rubber and plastic recycled building materials as an additive in concrete: The use of rubber can increase some properties in new concrete, such as increase the elasticity, tensile strength, impact strength, and so forth.
- The use of recycled tiles in concrete: Now, researches have been done on the use of recycled tiles and ceramics for decorative floor coverings in some countries that some factories producing the floor coverings are working in some countries, like Denmark.
- The use of brick powder in concrete: Adding the powder brick instead of cement in concrete leads to an acceptable level of reducing compressive strength or abrasion strength and can be used in concrete with normal strength and concretes that require no abrasion resistance.
- Types of plastic spacers of armature: Plastic spacers or armature spacers are recyclable from types of polymeric materials available in construction debris such as plastic products and PVC.
- Water stop: The use of recycled polymers from debris for building the strips of water stop to stop the water of construction joints and concrete expansion.
- Concrete fibers: Types of fibers which are used in two polymeric and metal kinds used in concrete have the capability of production from recycling the variety of polymeric materials and ironware available in the debris. These fibers create properties such as reducing the thermal and implementing cracks in the concrete and increasing the tensile strength, flexural strength and compressive strength of the concrete. Aggregate (using demolished concrete as aggregate): Recycling of aggregate concrete has the ability to reuse in concrete for many cases. If the crushed concrete to be used only as a coarse aggregate, it has no much impact on resistance and other characteristics of concrete also will not be undergoing the major changes. Thus, if it replaces the fine aggregate part, some properties such as compressive strength, tensile strength, modulus of elasticity and shrinkage depending on the replacement rate can increase up to 15 percent. As well as, the replacement of recycled aggregate from demolished concrete reduces the special weight of concrete about 2,100 kg.

10- Waste management in terms of materials

Wastes resulting from construction activities can be separated as follows:

Brick: Brick is one of the most common materials used in buildings and a lot of it are recycled after the destruction. Bricks resulting from the destruction may be contaminated to plaster and mortar and are often mixed with other materials such as wood and concrete. Healthy bricks can be used for new buildings and other purposes. Crushed bricks can be used as filler materials.

Asphalt: One of the materials that can be most probably recycled is the asphalt recycling. In some systems, asphalt is initially poured into two silos which a metal grid placed below them and there is a hot tank with a burner below the metal grid. Asphalt is unpacked after warming and fragmented from the metal grid and separated from bitumen in the materials

sector. The materials are poured on the screws and the materials are completely separated by turning the screws. Then, the riddled materials and the riddled remaining back into the system. The materials under the sieve are stored in a warm silo to reproduce asphalt. This system has the air conditioning system due to air pollution caused by smoke and dust generated. The environmental objectives and benefits of asphalt recycling include construction waste reduction with oil pollution, soil pollution reduction, land's preservation and lack of landfill, reusing the non-renewable resources, job creation, development of recycling industries, reducing the volume of buried materials, the lack of pollution through air purification system itself.

Concrete: Concrete is one of the materials that today is widely used in construction projects. The main components of concrete include sand, gravel, cement and water in which sand and gravel are stuck to each other by cement grout and comes in seamlessly. The importance of concrete recycling becomes more prominent from moment to moment; as the old concretes are eroded or destroyed over the times, therefore, a good strategy for concrete recycling and reusing the recycled materials is vital in different areas of Road & Building.

Plastic: Compared to traditional materials such as wood, glass and concrete, plastic has been almost recently entered to the construction works. A plastic which is usually used in buildings, is called vinyl or polyvinyl chloride. Vinyl (pvc) is a versatile and durable material that can be produced in hard and flexible, textured or smooth and flat and almost in all different shapes and colors. It is used in pipes, piping, channels and fixture, dark windows (no view) and it exists in its soft shape for Flooring and roofing, electrical cable layouts. As well as, it is a material which is often used for water and sewage piping due to the natural low cost and flexibility. Every day, millions of tons of plastic materials after the consumption are stacked in the nature which cause to the environmental pollution due to not returning to the recycling. The chemical composition of these materials is in such a way that no micro-organisms cannot break them down and return to the desired shape, and that means the long-term storage of these materials in nature. Unfortunately, damages caused by these materials are more in urban areas than the rural areas due to the large volume of materials used, and large amounts of these materials are easily buried in different places without any attention to the their damages that imposed a lot of damages and losses on human health and ecology cycle. Thus according to the mentioned cases, collecting and processing of plastics are the most important environmental principles that should be considered.

Some environmental objectives and benefits of plastic recycling include air pollution reduction through not burning this type of wastes, soil pollution reduction through the elimination of late biodegradable wastes and heavy metals from the environment, Reduction of burial of late biodegradable materials and reducing the volume of burial materials, increasing the life of landfill sites, reducing the consumption of natural resources by plastic recycling, job creation, development of recycling industries, reusing of materials and saving in the consumption of primary raw resources, lack of the pollution of recycling industry.

Wood: Resources of wooden, industrial and household wastes include cabinets, lockers, furniture, pallets, and old wooden boxes that are discarded as well as boards used in the construction or destruction of buildings. Here, the mean of wood industries and wood products is sawmills, factories making appliances and wood products such as boxes, pallets as well as factories making furniture and interior decorating of building.

The wood tails such as straw and sawdust and wood chips are applied as a valuable raw materials in the production of many wood products. Reprocessing of a wood that is part of the wood products production industry in a few recent decades greatly leads to recycling the wood wastes of sawmills and other industries related to wood. Assuming the successful isolation and absence of infecting such wastes, the wood wastes could theoretically find many applications as a new wood. At present, the tails' applications of the wood industry include:

- 1- Construction of wooden planks: There are large factories for making planks that produce OSB, MDF, plywood, and chipboard. The factories use part of the wood wastes etc. as a part of their raw materials. Although the high quality and clean wood waste products are often accepted from these factories, there is the possibility of recycling urban wood wastes in these factories.
- 2- Preparation of mulch and peat: Wood processing wastes are used in several companies to produce mulch (a material that is used as soil cover to contain the flowing sands) and peat. Preparation of mulch contains chopping the wood wastes to small particles so that they could be used as ground cover or decoration in outside of the house. Mulch is valuable because of its appearance. Several factories produce decorative colored mulch. Moreover, mulch prevents the growth of weeds. Wood waste products that appropriately shredded and grained can be used as filler and a carbon source in the production of peat. Several factories making fertilizers are ready to accept wood wastes.
- 3- Reusing the wood wastes: There are factories which are active in the field of repairing pallets. Some of these companies recycle a percentage of the collected wood pallets. The wood pallets are opened from each other and used with the new materials to build new pallets.
- 4- Wood as a fuel: Wood wastes are used in many factories as fuel. This is true especially in the case of wood processing plants, sawmills, and etc. This reduces their need to power consumption and storage of wood waste. Wood wastes are pollution-free, clean, and low-sulfur fuels. A number of sawmills use the burning of wood waste products as a heating source and for drying lumbers in kilns.

The new technologies are provided for the combination of wood wastes and non-wood materials that produce various composite products. Some innovative composite materials that have spread at international level include:

- 1- Plastic composites and wood fibers: The use of recycled wood, as a filler and amplifier in the thermoplastic plastics, is a new initiative. Thermoplastics such as light and heavy polyethylene (LDPE and HDPE), polypropylene and polystyrene can be combined with recycled wood. Polyester terephthalate (PET) which is usually used to make soda bottles, is not suitable for this task, because the melting temperature of this polymer is higher than the decomposition temperature and reduction of the wood properties. The use of wood fibers, as fillers and amplifier, decreases raw material cost and increases strength and rigidity of the material. Construction of composite products made of mixed recycled wood fibers and plastic costs about 1/3 to 1/6 times in manufacturing the pure plastic product. However, composite materials are not without problems. But, it does not matter for most applications. The combination of wood and plastic may also be difficult. The recycled composite material can be recycled repeatedly without reducing its properties. It can be used to build products that currently are only made with plastic. Conventional production equipment can be used to manufacture these products with a little change or even without any changes. Several species of new building materials of this type have successfully found their way to the market in America, including roof covers, windowsills, and door frames. They are made from recycled materials one hundred percent, have high resistance against weather factors and fire, and do not need to repairing and maintenance.
- 2- Wood composites with inorganic background: The wood composites with inorganic background are composites that enjoy from a material or a mineral mixture as the background. Three types of materials that are most commonly used as background composites include magnesium oxide, gypsum and Portland cement. Both of magnesium oxide and gypsum are sensitive to the moisture and products made from these materials are usually used for interior and exterior applications. All products with inorganic background have high resistance to fire, insects and other pests. Wood composites with cement background are used in a wide variety of buildings. In Philippines, cement boards usually are made manually by workers and used in the construction of cheap houses. In Japan, these components are produced automatically and used in the construction of precious houses. Diversity in manufacturing methods of the component provides the possibility of using recycled wood. The high-quality cement boards can be produced by less experienced workers, low capital and basic tools in small scale, and more advanced technologies to be used in the case of market development of this product, and increased productivity. Workforce can also be trained simultaneously with the gradual use of sophisticated technologies.
- 3- Pulp and paper production: In the past, 78 percent of the primary sources of pulp and paper production plant was financed by urban recycling woods, but now this amount has fallen to 33 percent. The main problem of using these materials is the presence of pollution in them, the need for raw materials with certain size, inadequate mixing of wood of trees particles and recycled wood and ultimately the lack of uniformity in recycled wood.
- 4- Other uses: Less valuable wood chips can be used to temporarily cover roads and paths and in animals' pastures, farms and other areas that dirt in them becomes difficult in rainy conditions. Also, these materials are used to cover the hippodrome, the floor of livestock complex etc.

Wood waste is highly valuable. The market of these wastes is already exists in several sections. However, there is a background for increasing the share of wood wastes in the markets as well as opening new market opportunities for recycled wood. Opportunities available for wood wastes include creating the further application in the manufacture of chipboards and MDF, increasing use in landscaping and gardening as mulch, using as filler and a carbon source making peat and establishing rules for increased use of recycled and remade wooden beams.

Conclusion

Human construction activities as well as excessive disposal of construction wastes have created several problems. Thus, attention to the management and organization of wastes is vital. To manage these wastes, the coordinated and effective measures should be done to not make problems and disruption in order and beauty of the city. Undoubtedly, management programs and recycling the construction waste and debris can increase productivity of building materials in the construction industry and prevent environmental pollution if to be studied and implemented.

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