sanat&tasarım art&design

Sanat&Tasarım Dergisi,14(1),2024: 61-85
Araştırma Makalesi / Research Article
Geliş Tarihi / Received: 18.01.2023
Kabul Tarihi / Accepted: 08.09.2023
DOI: 10.20488/sanattasarim.1505760

THE USE OF NATURAL STONE IN FURNITURE DESIGN WITHIN THE CONTEXT OF LIMITATIONS AND CREATIVITY

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ABSTRACT

The interaction of the individual with the environment contains boundaries. The phenomenon of creativity, which is revealed by the consciousness of the individual and the interaction of the environment, creates a tense situation with the limitations he is in and encounters. The study focuses on the correspondence of the boundaries created by the material in the design and the creative processes. The chain of choices that starts with the designer's reaction to the limits of the material determines the direction of the design. In the study, the use of natural stone in design is handled through furniture and it is aimed to investigate the direction it finds in furniture as a design input and the direction it gives to design. For this purpose, firstly, furniture samples designed using natural stone were researched and 24 furniture were determined. Then, the type of natural stone materials used in the furniture was determined, the characteristics of the material used (physical, chemical, mechanical), how it directed the furniture design (functional, technical, aesthetic) were examined and analysis graphics were created for each furniture. Based on the data obtained, the advantages and disadvantages of using natural stone materials in furniture design have been revealed. As a result of the study, the importance of natural stone can have creative or guiding effects on design and while doing this, it is emphasized that it can display a beneficial and sustainable approach to the environment with the use of natural materials. At the same time, it is among the most important benefits of the research that it paves the way for other research on different materials and creative constraints in design.

Keywords: *Limitations, Creativity, Creative limitations, Natural stone, Furniture design.*

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SINIRLAR VE YARATICILIK BAĞLAMINDA MOBİLYA TASARIMINDA DOĞAL TAŞ KULLANIMI

• Arş. Gör. İrem BEKAR[*] • Arş. Gör. Tolga CÜRGÜL[**]

ÖZET

Bireyin çevresiyle karşılıklı etkileşimi, sınırlar barındırmaktadır. Bireyin bilinci ve çevre etkileşimi ile açığa çıkan yaratıcılık olgusu, içinde bulunduğu ve karşılaştığı kısıtlamalarla gerilimli bir durum yaratır. Çalışmada malzemenin yarattığı sınırların tasarımda bulduğu karşılığa ve yaratıcı süreçlere odaklanılmaktadır. Malzemenin ortaya koyduğu sınırlara tasarımcının verdiği tepki ile başlayan seçimler zinciri tasarımın yönünü belirlemektedir. Çalışmada doğal taşın tasarımda kullanımı mobilya üzerinden ele alınarak doğal taşın yarattığı sınırların bir tasarım girdisi olarak mobilyada kendine bulduğu karşılık ve tasarıma verdiği yönü araştırmak amaçlanmaktadır. Bu amaçla öncelikle doğal taş kullanılarak tasarlanmış mobilya örnekleri araştırılmış ve 24 mobilya belirlenmiştir. Ardından mobilyalarda kullanılan doğal taş malzemelerin türü tespit edilerek kullanılan malzemenin özelliklerinin (fiziksel, kimyasal, mekanik), mobilya tasarımını ne şekilde yönlendirdiği (işlevsel, teknik, estetik) incelenmiş ve her bir mobilya için analiz grafikleri oluşturulmuştur. Elde edilen verilerden hareketle mobilya tasarımında doğal taş malzeme kullanımına yönelik avantajlar ve dezavantajlar ortaya konmuştur. Çalışmanın sonucunda doğal taş malzemenin, tasarıma yaratıcı veya yönlendirici etkilerde bulunabileceği, bunu yaparken de doğal malzeme kullanımı ile çevreye faydalı ve sürdürülebilir bir yaklaşım sergileyebileceğinin önemine dikkat çekilmektedir. Aynı zamanda farklı malzemeler ve tasarımda yaratıcı kısıtlamalara yönelik yapılacak diğer araştırmaların önünü açması araştırmanın hedeflediği en önemli yararlar arasındadır.

Anahtar Kelimeler: *Sınırlar, Yaratıcılık, Yaratıcı kısıtlamalar, Doğal taş, Mobilya tasarımı.*

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1. INTRODUCTION

Where there is design and design actions, there is also the concept of creativity. The communication of creativity with design starts at the point of having the ability to create the beautiful, the different and the original. The originality mentioned here is not only result-oriented, but also the ability to be creative in the process and to find solutions to problems in different ways (Çetinkaya, 2011). Creative thinking is a design and foresight approach, to see problems and gaps in knowledge, to develop ideas and hypotheses, to produce original ideas, to see the relationship between ideas, to develop thought components and to obtain new combinations (Aktamış and Ergin, 2006).

Even if it is assumed that creativity is a phenomenon that comes from the essence of man, it can be said that the acquisitions gained by the individual because of his interactions with his environment transform the phenomenon of creativity. Person-environment interaction has boundaries. Creativity, which is revealed by the consciousness of the individual and the interaction with the environment and continues to transform with the individual, creates a tense situation with the limitations it is in and encounters (Öztuzcu, 2017). Conflict or agreement with boundaries can create creative thinking and expand the individual's own boundaries, leading to the formation of new relationships.

Chris Bilton argued that limits and constraints on working processes in creative organizations are necessary to enable the creative process (Bilton, 2007). Heraclitus, on the other hand, states with the discourse that "Contradiction is both the king and the father of everything" contradiction foresees boundaries and that the struggle with boundaries is the source of creative productions (May, 1975). In his book, The Courage to Create, Rollo May talks about the relationship between borders and design using the following words: "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 occurs with and against what limits man." He states that limits are valuable in human life and creativity itself requires limits; because the creative act emerges with and against the thing that limits the human being (May, 1975: 126).

Boundaries and constraints help encourage creative thinking. This is where the concept of "thinking outside the box" comes in (Wilson, 2021). When you find yourself in constraints, you need to use your problem-solving skills to find a new solution (Wilson, 2021). Although most people think of unlimited resources that fuel innovation, the best ideas arise from creative constraints (Blaschka, 2020). Brandon Rodriguez (2017) explains in his "TedEd" short animation: "Any project is constrained by many factors, including

cost, materials at your disposal and unbreakable laws of physics. These factors are called creative constraints and they are the requirements and constraints we must address in order to achieve a goal… Constraints are the foundation of creativity, not the limits."

In many fields, limitations take on a special task that leads to discovery, invention and innovation. Design-based disciplines are one of them. First of all, the designer is faced with a certain material, physical and psychological limitations while conveying a certain message to the target audience (Becer, 2006: 34). In the essence of productivity and creativity in design, there is not only the evaluation of concrete information, but also other limitations or abstract thinking that can be opposite to them, but can complement them. Concepts such as function, purpose, causality are processed in the mind with concepts such as context, environment and emotionality (Kömürcüoğlu Turan & Altaş, 2003).

Boundaries in design can be from various aspects such as concept, environment, space, dimensions and materials. The study focuses on the correspondence of the boundaries created by the material in the design and the creative processes. Design is a whole consisting of material and form to serve a purpose (Bevlin, 1977). Various structural features of the material, its suitability to be processed, its weight, softness, volume, color, texture, interaction with the environment have been the factors that make designers think and guide. These features of materials can also be guiding in the creation of the designer's personal style.

Sculptor Constantine Brancusi (1876-1957) worked directly with the material without preparing a model and believed that the materials he studied had a life of their own and contained a unique essence. With this approach, the artist emphasized that this essence should be grasped in order to reveal the form that the material contains. In the ongoing debates on the subject of fidelity to material, honest design and material-oriented studies, one view belongs to the design theorist David Pye (1914-1993). Pye mentions that every substance has inherent features that can be expressed or suppressed during use (Uğur, 2020). This idea parallels with the approach of people who work in the fields of art and design with a focus on materials, to stay true to the essence of the material.

Today, due to the inadequacy of natural resources, the use and production of materials that are identical to or substitute for nature have gained importance. In the study, the borders created by the natural features of the material and its effect on the design are investigated through natural stone materials.

Natural stones are an important historical carrier that brings the cultural accumulation of human history up to the present day and ensures the continuation of this continuity. This continuity, which started with the tools of the first people, continued with the

religious structures built with devotion and care. Structural and spatial setup of places of worship, which represent civilizations in historical continuity and are important images, were brought into being with natural stone material (Türkeri, 2022). Natural stones have been used in monumental, religious, military and civil structures, obelisks, sculptures, and tombstones since ancient times (Çelik, 2003). The fact that natural stone is resistant to harsh weather conditions, has a high load-bearing power and is abundant in nature has enabled it to be used as the most noble building material of architecture for centuries (Ulu, 2009; Türkeri, 2022). The stone sometimes represented prestige and sometimes power. In various parts of the world, the stones that the emperors gave as gifts to different countries in the past or the stones used to symbolize certain events are the most known examples of these symbols that have survived to the present day (Alptekin, 2021).

Natural stones are a means of cultural expression with the minerals they contain, their geography, origin and processing. In addition, the region is a typical geographical indication for the region in terms of its socio-cultural and socio-economic characteristics (Şahin ve Akova, 2019; Türkeri, 2022; Bekar ve Erbay, 2023). While the globalizing world causes the materials used in designs to be similar to each other, designs using local materials such as natural stone are seen as privileged in terms of meaning and identity (Bekar ve Erbay, 2023). It is seen that they are also called by the name of the region where they were extracted, since they are unique to the place where they were mined among the natural stones. Ankara stone, Marmara marble can be given as examples. At this point, it is seen that natural stones are an important tool in reflecting the identity of the place they belong to. Based on all these, it can be said that natural stones, which are a reflection of the cultural characteristics of the geography, play a role as a means of cultural expression in design and add value.

The symbolic power of natural stones reflecting the identity has been utilized in various fields in every period (Alptekin, 2021). The use of Ankara stone (andesite) belonging to the region on the facade and flooring of the Ankara University Faculty of Science building is an architectural example of this. Oltu stone, which is extracted from the Oltu district of Erzurum and used in the design of jewelry or jewelery with its easy-to-process feature, can be shown as an example in terms of product design.

The properties of the material are one of the most important factors in shaping the design (Bekar ve Erbay, 2023). While the color, pattern, bands, veins and spots of natural stones differ, the removal and cutting of the stone to be used makes a difference depending on what kind of image you want to achieve in the design (Alptekin, 2021). For example, as finishing material, stones used as slabs can be used by cutting into shapes that will give a different appearance according to the vein structure, texture and pattern of the stone.

Natural stone materials have made strong contributions to design by using them in various fields from product design to interior design, from architecture to urban design. Within the scope of this study, the use of natural stone in design and its design contributions are discussed through furniture design.

Furniture (the word "mobilya=furniture" in Turkish comes from the root "mobil=mobile") is a movable element (Kurtoğlu et al., 1997). Natural stone, on the other hand, does not seem very mobile considering its weight. For this reason, the use of borders created by natural stone in furniture design is seen as a process that needs to be thought about and solutions to be produced. Developing technology and opportunities in the era we live in allow the use of natural stone materials in furniture. Today, this situation has led designers to prefer natural stone in their furniture. In addition, the number of competitions dealing with the use of natural stone in design has increased in recent years. The "Natural Stone Design Competition", which is traditionally organized every year by the Istanbul Mineral Exporters' Association, is an example of this. Another example is the "Novel Design Competition". In this competition, it was expected to design "decorative household items" from existing natural stone or natural stone waste. Another example is the "Amorf Natural Stone Project and Design Competition". In this competition, it is expected that the marble residues will be evaluated and designs for the exterior or interior will be produced. When the objectives of all these competitions are examined, the common objectives are; developing environmentally friendly and sustainable projects with high added value in the natural stone sector, contributing to the development of the sector and the country's economy, increasing the competitiveness of natural stone exports, supporting creative ideas and projects for the use of natural stone (http-1, http-2, http-3).Thus, people are encouraged to use natural stone in interior, furniture and product designs. Despite this, studies examining the use factors and results of natural stone in product design are very limited in the literature. When we look at the literature, it is seen that the use of natural stone in design is generally discussed in terms of sustainability and ecological. When a research is conducted on the Wos database, one of the most popular multidisciplinary databases used in the scientific research community, it is seen that the keywords that natural stone is used most often are sustainability-oriented. However, no study that deals with the effect of the use of natural stone in design on creativity has been found. This makes the study unique. In addition, when we look at the literature, many studies on creativity and creative thinking in design have been made and continue to be done. The factors affecting creative thinking have been handled by different researchers with different factors. However, no study has been found in which creativity is discussed in terms of materials and properties of materials. This study is

important in terms of revealing the role of material in the creative thinking process in design. Natural stones are materials with identity in terms of their properties. This situation leads the study to investigate the causes and consequences of the use of natural stone material in furniture design and the creative approaches in the resulting products.

Natural stone has some limitations due to its own characteristics. These limits, resulting from their physical, chemical and mechanical features, play a decisive role in furniture design and material interaction. 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 process in which all these boundaries are defined is undefined, but it is the time period in which creativity is used the most. (Kurşuncu, 2018). At this point, it can be said that the boundaries of the stone that seem like a disadvantage can be turned into an advantage with a properly managed process and new and creative solutions can be produced. The use of natural stone in design gives the opportunity to obtain different and creative products, while at the same time it is an environmentally friendly and sustainable approach.

In the study, the use of stone, which is a natural material, is handled through furniture design and the direction it finds in furniture as a design input and the direction it gives to design is investigated. For this purpose, drawing attention to the diversity of creative solutions offered by the natural stone material in terms of functionality, technique and aesthetics, it has been investigated how the designer handles the limits of the nature of the material in design as an effective means of expression. In this direction, firstly, furniture samples designed using natural stone were investigated. While choosing the furniture, care was taken to use different natural stones in order to provide diversity and to consider the use of natural stone from different perspectives. In this context, a total of 24 different furniture were determined by eliminating the similar ones among many types of furniture. These furniture include furniture that serves various functions such as chairs, coffee tables, cabinets, tables, and beds. Thus, it is ensured that the variety of use of natural stone in furniture belonging to different uses can be seen. Then, the type of natural stone materials used in furniture was determined and how the material used directed the furniture design was examined.

In the light of the data obtained, the use of natural stone in furniture design, the features of materials (physical, chemical, mechanical) and the ways of using these features in design (functional, technical, aesthetic) were examined and analysis charts were created for each type of furniture. At the last stage of the study, evaluations were made regarding all the findings and the advantages and disadvantages of using natural stone materials in furniture design were revealed. As a result of the study, it is aimed to draw attention

to the importance that natural stone materials, which seem to be a disadvantage for furniture design, can actually have creative or guiding effects on design. While doing this, it can display a beneficial and sustainable approach to the environment with the use of natural materials. It is also thought to pave the way for further research on different materials and creative constraints in design.

2. MATERIALS AND METHOD

The study was carried out in four stages. The first stage includes literature research, the second stage includes sample determination, the third stage includes analysis, and the fourth stage includes evaluation. The graphic showing the stages of the study is given below, and then all the stages are explained in detail (Figure 1).

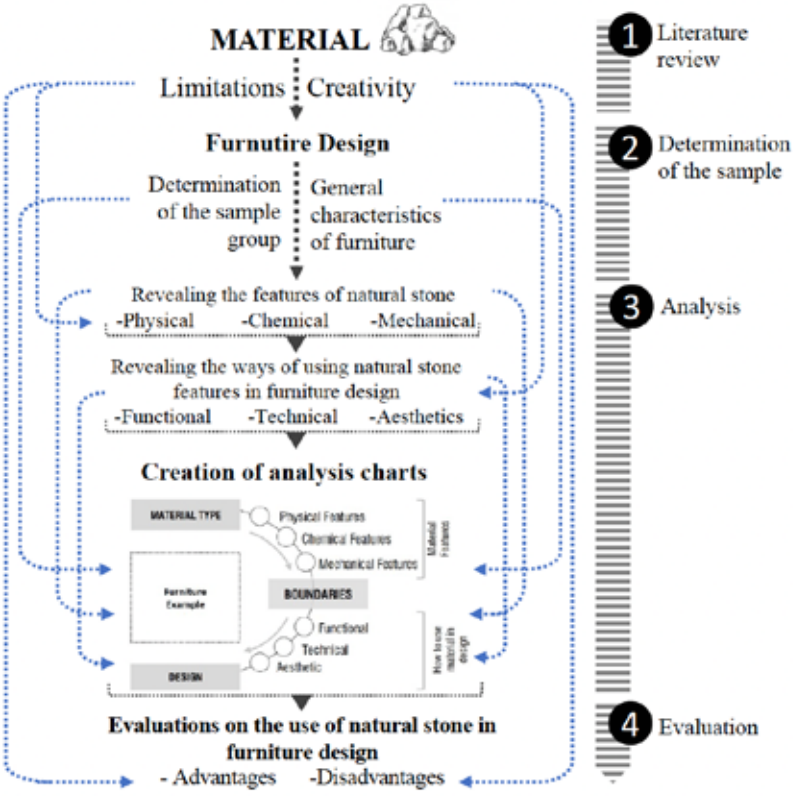


Figure 1. *Representation showing the stages of the work.*

In the first stage of the study, a literature review was conducted on the limitations in design, the relationship between creativity and material, and natural stone in design. This part is explained in the introduction. The second stage is the stage where the furniture to be examined is determined. At this stage, samples from Turkey were first researched, but the scope of the research was not limited to Turkey, as the same products were encountered during the research. While determining the furniture to be examined, the following criteria were taken into consideration;

- To be designed in 2010 and after,
- Being produced,
- Having enough data about it,
- Include information about physical properties, functions and materials,
- Treating natural stone as a design input

Another issue in choosing the furniture to be examined in the study is to consider different examples from various angles in order to see different creative solutions. In this direction, attention has been paid to the following features in order to see different approaches to the use of natural stone materials and to provide diversity;

- The use of different natural stone materials,
- Being from different geographies in order to reach different types of stones,
- Designers/firms being different from each other,
- Diversity in the ways of using natural stone material.

Although some of the furniture was awarded in the competitions, it was excluded from the study because it was not produced or did not contain enough information about materials and construction. In this direction, 97 examples in which natural stone was used in furniture were examined and similar ones were eliminated. While eliminating similar designs, the above-mentioned factors were taken into account. As a result of the researches, 24 different furniture were analyzed.

The third stage consists of two steps. In the first step, the natural stone materials used in the selected furniture were determined and then the way of using the boundaries created by the characteristics of the material used in the furniture design was explained. In the second step, in the light of the data obtained from the first step, "the features of the natural stone material used in the design" and "the way of using the material in the

design" were revealed.

Features of the natural stone material used in the design: Material features are generally considered as physical, chemical and mechanical features (Çorbacı, 2015; Özçatalbaş , 2019; Kılıçarslan et al., 2016; Kural et al., 2019; Felekoğlu, 2003; Çiçek, 2002). For this reason, the features of the natural stone material used in the design are discussed under these three headings. The physical features of the material include color, texture, optics, shape/form, magnetic, permeability, conductivity, density, water absorption, degree of saturation etc. The chemical features of the material include corrosion, activity, flammability, chemical reaction, rusting, behavior against acids and bases, activity, flammability, stability and reaction etc. The mechanical features of the material include durability, hardness, bending, ductility, brittleness, strength, fracture, tear, machinability, polishing, water absorption, abrasion, impact, pressure etc. (Çorbacı, 2015; Özçatalbaş, 2019; Kılıçarslan et al., 2016; Kural et al., 2019; Felekoğlu, 2003; Çiçek, 2002).

How to use the material in the design: In this part the purpose of the material used in furniture is revealed. In this direction, within the scope of the study, the way of making use of the material in the design has been discussed under three headings: functional, technical and aesthetic. While determining these titles, similar studies in the literature were taken as reference (Aydın & Uysal, 2009; Onsekiz & Sezer, 2009; Önlü, 2010). In terms of functionality; as the function that the material serves in furniture (backrest, armrest, lighting, etc.), technically; construction techniques of the material such as the combination of parts in furniture, interlocking, balancing; in terms of aesthetics, it has been evaluated as benefiting from the material in furniture visually and aesthetically.

The data obtained from the third stage were analyzed for each type of furniture and a graph was created. In the graphic, the type of material used in the furniture, the features of the material (physical, chemical, mechanical) -the limits-, the way of using the material in the design (functional, technical, aesthetic) and the final product (name and visual of the design) are listed (Figure 2).

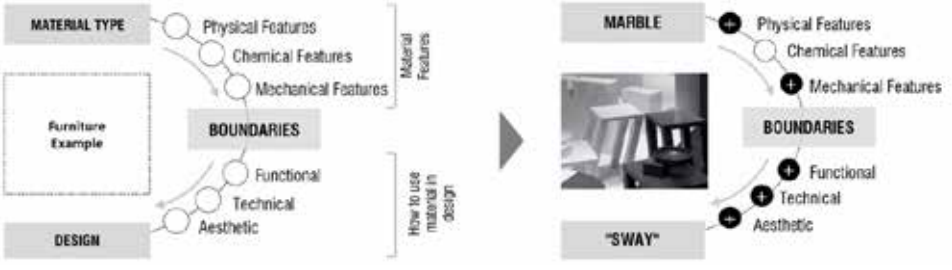


Figure 2. Analysis graph and sample furniture analysis.

In the fourth stage, all the findings were evaluated and the advantages and disadvantages of using natural stone materials in furniture design were revealed.

3. FINDINGS AND EVALUATION

The findings obtained in the study were discussed in two steps. In the first step, information about 24 furniture selected from the literature is given in accordance with the furniture selection criteria specified in the material and method section. In Table 1, information about the name, designer/company, type of furniture and the material used is given, respectively, under the furniture photo. In addition to this information, the effect of the natural stone material used in furniture design on the design has been examined (Table 1).

Table 1. *Furniture examined within the scope of the study and the effect of natural stone materials used on furniture design.*

 1.Sway Nendo Coffee table Marble	The weight of marble is considered as a design concept on the coffee tables that seem to be tilted to the side. Although the legs of the coffee tables seem bent under the heavy marble load, they are fixed with a special system. The weight disadvantage of marble has been turned into an advantage in this collection. The natural texture of marble was also used in the design.	 2.Orsetta Martin Massé Coffee table Limestone	Reflecting the natural texture of limestone, the coffee table attracts attention with its mushroom-like forms. Although the coffee table is made of large and thick pieces of natural stone, it has a soft feel. It's easy-to-shape structure and yet its durability have been the features utilized in the design. Limestone, which is not used much in design products with its heavy structure, adds a unique character to this collection.
 3. Lapella Zaha Hadid Chair Marble	The furniture, produced using marble reinforced with carbon fiber, is designed with three legs. The compressibility of the stone and the tensile features of carbon fiber were utilized in the design. In the design, different geometries were tried to improve the weight of the material and the structural performance. Lapella was created by adding modern technology and algorithmic extensions to traditional natural stone application techniques. The natural texture of marble has been a visual element in the design.	 4.Eros Angelo Mangiarotti Table Marble	The table sits on four cone-shaped legs. The design of the Eros table system is based on a jointless interlocking technique. The upper part locks itself to the marble feet placed at the corners and with the weight of the material. Technically, marble is important in design. Because its weight increases the sealing of the joint and the stability of the whole structure. Thus, a hard and static material such as marble has been transformed into a product with formal softness. The natural texture of marble was used in the design.
 5.Fragments Lex Pott Coffee table Marble, Belgium Blue Stone	The inspiration for the design comes from the way stones are broken, mined from quarries and large stone blocks. In the design, the natural defects of the material (congenital cracks, broken veins and raw lines) enrich the furniture visually. The stone pieces represent an open dialogue between nature and geometry. The differences in the way the stone is broken make each piece of furniture unique. The weight of the stone keeps the furniture in balance. The visual and tactile features of the material were utilized in the design.	 6. Petra Caterina Moretti Table Volcanic Stone	The table sitting on three cylindrical monoliths draws attention with its sculptural form. Petra, a monolithic table made entirely of black volcanic stone, was designed to express the material's unique natural qualities. The changing textural features and cultural significance of porous black stone were emphasized in the design. The way the material shapes Mexico's landscape and its relationship with the traditional culture of the region reinforces the meaning of the design. The color and porous texture of the stone have been the elements used visually in the design.
 7.Stone Table lex pott Table Belgian Bluestone	Belgian bluestone is made of natural stone material, including the table and legs. The designer, who wants to create the feeling of gravity, tells the story of the creation of natural stone from the quarry. The top of the table top has been cut flat and polished. The lower part is shaped with fracture marks. In his design, which combines industry and nature, the combination of natural rock formations with industrial geometry is seen. It has benefited visually from the color and texture characteristics of natural stone in the design.	 8.Alcarol Rapolano Table Travertine	The design is made of eroded travertine coated with resin. The resin, which strengthens and protects the cavities of the stone, is then polished to create angled blocks and plates. Travertine, which can be white, tan, cream-colored, or rusty, is a terrestrial sedimentary rock with a crystalline texture. Travertine's features such as color, texture and rusting have been the features that are used visually in the design.

	It is molded to embrace the adjacent rock below at every point where the glass tabletops meet the stone. Thus, the effect of naturally occurring forms, such as water from a stream flowing over the rocks, was created. At this point, the form of the rock was decisive in the design. The designer surprises the audience by adding an unexpected softness and fluidity to the hard and solid-looking rock. At the same time, the piece of rock forms the carrier of the coffee table with its weight and ensures that it stays in balance.		In Annex, whose parts can be assembled on site, the designer has aimed to produce minimum waste from start to finish. The coffee table, which consists entirely of marble, the two parts that make up the legs and the table, is formed by the combination of three parts in total. Gravity and the weight of the stone were used to assemble the pieces. The designer draws attention to the appeal of the contrast between natural material and simple functionality. The natural texture of the material has been a visual element in the design.
9.Slump Paul Cocksedge Coffee table Basalt Stone		10.Annex Joe Doucet Coffee table Arabescato Marble	
	The purity of the natural stone is a reference to the simple cube form of the furniture. The transparent and crystalline structure of Onyx marble is effective in the ability of the marble to transmit light. The light transmission feature of the material also enables the use of furniture for lighting purposes and also provides a visual effect. Using a simple cubic form, the designer highlighted these features of the material and brought the furniture to an aesthetically different point.		Modular Table has a system that can be easily assembled and disassembled. Thus, the stone not only brings the legs and tops of the table together, but also creates a flexible usage opportunity by combining it with other tables. In the design, legs and tables are held together by dovetail joints. In the design, a different technical point of view was presented to the use of hard materials such as marble and materials such as wood. The stone stud also gives the furniture a distinct accent and an air of elegance.
11.Cuby Atelier Alain Ellouz Coffee table Onyx Marble		12. Modular Table Livier vitriol Coffee table Marble	
	Antivol is supported by a basic metal frame. It features a piece of lava stone set in the simple metal frame of the stone table sourced from Sicily. The extraction of the stone from Sicily makes it a geographically specific cultural expression tool. Stone, in a pure and primitive state, has become functional in this coffee table design. While the lower part is preserved with the natural form of the stone, the upper part is cut with a water jet to form the table of the coffee table. Lava stone is a natural material, so each piece of furniture is a unique piece.		The design consists of onyx plates placed on an MDF frame. The texture of the material has been a visual element in the design. As with all natural materials, each table is different with its lines and texture. As with many other natural stones, since the interaction of marble with acid and base will discolor the material, it requires attention and precautions during its use.
13.Antivol Ctrlzak Coffee table Lava Stone		14. Petra Mitchell A., Bob W. Coffee table Onyx Marble	
	The tabletop of the coffee table, which consists of brass legs, is formed by onyx marble. The upper part of the marble is cut flat and forms the table top of the coffee table. The lower part of the stone is broken and used as a visual element with its natural form. At the same time, with the metal reflective surface placed under this section, the natural form of the stone can be seen when viewed from above. When the semi-permeable physical feature of Onyx is combined with light, it gives the design a different look. The visual and tactile features of the material were utilized in the design.		Inspired by Japanese craftsmanship traditions and ethics, the Wabi -Sabi Bed is handcrafted. It uses Japanese joinery techniques, interlocking with local materials. The designer carved the stone material to create the foot parts of the bed and combined the carved parts with wood in a way that they interlock. The design is inspired by the Japanese culture of appreciation and modesty, with techniques that embrace the natural edges and textures of the material. The natural texture of the material has been a visual element in the design.
15.Cramino Gianluca Pachioni Coffee table Onyx Marble		16.Wabi-Sabi Bed Ethan Stebbins Bed Granite	

 17.WS Bibliothéque Ethan Stebbins Cabinet Granite	The designer used Japanese joinery techniques, interlocking with local materials selected from natural environments. The design uses minimalist Japanese woodwork and traditional sculpting techniques to create organic forms that emphasize the material's natural beauty. While the stone undertakes a functional task by keeping the shelves standing, it also adds a different visual dimension to the design. The simple forms of the design place the raw material in the center. The natural texture of the material makes each piece of furniture different from each other.	 18. Steel Stone Chair Blanket&Camp Chair Rock	Designers produce functional furniture by combining raw stones with bent sheet metal, with the principle of “as little interference as possible”. Stone is used in its natural state under the metal construction in the chair, which is a minimally structured furniture made of steel and natural stone. The stone, which displays a statue, also contributes to the balance of the chair. Since stone is raw material, each piece of furniture is unique.
 19.Eddy Table Seth Rolland Table Granite	Eddy Coffee Table features a natural stone that is firmly gripped in a carved pedestal. The stone protruding from the side of the base and the wooden table surface evokes the feeling of a stone in the river or a Japanese rock garden with raked sand. The weight of the stone is also used to unite and balance the furniture. When moving furniture, the wooden table can be removed and the stone can be lifted from the carved base. The natural form of the stone and its combination with wood adds a different dimension to the design visually.	 20.Sprout Seth Rolland Coffee table Granite	Each stone and wooden leg of the glass coffee table is self-supporting. Movable legs allow for various arrangements. Thus, the designer aims to involve the user in the design. The feet made of natural stone and wood can stand on their own with the weight of the stone. Sprout can support a glass table of any shape or size and extra legs can be ordered for larger tables and endless variations. The stones used both functionally and visually create a natural effect in the design. Since each stone is different from each other and different numbers of feet can be used, each piece of furniture is different and unique.
 21. Arena Engold Coffee table Limestone	Made using a craft unique to the Philippine Islands, the furniture is a combination of rough and smooth limestone tiles. The sculptural design is aligned on a hollow wooden carcass. Surface parts are polished and sealed to protect against moisture and stains. Natural stone comes with its own distinctive color, texture variations and organic imperfections. Slight imperfections are part of the handmade process using this natural material, making each piece unique from the other. In addition, the fact that the stone is unique to the region where it was mined makes it a cultural expression tool.	 22.Cupiditas Amarist Table Basalt Marble	The body of the furniture appears as a balancing cube with one of its corners sunk into the ground. The body made of alabaster, a unique and translucent stone, can be controlled and illuminated by any smartphone or tablet device. This application allows users to change the light color and intensity. The color and texture of the stone was used as a visual element in the design.
 23. Zen Stone Apiwat Chitapanya Seat Shintai Stones	Inspired by zen gardens, where stones are considered as the soul of the garden, shintai stones are used in the design to show the balance of the blend between life and nature. The seat, which can be created using stones of different sizes, is different from its counterparts thanks to its natural form. Its design represents the concentration and calmness created by the art of stone arranging.	 24.Fragments Fict Studio Coffee Table, Chair Marble	The design is based on the fact that the pieces damaged during the transportation process and the remaining marble pieces lose their value because the pieces are too small to be used despite the high cost of the material. The designers reuse discarded material while demonstrating the "unique beauty of marble." Broken marble slabs were placed in rectangular molds and bonded with resin. These pieces were then glued together using adhesive glue. It has taken the design to a different dimension visually by making use of the natural texture of marble in the design.

In the second step, the data obtained within the scope of the use of natural stone in furniture design were evaluated and tabulated for each furniture sample in accordance with the following criteria (Table 2).

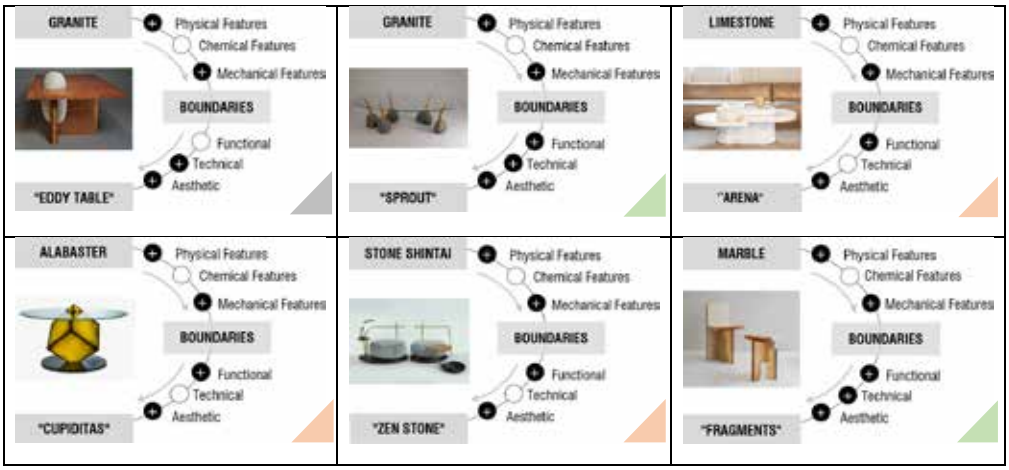
• Features of the natural stone material used in the design (physical features, chemical features, mechanical features)

• The way of using the material in the furniture design (functional, technical, aesthetic)

In the graphics of the furniture evaluated in accordance with these criteria, the graphics with the same marking type are marked with colors. 5 different types that emerged in this direction were expressed with 5 different colors. Green color indicates that physical and mechanical features are used functionally, technically and aesthetically. Orange color indicates that physical and mechanical features are used functionally and aesthetically. Blue color indicates that its physical, chemical and mechanical features are used functionally and aesthetically. Yellow color indicates that only the mechanical features of the material are used technically and aesthetically. Gray color, on the other hand, indicates that the physical and mechanical features of the material are used technically and aesthetically.

Table 2. *Analysis graphics of furniture.*

MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "SWAY"	LIMESTONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "ORSETTA"	MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "LAPELLA"
MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "EROS"	MARBLE, BELGIUM BLUESTONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "FRAGMENTS"	VOLCANIC STONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "PETRA"
BELGIAN BLUESTONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "STONE TABLE"	TRAVENTINE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "ALCAROL"	BASALT STONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "SLUMP"
MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "ANNEX"	ONYX MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "CUBY"	MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "MODULAR T."
LAVE STONE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "ANTIVOL"	ONYX MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "PETRA"	ONYX MARBLE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "CREMINO"
GRANITE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "WABI-SABI BED"	GRANITE Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "BIBLIOTHÈQUE"	PIECE OF ROCK Physical Features Chemical Features Mechanical Features BOUNDARIES Functional Technical Aesthetic "STEEL STONE "



The features of the material and the ways in which these features are used in design are shown in Table 2. When the results obtained from the analyzes are examined, the similarity in the graphic types draws attention. Graphic type, in which physical and mechanical features are utilized both functionally and aesthetically, can be seen in 13 furniture (furniture numbered 2, 5, 6, 9, 11, 13, 14, 15, 17, 18, 21, 22, 23). Graphic type, in which physical and mechanical features are utilized both functionally, technically and aesthetically, can be seen in 8 furniture (furniture numbered 1, 3, 4, 7, 10, 16, 20, 24). At this point, it can be said that the physical and mechanical features of natural stone are mostly used in furniture designs. It can be said that these features correspond to the most functional, aesthetic and technical aspects in design.

In the study, the analyzes carried out on the furniture samples and the obtained findings were evaluated. In this context, while it is seen that the physical features of the furniture are used functionally in 2 furniture and aesthetically in 24 furniture, it is seen that the physical features of the material are not used technically. While it is seen that the chemical features of the material are used aesthetically in 1 furniture, there is no example of functional and technical use. On the other hand, it is seen that the mechanical features of the material are used functionally in 22 furniture, technically in 8 furniture and aesthetically in 13 furniture (Figure 3).

	Furniture No.
Physical/Functional	11.12
Physical/Technical	-
Physical/Aesthetic	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
Chemical/Functional	-
Chemical/Technical	-
Chemical/Aesthetics	8
Mechanical/Functional	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24
Mechanical/Technical	1, 3, 4, 9, 11, 15, 19, 20, 24
Mechanical/Aesthetics	5, 7, 8, 9, 13, 15, 16, 17, 18, 19, 20, 21, 24

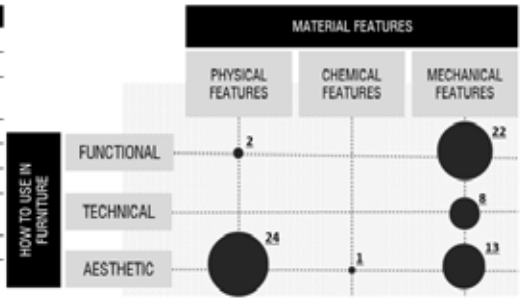


Figure 3. *The relationship between material features and utilization in furniture.*

The findings obtained from the samples examined in this part of the study were evaluated in terms of the advantages and disadvantages of using the physical, chemical and mechanical features of the material in design.

When the examined samples are evaluated in terms of the physical features of the material;

• The physical features of the material are clearly used for aesthetic purposes. It is seen that the physical features of natural stone (visual, tactile, etc.) are used aesthetically in every furniture (Sway, Lapella, Cuby, Annex, Petra, Cremino, Travertine etc.). The natural qualities of the material (natural porous form, color, texture, innate cracks, broken veins, raw lines, etc.) make each piece of furniture different and unique, providing an advantage in terms of the originality of furniture design. At this point, it can be said that the physical features of the material are used in the design, different and creative solutions can be produced and it gives direction to the design.

• The physical features of the material are also used functionally. In furniture in which a translucent natural stone such as Onyx is used, besides responding to functions such as sitting, lying, etc., it also allows the use of furniture with an additional function as a lighting element.

• In the samples examined, no example was found in which the physical features of the material were used technically.

When the examined samples are evaluated in terms of the chemical features of the material;

• It can be said that the chemical features of the material are the features that are avoided, not the features that are generally used. For example, in only one piece of furniture (Alcarol), the color change caused by the rusting of the material was used aesthetically. This

example is an indication of how rust, which seems to be a bad and undesirable situation on furniture, has become a design element with creative thinking.

• Features of natural stone material such as corrosion, reaction, behavior against acid-bases can negatively affect the furniture in terms of functionality, technique and aesthetics. Highly pigmented liquids, food and direct contact with objects that may cause color transfer can cause color changes in the material. For this reason, it is recommended to use natural stones that react against acid bases such as marble as a base for food and beverages. Another precaution taken is to cover or polish the natural stone with a material (Fragments, Arena, Petra, etc.). When all these are evaluated, it is possible to say that the chemical features of the material cause disadvantages rather than advantages in furniture design.

• In the samples examined, no example was found in which the physical features of the material were used in terms of functionality and technique.

When the examined samples are evaluated in terms of the mechanical features of the material;

• It is seen that the mechanical features of the natural stone material are used more than other features. Considering that stones have different mechanical features, each stone should be used in a function in line with its own characteristics.

• In cases where its weight, hardness and durability are high, it is advantageous to use natural stone as a foot, body, carrier, etc (Fragments, Slump, Eros, Eddy Table, Eros etc.). It enables the material to be easily used as a tabletop, chair back or foot, thanks to operations such as crushing, cutting and carving on natural stone materials. Looking at the examples examined, it is seen that the natural stone material responds to the functional requirements of the design in the majority of the furniture.

• When the use of natural stone in furniture is evaluated for technical purposes, it is seen that the features of stone such as hardness, durability, strength and weight are used for the purposes of combining, clamping or balancing (Eros, Petra, Stone Table, Annex, Slump, Eddy Table, Sprout etc.).

• When the use of the mechanical features of the material in furniture is evaluated in terms of aesthetics, the porous structure of the natural material, the differences in the way of breakage and wear make each furniture different and unique from each other and create a different effect on the furniture visually (Alcarol, Slump, Antivol, Fragments, Cremino, Arena, Steel Stone Chair etc.). Based on all these, it is possible to say that different and creative solutions can be produced in design by utilizing the mechanical

features of the material and that it shapes the design.

• Apart from the possibilities provided by the mechanical features of natural stone, there are also disadvantages that it may cause. At this point, it is very important to pay attention to the use of softer and brittle stones in furniture. Arena and Orsetta, where limestone is used, which is more likely to break and wear than others, can be given as examples. Conditions such as pushing, dragging, pulling and abrasion can cause the furniture to deform over time.

• There are examples where the mechanical features of the material are also used as the name of the furniture design (Fragments etc.). This can be seen as an indication of the importance of the mechanical features of the material for furniture design.

Apart from all these, it has been seen that the features of the natural stone in a piece of furniture, unlike the physical, chemical and mechanical features, also correspond to the design in terms of semantics. Natural stones are a means of cultural expression with the minerals they contain, the geography they are extracted from and their processing. It is seen that the natural stone used in the design is unique to the geography where it is located, as in the examples of Petra, Antivol and Arena. This shows that besides the use of natural stone for functional, technical or aesthetic purposes, it also plays a role as a cultural expression tool and adds meaning to the design. At this point, it is seen that natural stones enrich the meaning of the furniture as a cultural element, apart from being functional, technical, or aesthetic. Similarly, the meanings of natural stones in some thoughts also supports their use and meaning in furniture (Wabi Sabi Bed, Zen Stone, etc.).

CONCLUSION

The behavior of developing and designing products to serve a purpose is predominantly humanly. It is the cognitive skills and the ability to produce ideas that provide the ability to produce. People have gained and developed the ability to produce creative solutions against the problems that have arisen from the past to the present. Our abilities such as fictional thinking and creating stories have emerged in parallel with this. The constraints and boundaries that emerged at this point have been a phenomenon in design that prompts people to think, generate ideas and increase creativity.

Today, due to the inadequacy of natural resources, the use of materials identical to nature or replacing natural materials has increased in design. In the study in which the effects of the limitations created by the natural stone material on the furniture design were investigated; it has been revealed that while the boundaries created by the material restrict

the designer, it also allows for creative solutions. Thus, drawing attention to the diversity of creative solutions offered by natural stone in terms of functionality, technique and aesthetics, it has been seen that the designer can use the limitations of the nature of the material as an effective means of expression in design. It is clear that the stone material, which seems heavy and unusable for furniture, can produce functional, technical and aesthetically original solutions in design with correct and creative ideas. At this point, the designer should correctly establish the relationship between the materials used and the furniture designed.

Although the use of the material in accordance with its nature and emphasizing its characteristic features contributes to the impressiveness of the design, it is not correct to determine a single truth and make it dependent on the rules. So much so that each material contains new and creative solutions in countless different ways in line with the limits created by its various features. What has been done in this research is not to determine the physical, chemical and mechanical features of natural stone materials one by one, but to emphasize how the designer handles the limitations of the nature of the material in the design as an effective means of expression by drawing attention to the diversity of creative solutions it offers in terms of functionality, technicality and aesthetics.

Natural stone is also important in terms of being a material culture element that has a great place in human history and witnesses our past. Stone material, which has some technical limitations like every other material, is used in various fields. At this point, some structural features of the stone, which seem to be disadvantages, can be turned into an advantage with a correct and creative process. As a result of the analyzes made, it has been seen that the technology which provide the opportunity to directly interfere with the material, technical features or cultural and conceptual features that can be a source of inspiration for the designer, can provide various opportunities for original and creative forms of expression. Basically, human perception and ways of thinking are shaped by these factors. While the designer can consciously benefit from the symbolic, conceptual and cultural aspects of natural stone, these relationships can also be established by the viewer later on.

Although the use of natural stone in furniture design is generally avoided, the study focuses on the fact that a new story can be created by using the material's own essence. At this point, it shows that with the use of natural stone in furniture design, both original designs can be obtained and a sustainable approach that respects nature and the environment can be displayed. Considering the positive results in terms of both design and environment in cases where the natural stone usage process is managed correctly, it is thought that designers should adopt and popularize the use of natural materials.

Limits created by the characteristics of the natural stone material can lead to different and creative solutions in furniture design; however, some disadvantages can appear. While the hard, durable, heavy and solid structure of the natural stone (such as granite, marble) creates technical advantages, it can also be a disadvantage as the same features do not allow the stone to be shaped easily. While the fragility and softness (such as limestone) characteristics, which change according to the stone type, turn into an advantage by allowing the stone to take the desired shape easily, it is seen that they can also create disadvantages such as friction and wear. For this reason, the type of furniture, where and for what purpose it will be used are the points to be considered in the selection of natural stone materials. As can be seen in the examples examined, it is seen that many features created by the stone direct the furniture design, shape the design processes and contribute to the creative thinking process.

In the study, analyzes were carried out on 24 samples, in which various natural stone materials were used and designed with different solutions. However, as the number and variety of examples increase, it is possible to see different uses and different creative solutions. At this point, an analysis can be carried out by selecting a sample group of a single furniture type such as seating element, storage element, etc. for future studies. In addition, research can be done by considering products that use only one type of natural stone material. At this point, it is thought that this study will lead to future studies.

The study, which focuses on the subject of furniture design, guides the research of the use of different natural materials at different scales such as architecture, interior architecture, industrial design, painting, sculpture, etc. in other researches. It is thought that this study, which evaluates the use of natural stone materials in furniture, will guide the research by focusing on different materials.

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