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REVIEW ARTICLE

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Reuse of Building Materials as A Concept of Sustainability: A Review

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Abstract

The study stresses reusing building materials as much more vital than previously thought for sustainable construction activities and urges more knowledge and awareness from stakeholders to be sure that these strategies will be put into practice. The study emphasizes the reuse of building materials as an important aspect of sustainable construction and does need to ensure a higher awareness and knowledge among the stakeholders for proper implementation of these strategies. The study has several recommendations as follows: the need to develop new strategies in promoting the reuse of construction materials and applying sustainable solutions for saving natural resources and reducing carbon emissions. It also recommends further research that would assess the potential for reuse of construction materials after its lifespan from a focus on factors conditions, costs and regulations that would have an impact on them.

Keywords: Sustainable Construction, Building Material Reuse, Circular Economy, Waste Management in Construction, Environmental Impact of Construction

1. Introduction

In the last years, raw material use has increased due to population growth and key developments taking place. The need for protecting natural resources of our planet — and finding alternative solutions — has never been higher. A major step in solving the problem of waste generation is returning quality "materials" or "products" back into circulation so that they can be resold [1]. The reuse of building materials responds to this context: it involves environmental issues, but also questions of economic viability, social responsibility and cultural heritage. Whatever the further interpretation of the built object may be, materials represent an important element in space design and formation. Building materials make up space, giving it definition through texture as well as color and light. Materiality constitutes an intrinsic part of space conceptuality on an ontological level; thus, materials have a double role in architecture: physically and semantically [2].

Architectural reuse is often viewed as a way to sustain cultural and architectural heritage. In Western culture, there is, in general, a sharp differentiation made between the so-called "reference" buildings (which by definition cannot be altered without the approval of preservation organizations) and more modern buildings (deemed disposable) that are often abandoned and ultimately laid down. This

division obscures that, in the end, the vast majority of late 20th-century buildings will acquire an increasing residential value on purely aging grounds. Which might justify a conservation approach (even if such a building does not usually have heritage value in the strict sense) [5]. The paradigm shift does not imply transfer from one sphere to another in a direct/one-to-one way between policy making/public and individual buildings/real estate.

Architectural reuse is often considered a way of preserving cultural and architectural heritage. In Western culture, there is a general distinction made between the so-called reference buildings (which by definition cannot be altered without the consent of preservation organizations) and the rather modern ones considered expendable, which are likely to fall into disuse and be removed. This division overlooks that the great majority of late 20th-century buildings will eventually acquire significant heritage value simply as they age, which may justify a conservation approach (even if such fabric generally never has heritage value in the strict sense) [5]. The change in paradigm does not entail any automatic transfer at an individual building or policy-making level towards the public realm/involvement.

2. Methodology

This paper presents a review on reclaimed building materials with an approach to recycling and reviews the literature on waste materials: reusable and recyclable. It describes producers of deconstructive initiatives in North America opportunities presented by reuse, is a visual compendium of building materials also deals with decomposable structures equitable items. Reviews views and vision is presented in this paper on deconstruction initiatives for reuse: auto-decomposition for new construction, literature on reusable waste building material behaviors based by building materials Association Federation Proceedings and cases equitably dealt with as reusable. It summarizes the most important topics, methods, and findings on reusing building materials and organizes them. The framework will understand and implement reusing building materials in the built environment, public health, and occupational safety.

3. Literature Review

The circular economy is a viable solution to the enormous amount of waste generated by construction and demolition through the reuse of materials in their old place rather than burying them in landfills. The continuously increasing world population and rapid urbanization have put forward serious challenges for housing and infrastructure, such as reusing old building materials which is very important for sustainable development and achieving environmental safety goals. Materials reuse can provide artistic value, evoke emotional responses, conserve energy, and save resources: information about this is what architects are already implementing when reusing but do not accompany their actions. In some cases, it may be necessary to involve various stakeholders' groups so that they could intervene with the shortcomings gathered during a wide distribution. One such model could be creating knowledge-based platforms to propagate refurbishment and back up both industry as well as academy.

3.1. Definition of Reuse in the Context of Building Materials

The construction industry consumes a large amount of resources and generates a large amount of waste. However, recycling and reusing building materials is becoming increasingly important as an environmentally friendly and economically viable option. There are several approaches to reusing building materials in the existing literature. Reuse can be defended from a broad and unrestricted perspective, focusing on potential users and applications. This may include many types of materials that are not usually associated with reuse in the commercial market. Other approaches restrict the concept of reuse to items

that do not require material transformation before reuse. These texts approach the topic of reuse from a technical perspective and argue that recycling may be an impractical option for many building components. These processes are often capital intensive and require fundamental technological innovations [8].

Other documents apply the concept of reuse more strictly, limiting it to the formal reuse of components during the construction process. Reuse here can include used and demolished building components, which are often bought back during construction bidding. Compared to the broad and practical use of certain types of reuse in the previous literature, the focus of the concept of reuse here is narrower. Similarly, reuse can also be defined as the minimum set of transformation types that a material/component can undergo before being reintegrated into the industrial material chain. From this point of view, building materials can be reused in their original state. It is also clear from the above definition of reuse that reuse does not require the large economic efforts associated with the reuse of previously abandoned structures, without fully addressing the reuse of building components/materials/free structures to achieve the above goals [9].

Depending on the type of human intervention, the reuse/recycling of materials can also be distinguished. Some reused products/materials do not require conscious human intervention, the material/component itself is discarded and the natural environment takes care of its new use. Many examples can be found in proposals for the reuse of building materials, such as facade stones from eroded slopes, vegetation along sidewalks, abandoned building stones from fish ponds, and large amounts of waste stone [10].

3.2 Importance of Reuse in Sustainable Construction Practices

The construction industry contributes significantly to the global economy by providing housing and infrastructure that improve the quality of life. However, with the growing population and GDP, the demand for construction services is also growing rapidly. According to reports by the International Energy Agency (IEA) and the United Nations Environment Programme (UNEP), buildings consume more than 30% of the world's total energy. Depending on the geographical region, the global construction industry can contribute up to 30% of carbon dioxide emissions [11].

The construction industry has a significant responsibility for the environment. In order to meet the growing population and increasing demand, the construction industry must find innovative and sustainable solutions. Since it uses a large amount of natural resources and generates a large amount of waste, reducing resource consumption through waste recycling is a solution. As part of sustainable construction practices, the reuse of building materials (RBM) has an impact on the environment. RBM has received widespread attention due to its positive impact on reducing resource consumption, waste, and greenhouse gas emissions. Despite its advantages, RBM is not widely used in the construction industry [12].

Due to the rapid growth of urbanization and construction activities, the study of RBM is very important. Without sustainable solutions, environmental damage is inevitable. This study examines the current literature on RBM. Concepts, waste categories and reusable building components are discussed. A comprehensive overview of the reuse of building materials in sustainable building practices is then given. This section examines the previous knowledge on the application of RBM and discusses its limitations in achieving sustainability [13][14].

Stakeholder awareness and knowledge should be improved. Contractors can conduct waste audits to manage waste. To fully implement this strategy, standardized global references can be developed. This section

explores the potential of RBM and highlights knowledge gaps [15].

3.3. Economic and Environmental Benefits of Reusing Building Materials

Reuse of construction materials is recognized worldwide as a key aspect of improving resource management and reducing construction and demolition waste. Regarding the importance of reusing construction materials, literature suggests that 70% of all waste generated in developing countries is caused by construction activities. In the European Union (EU), construction waste accounts for 40% of total waste, while in the United Kingdom it accounts for 19.75% of total waste. Recycling and reusing demolished construction materials can significantly reduce the amount of landfill waste. However, despite their purported economic benefits, reuse practices remain neglected. Strategies such as increasing incentives and awareness, combining construction and demolition waste policies with reuse incentives, and developing management monitoring tools can promote reuse. In addition, appropriate technologies and methods are needed to assess the reusability of construction materials [16].

In order to achieve environmental sustainability, focus is placed on reducing resource consumption and carbon emissions in the construction industry. To this end, many approaches have been proposed, such as promoting the reuse of construction materials. However, current reuse practices are often limited and new strategies are needed to develop reuse solutions. Most previous studies have focused on evaluating individual building materials such as bricks, concrete, metal or wood, while some studies have examined reusable building materials as a whole [17].

The construction industry is crucial for national economic growth, development and job creation. At the same time, it is considered to be the main cause of anthropogenic environmental damage, especially the depletion of natural and energy resources and global warming or climate change. The construction industry consumes a large amount of materials worldwide. About 30% of natural resources and about 30% of energy are used to construct buildings each year. With population growth and improved living standards, resource consumption is increasing, which requires a focus on developing resource conservation strategies in the construction sector [18].

With the increasing popularity of urbanization and industrialization, the number and scale of construction and demolition activities are also increasing worldwide. In recent decades, construction activities in developing countries have generated a large amount of construction waste. Poland generated 300,000 tons of construction waste in 2000, 850,000 tons in 2003, and more than 7 million tons in 2005. 70% of all waste generated in developing countries comes from construction activities. The importance of construction waste generation is enormous, but the problem has not received the necessary attention from the authorities in developing countries [19].

Similar to the former Central and Eastern European countries, construction waste accounts for a large proportion of the total waste generated in the EU. According to the European Thematic Centre for Sustainable Waste Management, construction waste accounts for approximately 40% of the total waste generated in the EU [20].

3.4 Challenges and Barriers to the Effective Reuse of Building Materials

Waste management issues such as time, cost, and overcrowded landfills exist around the world. Building materials cannot be fully reused because there are serious barriers that need to be overcome. BuildingReuse studied the barriers to reuse of materials. A survey was conducted among various design and construction professionals. Issues affecting reuse were identified through keyword data mining and literature review. Nine reuse categories were found. Statistical analysis revealed the most

concerning issues. Non-technical barriers, especially project factors such as time, cost, and complexity, were responsible for most of the issues. The study recommended educational initiatives to increase reuse awareness and restructure project delivery, overall processes, and competitive modifications to promote the reuse of materials [21].

Reusing building materials can solve many of the world's waste management problems. The built environment is considered a necessity and is therefore a long-term asset that requires time and money to plan and build. Finally, the demolition of buildings generates a large amount of waste, which leads to overflowing landfills around the world. The reuse of building materials offers great potential for resource conservation and waste minimization. Despite the many benefits of building materials, they are not reused as much as they should be due to serious barriers. Cultural, institutional, technological, and market barriers have been addressed since the late 1980s, but reuse efforts have gone unnoticed. Despite the fact that the volume and variety of materials offer a huge market potential for second-hand building products, waste streams continue to be generated in the built environment. Research on the reuse of building materials has particularly highlighted the need for a clearer understanding of reuse practices [10].

In order to shed light on the current state of material reuse in design and construction, this study provides a detailed analysis of the barriers to material reuse faced by design and construction professionals who are actively engaged in the reuse process. The analysis was initially guided by two aspects: the underlying communication processes between professionals and the relative priority of concern. A keyword data mining analysis was conducted to discover unique processes that influence reuse among professionals who work only with a single reuse company. The small sample size limited the breadth of the analysis. A comprehensive literature search was then conducted to identify the categories of material reuse that were affected. These categories were initially created through in-depth interviews with practitioners from various industries who were actively concerned about the level of material reuse [22].

4. Results and Discussions

It is recommended that further research be undertaken in Cuba on assessing the prospect of reusing building materials at the end of their life because the diminishing availability of building materials that are used in construction of buildings promotes the reuse of post-consumer building materials. Certain building materials can be reclaimed and inappropriate material conserved for alternative uses. Waste materials that are of good quality and condition and can be reused/recycled/conserved should be separated. Major building materials for refurbishment works include concrete, bricks, asphalt pavements and wooden materials. Sewer pipes, cements, metal fittings and steel rods can also be recycled. The substitution market of recycled bricks raw stones or blocks is vast in has many potentials in reuse The demolition of a house yields some recyclables like tiles, bricks or even other ornamental stones upon roads Re-construction/rehabilitation concrete works/ Rehabilitation is made way for which consists mainly of concrete or alternatively asphalt pavements, more tiling rather than slag derives from these activities which are then used as aggregates likewise to build new roads. Examples on re-using steel: caps slabs pipe frame beam etc., concrete brickwork. Further research should concentrate on the conditions, costs, regulations, and limitations of reusing the building materials after demolition. The collected waste materials shall also be treated properly based on the recommendations for further recommendations on treatment of recycled materials. Also, it shall be based on a recommendation that all waste materials be disposed of in a landfill for further disposal.

Needs research further the option of recycling building materials at the end of their

useful life, for care because the increase in unavailability of building materials used in constructing buildings encourages reusing post-consumer building materials.

5. Conclusion

Building materials, as a result, are the largest source of construction, renovation and demolition waste. With improper waste disposal growing as a problem on its own right, there is also the issue of a spiral depletion of natural resources looming over the planet. Recycling and reuse of various types of waste play a very important role in the concept of sustainable development that is why much attention is paid to this issue when it comes to handling construction and demolition waste. Due to considerable environmental damage from their use and inextricable processes with natural mineral resources some need to be replaced from among the existing construction materials active use, focus has come about now needing alternative materials where secondary or by-product raw materials are used. Since it ranked second among industries generating millions of tons worldwide for many years this industry should try toward sustainable keep resources recycling promote circular economy within cycle closed system. Some of the important issues reviewed include the waste streams resulting from construction and demolition, consumption of natural resources, appropriateness, properties and durability of secondary or alternative materials in the construction sector, encountered impurities and their impact on natural resources. Other guidelines already in existence in Europe, the United States and other countries and even existing standards for reusing, recycling and characterizing construction materials and waste are also part of the review.

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