

## A Studio Study on “Reuse” in Architectural Design

İrem BEKAR <sup>1\*</sup> , Saffet Ertuğrul LÜLECI <sup>1</sup> , Mert ÇAKIR <sup>2</sup> 

ORCID 1: 0000-0002-6371-9958

ORCID 2: 0000-0001-8472-2024

ORCID 3: 0000-0003-0079-0375

<sup>1</sup> Karadeniz Technical University, Faculty of Architecture, Department of Interior Architecture, 61000, Trabzon, Türkiye.

<sup>2</sup> Süleyman Demirel University, Faculty of Architecture, Department of Landscape Architecture, 32260, Isparta, Türkiye.

\*e-mail: irembekar@ktu.edu.tr

### Abstract

As a result of the rapid depletion of resources and the damage caused by excessive consumption to the environment, resource management, and material reuse in the construction sector are a necessity for sustainability. This study aims to emphasize the importance of reuse. For this purpose, a workshop was conducted to transform the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function. The first stage of the study, which is carried out in three stages, is the preparatory stage, where the students do preliminary research on the subject; the second stage is the stage where the students do design studies, and the third stage is the stage where the evaluations regarding the design decisions and learning outcomes are made. At the end of the study, fourteen products were designed by the students, and eight of them were handled within the scope of the study. The direction of the advantages and disadvantages created by the properties of the materials in the design has been evaluated in terms of functionality, technique, and aesthetics. Then, the awareness and development of the students about reuse were evaluated. As a result of the study, it has been revealed that the materials that are out of use and/or produced for different purposes can have creative or guiding effects on the design, and while doing this, they can exhibit a beneficial and sustainable approach to the environment.

**Keywords:** Reuse, sustainable design, architectural design.

## Mimari Tasarımda “Yeniden Kullanım” Üzerine Bir Stüdyo Çalışması

### Öz

Kaynakların hızla tükenmesi sonucu değişen ihtiyaçlar ve aşırı tüketimin çevreye verdiği zararlar yapı sektöründe kaynak yönetimi ve malzemeler yeniden kullanımı sürdürülebilirliğin bir gerekliliği olarak karşımıza çıkmaktadır. Bu çalışma yeniden kullanımın önemini vurgulamayı amaçlanmaktadır. Bu amaçla kullanım dışı olan veya hazır üretimdeki materyallerin sağladığı hacimlerin farklı bir işlev ile yeniden kullanım mekanlarına dönüştürülmesine yönelik bir stüdyo çalışması gerçekleştirilmiştir. Üç aşamada gerçekleştirilen çalışmanın ilk aşaması öğrencilerin konuya ilişkin ön araştırma yaptığı hazırlık aşaması, ikinci aşama öğrencilerin tasarım çalışmaları yaptığı aşama, üçüncü aşama ise tasarım kararlarına ve öğrenim çıktılarına yönelik değerlendirmelerin yapıldığı aşamadır. Çalışma sonunda öğrenciler tarafından on dört adet ürün tasarlanmış olup sekiz adedi çalışma kapsamında ele alınmıştır. Materyallerin sahip olduğu özelliklerin yarattığı avantaj ve dezavantajların tasarıma verdiği yön işlevsel, teknik ve estetik açıdan değerlendirilmiştir. Ardından öğrencinin yeniden kullanım konusundaki farkındalıklarını ve gelişimi değerlendirilmiştir. Çalışmanın sonucunda kullanım dışı kalan ve/veya farklı amaçlar için üretilen materyallerin, aslında tasarıma yaratıcı veya yönlendirici etkilerde bulunabileceği, bunu yaparken de çevreye faydalı ve sürdürülebilir bir yaklaşım sergileyebileceği ortaya konmuştur.

**Anahtar kelimeler:** Yeniden kullanım, sürdürülebilir tasarım, mimari tasarım.

**Citation:** 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.

**DOI:** <https://doi.org/10.30785/mbud.13201104>



## **1. Introduction**

The rapid depletion of resources, changing needs, and damage caused by excessive consumption of the environment have increased the importance of the concepts of sustainability and ecology in the construction sector. One of the most basic requirements for achieving a sustainable and ecological structure is to ensure the use of natural resources without consuming or polluting the environment (Türkeri, 2021). Waste management has become an important criterion, as has the construction of energy-efficient structures, to be affected by the consequences of environmental pollution at a minimum level (Mutdoğan & Wong, 2011). The amount of solid waste is increasing due to population growth, technological developments, industry, and urbanization. This increase, which occurs with the unconscious consumption of raw materials, also increases the burden on the environment (Elibol, Bezci, Dündar Türkkkan & Varol, 2018).

Implementing a sustainable approach is possible through the conservation and efficient use of resources. The fact that the material can be reused or easily disposed of is at the heart of creating a sustainable product. Therefore, in cases of both prevention of environmental pollution and irresponsible use of resources and nature, materials should be reused and turned into a resource that benefits the economy (Curi, 1992). At this point, the importance of reusing out-of-use materials to minimize the resource use caused during the construction and demolition phases emerges once again (Ringdon & Kim, 1998). Various methods are being developed to study the use value of out-of-use materials and to reuse them. One of the accepted approaches to the management of waste materials is the 3R principle, which focuses on "reduce, reuse, and recycle". This principle is an approach that encourages the use of waste materials in new products to be produced, and today it has taken its place at various scales, from urban spaces to architecture, from interior applications to industrial designs (Bekar & Nayeb, 2022). The 3R principle supports the creation of a responsive environment for obsolete materials to be viewed as a resource, not a loss, and to be reused. The use of waste materials and resource management, which have the potential to be utilized in many areas of design, is considered a sustainable design strategy. Celadyn (2019) considered resource management among sustainable design strategies with the principle of "reduce, reuse, recycle". In its most general sense, 'reduce' includes measures to reduce waste generation. 'Reuse' is expressed as the repair and functionalization of existing objects by applying simple operations. 'Recycle' is the evaluation of the material to serve a different use by converting it into raw material. Reuse is an approach that should be preferred over recycling because less energy is consumed in production (Kendir Beraha, 2019). For this reason, within the scope of the study, the focus is on the evaluation of the material through "reuse".

In order for a material to be accepted as a reuse input, it must meet conditions such as allowing multiple uses, being functional, long-lasting, and durable, being easy to dispose of, being easy to disassemble and reassemble, reducing energy consumption, and containing no toxic materials (Mercan, 2016). Reusing is not only a sustainable approach but also brings various benefits. Brass & McIntosh (1999) list the benefits of reuse as energy savings, material recovery, labor recovery, recovery of added value in manufactured parts, reduction of solid waste, reduction in the prices of goods, increase in the profit rate of remanufacturing companies, low capital requirements as a result of providing competitive opportunities through low prices, recovering a larger share of added value compared to recycling, and decreasing the machinery investments required for the production of product components.

There are also some prejudices or barriers to products being designed through reuse. One of the most important of these obstacles is the design of the product that will emerge from reused materials (Elibol et al., 2018). Each of the materials has some limitations due to its characteristics. These boundaries, arising from both technical and visual characteristics, play a decisive role in the interaction of architectural design and materials. The chain of choices that starts with the designer's reaction to the limits of the material determines the direction of the design (Kurşuncu, 2018). The attitude process when all these boundaries are defined and in contact with them is undefined, but it is the time when creativity is used the most (Kurşuncu, 2018; Bekar, 2023). When Rollo May (1975) talks about the

relationship between borders and design, he says, "Human consciousness is the distinguishing aspect of our existence; we would never have developed it without limitations. Consciousness is an awareness that arises from the dialectical tension between possibilities and limitations. The creative act arises with and against what limits man." He draws attention to the fact that boundaries that seem like a disadvantage can be turned into an advantage with a properly managed process and offer new and creative solutions. Another limitation in designing products through reuse is the difficulty of collecting and combining reused products.

Reuse practice, with both its benefits and prejudices, is preferred by different designers in various design fields. Especially in the fields of architectural design and product design, the concept of reuse is frequently encountered. Reuse, which is read from the perspective of the function factor in architectural structures, is also closely related to the economic value of the building (Kutlu, Bekar & Şimşek, 2022; Elibol et al., 2018).

This study deals with the reuse approach through architectural design products. In this direction, a studio study was held to transform the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function. It is aimed to reveal the direction that the advantages and disadvantages created by the features of the materials give to the design. In this context, the study was carried out in three stages. The first stage is the preparation stage where students do preliminary research on the subject. In the second stage, students determined a material and function for the volume they would design and then started their design line with a scenario they produced. At the end of the second stage, fourteen products were designed by the students based on reuse principles. Eight of these designs were considered within the scope of the study. The third stage is the stage where evaluations are made regarding design decisions and learning outcomes. At this stage, the direction that the advantages and disadvantages created by the properties of the materials gave to the design was evaluated from a functional, technical, and aesthetic perspective. Thus, it is emphasized that the materials that are out of use and/or produced for different purposes can have creative or guiding effects on the design while exhibiting a beneficial and sustainable approach to the environment. The study is important because it covers a studio experience process for students to organize existing volumes with a new function and evaluates the spatial and design solutions caused by the advantages and disadvantages of the spaces presented in the resulting products. At the same time, it is thought that the study will raise awareness among students, researchers, and designers about reuse and pave the way for another research to be done.

## **2. Material and Method**

This study was carried out with the 4<sup>th</sup>-grade students of the Department of Interior Architecture, Faculty of Architecture, Karadeniz Technical University, within the scope of the Interior Architecture Project 7 course to raise awareness about reuse in design. In this direction, the students were given the subject of "converting the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function". In this study, a studio study was carried out during the project course, which included a total of thirteen weeks. In this direction, fourteen students participated in the course. At the end of the course, a total of fourteen projects were delivered, and eight projects were examined within the scope of the article. While selecting the projects, care was taken to ensure that there were no projects working with the same or similar materials in order to create diversity and examine different materials. The method of the study carried out within this framework was designed in three stages (Figure 1).

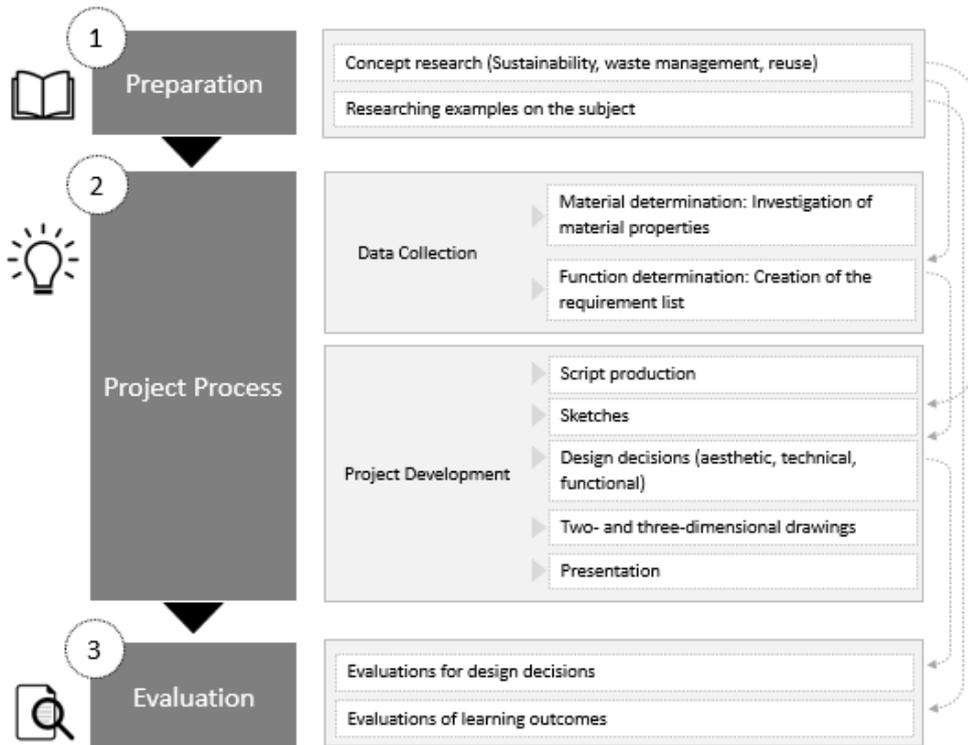


Figure 1. Representation showing the stages of the study

### Phase 1: Preparation

The first stage is the preparatory stage, in which concept research, an introduction of the subject, and sample research are carried out. The purpose of concept research is to provide students with knowledge about the project subject. In this direction, students were asked to research sustainability, waste management, and reuse. Then, as a project topic, the subject of "conversion of the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function" was explained to the students. The material to be selected for reuse in the project and the function to use this material are left to the student's choice. It is expected that the outputs of the project will be used with a function that can meet today's needs. In this context, students were asked to construct their projects to include factors such as spatial organization, equipment design, lighting, air conditioning, material selection, and detailing. In this direction, first of all, the students were asked to investigate the examples related to the subject. Thus, it was ensured that the students had an idea about the current studies on the subject and adapted to it.

### Phase 2: Project process

The second phase of the study consists of the project process, which includes the collection of data and the project development phases. At the stage of data collection, the students determined the materials they would study and the functions they would use to construct this material. In this context, the students researched the properties of the materials and created a list of needs for the function they chose. During the project development phase, the participants created their scenarios in light of the information they obtained from the data collection step. In other words, the participants created a space setup that could meet the needs of the material and function they chose. Then, for eleven weeks, the space designs foreseen by the scenario were carried out. At this stage, students were expected to make aesthetic, functional, and technical design decisions for the development of the project, taking into account the properties, advantages, and disadvantages of the material they chose. In this direction, various design sketches were made. When the project reaches a certain functional, technical, and visual saturation, the maturation process is completed with two-dimensional and three-dimensional drawings. At the end of the project, the students were asked to prepare a presentation sheet expressing the character of the project, the design process, and the functional, technical, and visual aspects of the design.

### Phase 3: Evaluation

The third stage of the study is the stage in which the design decisions and the learning outcomes of the course are evaluated in the final product. At this stage, the students were first asked about the advantages and disadvantages of the material they chose during the project development process. In this context, questions regarding design decisions were asked: What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages direct your design? Students were asked to group their answers in terms of functional, technical, and aesthetic aspects. Accordingly, the letter 'F' is placed next to each relevant item if it is functional, 'T' if it is technical, and 'E' if it is aesthetic. Another question asked during the evaluation phase is aimed at understanding the gains of the project process for the student. For this purpose, the question "What were the contributions of your project to you regarding the gains obtained from the course?" was asked. This question is aimed to reveal the learning outcomes of the course and the student's awareness and development about reuse.

### 3. Findings

The project process was carried out with the participation of fourteen students. When the same or similar materials were eliminated among the fourteen projects put forward, eight different student projects were considered within the scope of the study, including Bus Cabin, Polypropylene Tank, FGRP Fiberstrong Pipe, Concrete Water Pipe, Truck Trailer, Train Wagon, Generator Cabin and Water Tank. Information about the examined projects (project number, student name, material, and function) is given in Table 1.

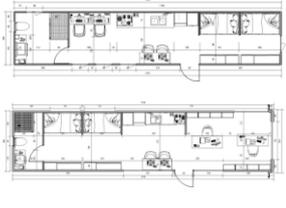
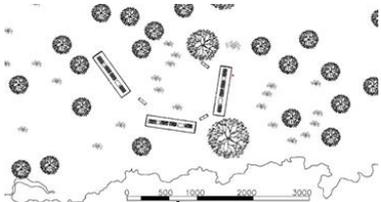
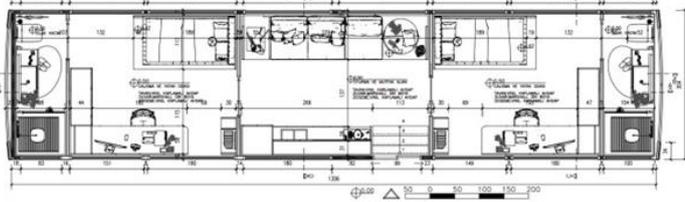
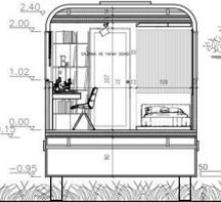
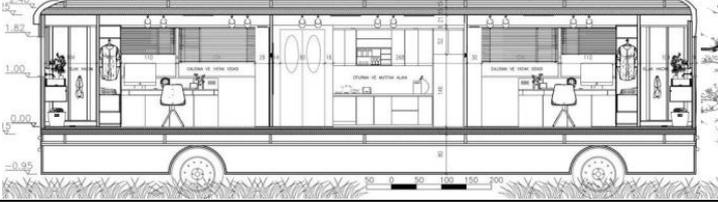
Table 1. Information about the projects

Project Number	Material	Function	Student
1	Bus cabin	Home office	Mustafa Kaptan
2	Polypropylene tank	Trade center	Elif Zehra Yıldırım
3	FGRP fiberstrong pipe	Accommodation and camping area	Özge Sabak
4	Concrete water pipe	Art village	Aleyna Çam
5	Truck trailer	Painting and ceramics workshop	Rümeysa Karagülle
6	Train wagon	Medical center	Şeymanur Taşçı
7	Generator cabin	Newsgathering center	İrem Çibıklı
8	Water tank	Social work center	Şule Tombalak

In this part of the study, the projects carried out within the scope of the course are summarized with tables containing the project information. The table consists of three parts. The first part contains the name of the project and the material used. In the second part, there are two-dimensional and three-dimensional drawings of the projects. In the two-dimensional expressions, there are sketches of the projects, site plans of the projects, floor plans, and sections. In the three-dimensional expressions, the exterior and interior visuals of the projects are included. In the third part of the table, there are questions and answers for the students regarding the design decisions of the projects and the achievements obtained from the course.

A home office design was made using the bus cabin. Within the scope of the project, a home office was designed with the functions of a kitchen, WC, working area, sleeping area, and resting area (Table 2). Bus cabins were chosen as the material due to reasons such as the presence of a large number of unused bus cabins, their easy accessibility, ease of transportation, being economically suitable, and being easily convertible in terms of volume.

**Table 2.** Project no 1: Functioning of the bus cabin as a home office

<b>Project name: Change Bus</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: Bus Cabin</b>		<b>Outdoor</b>	<b>Interior</b>
<b>Material</b>			
<b>Process/Sketches</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			

**Design Decisions**

**1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?**

*Advantages*

- Using the existing windows of the bus (F)
- Providing convenience in space organization and planning thanks to the rectangular form of the bus (F)
- Availability of luggage space for installation (F, T)
- Being portable (T)

*Disadvantages*

- Difficulty in placement due to the narrowness of the bus (F)
- The curved surfaces of the bus force the interior surface design (A)
- Obligation to use singular due to not being able to be connected (F, T)

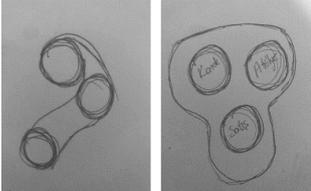
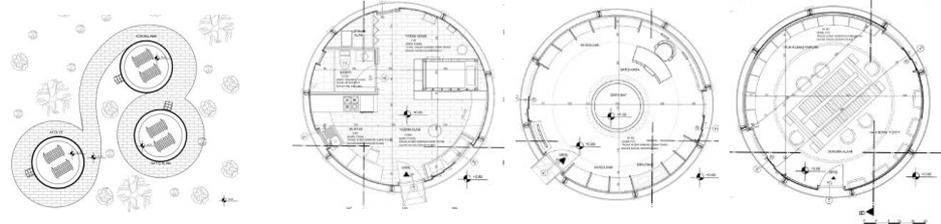
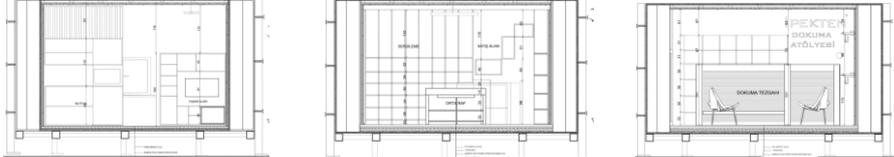
**2. What were the contributions of your project to you?**

- I understood the relationship between reuse and sustainability.
- I realized that I could produce economical solutions with reuse.
- I gained knowledge of waste management and resource management.
- I witnessed how out-of-use materials can meet the needs of daily life through reuse.
- I gained knowledge about space organization and equipment design in small and narrow spaces.

A trade center design was made using a polypropylene tank. Polypropylene tanks serve purposes such as storing, mixing, heating, and cooling large volumes of materials without deterioration or wear and tear for many years. Polypropylene tanks can be produced in desired sizes and shapes. Polypropylene tank was preferred as a material because it can create flexible solutions, is easy to produce, is recyclable, is resistant to heat, moisture, chemicals and other corrosive substances, is lightweight, is easily portable, is easily repaired and is easily intervened.

Within the scope of the project, a trade center with an accommodation area, a workshop area, and a sales area was designed (Table 3).

**Table 3.** Project no 2: Functioning of polypropylene tanks as trade centers

<i>Project name: İpekten</i>		Three-Dimensional Expressions	
		Outdoor	Interior
Material			
			
<b>Two-Dimensional Expressions</b>			
Plans			
			

**1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?**

<i>Advantages</i>	<ul style="list-style-type: none"> <li>Being high above ground (T)</li> <li>Resistance of the outer mass to factors such as rain, chemicals, etc. (T)</li> <li>Water resistance of the material (T)</li> <li>Easy application of window and door openings (F, T)</li> <li>Good thermal insulation (T)</li> <li>The ability to use the exterior image of the bus as a design element (A)</li> </ul>	<i>Disadvantages</i>	<ul style="list-style-type: none"> <li>Requirement of an additional inward material for glass and window openings (T, F)</li> <li>Since the form is circular, it is necessary to design furniture suitable for the form (f)</li> </ul>
-------------------	--	----------------------	--

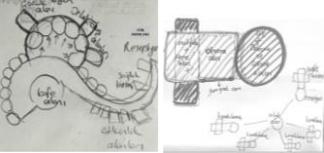
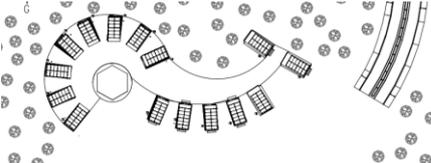
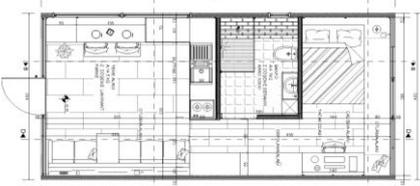
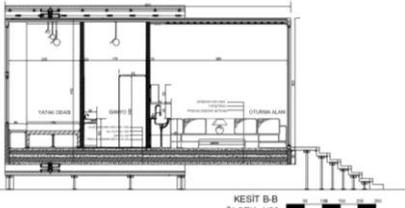
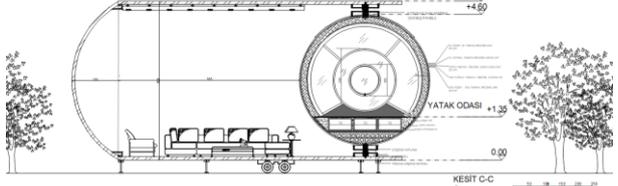
**2. What were the contributions of your project to you?**

- I saw how I could construct spaces that were designed with different functions before, with different function.
- The process improved my creativity in concept and detail.
- I learned different material combination details.
- I saw how fast and economical solutions can be produced for fast installation and disassembly.
- I experienced the process of reusing unused materials.
- I learned about the concept of reuse and its relationship with sustainability.

An accommodation and camping area were designed using FGRP fiberstrong pipe. Fiberstrong pipe is used as a material due to reasons such as high corrosion resistance, light and elastic structure, superior hydraulic properties, environmental friendliness, long service life, high strength structure, low

operating and maintenance costs, fast and easy laying, compatibility with ground movements, economical transportation and cost. the pipe has been selected. In the project scope, an accommodation and camping area was designed with accommodation capsules, wet areas, and socializing areas (Table 4).

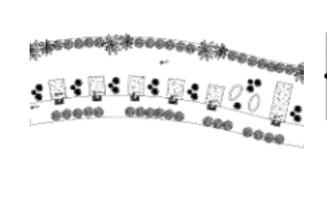
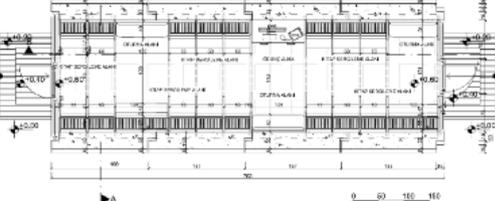
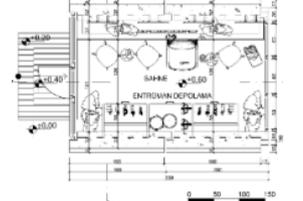
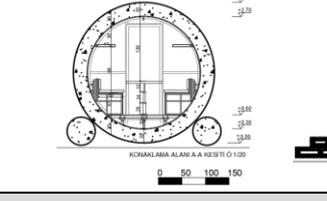
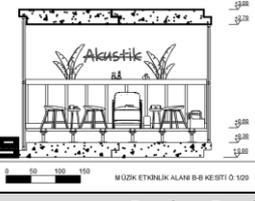
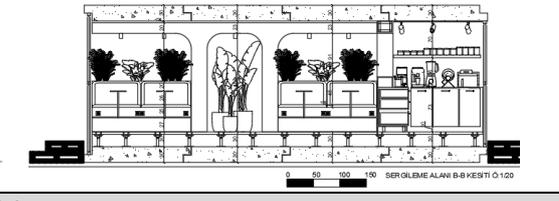
**Table 4.** Project no 3: Functioning of FGRP fiber strong pipe as accommodation and camping area

<b>Project name: Hand of Nature</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: FGRP Fiberstrong Pipe</b>		<b>Outdoor</b>	<b>Indoor</b>
<b>Material</b>			
<b>Process/Sketches</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			
<b>Design Decisions</b>			
<b>1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?</b>			
<b>Advantages</b>	Being strong (T) Being light (T) Having smooth interior surfaces (A) Not causing any water leakage thanks to its hydraulic properties (T) Easy connection thanks to its modular structure (T, F)	<b>Disadvantages</b>	Designing site-specific furniture instead of ready-made furniture in the interior due to its circular structure (T, F) Need for support in fixing due to its circular structure (T, F)
<b>2. What were the contributions of your project to you?</b>			
<ul style="list-style-type: none"> <li>• I understood the concept of reuse.</li> <li>• It was a project that made me think about how to evaluate a material, and in this sense, different ideas allowed me to come up with different solutions.</li> <li>• I understood the importance of reuse for sustainable design.</li> <li>• I developed myself in terms of producing space-specific details.</li> </ul>			

An art village design was made using a concrete water pipe. Concrete water pipe was chosen as the material because it is a very easy-to-access material, environmentally friendly, durable, low production cost, easy to maintain and repair, compatible with climatic conditions, and non-flammable. Within the scope of the project, an art village with accommodation, a library, an exhibition, a cafeteria, and

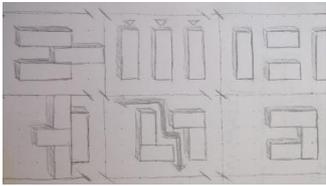
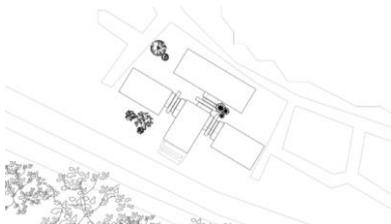
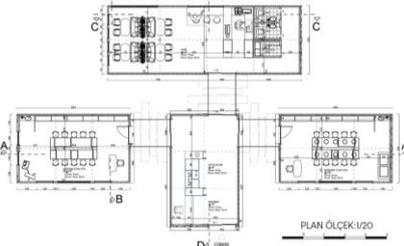
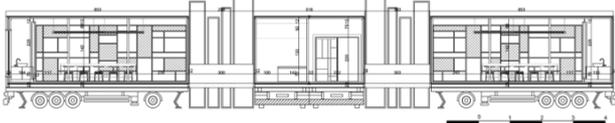
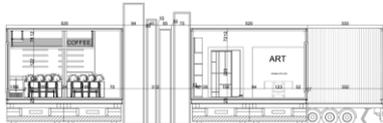
activity areas were designed (Table 5). Concrete pipes were sometimes singular and sometimes joined to each other to design spaces.

**Table 5.** Project no 4: Functioning of the concrete water pipe as an art village

<b>Project name: Art Village</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: Concrete Water Pipe</b>		<b>Outdoor</b>	<b>Indoor</b>
<b>Material</b>			
<b>Process/Sketches</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			
<b>Design Decisions</b>			
<b>1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?</b>			
<b>Advantages</b>	<ul style="list-style-type: none"> <li>Being modular (F, T)</li> <li>Creating wider spaces by being connected (F, T)</li> <li>The curvilinear surfaces supported the shelf design while designing the library section (A)</li> <li>Relief of the circulation space by making use of the inclined surfaces in the exhibition area (F)</li> </ul>	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>Ability to produce flexible solutions despite the narrow interior space (F, A)</li> <li>Being able to design space-specific furniture despite not being able to use ready-made furniture (T)</li> <li>Preventing the breathing of the concrete by insulating the concrete pipe against the asbestos problem (T)</li> <li>Being able to use the spaces formed when inclined surfaces are smoothed for areas such as storage, installation, etc. (T, F)</li> </ul>
<b>2. What were the contributions of your project to you?</b>			
<ul style="list-style-type: none"> <li>I developed my skills in the organization of small spaces and furniture design.</li> <li>The problem of how I could make what I wanted inside the concrete pipe triggered my creativity.</li> <li>The subject of the project supported and triggered my intellectual process.</li> <li>I improved myself on details.</li> <li>The subject of the project made me look at the materials around me from a different perspective.</li> <li>I realized the importance of a sustainable approach with the evaluation of the materials that we ignored.</li> </ul>			

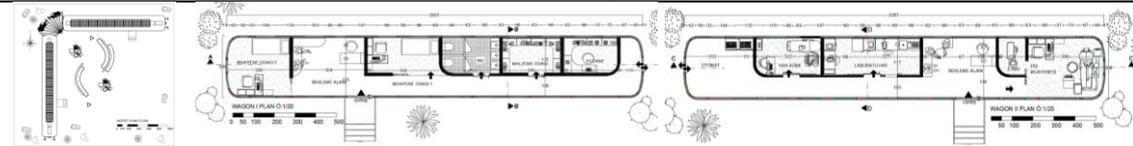
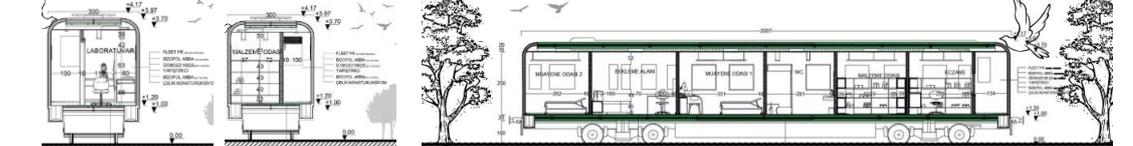
A painting and ceramics workshop was designed using truck trailers. Truck trailers were preferred as a material due to their features such as being volumetrically recyclable, being durable, allowing flexible use, easy access, being lightweight and portable. Within the scope of the project, a workshop design was made, which includes a painting workshop, a ceramic workshop, a cafe, sales areas, an exhibition, a wet area, and storage units (Table 6).

**Table 6.** Project no. 5: Functioning of truck trailers as a painting and ceramics workshop

<i>Project name: Unit</i>		<b>Three-Dimensional Expressions</b>	
<i>Material: Painting-Ceramic Workshops</i>		Outdoor	Outdoor
<b>Material</b>			
<b>Process/Sketch</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			
<b>Design Decisions</b>			
<b>1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?</b>			
<i>Advantages</i>	Durability of the material (T) Formal features facilitate the organization of space (T, F) Being modular and combining units easily (T, F) Ability to create different combinations when units come together and separate (T)		<i>Disadvantages</i>
			Although the unit volume is small, it can be used by combining units (T) Difficulty applying design ideas to materials (A) Insulation requirement (T)
<b>2. What were the contributions of your project to you?</b>			
<ul style="list-style-type: none"> <li>• I got to know new materials.</li> <li>• I had the opportunity to create modular design alternatives.</li> <li>• I had an idea about reuse and resource management.</li> <li>• I had the opportunity to see different approaches to reuse in the workshop environment.</li> <li>• I had the opportunity to redesign the materials used for different purposes.</li> </ul>			

A medical center was designed using a train wagon. Train wagon was preferred as a material because many train wagons are out of use, it is resistant to corrosion, has an aesthetic appearance, can be combined, is easy to transport, and has volumetric advantages and climatic advantages. Within the scope of the project, there are examination rooms, reception, waiting areas, material rooms, pharmacies, laboratories, etc. A medical center was designed to accommodate space (Table 7).

**Table 7.** Project no 6: Functioning of the train wagon as a medical center

<b>Project name: Heacen</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: Train Wagon</b>		<b>Outdoor</b>	<b>Interior</b>
<b>Material</b>			
<b>Process/Sketch</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			

**Design Decisions**

**1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?**

<i>Advantages</i>	<ul style="list-style-type: none"> <li>Ability to visually benefit from the characteristic features of the wagon (A)</li> <li>Ability to use existing window and door openings (F)</li> <li>Being able to be protected from the effects of water, etc. by the fact that the wagon is high from the ground (T)</li> <li>Being portable (T)</li> <li>Being modular (F)</li> </ul>	<i>Disadvantages</i>	<ul style="list-style-type: none"> <li>Use of sliding doors due to the narrow and long shape of the wagon (F)</li> <li>Difficulty in spatial organization due to narrow and long-form (T)</li> <li>Designing multifunctional furniture because it does not have enough width (F, A)</li> <li>Insulation requirement (T)</li> </ul>
-------------------	---	----------------------	--

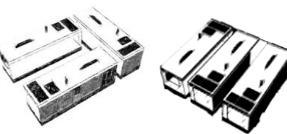
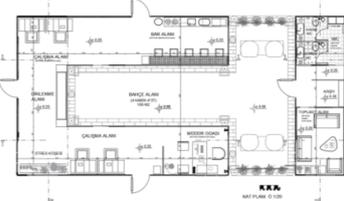
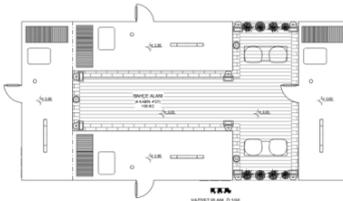
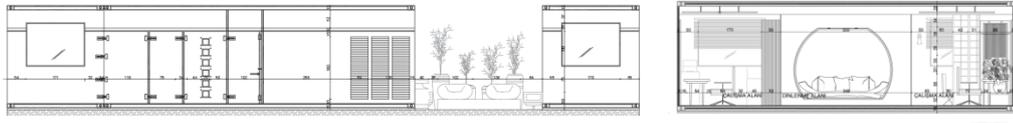
**2. What were the contributions of your project to you?**

- I learned the importance of reuse in terms of recycling and environmental pollution.
- I realized that materials that we are not aware of, that we do not see, and that we ignore can be reused.
- I realized that materials that seem like waste can be sustainable with the right use.
- I realized that I could design flexible and multifunctional furniture for narrow spaces.
- Finding solutions to the limitations created by the material triggered my creativity.

A news gathering center was designed using generator cabins. Generator cabins were preferred as materials due to their features such as being easily accessible, easy to maintain and repair, being light and portable, being easily convertible due to their volume characteristics, being able to create flexible solutions, and being affordable. The news-gathering center is conceived as a venue used for rapid and

effective collection of news at emergency events and small living centers. Within the scope of the project, a design including working areas, a meeting area, a bar, a wet area, an executive room, and resting areas was made (Table 8).

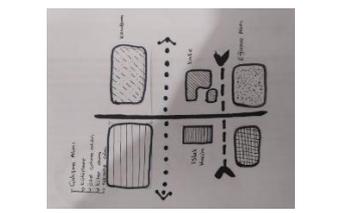
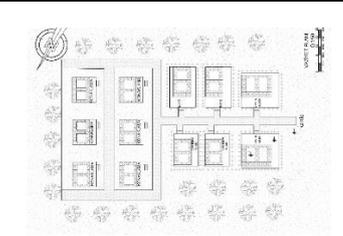
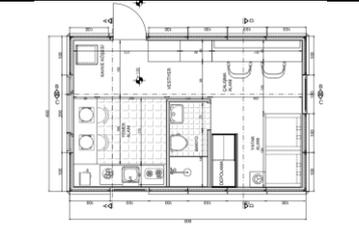
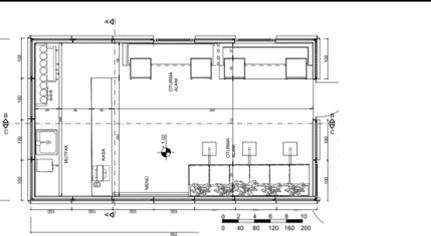
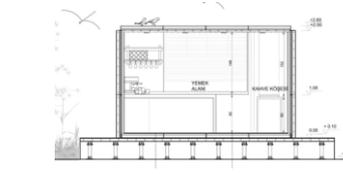
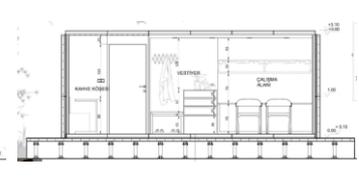
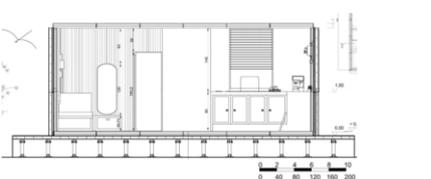
**Table 8.** Project no 7: Functioning of generator cabins as news gathering center

<b>Project name: Streaming</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: Generator Cabin</b>		<b>Outdoor</b>	<b>Interior</b>
<b>Material</b>			
<b>Process/Sketches</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			
<b>Design Decisions</b>			
<b>1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?</b>			
<b>Advantages</b>	<ul style="list-style-type: none"> <li>Easy to attach and remove parts (T)</li> <li>Having its own sound and heat insulation (T)</li> <li>Ensuring air flow with its ventilation sections (T)</li> <li>Lightweight and easy to carry (T)</li> <li>Easy to color (A)</li> <li>Easy assembly of cabins to each other (T, F)</li> </ul>	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>Negative effect of glass and steel jointing for glasses (T)</li> <li>Color mismatch (A)</li> <li>Difficulty associating ventilations on vertical surfaces with the space (T)</li> </ul>
<b>2. What were the contributions of your project to you?</b>			
<ul style="list-style-type: none"> <li>• I learned about the concept of reuse in architecture.</li> <li>• I realized that unused materials can be used for different functions, and we can add various needs to our lives at a low cost.</li> <li>• I learned to find solutions to the limitations created by the materials we choose.</li> <li>• The process triggered my creative thinking.</li> <li>• I developed myself by producing details specific to the place and material.</li> </ul>			

A social work center was designed using modular water tanks. In the project, a social center where people can socialize together and at the same time retreat to nature has been considered. Water tank was preferred as a material because it is long-lasting, healthy and hygienic, easy to transport and transport to the installation site because it is produced in pieces, does not burn, is resistant to climate

changes, easy and practical installation, easy to transport and provides flexible use due to its modularity. Within the scope of the project, a design including accommodation, a working and reading area, a cafe, and an entertainment area was designed (Table 9).

**Table 9.** Project no 8: Functioning of generator cabins as a news gathering center

<b>Project name: Clubby-ED</b>		<b>Three-Dimensional Expressions</b>	
<b>Material: Water Tank</b>		<b>Outdoor</b>	<b>Interior</b>
<b>Material</b>			
<b>Process/Sketches</b>			
<b>Two-Dimensional Expressions</b>			
<b>Plans</b>			
<b>Sections</b>			
<b>Design Decisions</b>			
<b>1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?</b>			
<b>Advantages</b>	<ul style="list-style-type: none"> <li>Ability to produce flexible plan solutions by being modular (F)</li> <li>Being resistant to external factors (F)</li> <li>Easy application of door and window openings (F, T)</li> <li>Being light and portable (T)</li> <li>The fact that the material is curved inward provides convenience in insulation (T)</li> </ul>	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>The requirement to raise the ground against the factors coming from the ground (T)</li> <li>Curves on the surface create visual boundaries (A)</li> <li>Insulation requirement (T)</li> </ul>
<b>2. What were the contributions of your project to you?</b>			
<ul style="list-style-type: none"> <li>I learned about fast installation and production.</li> <li>I gained experience in producing solutions for small spaces, space organization, and equipment design.</li> <li>I developed myself by producing project-specific details.</li> <li>I have increased my awareness of ensuring sustainability by evaluating previously unconsidered spaces with different functions.</li> </ul>			

#### 4. Evaluation

Within the scope of the study, each project was redesigned by evaluating the materials produced to serve different functions. It is seen that the materials chosen in the realization of the designs are effective in directing the design. The results obtained when an evaluation is made regarding the effect of selected materials on design decisions are listed below.

- Each material has functional, technical, and aesthetic advantages and disadvantages caused by its characteristics. These advantages and disadvantages were the issues that students benefited from or produced solutions for during the project development process. When the students were asked how they benefited from the advantages and disadvantages of the material in the project development process, functional, technical, and aesthetic, the answers given are summarized below (Table 10). While it is seen that the students greatly benefit from the technical, functional, and aesthetic aspects of the materials in the project development process, it is also seen that the limitations of the materials, especially in technical terms, force the students.

**Table 10.** Advantages and disadvantages of the selected materials

P.N.	Material	Advantages			Disadvantages		
		Technical	Functional	Aesthetics	Technical	Functional	Aesthetics
1	Bus cabin	•	•	•	•	•	•
2	Polypropylene tank	•	•		•	•	
3	FGRP fiberstrong pipe	•	•	•	•	•	
4	Concrete water pipe	•	•	•	•	•	•
5	Truck trailer	•	•		•		•
6	Train wagon	•	•	•	•	•	•
7	Generator cabin	•	•	•	•		•
8	Water tank	•	•	•	•		•

- Based on the data obtained from the questions asked to the students, it is seen that the formal characteristics of the materials are largely decisive in the project development process. At this point, it is seen that materials with cylindrical or circular forms create limitations in the design phase and direct the design process. So much so that the cylindrical volumes used in projects 2, 3, and 4 challenged the student in terms of space usage. On the other hand, students searched for different surface designs. Circular shelf designs, seating fittings following the surface, and exhibition surfaces are some of them.
- It has been seen that modular and connected materials facilitate the project development process, especially in functional terms. The volumes that can be easily combined and separated from each other have been an advantage for students in reaching different and flexible planning solutions. As seen in the examples of the truck trailer, concrete water pipes, generator cabin, and water tank, the students were able to create plan organizations of various sizes by bringing the materials together in more than one form and with different variations.

- When evaluated from a functional point of view, it is seen that the dimensions of the selected materials are generally small and narrow in volume, creating difficulties, especially in spatial planning, as they allow for limited spaces. In the face of this situation, which seems like a disadvantage, the students designed equipment that serves flexible and multifunctional purposes in the furniture they placed in the spaces. At this point, it can be said that the boundaries created by the material trigger the student's creative thinking process.
- Another issue is the technical limitations created by the materials. One of the most obvious problems with the concrete water pipe used in project number 4 is asbestos. Asbestos is a harmful substance that causes various diseases when it enters the body through respiration. For this reason, an insulation solution has been considered in the project despite this problem. Another example is the problem of cylindrical volumes used horizontally in projects 4 and 5. Despite this problem, the students found a solution to the problem of keeping the material fixed with support equipment or by fixing it to the floor. As seen in these examples, it is possible to say that the technical limitations created by the material also trigger the student's thinking and solution-generation processes.
- When considered from an aesthetic point of view, it is seen that the visual properties of the materials are evaluated as an advantage in some projects and a disadvantage in others. In the examples of bus cabins and train wagons, it is seen that the outer appearance of the materials is used as a design element. Since the colors of the generator cabinet used in Project 7 are incompatible, the student felt the need to change its color as it was seen as a disadvantage. At this point, it can be said that the visual properties of the materials are directive, as they directly affect the perception of the project.

The evaluations made in line with the answers given by the students regarding the project subject and the achievements of the project process are listed below:

- At the end of the project process, it is seen that the awareness of the majority of the students about the concept of reuse has increased, and the fact that they can establish its relationship with sustainability is considered one of the most important achievements of the course.
- Students comprehended how waste or out-of-use materials become useful with the right projecting and functioning process. Thus, they realized that out-of-use materials would be considered a resource, not a loss.
- It is seen that the boundaries created by the materials lead the students to produce solutions and trigger their creative thinking processes to find solutions to functional, technical, and aesthetic problems.
- It can be said that instead of using ready-made furniture, the skills of designing and producing details for the limitations of the existing space have improved.
- Another important achievement within the scope of the study is that students witnessed the reuse processes of different materials besides their own by seeing and listening to each other. Thus, students also saw the development processes of different materials.

## **5. Results**

As a result of changing and increasing consumption habits and rapid production, the increase in the amount of waste all over the world causes economic and psychological destruction as well as negative effects on the environment, human health, and all living things. As a result, the damage caused by excessive consumption of the environment has increased the importance of the concepts of sustainability and ecology in the construction sector. The reuse approach in architecture is an important and guiding method in the process of designing sustainable spaces. For this reason, encouraging designers and users to reuse spaces is an important step in reducing the damage to nature and providing a sustainable environment.

The study dealt with the transformation of the volumes provided by out-of-use or ready-made materials into re-use spaces with a different function through a studio study. The study, which emphasizes how materials that are often overlooked, neglected, or out of use can create new stories in space design with the right applications, shows what kind of contributions they can make both functionally and aesthetically. Despite the limitations created by the materials, both creative and environmentally friendly spaces can be obtained by recognizing the material properties well and producing solutions in this direction. Therefore, encouraging designers and users to reduce and reuse waste materials is an important step in reducing the damage to nature and providing a sustainable environment.

While evaluating the existing volumes with a new function, it has been seen that the characteristics of the material such as economy, easy availability, portability, processability, cuttability, combineability, repairability, paintability, and mountability are decisive in the selection of the material to be transformed. It is thought that the volumes evaluated with a reuse approach will raise awareness by making the user and society aware of environmental approaches and the reuse of waste. Conducting the research together with a studio study contributed to students' awareness about reuse spaces.

With the studio study held within the scope of the research, the student's awareness of sustainability, resource management, waste management, and reuse has increased. In addition, it was observed that the students improved themselves in recognizing the material, designing by considering the advantages and disadvantages created by the material, developing a special design for the place, and developing details at the spatial and reinforcement scales. At this point, the inclusion of courses and topics on the reuse of waste materials in architecture and design-based disciplines will contribute to the awareness of designers in the creation of a sustainable environment.

In addition to raising awareness among students, the research is thought to be a guide for designers and researchers in studies on the subject. Among the most important benefits of the study are raising the awareness of designers about the widespread adoption of the reuse approach and paving the way for further research on the subject.

### **Acknowledgements and Information Note**

The authors would like to thank Dean Southern, who is a native English speaker, for language control. The authors are very grateful to the students for their efforts in producing the volumes that inspired this study. The paper complies with national and international research and publication ethics. Ethics committee approval was not required for this manuscript.

### **Author Contribution and Conflict of Interest Declaration Information**

There is no conflict of interest. All authors contributed equally to this manuscript. İrem BEKAR: Designing the research, writing and reviewing the manuscript, and obtaining the materials for conducting the research. Saffet Ertuğrul LÜLEÇİ: Designing the research, writing and reviewing the manuscript, and obtaining the materials for conducting the research. Mert ÇAKIR: Designing, writing, and reviewing the manuscript and supervising.

## References

- Bekar, İ. (2023). Mobilya tasarımında atık malzeme kullanımının örnekler üzerinden değerlendirilmesi. *Sanat ve Tasarım Dergisi*, 13 (1), 84-99. DOI: 10.20488/sanattasarim.1313909
- Bekar, İ. & Nayeb, A. (2022). Reuse of Waste Wood Material in Interior Design. *Architectural Sciences and Spatial Design*. (Ed. Elif Sönmez, Halime Gözlükaya), 197 -225.
- Brass, B. & McIntosh M. W. (1999). Product, process and organizational design for remanufacture – an Overview of Research”, *Robotics and Computer-Integrated Manufacturing Journal*, 15, 167 178.
- Celadyn, M. (2019). Interior architectural design for adaptive reuse in application of environmental sustainability principles. *Sustainability*, 11(3820), 2-16. doi:10.3390/su11143820.
- Curi, K. (1992). Atıkların Geri Kazanımı, İstanbul: *Katı Atık ve Çevre Dergisi*, Sayı 7, s. 3-5.
- 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. DOI: 10.21602/sduarte.344513.
- Kendir Beraha, E. (2019). Sürdürülebilir yıkım teknolojileri ya da mimarlıkta ölümden sonra yaşam var mı? Ed. A.Ciravoğlu (Ed), Ters Köşe Ekoloji, İstanbul: Puna Yayın.
- Kurşuncu, A. (2018). Seramik eğitiminde sınırlar ve yaratıcılık, *Journal of Arts*, Cilt 1, Sayı 1, 1-12.
- 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, Ankara, s. 103-133.
- Mercan, B. N. (2016). Mobilyanın Yeniden Kullanımının Sürdürülebilirlik Bağlamında İncelenmesi, Yayınlanmamış Yüksek Lisans Tezi, İstanbul: Beykent Üniversitesi, Fen Bilimleri Enstitüsü, İç Mimarlık Anabilim Dalı.
- Mutdoğan, S. & Wong, T. (2011). Towards Sustainable Architecture: The Transformation of the Built Environment in İstanbul, Turkey, *Eco-city Planning: Policies, Practice and Design*, Springer, s. 239-260.
- Ringdon, B. & Kim J. J. (1998). Sustainable architecture module: Introduction to sustainable design. National Pollution Prevention Center for Higher Education, The University of Michigan, Michigan, 8-15.
- Rollo, M. (1975). *Yaratma Cesareti*, İstanbul: Metis Yayınları.
- Türkeri, İ. (2021). Ahşabı geri kazanmak. *Yapı Dergisi*. <https://yapidergisi.com/ahsabi-geri-kazanmak/#:~:text=At%C4%B1k%20bir%20ah%C5%9Fap%20malzemenin%20geri,str%C3%BCkt%C3%BCrel%20ve%20mekansal%20ortamda%20de%C4%9F> (Access Date: 26.06.2022).

