

Construction waste recycling and utilization

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Abstract. People's living conditions and the popularization of infrastructure are regarded more and more as China's economy and culture improve. There are also increasing building demands. However, as there are more and more structures, rubbish production increases. There are steps that must be done to deal with the trash produced in building as people's knowledge of environmental friendliness and resource reuse increases and as the impact of construction waste on the entire ecological environment cannot be disregarded. In the past, concrete, asphalt, and other specific types of building debris were the main focus of research and reviews on construction waste and recycling. Despite certain research will consider a wider range of categories, they are not in-depth enough to analyze their essence. This research integrates the classification of building waste and takes its reuse into consideration in comparison to other studies and evaluations. This essay examines recycling of demolition debris and construction debris. Among these, construction debris is split into four categories: excavation of land, road maintenance and destruction of old buildings, buildings, unusual structures. This paper is a more thorough examination of all pollutants connected to the building sector. The recycling of demolition debris is separated into four categories: Housing development, Building roads, Recycled paper, Production of agriculture; Housing development makes up the major chunk of them. With the help of this paper, all construction-related departments should make every effort to eliminate construction pollution at its source. Relevant professionals in the building sector may also recognize how their profession negatively affects society.

Keywords: Construction waste; excavation of land; road maintenance; destruction of old buildings.

1. Introduction

People's living conditions and the popularization of infrastructure are regarded more and more as China's economy and culture improve. There are also increasing building demands. However, as there are more and more structures, rubbish production increases. There are steps that must be done to deal with the trash produced in building as people's knowledge of environmental friendliness and resource reuse increases and as the impact of construction waste on the entire ecological environment cannot be disregarded. On the Internet nowadays, there are several publications regarding how to lessen building waste in various nations, but this essay focuses mostly on China [1]. As it is a new business, the waste produced by various construction kinds and situations is diverse. Therefore, certain issues should be examined by us. Find the logical relationship at the bottom, as well as the problems that exist and the solutions that should be used.

As an illustration, pertinent departments create matching policies, Reputable environmental protection businesses should also work to increase the garbage's recycling rate. Europe has done a terrific job in this area. Rabia Charef authored a piece regarding the improvements made by the British government to safeguard the environment throughout the world using the BIM and CE platforms [2]. There are literatures that describe the actions of these firms, and some companies have launched reward and punishment measures in this area some years ago [3]. Relevant scientists can also investigate a sizable portion of the industry and do their best to identify substitute materials that are less polluting. To handle them, various government departments need develop relevant policies. Of course, some areas have established regulations in this area and achieved successful outcomes, such as Hong Kong, China [4]. The kinds and amounts of waste produced vary over the entire spectrum of building. Varied building kinds, different building structures, and even various construction environments all have their own unique characteristics.

In the past, concrete, asphalt, and other specific types of building debris were the main focus of research and reviews on construction waste and recycling. Despite the fact that certain research will take into account more categories, they are not in-depth enough to analyze their essence; For example, Lau H.H. offered an excellent piece, but it is exclusive to the housing industry [5]. The research integrates the classification of building waste and takes its reuse into consideration in comparison to other studies and evaluations.

The rubbish produced throughout various stages of new building construction is the main topic of this essay's two main sections. The building waste will first be categorized. Second, a variety of fields related to the secondary exploitation of building waste are investigated and discussed.

2. Construction debris

Every building that is constructed from scratch generates a significant amount of waste, it is vital to classify these wastes in order to dispose of them responsibly and encourage reuse. The trash produced varies depending on the various building types and the various construction techniques. Garbage is categorized using a variety of guidelines and criteria. Individuals have varying standards. Prior to that, Australian Davis utilized the convolutional neural network (CNN) categorization system, which I found to be useful [6]. The following classification is developed following extensive research and data gathering.

2.1. Debris from excavation of land

There may be excavation issues during building construction due to the height difference between the old foundation and the design foundation, and the removed soil layer is divided into topsoil for planting and deep soil for backfilling and landscaping.

2.2. Debris from road maintenance and destruction of old buildings

The old buildings and roads have almost surpassed the time required for upkeep and reconstruction due to the extensive building construction in the last century. Bricks, stones, concrete, wood, plastics, gypsum and mortar, roof wastes, steel, and non-ferrous metals are the principal wastes in the house building sector. Waste concrete blocks and waste asphalt concrete blocks from the excavation of asphalt roads are the two primary types of waste blocks found in the road rebuilding and maintenance area.

2.3. Construction debris from buildings

There is a good chance that various types of waste will be produced throughout the entire construction process, whether it be the repair and demolition of old buildings or the construction of new buildings. This waste includes concrete that has not been used up in the project or concrete that has been suspended and not used in time due to weather changes, old concrete produced during chiseling and plastering Mortar mineral materials, and surplus wood, metal, paper, or o; For instance, a study based in the Netherlands was reported in an article. It measured the amount of money lost on building trash as a percentage of all construction waste. Table 1 shows the costs of waste of fraction as percentage of total waste costs.

Table 1. Costs of waste of fraction as percentage of total waste costs [7]

Application of construction material	Costs of waste
Stone tablets	26
Piles	13
Concrete	7
Sand-lime elements	8
Roof-tiles	13
Mortar	5
Stand-lime bricks	3

2.4. Garbage produced by a few unusual structures

Diverse types of buildings produce different types of construction debris, including those made of steel, bamboo, wood, and raw earth. There are still many locations where these constructions are employed, albeit being less frequent than reinforced concrete structures. For instance, tuzhangfang, a type of home building, is found in the Yi nationality area of China's minority zones; it will serve as the site of the 2008 Beijing Olympic Games' opening ceremony.

The industrial manufacturing process and the deconstruction of ancient structures produce the majority of the waste in steel structure buildings. All leftover wastes from the smelting of different metals, such as blast furnace slag, steel slag, other non-ferrous metal slags, ferroalloy slag, cupola slag, and miscellaneous dust and sludge, are considered industrial wastes. mining waste residue produced during the extraction of different ores and coal, including waste rock from stripping, excavation, coal gangue, and mineral processing, as well as waste rock from washing. produced by the burning of gasoline Coal slag, flue ash, pulverized coal slag, and shale ash are the primary components of fuel waste slag; Sulfuric acid ore slag, calcium carbide slag, alkali slag, gas furnace slag, phosphorus slag, mercury slag, Ming slag, salt mud, sludge, and boron slag are the principal chemical wastes discharged from the production of the chemical industry; in industrial solid waste. Additionally, it contains construction waste plum, glass waste residue, ceramic waste residue, and paper waste residue. Many regions and nations are eager to utilize this trash, such as Brazil. Table 2 shows the construction waste of specific material as percentage of total purchased amount of specific construction material in Brazil (by Weight) [7].

Table 2. Construction Waste of Specific Material as Percentage of Total Purchased Amount of Specific Construction Material in Brazil (by Weight) [7].

Construction material	Pinto (1989)	Soibelman et al. (1994)	Pinto and Agopayan (1994)
Steel	21%	16%	26%
Cement	25%	46%	33%
Concrete	1%	12%	2%
Sand	28%	31%	28%
Mortar	50%	48%	46%
Ceramic block	-	21%	-
Brick	11%	23%	12%
Timber	-	-	32%
Hydrated lime	-	-	51%
Wall ceramic tile	-	-	9%
Floor ceramic tile	-	-	7%

There will be more or less surplus in the bamboo and wood structures because the rate of scrap and other construction-related elements can't be fully predicted by us. The scrap rate and other factors

during construction a few surviving wooden beams and columns, for instance; besides the dust created during building.

Constructions made of raw dirt are less frequent than other structures. Tuzhangfang is one of the ethnic minority buildings described above. The foundation of this kind of structure is normally stone, and the wall is constructed from adobe or earth. Beams are used to construct the wall, and wood, wood strips, or bamboo are used to cover the beams. A layer of earth acts as the pavement on top. The platform roof is built without rain leaks after watering and pounding. Additionally, the roof is tan. Large beams may be supported by wooden pads, built on wooden columns, covered in thatch or straw, covered in mud, and finally hammered with fine soil. A few of them have two or three levels, and the majority are bungalows. There will be a ton of extra crushed stone in such structures, including topsoil for planting and deep soil for backfilling and landscaping.

3. Recycling of demolition debris

China's main cities generate more than 5 billion tons of building trash annually due to the country's economy's rapid development. Construction debris is directly buried without any treatment as a mixture of different decorative building materials, which not only harms the environment but also represents a significant resource waste. Reusing construction waste as a renewable resource after categorization and recycling is an efficient strategy to conserve resources and protect the environment; for instance, Italy fully used the debris left over after demolition [8].

In China, a great deal of homes is constructed in the last century, and as the years went by, a great deal of those homes started to age. The old community's transformation came next. A large amount of work has been done on centralizing settlement and relocating villages as urbanization in China has started to spread to urban areas at the same time. Due to the lack of room in the backfill layer, a significant proportion of trash cannot be processed centrally as a result of the substantial amount of building and decoration waste that will be produced. If building trash can be recycled repeatedly, it can lessen the risk of re-pollution brought on by home garbage in addition to solving the issue of land resources being taken up by landfills.

3.1. Housing development

There will be more or less surplus wood produced because the amount of wood needed for the construction project cannot be accurately anticipated by us. The wood wastes that don't have any evident damage can be used right away for construction. For instance, Annette Hafner based one of her articles on the ideas generated by the destruction of a wooden home in the Alps [9].

Waste building materials like waste bricks and cement concrete can be produced and processed into recycled coarse and fine aggregates that can then be used to create building materials like block bricks, slab walls, and floor tiles or cement concrete and cement mortar with relatively high compressive strengths. All aggregates in recycled concrete are recycled aggregates; coarse aggregate is recycled aggregate; and fine aggregate is natural sand. This depends on the combination form of aggregate. Natural gravel or pebbles serve as the coarse aggregate, while recycled concrete serves as the fine aggregate. A portion of fine or coarse material is replaced by recycled aggregate. Waste concrete blocks offer numerous benefits in addition to being a high-quality concrete aggregate. For instance, high-quality concrete blocks and silty sand from the building's dismantling can be utilized to regenerate concrete after crushing and screening. Large quantities of fine powder can be utilized directly as the cement's raw material in addition to coarse and fine aggregates. Concrete made using recycled aggregates and recycled cement can both move on to the following cycle. All garbage will be released to zero throughout the cycle.

Several types of environmental protection bricks, including lawn bricks, square bricks, blind hole bricks, permeable bricks, partition bricks, module bricks, thermal insulation bricks, and block bricks, can be made using concrete, cement, and other wastes from the construction after reasonable crushing, screening, and crushing.

3.2. Building roads

After being mixed with the solidified materials, the recycled coarse and fine aggregate can also be used for the base of the road surface. Perform a preliminary cleaning of the construction waste, separate the recyclable steel bars and wood, crush the remaining bricks, cement, and concrete into aggregates using specialized crushing and sand-making equipment, and screen the resulting material to remove impurities. The used ground asphalt concrete can either be processed into recycled aggregate by expert crushing equipment and then configured as recycled concrete in an appropriate proportion, or it can be used directly as recycled asphalt concrete in the suitable proportion. In the application, cement, fly ash, and other auxiliary materials are added to the raw materials in accordance with the requirements of the grading design, and then water is added for mixing. This allows for the production of various building and road construction products and the complete replacement of common sand and gravel as the road base, previous publications touched on the features of recycled aggregate [10].

3.3. Recycled paper

The seriously damaged material can be utilized as a raw material to make paper or wood-recycling boards. The types of wood used to make paper are extremely varied, and some old wood that has been recycled will be utilized because waste wood can be recovered and is a sustainable resource. They may also be utilized as raw materials in the manufacture of paper. Utilizing discarded wood promotes environmental conservation while also adding value economically. The advantages of recycling wood were also discussed in September of this year by Chiara from Aalto University in Finland, who considered them from a worldwide standpoint [11]. Paper can be processed using extra construction wood, residual supplies, trash tables, wooden furniture, etc.

China has a wide variety of tree species, thus different regions' prevalent engineering wood species also differ. It typically originates from one of the following three types of materials: First, wood: Coniferous wood and broadleaf wood are the two types of wood. Coniferous trees include Chinese fir and various pine, spruce, and fir; broad-leaved trees include oak, Manchurian ash, camphor, sassafras, and numerous birches, nanmu, and poplar. By using a wood chipper, the wood is converted into chips, which are subsequently converted into pulp, which is then used to carry out the chemical reaction. The paper can be converted into regular paper after a series of modulation operations.

3.4. Production of agriculture

Much silt and dust will be produced while structure is being constructed. Construction waste can be separated into sludge and stone powder, which can then be used as raw materials for crushing. To create construction waste recycling planting soil, additional wastes (mostly sludge from sewage treatment plants, waste residue from distilleries, and food factories) and trace elements of peat soil are added and blended in a specific mass ratio. In addition to having the qualities of natural soil, it also has great water retention, good ventilation, and high fertilizer efficiency. Reclaimed planting soil satisfies the requirements for high-yield farmland fertility and meets or exceeds national soil standards.

4. Conclusion

The easy living and excellent conditions that have come with human civilization's fast progress have created several environmental risks. For instance, the overuse of coal resources, the loss of many species of life, and global warming. In order to safeguard the environment, this study separates and thoroughly examines the waste produced by buildings, each category also includes analysis and integration. Four categories: Debris from excavation of land, Debris from road maintenance and destruction of old buildings, Construction debris from buildings, and Garbage produced by a few unusual structures used to group the entirety of the building trash, and each category is also thoroughly examined. The earth's resources are dwindling due to global population growth and the

quick development of several businesses. Therefore, we should decrease the waste produced during building from the outset and do all possible to achieve the maximum recycling rate possible in order to promote the long-term growth of the planet and humanity. Construction debris that may be recycled is separated into four categories: Housing development, Building roads, Recycled paper, and Production of agriculture. The public should have their own concept of environmental protection and that various organizations and departments can develop matching policies and laws to address this idea based on the study presented in this paper, in order to reduce resource waste and the progression of a number of environmental challenges, such as global warming.

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