

Sustainable Solutions in Architecture: The Role and Impacts of Waste Materials

Mimaride Sürdürülebilir Çözümler: Atık Malzemelerin Rolü ve Etkileri

ABSTRACT

The waste generated as a result of overproduction caused by rapid consumption, one of the greatest problems of our time, has detrimental effects on nature and all living beings. Instead of being regarded as waste, products that have reached the end of their life cycle should be reused as resources, emerging as a necessity for sustainable living. This study addresses the role of waste materials in sustainable architecture. In this context, the use of waste materials in architectural design is explained through examples, highlighting their advantages and disadvantages. To this end, five projects were selected for examination within the scope of the study, and the locations of waste material usage for each building were researched to investigate their positive and negative impacts. Based on the data obtained, the structures were evaluated, and the advantages and disadvantages of using waste materials in architecture were summarized in a tabular format. As a result, while the use of waste materials in architecture provides benefits in areas such as resource conservation, waste management, cost, local economy, energy efficiency, innovative design, sustainable practices, and time savings, it may also pose challenges related to durability and longevity, aesthetic concerns, technical knowledge requirements, maintenance issues, insulation problems, compatibility issues, and legal and regulatory barriers. One of the main objectives of this study is to raise awareness among designers regarding the use, proliferation, and adoption of waste materials in design, as well as to pave the way for future research on the subject.

Keywords: Sustainability, Sustainable architecture, Waste management, Materials.

ÖZET

Çağımızın en büyük problemlerinden olan hızlı tüketimin neden olduğu aşırı üretim sonucu ortaya çıkan atıklar, doğa ve tüm canlılar üzerinde olumsuz etkilere sebep olmaktadır. Kullanım ömrünü tamamlayan ürünlerin atık olarak değerlendirilmesi yerine birer kaynak olarak yeniden kullanılması sürdürülebilir yaşamın bir gerekliliği olarak ortaya çıkmaktadır. Çalışma atık malzemelerin sürdürülebilir mimarideki rolünü ele almaktadır. Bu doğrultuda, atık malzemelerin mimari tasarımda kullanımı örnekler üzerinden açıklanarak avantaj ve dezavantajlarını ortaya koymak amaçlanmaktadır. Bu amaçla öncelikle çalışma kapsamında incelenmek üzere 5 proje belirlenmiş, ardından her bir bina için atık malzemenin kullanım yerleri araştırılarak yarattığı olumlu ve olumsuz etkiler araştırılmıştır. Elde edilen veriler ışığında yapılar değerlendirmeler ile mimaride atık malzeme kullanımında avantaj ve dezavantajlar ortaya konmuş ve özet bir tablo haline getirilmiştir. Sonuç olarak, atık malzemelerin mimaride kullanımında kaynak tasarrufu, atık yönetimi, maliyet, yerel ekonomi, enerji verimliliği, yenilikçi tasarım, sürdürülebilir uygulama ve zaman tasarrufu gibi alanlarda fayda sağlarken; dayanıklılık ve uzun ömür sorunları, estetik sorunlar, teknik bilgi gereksinimleri, bakım sorunları, izolasyon sorunları, uyum sorunları, yasal ve düzenleyici engeller gibi konularda ise problemler yaratılabileceği ortaya konmuştur. Yapılan çalışmanın atık malzemelerin tasarımda kullanılması, yaygınlaşması ve benimsenmesini konusunda tasarımcıların bilinçlendirilmesi ve konuya ilişkin yapılacak olan araştırmaların önünü açması çalışmanın hedeflediği en önemli yararlar arasındadır.

Anahtar Kelimeler: Sürdürülebilirlik, Sürdürülebilir mimari, Atık yönetimi, Malzeme.

INTRODUCTION

In today's world, where resources are rapidly depleting due to technological developments, population growth, irregular urbanization and industrialization movements, unconscious consumption of raw materials endangers human and environmental health. The increasing consumption trend and the intensive and irresponsible use of natural resources create 'waste' problems, and this situation disrupts ecosystem balances and triggers environmental crises (Elibol et al., 2017; Bekar & Nayeb, 2022). In this context, considering the fact that natural resources are not infinite and may run out one day if used unconsciously, it is of great importance to transform waste materials into resources that benefit the environment and the economy (Tandoğan, 2018; Curi, 1992; Bekar et al, 2023). Considering waste as a resource rather than a loss is a critical step for a sustainable future, and social awareness needs to be raised to ensure this transformation. In addition, creating a sensitive environment for materials that are

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depleting to become reusable not only increases environmental sustainability, but also demonstrates the potential to create economic value. In this context, the effective implementation of waste management and recycling processes becomes a fundamental requirement for efficient use of resources and reduction of environmental impacts. Therefore, the re-evaluation of waste materials emerges as a necessity of sustainable life and this process provides an opportunity for individuals and societies to fulfill their environmental responsibilities.

Countries are increasing their policies and incentives to create environmental awareness. Sustainable architecture is an approach that aims to reduce the environmental impact of the construction sector and increase resource efficiency (Arkun, 2020; Kutlu et al., 2022; Yalçınkaya & Karadeniz, 2022). In this context, the use of waste materials plays an important role in ensuring sustainability. The search for solutions to today's environmental challenges such as global warming, increasing energy consumption and waste management problems highlights the potential of waste materials in the construction sector. In particular, the use of recycled materials in construction projects supports environmental sustainability, creates new job opportunities and contributes to local economies. In addition, these applications increase social awareness and encourage the adoption of environmentally friendly design principles. Today, various applications and methods continue to be developed in order to collect waste materials, conduct studies on their usage value and reuse them. One of the approaches accepted worldwide is the 3R principle, which focuses on "reducing, reusing and recycling" and enables the management of waste materials. This principle is an approach that encourages the use of waste materials in new products to be produced and has found a place for itself in various scales from urban spaces to architecture, from interior applications to industrial designs (Bekar & Nayeb, 2022; Bekar, 2023). The use of waste materials in architecture offers several key advantages in terms of environmental sustainability. First, the use of recycled materials helps preserve natural resources while also reducing waste. This process reduces the consumption of raw materials, thus relieving pressure on the ecosystem and allowing for more efficient use of natural resources. Second, the integration of waste materials in architectural projects saves energy. Since the production process of recycled materials generally requires less energy than the production of new materials, it has the potential to reduce the carbon footprint. Third, this practice contributes to both environmental and economic sustainability by ensuring cost-effectiveness in construction processes.

Waste was first defined in our country's legislation in the Environmental Law No. 2872 dated 1983 as "any substance that is thrown or left in the environment as a result of any activity" (Environmental Law, 1983). In its most general sense, waste refers to any substance that is not used, does not want to be used, or has become unusable (Şahin & Hatunoğlu, 2016). Waste management defines the process that includes recycling waste, limiting production and consumption types that increase waste, protecting the environment and ecological balance, and creating employment (Balaban, 2014; Bekar, 2023, Yanılmaz & Tavşan, 2023). Waste management, which is becoming increasingly important, greatly affects many parameters including climate change, raw material acquisition and soil/water production resources (Berrini Bono, 2010). While waste can be considered a resource when managed correctly, it can cause losses when not managed or mismanaged.

Waste materials are being re-evaluated in various sectors and disciplines, and in this context, they are frequently preferred by designers today, where the concept of sustainable living is increasingly prominent. Waste materials, which find a place in a wide range from urban scale to product design, have become an important tool in the creation of sustainable and environmentally friendly spaces and products. This study will examine the role of waste materials in sustainable architecture in depth and systematically evaluate the advantages and disadvantages of these materials in architectural applications. In addition, it will focus on how waste materials are applied in practice and the results of these applications through various project examples. In this context, existing literature will be used to understand the effects of waste materials on sustainable architecture. This study provides significant support to efforts to contribute to environmental sustainability by revealing the potential of waste materials in sustainable architecture. It also paves the way for more effective use of waste materials in future projects by enabling designers and architects to develop innovative approaches.

MATERIAL AND METHODS

Waste materials are one of the basic components of sustainable applications in the construction and architecture sector. When these materials are used as recycled or re-evaluated raw materials in construction processes, they contribute to minimizing environmental impacts and preserving natural resources. The diversity of waste materials allows for a wide range of applications in the construction sector. For example, construction waste, industrial by-products and household waste can be used in the production of various building elements. The use of these materials provides both economic benefits and supports environmental sustainability. However, the adoption of waste materials in architectural applications requires certain standards and quality control processes. In this context, the evaluation of the physical and mechanical properties of waste materials is of critical importance in order to

ensure the safe and effective use of these materials. Therefore, this study aims to contribute to sustainable building design by deeply examining the potential and application possibilities of waste materials in architecture. Figure 1 includes the artificial intelligence-supported visual using the keywords “Sustainable Solutions in Architecture: The Role and Effects of Waste Materials”, which is the title of this study. This visual shows that the role and effects of waste materials are highly related to nature and green areas. It is clear that access to a more livable environment and livable cities can be achieved by recycling the increasing waste with technological developments.



Figure 1: The image produced by artificial intelligence algorithms using the title of the study

Source: Generated by the author using Canva AI

The study aims to emphasize the importance of using waste materials for sustainable architecture and to reveal their effects. In this context, the study includes a 4-stage process (Figure 2). In the first stage of the study, a literature review was conducted to create a conceptual framework regarding waste materials. In the second stage, 5 important projects produced from waste materials, which were obtained from the literature review and thought to have caused significant changes in the position they took place, were identified. In the third stage, important findings regarding the structures were included. While examining the projects, waste materials used in the building were determined and the positive and negative effects created by the materials used in the design for each project were examined. In the fourth stage, the discussions on the waste materials and the characteristics of the materials as a design input in architecture and the advantages and disadvantages created by waste materials were discussed. In the light of the obtained data, evaluations were made and the use of waste materials in architecture was revealed and a summary table was prepared.



Figure 2: Representation of the work process

Source: Produced by the author

The four-stage structure of this study process provides a systematic approach to deeply understand the potential of waste materials in architectural applications. The process, which begins with a literature review, evaluates the existing knowledge, reveals the importance of waste materials and clearly determines the role of these materials in sustainable architecture. The studies conducted on the five selected projects support the positive contributions and difficulties of integrating waste materials into design processes with concrete data, and in this context, help architects and designers make conscious decisions. In addition, the compilation and discussion of the findings aims to contribute to the achievement of sustainability goals in future projects by providing suggestions on how waste

materials can be used more effectively in architectural design. Thus, this method provides an important step towards environmental sustainability by increasing the value of waste materials in both academic and practical areas.

FINDINGS AND EVALUATION

In this section, five important projects are discussed on how waste materials are used in architectural design. The selected projects provide important examples of how waste materials are integrated into architectural design processes in a creative and effective way. Each project will be examined in detail in terms of the characteristics of the materials used, their contributions to the design processes and the results obtained, in this context, the role and potential of waste materials in architecture are emphasized.

Pavillon Circulaire, France

Designed by Encore Heureux Architecture and used as an exhibition and workshop center, the building was dismantled after 2016 and started to be used as a sports association's premises in the 14th district of Paris. Only materials that were left over from construction sites or had lost their value in stockpiles were used in the construction of the building. The facades of the building were created using 180 doors that were considered waste (Figure 3).



Figure 3: Pavillon Circulaire, Paris, 2016

Source: Produced by the author using Darrieus (2015).

When the advantages of the waste materials used in the Pavillon Circulaire are evaluated:

- ✓ Wooden doors offer a natural and warm aesthetic. In the design of the Pavillon Circulaire, this feature supports the organic and natural form of the structure. Wood can be customized with different surface finishes and color options, which increases the visuality of the design.
- ✓ Wood is a sustainable and renewable resource. This makes it an eco-friendly option. Wooden doors create a natural atmosphere, which helps make the space feel warmer and more inviting.
- ✓ Wood provides good thermal insulation, which is beneficial for energy saving. Wooden doors in the Pavillon Circulaire can increase energy efficiency by maintaining indoor temperature.
- ✓ Wooden doors can be successful in sound insulation. This is especially advantageous in projects that want to increase the acoustic comfort of the space.

When the disadvantages of the waste materials used on the building are evaluated:

- ✓ Wooden doors require regular maintenance and care. Over time, wooden doors can be affected by moisture, sunlight and other environmental factors, which can cause cracks or discoloration on the surface.
- ✓ Wooden doors can be more sensitive to water and weather conditions, especially when used outdoors. If appropriate protection measures are not taken, their lifespan may be shortened.

Manifesto Eco House, Chile

Manifesto Eco House is a residence built in Chile, completed in 2009 as an environmentally friendly project. The house is an integration of bioclimatic design, recycled, reused materials, non-polluting constructive systems, renewable energy. The house is built on two floors, using three shipping containers, prefabricated and modular components, on a total floor area of 160 square meters. The waste material used in the construction of the house is

recycled wooden pallets. More than 85% of the construction materials in the project are reusable or recycled insulation, iron-steel, paper, aluminum. Built in just 90 days, approximately 70% of the house's energy needs were met by solar panels and wind. Thus, a sustainable and environmentally friendly structure emerged, since modular, low-cost, sustainable materials were used. A different, original facade and idea were captured (Figure 4).



Figure 4: Manifesto Eco House, Chile

Source: Produced by the author using Arslan (2015).

When the advantages of the waste materials used in Manifesto Eco House are evaluated:

- ✓ The use of wooden pallets allows the recycling of waste materials. This prevents the cutting of new trees and contributes to the preservation of forest resources. It also reduces energy consumption and carbon emissions in production processes.
- ✓ Wooden pallets are available at low cost and provide significant savings in the construction process. This is a great advantage for projects with budget constraints.
- ✓ Wooden pallets offer a modular and flexible design opportunity. This allows you to develop creative and original architectural solutions.
- ✓ The modular structure of the pallets and easy installation provide a fast construction process and save time.

When the disadvantages of the waste materials used in Manifesto Eco House are evaluated:

- ✓ Wooden pallets can wear and rot over time, which can negatively impact the structural integrity of a building in the long term.
- ✓ Wood is susceptible to fire, which can pose a safety risk.
- ✓ Wooden pallets may require regular maintenance to maintain them. This can add cost over time.
- ✓ Pallets do not have high insulation capacity. This may require additional insulation materials and reduce energy efficiency.

Pet Pavilion, Netherlands

The PET pavilion in Enschede, Netherlands is a temporary pavilion structure built for workshops and exhibitions, where over 40,000 plastic bottles were used as building material. The structure was initiated with the idea that "the designers found parallels to the creation of a temporary building, unlike a permanent building material such as concrete, where reuse and reuse does not lose any tangible value." The majority of the plastic bottles used as building material were collected from incinerators. The collected bottles were pressed into 100x100x80 cm bales and used in the structure (Figure 5).

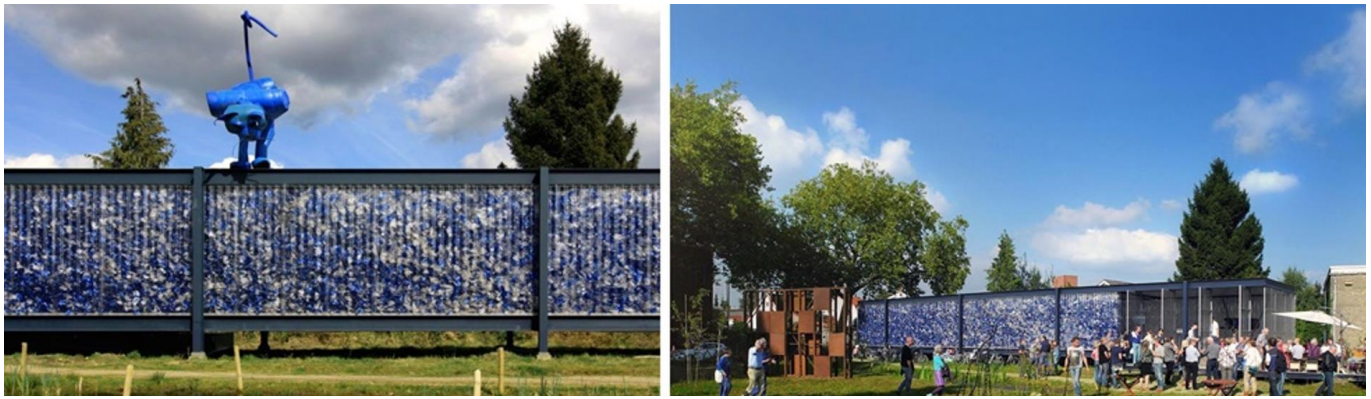


Figure 5: Pet Pavilion, Netherlands

Source: Produced by the author using Arslan (2015).

When the advantages of waste materials used in the Pet Pavilion are evaluated:

- ✓ The use of plastic bottles as building materials provides a great advantage in terms of waste management. This method prevents plastic waste from harming nature and supports recycling processes. Reusing plastic bottles reduces the energy and resource consumption required to produce new materials, thus reducing the carbon footprint.
- ✓ Waste plastic bottles are much cheaper than other building materials. This makes the project budget-friendly and saves costs.
- ✓ Plastic bottles are widely available and easy to source. This provides advantages in terms of logistics and supply.
- ✓ The modular and flexible structure of plastic bottles allows designers to develop creative solutions.
- ✓ Structures made from plastic bottles are easy to transport and assemble because they are lightweight. This makes them an ideal material for temporary structures.
- ✓ Plastic bottles are reusable and recyclable, making them an excellent choice of material for temporary structures. This means that even after they are demolished, they can be used in other projects without harming the environment.

When the disadvantages of waste materials used in the Pet Pavilion are considered:

- ✓ Plastic bottles are less durable than traditional building materials such as concrete or wood. This can lead to structures not lasting as long and losing structural integrity over time.
- ✓ Plastic can deteriorate over time, especially when exposed to sunlight and other external factors. This can negatively impact the aesthetics and structural integrity of the structure.
- ✓ Plastic bottles generally do not provide good thermal insulation. This can reduce the energy efficiency of the building and reduce the comfort level of the interior spaces.
- ✓ Plastic materials are sensitive to high temperatures, which can lead to problems such as fire risk or deformation.
- ✓ Buildings made of plastic bottles may not always meet aesthetic expectations. The appearance of the structure may limit the visual and architectural value of the project in some cases.
- ✓ Plastic can often be perceived as a poor quality or temporary material. This can negatively impact the overall value and acceptability of the structure.
- ✓ The degradation of plastic bottles over time can cause microplastics to be released into the environment, which is a disadvantage, especially in terms of environmental sustainability goals.

Gallery of Furniture, Czech Republic

Designed in the Czech Republic in 2016, the building has been transformed into a building with a new, easily recognizable facade made up of over 900 black plastic seats. The building is covered with a homogeneous product, a plastic black seat for around 80 CZK/piece, without any further adjustments to the exterior. It creates an abstract texture that reflects what is happening inside, without any other banner advertising. The material used is the basic form of an indoor chair called Vicenza, which the supplier regularly delivers. Black granulate was used for the outdoor areas because it is resistant to different weather conditions, especially UV light. The individual seats are

fixed on a structure made of steel sections fixed to the facade. In case of mechanical damage, it is possible to replace each piece with a new one, and even the facade can be easily cleaned once or twice a year with a high-pressure cleaner. A distinctive and modular facade has been designed with an emphasis on innovative thinking and recycling (Figure 6).

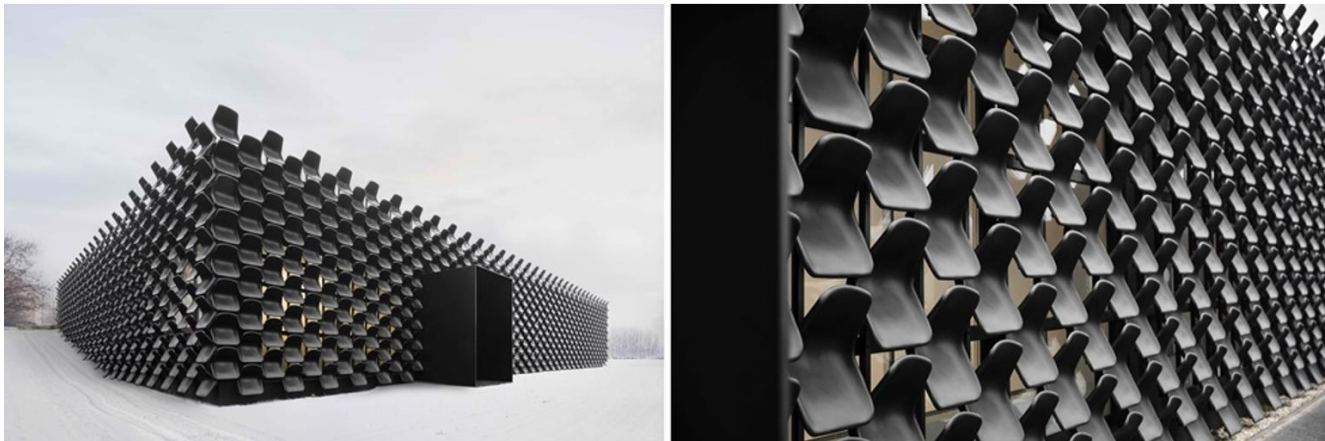


Figure 6: Gallery of Furniture, Çek Cumhuriyeti
Source: Produced by the author using Arslan (2015).

When the advantages of waste materials used in Gallery of Furniture are evaluated:

- ✓ Using plastic seats as facade cladding contributes to the recycling and reuse of waste materials. This helps preserve natural resources and supports environmental sustainability.
- ✓ The plastic seats used are supplied at a low cost. This greatly reduces the cladding costs and makes the project budget-friendly.
- ✓ Each part of the seats can be easily replaced when necessary, reducing maintenance costs and ensuring longevity of the structure.
- ✓ The facade created with plastic seats gives the building a unique and easily remembered aesthetic. This makes the building stand out visually.
- ✓ The plastic seats used on the facade create a texture, which gives the building a modern and innovative look.
- ✓ The plastic seats used are resistant to various weather conditions thanks to the black granulated material. This ensures the longevity of the exterior cladding.
- ✓ Facade cleaning can easily be done once or twice a year with a high-pressure cleaner, simplifying the maintenance process and protecting the façade in the long term.

Considering the disadvantages of waste materials used in Gallery of Furniture:

- ✓ Plastic seats can wear out or break over time. This can require frequent replacement and can negatively impact the facade's aesthetics and structure in the long term.
- ✓ Placing plastic seats homogeneously on the facade can create an aesthetically monotonous appearance, which may make it less appealing to some users or spectators.
- ✓ Plastic materials can often be perceived as low quality, which can negatively impact the overall aesthetic perception and value of a building.
- ✓ Plastic seats do not provide high heat or sound insulation as a building material. This can negatively affect the building's energy efficiency and indoor comfort.
- ✓ Plastic material can be sensitive to temperature changes. Problems such as deformation or discoloration may occur in extreme temperatures.
- ✓ Over time, the degradation of plastic materials can release microplastics into the environment. This can be a disadvantage in terms of environmental sustainability.

Hualien Bay Mall, Starbucks, Taiwan

In Hualien Bay Mall in Taiwan, a Starbucks store was designed with 29 containers. The structure was designed by the famous architect Kengo Kuma. The containers were used in a certain order to create a dynamic effect. It has a total area of approximately 320 square meters. The interior of the store is decorated to reflect the cultural history of Hualien. Thanks to its structure that benefits from daylight, the interior of the store has a spacious atmosphere (Figure 7).



Figure 7: Hualien Bay Mall, Starbucks, Taiwan

Source: URL-1.

Considering the advantages of container materials at Hualien Bay Mall, Starbucks:

- ✓ Using old shipping containers as building materials prevents them from being considered as waste and creates a sustainable structure. This reduces environmental impact and provides a greener construction process.
- ✓ Shipping containers are generally less expensive than traditional building materials. This helps make the project more economical by reducing construction costs.
- ✓ Since containers are modular structures, the construction process can be completed much faster than traditional buildings, reducing labor and time costs.
- ✓ Containers can be put together in a variety of ways because they are modular structures. This offers creative and flexible design options, allowing different structures to be easily created.
- ✓ Container structures can be moved to another location when needed. This makes the structures mobile and suitable for temporary use.
- ✓ Shipping containers are highly durable as they are designed to carry heavy loads. This provides a structure that is resistant to harsh weather conditions and physical wear. The durable structure of steel containers makes them resistant to natural disasters such as earthquakes.

Considering the disadvantages of container materials at Hualien Bay Mall, Starbucks:

- ✓ The metal structure of the containers is sensitive to temperature changes and does not provide good insulation. This can cause the interior to be extremely hot in summer and cold in winter. Additional insulation materials are required, which means additional costs and labor.
- ✓ Metal surfaces can cause condensation during sudden changes between hot and cold weather, which can lead to moisture and dampness problems in indoor spaces.
- ✓ The original design of the containers may not have sufficient load-bearing capacity for living spaces. Therefore, structural changes such as opening doors and windows may require additional reinforcement, which may increase costs.

DISCUSSION

Discussions on the use of waste materials in architectural applications are gaining importance along with sustainability and environmental awareness. While the use of recycled materials offers various advantages such as preserving natural resources and reducing environmental impact, it also poses some technical and aesthetic challenges. In this context, the integration of waste materials into the construction sector both supports innovative designs and provides cost advantages. For example, the use of waste materials reduces raw material costs in

construction processes, offers budget-friendly solutions, while also minimizing environmental impacts. However, the disadvantages of these materials such as durability, compliance with current building standards and longevity cannot be ignored. In particular, uncertainties about the structural integrity and safety of some waste materials can prevent the successful completion of projects. In addition, aesthetic concerns stand out as an important factor in how waste materials are perceived and used in design. Therefore, designers and engineers need to develop balanced solutions in terms of both functionality and aesthetics when using waste materials. Table 1 summarizes the advantages and disadvantages of using waste materials in architecture in detail.

Table 1: Advantages and disadvantages of using waste materials in architecture

Advantages		Disadvantages	
Resource Saving	Recycled materials reduce the need for new raw materials and help conserve natural resources. They minimize environmental impact by reducing the amount of waste in landfills.	Durability and Longevity Issues	Some recycled materials may not be as durable as standard materials, and materials such as recycled plastic and glass in particular can develop structural weaknesses.
Waste Management	It reduces the amount of waste and lightens the load on landfills. It can alleviate waste management problems.	Aesthetic Problems	Some recycled materials may not be aesthetically compatible with traditional expectations. Recycled materials often offer limited color and texture options. This can limit aesthetic diversity and limit design freedom.
Cost Savings	Waste materials are generally low cost, significantly reducing construction costs. This is an advantage for budget-friendly projects.	Application Process and Technical Information Requirements	It may be more complex than traditional methods and may require special knowledge and skills.
Supporting the Local Economy	Materials are procured from local sources. The use of local waste materials supports the local economy.	Maintenance Issues	Additional maintenance may be required as they do not last long.
Energy Efficiency	It can increase energy performance, provides good insulation. Recycled materials reduce energy consumption by providing good insulation. For example, recycled glass and plastic increase thermal performance.	Isolation Problems	In humid climates, some waste materials can cause insulation problems. For example, old tires and soil can reduce insulation performance if not properly protected.
Innovative Design	Waste materials offer the opportunity to create creative and unique designs. Recycled materials provide architects with different color and texture options, which add originality to projects.	Compatibility Issues	Some waste materials may be incompatible with existing building systems and construction standards, leading to technical compliance issues.
Sustainable Application and Time Savings	It offers technically efficient and sustainable solutions. Recycled materials provide long-term sustainability by reducing the environmental impact of buildings. In addition, the use of readily available waste materials provides a fast construction process with easy installation and saves time.	Legal and Regulatory Obstructions	The use of non-traditional materials can create challenges in complying with local building codes, which can cause projects to encounter regulatory hurdles.

The above advantages and disadvantages provide a balanced assessment of the use of waste materials in architectural projects. The use of waste materials seems particularly attractive for projects seeking environmentally friendly and cost-effective solutions. In addition to saving resources, the use of recycled materials makes a significant contribution to the conservation of natural resources and the reduction of waste in landfills. This allows both the minimization of environmental impacts and the promotion of sustainable architectural practices. However, despite these advantages, disadvantages such as durability and longevity issues should also be taken into account. Some recycled materials may not be as durable as standard materials, which can threaten the safety and longevity of projects. There are also significant benefits in terms of waste management; the use of these materials reduces the amount of waste, reduces the burden on landfills and therefore contributes to the solution of environmental problems. However, aesthetic concerns are another important issue encountered in the use of recycled materials. Some materials may not be compatible with traditional expectations and may limit design freedom by offering limited color and texture options. This can affect the creative process of architects. Cost savings is another important advantage of waste materials. Their low cost significantly reduces construction costs, making them an attractive option for budget-friendly projects. However, this advantage should also be considered along with the application process and technical knowledge requirements. Using recycled materials can be more complex than traditional methods and may require special knowledge and skills. In addition, the potential to support the local economy can be increased by locally sourced materials, which promotes economic sustainability. Energy efficiency is another important benefit of waste materials. These materials can reduce energy consumption by providing good

insulation, thus further minimizing the environmental impact of projects. However, it should be noted that some waste materials can cause insulation problems in humid climates. Compatibility issues can also arise with the use of waste materials, which may be incompatible with existing building systems and construction standards, which can lead to technical compliance issues.

As a result, the use of recycled materials should be carefully planned according to project requirements and local regulations. In the future, the proliferation of these materials can be made more efficient and reliable with innovation and technological developments. Thus, more effective use of waste materials can be achieved in architectural practice and contribute to the development of sustainable architectural solutions.

CONCLUSIONS

The waste that is produced as a result of excessive production caused by rapid consumption, which is one of the biggest problems of our age, causes negative effects on nature and all living things. Evaluating a product as waste after its lifespan can create negative effects in economic, social and psychological terms, in addition to the damage it causes to the environment and human health. Therefore, encouraging designers and users to design products that focus on the re-evaluation of waste materials is important in order to reduce the damage to the environment.

The use of waste materials in architecture has significant potential for a sustainable future. In the examinations conducted, the contributions and limitations of waste materials used in each project example were observed. Reuse of waste materials reduces the negative impact on the environment, reduces the carbon footprint, limits the consumption of natural resources and optimizes energy use. In a world where a large amount of waste is produced, especially in the construction sector, the reuse of these materials also serves the principles of circular economy and prevents material waste. However, the use of waste materials in architecture does not always provide a problem-free solution. As can be seen from the project examples, the performance properties of some materials are weak or have disadvantages due to aesthetic concerns. At this point, the type and properties of the waste material should be analyzed well and used in the project. Using waste materials in design is a process that needs to be thought over and managed correctly. Recognizing the properties of the material and developing solutions accordingly is one of the biggest responsibilities of the designer. As a result, while the use of waste materials in architecture is a powerful tool for sustainable design, it is necessary to design these materials correctly, analyze the structural and aesthetic potential of the material well and take the local context into consideration. The use of waste materials not only provides environmental benefits, but can also pave the way for new aesthetic and functional approaches in architecture. In general, the use of waste materials in architecture is considered an important step for a sustainable and environmentally friendly future. It is anticipated that this approach will find a wider application area in future projects with more innovative and scalable solutions. The most important benefits of this study are that it will raise awareness among researchers and designers on waste use and management and pave the way for other research to be conducted.

REFERENCES

- Arkun, A. K. (2020). Türkiye’de sürdürülebilir kentsel tasarım modeli ve değerlendirme sistemi geliştirmek. *Şehir ve Medeniyet*, 6(12), 109-134.
- Arslan, M. (2015). Cephe Tasarımında Geri Dönüşüm, Hayal Gücü ve İnovatif Düşünce. https://www.yapikatalogu.com/blog/cephe-tasariminda-geri-donusum-hayal-gucu-ve-inovatif-dusunce_265 adresinden 02 Ekim 2024 tarihinde erişildi.
- Balaban, B. (2014). Yapım Şantiyelerinde Oluşan Yapı Malzemesi Atıklarının Yönetimine Yönelik Bir Öneri. Yüksek Lisans Tezi, Mühendislik ve Fen Bilimleri Enstitüsü, Gebze Yüksek Teknoloji Enstitüsü, Gebze.
- Bekar, İ. (2023). Mobilya Tasarımında Atık Malzeme Kullanımının Örnekler Aracılığıyla Değerlendirilmesi. *Anadolu Üniversitesi Sanat & Tasarım Dergisi-Anadolu Üniversitesi Sanat & Tasarım Dergisi*, 13(1), 84-99.
- Bekar, İ., Lülecı, S. E., & Çakır, M. (2023). A studio study on “reuse” in architectural design. *Journal of Architectural Sciences and Applications*, 8(2), 541-557.
- Bekar, İ., & Nayeb, A. (2022). Atık Ahşap Malzemenin İç Mekan Tasarımında Yeniden Kullanımı. Sönmez, E. & Gözlükaya, H. (Eds.), *Mimarlık Bilimleri ve Mekansal Tasarım*, 197-225.
- Berrini, M., & Bono, L. (2010). Measuring Urban Sustainability: Analysis Of The European Green Capital Award 2010 And 2011 Application Round, *Ambiente*, İtalya.
- Curi, K. (1992). Atıkların Geri Kazanımı. *Katı Atık ve Çevre Dergisi*, (7), 3- 5.

- Darrieus, M. (2015). Le Pavillon circulaire d'Encore Heureux, un manifeste pour une architecture plus responsable. <https://www.amc-archi.com/photos/le-pavillon-circulaire-d-encore-heureux-un-manifeste-pour-une-architecture-plus-responsable,3597/le-pavillon-circulaire-par-le.7> adresinden 02 Spetember 2024 tarihinde erişildi.
- Elibol, G. C., Bezci, İ., Dündar Türkkkan, V., & Varol, A. (2018). Mobilya Tasarımında "Yeniden Kullanım": Tasarımdan Üretime Dönüşüm. *Art-e Sanat Dergisi*, 11(21), 134-156.
- Kutlu, İ., Bekar, İ., & Şimşek, D. (2022). Sustainable Preservation in the Context of Building Certification Systems. Çakır, M., Tuğluer. M., & Fırat Örs, P. (Eds). *Architectural Sciences and Ecology*, IKSAD Publishing, 103-133.
- Şahin, S., & Hatunoğlu, Z. (2016). Geri Dönüşüm Sistemlerine Yönelik Algı Düzeyi, Finansman ve Muhasebeleştirilmesi: Kahramanmaraş Sütçü İmam Üniversitesi Örneği. *Ekonomik ve Sosyal Araştırmalar Dergisi*, 12(2), 73-93.
- Tandoğan, O. (2018). Atık Malzemelerin Mimaride Kullanılması. *Ulusal Çevre Bilimleri Araştırma Dergisi*, 1(4), 189-202.
- URL-1: Starbucks Opens First Container Store in Taiwan. <https://stories.starbucks.com/press/2018/starbucks-opens-first-container-store-in-taiwan/> adresinden 01 Septmeber 2024 tarihinde erişildi.
- Yalçınkaya, Ş., & Karadeniz, İ. (2022). Sürdürülebilir Mimari Tasarımda Atık Malzemenin Yeri. *Journal of Architectural Sciences and Applications*, 7(2), 750-762.
- Yanılmaz, Z. & Tavşan, F. (2023). Afet Atık Yönetimine İlişkin Uluslararası Yazının Bibliyometrik Analizi. *Journal of Architectural Sciences and Applications*, 8 (Special Issue), 583-603. <https://doi.org/10.30785/mbud.1334994>