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Utilization Of Construction Waste: Global Experience

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Abstract
The article examines modern approaches to the utilization of construction waste based on global experience. The main methods of recycling construction and demolition waste, as well as the specific features of stationary and mobile processing equipment, are analysed. Particular attention is paid to the classification of recycled fractions and their application in the production of building materials and road construction. It is shown that the recycling of construction waste reduces environmental pressure, decreases landfill volumes, and ensures the efficient reuse of secondary mineral resources. The prospects for implementing international experience in the utilization of construction waste under the conditions of Uzbekistan are also discussed.
Keywords: utilization, recycling, construction waste, stationary equipment, mobile equipment, fractions.

Introduction

Rapid urban development and intensive construction activities have led to a significant increase in the volume of construction and demolition waste worldwide. The demolition of obsolete buildings, renovation of existing infrastructure, and construction of new facilities generate large quantities of solid waste, making construction waste management one of the most urgent challenges faced by modern cities. Without proper planning and regulation, the accumulation of construction waste poses serious environmental, economic, and public health risks. Therefore, prior to the commencement of construction works, it is essential to determine not only the logistics of waste removal but also effective and environmentally sound methods of its utilization.

Unlike household waste, which is generally considered relatively safe for human health, construction waste often consists of heterogeneous and potentially hazardous materials. These include crushed bricks, concrete fragments, reinforced concrete elements, metal residues, bent steel reinforcement, linoleum, wallpapers, paint containers, insulation materials, noise-absorbing panels, waterproofing components, and various chemical-based construction products. Many of these materials may contain toxic substances or pose mechanical hazards, thereby requiring special handling and disposal measures. According to the classification provided in the Appendix to the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 14 dated January 21, 2014, a significant portion of construction waste falls under hazard classes I (highly hazardous), II (hazardous), and III (moderately hazardous). This classification highlights the necessity of implementing advanced waste management strategies rather than relying solely on landfill disposal.

Traditional methods of construction waste disposal, primarily involving landfilling, are increasingly regarded as unsustainable. Landfills occupy large areas, contribute to soil and groundwater contamination, and fail to address the depletion of natural resources. In contrast, recycling and reutilization of construction waste provide a more rational and sustainable solution. Recycling, or the process of returning construction waste into secondary production cycles, enables the transformation of waste materials into valuable secondary raw resources.

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This approach aligns with the principles of sustainable development and the circular economy, which emphasise waste minimisation, resource efficiency, and environmental protection.

The economic advantages of construction waste recycling are also substantial. Recycling reduces costs associated with waste transportation, landfill fees, and the extraction of natural aggregates. In many cases, demolition and new construction activities take place at the same site, creating an opportunity to reuse processed concrete and brick waste as aggregates for foundations, road bases, and backfilling works. This practice not only lowers material costs but also decreases energy consumption and greenhouse gas emissions associated with raw material extraction and long-distance transportation.

International experience demonstrates that construction waste recycling has become an integral component of modern construction practices in many developed countries. The widespread use of stationary and mobile recycling equipment has enabled efficient on-site processing of construction waste, ensuring high recovery rates and the production of recycled materials with stable quality characteristics. These practices have proven their effectiveness in reducing environmental impact while maintaining economic feasibility.

In the context of Uzbekistan, the issue of construction waste utilization is gaining increasing importance due to rapid urbanisation and large-scale infrastructure development. The adoption of advanced recycling technologies and international best practices offers significant potential for improving waste management systems and enhancing the sustainability of the construction sector. Therefore, the study of global experience in construction waste utilization and its adaptation to local conditions represents a relevant scientific and practical task.

Materials and Methods

This study is based on a comprehensive analysis of construction and demolition waste management practices, with a particular focus on recycling technologies and equipment used in different countries. The research materials include construction waste generated during the demolition, reconstruction, and construction of buildings and infrastructure facilities. The primary types of waste considered in the study are reinforced concrete, brick debris, asphalt concrete, metals, glass, plastics, insulation materials, and composite construction products.

The methodological framework of the study involves a combination of analytical, comparative, and descriptive research methods. At the initial stage, construction waste was classified according to material composition and hazard level in accordance with national regulatory documents of the Republic of Uzbekistan. Special attention was paid to waste categories belonging to hazard classes I–III, which require controlled handling and utilization.

The technological methods analysed in this study include mechanical processing of construction waste, such as crushing, grinding, screening, and separation. Reinforced concrete waste was considered as a key material due to its high recycling potential. The processing sequence includes preliminary dismantling using hydraulic hammers or hydraulic shears, followed by crushing in jaw, cone, impact, or hammer crushers. Magnetic separators were taken into account as an essential component of the recycling process for the removal of ferrous metal elements from crushed material.

Both stationary and mobile recycling systems were analysed. Stationary recycling complexes were evaluated based on their productivity, level of automation, and ability to produce standardised recycled aggregates. Mobile recycling units were assessed in terms of operational flexibility, on-site applicability, reduction of transportation costs, and suitability for urban construction projects. Different types of mobile crushing equipment, including jaw, cone, rotor, roller, and impact-centrifugal crushers, as well as vibrating screens, were considered.

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The fractionation of recycled materials was analysed by dividing processed waste into size fractions suitable for specific construction applications. Fine fractions (up to 10 mm), medium fractions (5–20 mm and 20–40 mm), and coarse fractions (40–70 mm) were evaluated in terms of their potential use in landscaping, soil stabilisation, drainage systems, road construction, and as fillers in concrete structures.

In addition, regulatory and policy documents related to waste management were reviewed, including the Strategy for Solid Waste Management in the Republic of Uzbekistan for the period 2019–2028. This allowed the assessment of institutional and legislative conditions for the implementation of construction waste recycling technologies under local conditions.

Results and Discussion

The analysis of construction and demolition waste utilization demonstrates that recycling provides significant environmental and economic advantages compared to traditional landfill disposal. The results indicate that the largest share of construction waste consists of mineral materials, particularly concrete, reinforced concrete, and brick debris, which possess high potential for secondary processing and reuse in construction activities.

The conducted assessment shows that on-site recycling of construction waste substantially reduces transportation and landfill costs. Since new construction projects are often implemented on the same sites where old buildings are demolished, recycled concrete and brick materials can effectively replace natural crushed stone in foundation layers and road base applications. This approach not only lowers material procurement costs but also reduces the consumption of natural aggregates and associated environmental impacts.

Table 1. Utilization of recycled construction waste fractions and their applications

Fraction size (mm)	Type of recycled material	Main application area	Technical advantage
0–10	Fine crushed concrete, brick dust	Landscaping, decorative layers	Improves surface stability
5–20	Recycled concrete aggregate	Soil stabilisation, sub-base layers	Increases bearing capacity
20–40	Crushed concrete and brick	Drainage systems	High permeability
40–70	Coarse recycled aggregate	Road base layers, concrete filler	Load distribution, durability

The processing of reinforced concrete waste proved to be particularly efficient when a combination of hydraulic dismantling equipment and crushing units was applied. Large reinforced concrete elements were initially fragmented using hydraulic hammers or shears, after which the material was fed into crushing installations. The use of magnetic separators ensured effective removal of steel reinforcement, allowing the production of cleaner recycled aggregates suitable for further use. The obtained fractions demonstrated satisfactory physical characteristics for application in various construction processes.

The fractionation analysis revealed that different size fractions of recycled materials could be effectively utilised for specific purposes. Fine fractions up to 10 mm were found to be suitable for landscaping and decorative applications. Medium fractions ranging from 5–20 mm contributed to soil stabilisation and improvement of bearing capacity, while fractions of 20–40 mm were effectively applied in drainage systems. Coarse fractions of 40–70 mm showed good performance as fillers in concrete structures and as base layers in road construction. These

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findings confirm the versatility of recycled construction waste and its adaptability to different construction needs.

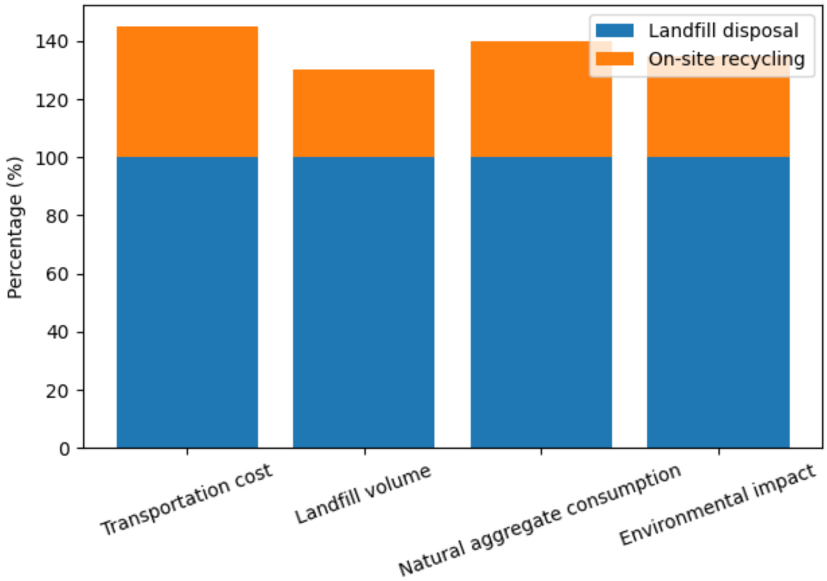

Figure 1. Reduction of construction waste impact through on-site recycling

The reuse of asphalt waste also demonstrated positive results. Thermal treatment of reclaimed asphalt pavement allowed the restoration of its binding properties, making it suitable for reuse in road construction. In cases where material properties deteriorated, the addition of stabilising and binding agents improved performance, thereby extending the service life of recycled asphalt materials.

A comparative analysis of recycling equipment showed that stationary plants provide high productivity and stable quality of recycled materials due to advanced sorting and processing systems. However, mobile recycling units offered greater flexibility and economic efficiency, particularly in urban construction projects. Mobile equipment eliminated the need for transporting waste to distant recycling facilities, resulting in reduced fuel consumption, lower emissions, and decreased operational costs. These advantages make mobile recycling systems especially suitable for large-scale residential and infrastructure projects.

From an environmental perspective, the results indicate that construction waste recycling significantly reduces the volume of waste disposed of in landfills, thereby mitigating soil and groundwater contamination risks. Additionally, the reduction in natural resource extraction contributes to the preservation of non-renewable materials and supports sustainable construction practices.

In the context of Uzbekistan, the findings highlight the strong potential for implementing construction waste recycling technologies. The alignment of recycling practices with national waste management strategies creates favourable conditions for the development of an efficient recycling infrastructure. The adoption of both stationary and mobile recycling systems can significantly improve construction waste management and enhance environmental and economic sustainability in the construction sector.

Conclusions

The conducted study confirms that the utilization of construction and demolition waste through recycling represents an effective and sustainable solution to the growing waste management challenges associated with rapid urban development. Construction waste, particularly mineral materials such as concrete, reinforced concrete, and brick debris, possesses high potential for secondary use and can be successfully transformed into valuable construction resources.

The results demonstrate that recycling construction waste significantly reduces the need for landfill disposal, lowers transportation and material procurement costs, and decreases the consumption of natural aggregates. The use of stationary and mobile recycling equipment ensures efficient processing of waste materials and allows the production of recycled aggregates with properties suitable for various construction applications, including foundations, road bases, drainage systems, and landscaping works.

Mobile recycling systems, in particular, offer substantial advantages under urban construction conditions by enabling on-site processing, reducing environmental impact, and improving economic efficiency. The classification and utilisation of recycled fractions according to their size further enhance the versatility and practicality of construction waste recycling.

In the context of Uzbekistan, the implementation of construction waste recycling technologies in accordance with national waste management strategies can significantly improve environmental protection, resource efficiency, and sustainability in the construction sector. The adoption of international best practices, combined with the development of appropriate regulatory frameworks and technological standards, will contribute to strengthening national resource security and improving the quality of life of the population.

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