DESIGNERS’ FINISHING MATERIAL SELECTION CONSIDERATIONS IN INTERIOR SPACES

The Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

by

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In Partial Fulfillment of the Requirements for the Degree of
MASTER OF FINE ARTS

THE DEPARTMENT OF
INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN
İHSAN DOĞRAMACI BİLKENT UNIVERSITY
ANKARA

June 2019

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts.

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ABSTRACT

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June 2019

This study aims to explore the different considerations contributing to the material selection process in interior architecture discipline and understand designers' finishing material preferences for interior surfaces, namely floors, walls, and ceilings. Also, designers' prioritizations when selecting materials for these surfaces are examined. The study was conducted through interviews and questionnaires with 30 interior architects/ architects professionally working. In the study, designers' material selection considerations were analyzed in general and then entrance areas of interior residential projects were focused on. The findings of the study show that a wide range of considerations is made before selecting a material. The determinants of these considerations are mainly material related, project related and designer related. Designers have different considerations for each material and consequently, for each surface. Their prioritization mostly focuses on the materials' sensorial properties and walls are the surfaces that these properties are the highest. Technical properties are prioritized at a secondary degree for each surface. Moreover, materials' intangible properties are more prior than manufacturing properties in walls and less prior in floor and ceiling surfaces. Lastly, materials' ecological properties are prioritized the lowest by designers for each surface. This study helps to improve material knowledge in interior architecture and to disseminate material education. Also, it has implications for designers while selecting materials, and for material manufacturers while designing finishing materials.

Keywords: Finishing Materials, Interior Surfaces, Material Properties, Material Selection Considerations, Residential Spaces

ÖZET

İÇ MEKANLARDA TASARIMCILARIN BİTİRME MALZEMESİ SEÇİM ETMENLERİ

Salcı, Elif

Yüksek Lisans, İç Mimarlık ve Çevre Tasarımı Bölümü

Tez Danışmanı: Dr. Öğr. Üyesi Burçak Altay

Haziran 2019

Bu çalışma, iç mimarlık disiplininde tasarımcıların malzeme seçim sürecine katkıda bulunan farklı etmenleri araştırmayı ve tasarımcıların zeminler, duvarlar ve tavanlar olarak adlandırılan iç yüzeyler için bitirme malzemesi tercihlerini anlamayı amaçlamaktadır. Ayrıca, tasarımcıların bu yüzeyler için malzeme seçim öncelikleri de incelenmiştir. Çalışma, profesyonel olarak çalışan 30 mimar/iç mimar ile yapılan görüşmeler ve anketler aracılığıyla gerçekleştirilmiştir. Çalışmada, tasarımcıların malzeme seçimlerinde dikkate alınan etmenler genel olarak analiz edilmiş ve daha sonra konut projelerinin giriş alanlarına odaklanılmıştır. Çalışmanın bulguları, malzeme seçerken çok çeşitli etmenlerin olduğunu göstermektedir. Bu etmenlerin belirleyicileri temel olarak malzemeye, projeye ve tasarımcıya ilişkindir. Tasarımcılar her malzeme için ve dolayısıyla, her yüzey için farklı değerlendirmelere sahiptir. Tasarımcıların öncelikleri çoğunlukla malzemelerin duyusal özelliklerine odaklanır ve duvarlar bu özelliklerin en yüksek olduğu yüzeylerdir. Malzemelerin teknik özellikleri her yüzey için ikincil derecede önceliklidir. Ayrıca malzemelerin soyut özellikleri duvarlarda malzemelerin imalat özelliklerinden daha fazla önceliğe sahipken, zemin ve tavan yüzeylerinde daha az önceliğe sahiptir. Son olarak, her yüzey için malzemelerin ekolojik özelliklerine tasarımcılar tarafından en düşük öncelik verilmiştir. Bu çalışma, iç mimarlıkta materyal bilgisinin geliştirilmesine ve materyal eğitiminin yaygınlaştırılmasına yardımcı olmaktadır. Ayrıca, tasarımcılara malzeme seçimlerinde, malzeme üreticilerine ise bitime malzemesi tasarımlarında katkıda bulunur.

Anahtar Kelimeler: Bitirme Malzemeleri, İç Yüzeyler, Konut Mekanları,
Malzeme Özellikleri, Malzeme Seçim Etmenleri

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to Asst. Prof. Dr. Burçak Altay her invaluable support, endless patience, supervision and guidance throughout my graduate education and this study. I consider myself as privileged for being one of her students.

I would also like to thank to my jury members Asst. Prof. Dr. Çağrı İmamoğlu and Assist. Prof. Dr. İpek Memikoğlu for their contributions and feedbacks.

I also want to thank you to Murat Özdamar, Ph.D. for your continuous encouragement and support throughout my study.

I would also like to thank all the designers who participated in my study and shared their ideas and thoughts with me. Without their passionate participation and input, the study could not have been successfully conducted.

I am grateful to all faculty members and staff of İhsan Doğramacı Bilkent University Department of Interior Architecture and Environmental Design and Department of Architecture.

I am mostly grateful to my family. I am indebted to my father Levent Salcı, my mother Nurten Salcı and my sister Selin Salcı for their endless love and trust throughout my life but especially their patience during this study.

Lastly, I would like you to thank you to my lovely friends Damla Trakya and Sinem Naz Karagöz for your trust and moral support during this study.

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CHAPTER 1

INTRODUCTION

Materials are the essence of the designer's palette and each material offers distinctive characteristics which the designer can utilize for new design possibilities (Hodgson & Harper, 2004). Decisions about materials, about their precise and meaningful use, make a crucial difference to the quality of the design and ultimately of the space that emerges (Ashby & Johnson, 2002). In history, designing with materials began with natural sources such as wood, stone, leather, and bone. In the following years, with the help of material discoveries, material science, and engineering, a variety of materials were created (Akın & Pedgley, 2016).

In the 21st century, the increasing amount of materials are available for designers and to select among the immense number of materials, there are many factors and constraints that have to be considered (Wastiels & Wouters, 2012). Therefore, in order to identify the best material for the design project, it is significant to understand which kind of material considerations play a role in designers' material selection process.

In the literature, numerous sources provide the material related considerations for engineering (Ashby, 1992, 2005; Budinski, 1996; Lindbeck, 1995; Mangonon, 1999), architecture (Hegger, Drexler, & Zeumer, 2007; Wastiels & Wouters, 2012), and product design disciplines (van Kesteren, Stappers, & de Bruijn, 2007; Karana, Hekkert, & Kandachar, 2010). Also, some studies focus on the designers' prioritizations of material related considerations (Ashby, Bre´chet, Cebon, & Salvo, 2004; Karana, Hekkert, & Kandachar, 2008). In interior architecture context, material related studies mostly focus on investigating the relation between the materials and their perceived values (e.g. Wastiels, Schifferstein, Heylighen, & Wouters, 2012), or the effects or outcome of a specified material on a specific topic (e.g. Fujisaki, Tokita, & Kariya, 2015, Harris, 2016). However, none of the studies focus on the relationship between the consideration of designers during designing an interior space, and specified materials as an outcome of those considerations. By referring to this gap in the literature, the aim of the study was identified.

1.1. Aim of the Study

The present study aims to explore the different considerations contributing to the material selection process in interior architecture discipline and understand the interior designers' finishing material preferences for interior surfaces. Moreover, designers' prioritizations that are considered for interior surfaces is to be examined.

To achieve these aims, interior spaces were analyzed referring to interior surfaces which are floor, wall, and ceiling. Accordingly, finishing materials were described as the final layer that fixes and protects these surfaces. Within the context of the thesis, all discussion and analysis were based on these materials. While the study investigated general considerations of designers; for actual material preferences and prioritization of designers, the focus was an entrance of the residential spaces in order to decrease the multiple factors and diversity. Also, entrances of residential projects are accepted as the areas where the material diversity is higher than the other parts of the residence (Kicklighter, Baird, & Kicklighter, 1990). With this approach, it was expected to reach more diverse material preferences and accordingly, different material considerations for the context of the study.

1.2. Structure of the Thesis

The present study consists of six chapters. The introduction is the first chapter that gives general information about the study. In the second chapter, in order to understand the materials in detail, the material classifications that exist in literature are described with the material families. Then, within the same chapter interior surfaces and the finishing materials used for these surfaces are presented. In the third chapter, traditional material selection processes and considerations contributing to the selection processes based on previous studies are defined. The methodology of the study is described in the fourth chapter by referring to the aim of the study. Research questions, participants, study instruments with the procedure and the data analysis procedures are explained. Results are given in the fifth chapter with regards to designers' material considerations, preferences and prioritizations. Also in this chapter, results of the study are discussed by making some comparisons with literature. In the last chapter, a brief conclusion is given to summarize the study, also, limitations and possible further studies that may be conducted are mentioned.

CHAPTER 2

MATERIAL CLASSIFICATIONS

In this chapter, material classifications in the discipline of material science, engineering, product design, and architecture will be discussed. Then, materials in the interior architecture discipline will be presented in reference to already existing classification systems in the literature. In doing this, firstly, interior surfaces and finishing materials are described and each material is discussed by referring to these descriptions.

Each material offers distinctive characteristics which the designer can utilize for new design possibilities. At the same time, materials determine the constraints, in terms of shape, size or geometry, processing capabilities and property characteristics within which the design must develop (Hodgson & Harper, 2004). To explore the materials' characteristics and their possibilities, material classifications are made so as to group common material properties. It is an essential step not only for identifying material properties, but also identifying measurable differences in their behavior, which provide valuable knowledge for making a sufficient selection among various materials

(Fernandez, 2006). There are a number of existing classifications and descriptive systems used to build an understanding of materials and in general, each system follows a particular point of view that is related to its field. For describing the materials used in different design disciplines, many material classification approaches evolved over the years (Addington & Schodek, 2005).

2.1. Materials in the Disciplines of Material Science and Engineering

Classification systems in material science and engineering disciplines are mainly based on the terms of precisely defined material properties through established standardization from research and disciplinary consensus (Fernandez, 2006). However, their approach to the way of classifying material show some differences.

Material science revolves around the internal structure of the material and therefore, provides a core understanding of classification systems. The classification based on this approach focuses on the basic structure of materials or what a material is composed of. This way of classifying materials is highly useful because of many reasons. In particular, knowledge of the basic structure of materials such as molecular and atomic properties provide a way of describing the specific qualities of properties (e.g., electrical conductivity, hardness, stiffness) that characterize different materials. The hierarchical organization of the classification system in material science describes the broadly descriptive categories such as Metals, Polymers, Ceramics, and these categories are also referred to material families (Addington & Schodek, 2005; Wastiels, 2010).

Engineering disciplines focus on what a material can do, by mixing and matching properties to solve the problem or need. With this approach, typical engineering classifications are made according to six distinct determinants to classify the material families. These are the state (solid, liquid, gas, etc.), the structure (amorphous, crystalline, etc.), the origin (natural, synthetic, etc.), the composition (organic, inorganic, alloy, etc.), property (conductivity, density, etc.), and the application (adhesive, paint, fuel, etc.) (Addington & Schodek, 2005). By focusing on these determinants, the members of each family share common features like similar properties, similar processing routes, and similar applications (Ashby, 2005). In short, while the material science classification explains why one material is differentiated from another, the engineering classification describes how a material performs.

2.2. Materials in the Disciplines of Product Design and Architecture

The precisely defined material properties through established standardization from research and disciplinary consensus in material science and associated engineering discipline have a greater emphasis on the grouping of common material properties and they form a basis of widely accepted material families for a variety of disciplines (Addington & Schodek, 2005; Fernandez, 2006).

In the discipline of product design, the defined material properties are called as material technical or engineering attributes. The classification system is based on material families (metals, polymers, ceramics, and composites), its classes (types of the materials in a family), and its members (a set of attributes that quantify material physical, mechanical, thermal, electrical and optical behavior). This kind of classification system provides some technical profiles of materials in product design such as physical, mechanical, thermal, electrical, and optical (Ashby & Johnson, 2014). Similarly, in architecture discipline, these type of material properties are discussed as technical properties of materials in the context of structural requirements. For example, in Wastiels and Wouters' (2012) study, technical aspects refer to the engineering concerns like stiffness, porosity, strength, density, etc. and these properties are organized according to their mechanical, technical, physical, optical, or thermal nature. In Hegger et al.'s (2007) model, technical properties refer to the basis of material inner values, its physical (density, thermal conductivity, etc.), its mechanical (tensile and compressive strength, elasticity, hardness, etc.), and its chemical (corrosion, resistance to UV light, etc.) parameters.

The mentioned material properties have a mixed classification perspective based on pure performance requirements and are presented with a generalization (Addington & Schodek, 2005). This generalization forms the basis of some widely accepted families in literature. For example, by taking the classification suggested by Fernandez (2006) as a reference from the architecture discipline, five major families of materials can be specified which are metal, polymers, ceramics, natural materials, and composites. In reference to these commonly used material families, other classifications used in various literature sources are presented in Table 1.

Table 1. Classification of materials into material families or categories according to different sources

	Fernandez, 2006	Ashby & Johnson, 2002	Lefteri, 2007	Ojeda et al., 2003
METALS	x	x	x	x
POLYMERS or plastics	x	x	x	x
CERAMICS	x	x	x	
Glass				x
Concrete				x
Natural Stone				x
NATURAL MATERIALS	x	x		
Wood			x	x
COMPOSITES	x	x		

The comparisons between the material classifications of various sources show some differences, but in fact, they have many commonalities. For example, in some systems natural materials are not present as a group, rather than this a group named wood are specified (Lefteri, 2007; Ojeda, Warchol, Pasnik, & McCown, 2003). Also, while some sources prefer to group the natural stone as a separate category to keep the natural materials as a distinguished group (Ojeda et al., 2003), some group the natural stone under the category of ceramics with glass and concrete because of the similarities in terms of their behaviors and substances (Fernandez, 2006; Ashby & Johnson, 2002; Lefteri, 2007). Besides the differences in the classifications of materials, these five materials are widely accepted in many sources and they will be discussed in detail with their properties in the next section.

2.3. Materials in the Discipline of Interior Architecture

In this section of the thesis, interior surfaces are explained, and an overview of finishing materials that are commonly used in interior surfaces are defined.

2.3.1. Interior surfaces

Interior surfaces are divided into three categories as wall, floor, and ceiling. These elements are organized to give a form and define the boundaries of interior spaces (Ching & Binggeli, 2018).

The wall defines the space of a room or the sequence of movement through an interior, and its function is to separate spaces from each other vertically (Grimley & Love, 2013; Koca, 2016). Depending on the structural system, walls can be used as structural bearing walls or nonstructural partitions. In any interior, mainly walls constitute more square footage than any other internal surfaces and they are accepted as the primary spatial tool of the designer. Today, a vast palette of finishing materials are available for wall surfaces and they range from simple paints to more complicated paneling and stone veneers (Grimley & Love, 2013; Sharma & Dhanwantri, 2017).

The floor is the horizontal structural element of building and is integral to an interior project as any wall treatment (Grimley & Love, 2013; Koca, 2016). The prior function of the floor is load bearing. At the structural system, it has to carry its own load and transfer it to the system (Koca, 2016). Also, according to its location in a building, it has to be resistant to effects such as; heat, water, moisture, and noise (Sharma & Dhanwantri, 2017). The finishing of the floor can be a continued single material or designed with a combination of different materials. This variety in usage provides designers a template that influences the color, acoustic, and reflectance within a space (Grimley & Love, 2013).

The ceiling is the lower part of the floor and it is as important as any other surface in any interior space. If there is no equipment on the ceiling surface, such as HVAC or installation, it is usually planar and can be solved easily. However, if the ceiling has an acoustic, HVAC, lighting or sprinkler system equipment on it, in order to hide the system, a suspended ceiling has to be created; or in some cases, designers may wish to leave it exposed (Toydemir, Gürdal, & Tanaçan, 2000). For suspended ceilings, a hanger system is installed primarily and then the finishing material is installed to the system. Designers can use a variety of materials to finish a ceiling (Grimley & Love, 2013; Koca, 2016).

2.3.2. Interior finishing materials

Finishing can be defined as the final layer that fixes and protects the building elements' surfaces, in this context wall, floor and ceiling. Interior finishes enclose all materials and surfaces that can be seen or touched (McMorrough, 2006). Therefore, this layer plays a substantial role not only in the structural definition of interior spaces but also in the visual and psychological definitions (Hegger et al., 2007).

Improvements in building techniques affect the need for the finishing layer. Historically, buildings were usually produced by materials such as stone, wood, and adobe and these traditional materials were mainly used uncoated or barely plastered. Later, with the development of modern building techniques, the building structure became thinner and new layers had to be added. This makes the finishing essential to coat wall, floor and ceiling surfaces in order to gain a suitable appearance in interior spaces and protect the construction layers from exterior effects such as water, heat, moisture, and abrasion (Koca, 2016).

For an interior project, the selection of finishing materials can be based on many determinants like the function of the space, the anticipated volume of traffic, acoustical effects, fire-resistance ratings, or aesthetic appearance in a design project (McMorrough, 2006). Within the context of the thesis, to understand the finishing materials and their possible usage ways in a detail and organized way, interior finishing materials are clarified under five major category as metals, polymers, ceramics, composites, natural materials pertaining to Fernandez (2006) classification on material families (See Table 1). Additionally, there are some other materials that is not categorized in the Table 1, which are included in our list due to their extensive use in interior design like textile, paint, and wallpaper (Grimley & Love, 2013). The overview of these materials and their used surfaces in interior spaces can be seen in Table 2.

Table 2. Material families and their usage in interior spaces

MATERIAL FAMILIES	TYPES	SURFACES		
		Wall	**Floor**	**Ceiling**
METALS	Aluminum	x		x
	Zinc, Copper, Brass	x		x
	Steel	x	x	
POLYMERS / PLASTICS	Vinyl Resins, PVC	x	x	x
	Epoxy		x	
CERAMICS	Concrete	x	x	x
	Glass	x	x	
	Stone	x	x	
	Clay	x	x	
NATURAL MATERIALS	Wood	x	x	x
COMPOSITES	Terrazzo		x	
	Laminated Materials	x	x	x
OTHERS	Paint	x		x
	Wall Paper	x		x
	Textiles / Fabric	x	x	x

2.3.2.1. Metals

Ductility, high strength, hardness, durability, and conductivity are just some of the technical properties of metals. Metals carry loads in very useful ways, demonstrating good resilience and significant ductility. They are divided into two groups as heavy metals with a gross density like lead, copper, zinc and iron; and light metals with a low gross density like aluminum. An additional distinction is made between ferrous metals, or iron bearing and non-ferrous, lacking iron content (Fernandez, 2006; Hegger et al., 2007). Ferrous metals are mainly used in structural situations in which the transfer of compressive and tensile load is required. In contrast, nonferrous metals (aluminum, copper, tin, nickel, zinc, titanium and chromium) are not used for load transfer (Fernandez, 2006).

Metals are almost never used in their pure forms. Not only are these pure forms often difficult and expensive to produce, but also the pure forms of the materials easily react with gasses and water that cause corrosion. Therefore, alloys that are obtained by melting and mixing two or more metals increase the strength of metals and make them more resistant to corrosion (Fernandez, 2006; Koca, 2016).

Metals are easily processed using heat and mechanical working. They can be shaped mechanically by bending, edging, stamping and melting procedure. Also, there are some other shaping procedures like extrusion (under high pressure shaping the material according to the desired template), forging (shaping metals by using hammer and anvil), and casting (melting metal until fluid enough to pour into a mold to shape) (Fernandez, 2006; Hegger et al., 2007).

In interior surfaces, metal is preferred because of its structural strength and aesthetic appearance. It can be used in panel or tile form as a wall and floor coating material and can be used at the ceilings as suspended ceiling material (Toydemir et al., 2000). Metal wall cladding panels are usually produced from aluminum in different dimensions, because aluminum is a lightweight nonferrous metal and can be used wherever reduced weight and weatherproof qualities are important. Additionally, for walls, ceramic-like metal tiles and mosaics that are produced from stainless steel copper, brass, and zinc can be used because they are resistant to corrosion and easy to work (Hegger et al., 2007; Toydemir et al., 2000). In steel constructions, metal floor coating materials can be used. They are resistant to high temperature, friction, abrasion, and impact. This type of floor coating materials have glossy, lined and slippery surfaces, therefore, their surface is roughened in production stage in order to increase the walking safety. Different sized and formed metal panels can also be used on the ceiling as suspended ceiling material. These metal-faced panels are available in a variety of finishes and perforations (Toydemir et al., 2000). With perforations and absorptive material behind, these panels also provide various levels of acoustic dampening on ceilings (Grimley & Love, 2013).

2.3.2.2. Polymers

Polymers, also known as plastics, are the primary source materials for all manner of design disciplines, because of their ease of processing, seemingly endless formulations, competitive pricing, and global availability (Fernandez, 2006). Some technical properties of polymers like lightness, low gross density and thermal conductivity, high coefficient of thermal expansion, high tensile strength, and high resistance against environmental factors increase their frequency of use (Hegger et al., 2007; Koca, 2016).

According to their thermal behavior, polymers are divided into two groups as thermosets and thermoplastics. Thermosets melt when they are heated and after a certain temperature, they begin to break down. In contrast, thermoplastics soften when heated and harden again to their original state when cooled. This allows them to be molded to complex shapes (Ashby & Johnson, 2014; Binggeli, 2008). Thermoplastics accept coloring and fillers before forming, and many can be blended to give desired physical, visual and tactile effects. They can be bent according to the desired radius. Besides, by adding UV filters, sunlight sensitivity, and with flame retardants, flammability can be reduced (Ashby & Johnson, 2014; Godsey, 2013). Polymers are easily processed and provide unlimited production forms. Some methods to shape the polymers are: extrusion (shaped in a press), injection molding (at a high temperature, pressing the plastics into molds under pressure), and calendaring (rolling and stamping) (Hegger et al., 2007).

Polymers are used in many ways in interiors, because there is an endless option to form and color them. Their finish is continuous and a variety of color can be tinted in it (Grimley & Love, 2013). For walls, polymer panels can be produced in the desired width and color from PVC. For floors, they are manufactured as tiles or rolls and installed to a fine leveled surface with glue. Vinyl is very popular for residential and commercial use and it is very impervious to water (Godsey, 2013). Epoxy is another type of polymer that is mostly used on floor surfaces. It is a mixture of synthetic resin, aggregate, and pigment. It is very thin, durable, and resistant material to chemicals and other hazardous materials. For ceiling, plastics are mainly used in stretch ceilings. These ceilings are usually created with PVC fabric and installed to an aluminum ceiling frame (Koca, 2016).

2.3.2.3. Ceramics

Ceramics are widely available, but challenging materials because of their technical properties. They have high strength with low ductility necessitates. It means that ceramics do not distribute internal stress as successfully as metals and polymers. The lack of ductility makes ceramics a material for which the risk of failure is particularly difficult to assess. Classification for this material family is complicated, but it can be divided into four as: Stone, concrete, glass, and fire-clay ceramics (Fernandez, 2006).

Stone is a material of low cost and local ability. According to their origin, their technical properties like high density, hardness, compressive strength, thermal conductivity, and storage capacity vary (Hegger et al., 2007). Stone is used in two forms as dimension stone and crushed stones (Fernandez, 2006). In an architectural context, stone is mainly discussed in reference to granite, limestone, marble, sandstone, and slate. These are the primary stone sources for both structural and non-structural purposes (Fernandez, 2006; Grimley & Love, 2013).

Concrete is a well-known and widely-used material. The mixture of cement, aggregates and water determine the intrinsic properties of concrete. However, typical concrete has a high gross density, great surface hardness and great strength. It can be produced in any required shape by molding methods, and used in many forms (Hegger et al. 2007).

Concrete is not a material that can be used as a separate surface finishing materials, however, it is a material that can be exposed on walls, floors and ceilings. Concrete finishes are durable and economic, and also exposed concrete can be an efficient finish for high impact areas (Grimley & Love, 2013).

Glass is also defined as a kind of ceramic. It is an amorphous, brittle and transparent material. High gross density, compressive strength, and hardness are some technical properties of the material (Hegger et al. 2007). Glass can be divided into two groups as tempered and laminated glass. Tempered glasses are constituted by the process that is based on heating the glass to a high temperature and then cooling it quickly. On the other hand, laminated ones are constituted by combining the two sides of the glass with an adhesive foil. Therefore, when this type of a glass cracks, it does not break into pieces and retains its surface integrity (Koca, 2016). Glass is formed by melting the ingredients at a higher temperature, shaping, and annealing of the material; in this sense shows similarities with metals. Also, glass can be shaped by rollers or presses. With this method, decorative elements and ornaments can be added to the material (Hegger et al. 2007; Toydemir et al. 2000). During the production of the materials, the transparency can be changed and glass can be produced opaque, and it can be colored and tinted (Bingelli, 2008; Godsey, 2013; Toydemir et al., 2000).

Clay is the basic material for ceramics. The process of firing is essential for this material, because it makes the material water-resistant. In terms of the technical properties, they have high gross density, hardness, compressive strength and abrasion resistance. Clays are often used as found in nature, but with more stringent requirements of the projects, some constituent materials may be processed in the mix before inclusion (Fernandez, 2006; Hegger et al., 2007).

In interior spaces, each mentioned ceramic type provides a broad opportunity as finishing materials. For walls and floors, stones that are resistant to environmental factors can be used as finishing material (Grimley & Love, 2013; Toydemir et al., 2000). Concretes can be exposed on not only walls and floors but also on the ceiling surface. This kind of finishing is especially welcome where the aesthetic of the space requires a raw, industrial look (Grimley & Love, 2013). Additionally, glass is also used as glass bricks walls, floor tiles, and mosaics on interior surfaces. According to surface requirements, glass foam can be used on walls for acoustic purposes. Also, fired-clays ceramics are used as flooring and wall tiles (Toydemir et al., 2000).

2.3.2.4. Natural materials

This material family is also specified the group name of wood. It is now and continues to be the most important natural material used in interior architecture and its species are probably the most familiar building material to people due to the versatility of their use. Technical properties of woods are directly related to the geographic area where the tree is grown, climate, orientation and amount of water in the soil. Therefore, they often possess a significant uncertainty in the actual values of their material properties and each material produced from wood has its own characteristics. Also, because wood is an organic material, it may deteriorate due to environmental factors and these factors can be physical, chemical and biological (Arntzen, 1994; Fernandez, 2006).

Wood can be divided as composite and solid wood. The aim of the wood composites is to reduce wood movement by producing laminates containing layers in different directions. They are more dimensionally stable than solid wood and is better suited for high circulation areas (Fernandez, 2006). According to surface requirements, wood is easily machined, carved and joined, also when it is laminated it can be molded to complex shape (Ashby & Johnson, 2014). It also offers a variety of widths and thicknesses, as well as methods of installation (McMorrough, 2006).

Wood has a versatility of its use. It can be used for structural frames, sliding, interior surfaces, furniture, paneling and many other components (Fernandez, 2006). In an interior, for walls, wood panels can be used in different dimensions. However, while solid wood panels are used in small dimensions because of the movement of the wood, composite wood panels can be manufactured in larger sizes (Riggs, 2003). In terms of floor coverings, parquet wood floorings are widely used. They are divided into several groups like solid wood, engineering wood, and laminated wood parquet. Solid ones are directly derived from wood, produced in different sizes. Engineering ones consist of three solid wood layers. While the top layer has an aesthetic appearance and high quality, other layers have a relatively poor quality (Riggs, 2003). They are more dimensionally stable than solid wood and better suited for highly circulated areas (Grimley & Love, 2013). Laminated wood parquet is often mixed with engineering ones. The main difference is that laminated wood parquet is obtained from fiberboard and particle board. On the ceilings, in terms of the design needs and desires, wood can be used as solid wood, fiberboard and particleboard (Toydemir et al., 2000). Also, for suspended ceilings, to improve the acoustical quality, wood panels can be preferred. These panels can be cut according to desired size and they can be left natural, or painted multiple times without losing their acoustical properties (Binggeli, 2013; Grimley & Love, 2013).

2.3.2.5. Composites

A composite is simply the combination of a number of materials, of like or different material classes into an assembly, usually for the purpose of capturing a novel set of properties not possible with the use of one material alone (Hull & Clyne, 2019). Every other material family contributes to the making of various composites. By combining at least two of any metal, ceramic or polymer, one composite material can be produced that may prove useful according to design needs. Therefore, there are various types of composites that exist today (Fernandez, 2006).

Composites are accepted as high-performance engineering materials, because they allow customization of functional properties. Lightness, strength, and stiffness are the most outstanding technical characteristics of composites but according to design needs, their properties may vary (Fernandez, 2006).

In an interior context, terrazzo and laminated wood can be some examples for composites (Fernandez, 2006). Terrazzo floors basically contain stone or glass aggregate, and binder that holds the aggregate together like epoxy or cement, and its properties can be changed according to its contents (Godsey, 2013). Laminated wood that was mentioned under the category natural materials can be another example for composites.

2.3.2.6. Textiles

Textiles are used as carpets, upholstery fabric for furniture, and curtains. They can be natural (wool, silk, cotton, linen) or man-made (nylon, polyester).With some additives, textiles can be water, stain and flame resistance. Their acoustical properties and maintenance requirements mainly depend on rubs and weaves. Also, according to interior context, antistatic and bacteriostatic treatments can be applied to the material (Grimley & Love, 2013; Toydemir et al., 2000). Textile serves a vast range of interior applications and it can be used from wall to ceiling or furnishing to carpeting (Grimley & Love, 2013).

2.3.2.7. Paints

Paints are used to add color, durability, and decoration to many elements in an interior space, and they are especially appropriate for walls and ceilings. Latex and alkyd (oil paint) are some of the paint types. Latex paints dry more quickly than oil-based paints and also more elastic. The finished surface of paint is often referred to in relation to its level of gloss the paint has when dry. This affects its durability and maintenance. Also with gloss, light and color are reflected from painted surfaces and some highlight in an interior space can be created (Grimley & Love, 2013).

2.3.2.8. Wallpapers

Wallpaper is composed of a printed face adhered to a backing. The front face is treated for decorative surfaces and then applied to a wall, in some cases also ceilings. There are a variety of wall coverings in terms of scale, dimension and material. They are durable and have the ability to hide surface imperfections. According to design intentions, they can be vinyl, textile or paper base and can be produced by printing techniques or produced as hand-made. Especially, textile-based wallpapers provide the dimensional stability and acoustical benefit that is not found in papers on vinyl types (Grimley & Love, 2013).

CHAPTER 3

MATERIAL SELECTION CONSIDERATIONS

3.1. Material Selection

In general, the aim of material selection is identifying the best material for a specific application in the design process (Fernandez, 2006). Traditional material selection process basically consists of four main steps: (1) translating the design requirements as constraints and objectives, (2) screening the material world to identify which material is suitable for the design project, (3) ranking the materials that can meet the design need best, and (4) exploring the top-rated materials. In that sense, consciously or not, material selection is carried out as a design activity, involving the phases: concept creation that refers to process in between formulating material objectives and arriving at candidate materials, testing and comparing candidate materials, and making a detailed selection with technical specifications (Ashby & Cebon, 2007). Although there are some defined certain steps for the selection activity, in fact, it is as an iterative process (Ashby et al., 2004). Based on the project requirements or problem, the way to make material selection may vary.

The increasing number of materials make the material selection activity diverse and complex (Wastiels & Wouters, 2012), therefore during the process, there are many factors and constraints that have to be considered. Although there are some situations where the material specifications are defined at the beginning of the design and dominate the selection process, most of the time, materials are selected based upon the design problems that are always open-ended (Fernandez, 2006; Karana et al., 2010). Therefore, in order to identify the best material for the design project that has to be addressed, it is significant to understand which material considerations play a role in designers' material selection process.

3.2. Material Considerations

Although some steps that are followed during the selection activity was described in previous section, in fact, there is no strict way to find the best material for a design problem because the designers' considerations during the selection activity may vary according to project requirements (Karana et al., 2008). In the following parts, considerations on materials in different design disciplines will be discussed.

3.2.1. Considerations on materials in engineering design

In different engineering based sources, the considerations that affect the selection of the materials are grouped under various subtitles, which can be followed in Table 3. These sources mostly concentrate on the material technical properties while discussing designers' material considerations.

Table 3. Material considerations based on engineering design sources

Ashby, 1992	• General Properties • Mechanical Properties • Thermal Properties • Wear • Corrosion
Budinski, 1996	• Chemical Properties • Physical Properties • Mechanical Properties • Dimensional Properties • Business Issues
Mangonon, 1999	• Physical Factors • Mechanical Factors • Processing and Fabricability • Life of Component Factors
Ashby, 2005	• General Properties • Mechanical Properties • Thermal Properties • Electrical Properties • Optical Properties • Eco Properties • Environmental Resistance

In Budinski's (1996) study, the factors considered in material selection consist of four major categories; chemical properties, physical properties, mechanical properties, and dimensional properties. He especially emphasizes the category of dimensional properties and states that the available size, shape, finish, and tolerance on materials are often the most important selection factors. Another category used in the study is business issues which refer to environmental and regulatory issues. Budinski also addresses the significance of the availability factor and recommends designers to select materials that are known to be readily available (1996).

Another study defines six factors having an influence on the material selection of designers (Mangonon, 1999). These are physical factors, mechanical factors, processing and fabricability, life of component factors, cost and availability, and codes and statutory. In this study, life of the component factor is related to the length of the time that material performs in the exposed environment. The factor cost and availability is related to market-driven economy. The last category which is codes and statuary is similar to the Budinski (1996) business issue factor. It explains the codes as a set of technical requirements imposed on the material by a customer or technical organizations, and it explains the statutory as a set of factors based on local, state and federal regulations about materials and processes used for disposal of the material.

Ashby (1992) puts emphasis on general properties (cost and density), mechanical properties (strength, elastic moduli, toughness, damping capacity, ...), thermal properties (melting point, expansion coefficient, thermal diffusivity, ...), wear and corrosion/oxidation properties of materials. In the recent edition of his book, as an addition to general, mechanical and thermal properties of materials, Ashby adds electrical, optical, eco and environmental resistance properties of materials as the basic design limiting properties (2005).

3.2.2. Considerations on materials in product design and architecture

The mentioned consideration in engineering sources are based on pure performance requirements of materials and predominantly concentrates on materials' technical properties. However, in architecture and product design fields, as an addition to technical properties of materials there are some other considerations that are called with different names such as non-physical properties of materials (Ljungberg & Edwards, 2003), or non-technical issues of materials (Ferrante, Santos, & de Castro, 2000). Although, in each study and many others, they have different names, in contrast to considerations on materials technical properties, these mainly focus on the myriad properties of materials from the purely functional to the relation between material and user, or material and society (Ashby & Johnson, 2002; Fernandez, 2006; Malnar & Vodvarka, 2004; Pallasmaa, 2005). By referring these existing studies in literature, the considerations that influence the material selection from product design based sources can be followed in Table 4.

Table 4. Material considerations based on product design sources

van Kesteren et al., 2005	• Engineering Dimension • The Use Dimension • Environmental Dimension • Aesthetic Dimension • Personality Dimension
Karana et al., 2008	• Technical Properties • Sensorial Properties • Intangible Properties • Ecological Properties • Manufacturing Properties • Economical Properties

Within the discipline of product design, in order to select an appropriate material, project related considerations such as materials' technical and sensorial properties, manufacturing processes, availability, cost, function, shape, use, as well as meanings, associations, emotions, characteristics of users, and cultural aspects play an important role (Karana et al., 2010).

van Kesteren, Stappers, and Kandachar (2005) define the material considerations into five dimensions which are: engineering, use, environmental, aesthetic, and personality. In this study, the engineering dimension refer to the technical properties of material such as its physical, mechanical, thermal, electrical and optic behavior. The use dimension is related the ergonomics and product interface. The environmental dimension is based on the material toxicity or scarcity. The aesthetic dimension is related with the five senses: For example, visual properties such as transparency or color, tactile properties such as hardness or softness, and acoustical properties of materials. The personality dimension describes the users' associations with a material.

Karana et al. (2008) based on previous literature offer a categorization in their research and based on this, discuss the selection activity for product designers. This categorization includes the material properties such as technical (durability, density, conductivity, strength, elasticity, ductility, toughness, damping capacity, hardness, …), sensorial (vision, touch, auditory, olfactory), intangible (emotions, meanings, effects of cultural differences, trends, …), ecological (recyclability, sustainability, embodied energy, toxicity, …), manufacturing (easy to manufacture with existing manufacturing facilities, suitability for assembly and finishing techniques, …), and economical (cost for material and production, availability). In their analysis, based on these five material properties, they represent a type of data list including fundamental considerations of designers in material selection. In this list, the considerations not only cover the mentioned material properties, but also the issues about material availability and consultancy. Availability is evaluated as a factor that affects the designers' considerations in any time through the whole selection process, and the consultancy is evaluated as a factor about getting advice and benefitting from the colleagues' experiences on candidate materials.

Similarly, material selection in the architecture design field does not only focus on the material technical properties as in the engineering based sources. The considerations that influence the material selection from architecture design based sources can be followed in Table 5.

Table 5. Material considerations based on architectural design sources

Hegger et al., 2007	• Perception • Technical Performance • Functional Attributes • Ecological • Economic
Wastiels & Wouters, 2012	• Context • Manufacturing Process • Material Aspect • Experience

Hegger et al. (2007) puts emphasis on five main criteria which are perception, technical performance, functional attributes, and ecological and economic aspects of materials. Perception category refers to material visual, tactile, thermal, acoustic, and olfactory properties. The technical performance includes not only the technical behavior of materials, but also manufacturing issues. Functional attributes are about the durability related, cleaning and maintenance oriented properties of materials as well as materials' toxicity, and suitability for the intended use. The environmental criterion focuses on the importance of using recyclable materials also the amount of using natural resources. Last, the economic criterion covers the issues about the availability of resources and cost.

According to Wastiels and Wouters' (2012) study, the architects' considerations while selecting materials can be divided into four main categories which are context, manufacturing process, material aspect, and experience. In their study, the category context defines the considerations about the current project culturally, physically and also in terms of use. Cultural context is related with all the cultural values in terms of ethics, style, and ecology, also related with the interaction between time, money and ethics. Physical context describes the project location in terms of accessibility and orientation, and the immediate environment in terms of adjacent materials and buildings. The context of use defines which materials are used in which contexts. For example, based on their study, interior/ exterior and renovation/newly built has different contexts and accordingly need different considerations. Moreover, the context of use describes the function of the materials' intended use, and eventually determines the materialization. Other considerations in the study like manufacturing process are directly related to the production process, assembly and finishing technique of materials. Material aspects are described as a group of considerations concerning the technical performance of the material (technical aspects) and at the same time, relating how a material relates to our senses (sensory aspects). The category of experience covers the considerations about how a material may be perceived by an individual.

3.2.3. Considerations on interior surface finishing materials

Different from the product and architectural design, interiors can be identified distinctly by their defining surfaces; floors, walls, and ceilings. However, in literature, materials are extensively studied in architecture by focusing on the structural components and product design by focusing on the market needs and material consumption for years. Thus, designers' considerations on these defined interior elements are not studied.

Additionally, designers' finishing material specifications based on their considerations are not studied in the literature. Rather than this, some directly focuses on an exact material and evaluate its effects on a specific topic. For example, Fujisaki et al. (2015) study the material wood and investigate the perception of the material properties of wood based on vision, audition, and touch. Some studies investigate the relation between the material properties and their perceived values. As an example, Wastiels et al. (2012) investigate the extent which technical material parameters are linked to the perception of material warmth. Only few studies focus on the surface material finishes and analyze their outcomes. For example, Harris (2016) defines surface finishes as flooring, ceiling, walls, work surfaces and upholstery and evaluate the finishing material requirements that has to be considered for neonatal intensive care unit. However, none of the studies focus on the relation between the designers' considerations and specified materials as an outcome of those considerations. Therefore, these need to be studied to fill the gap in literature.

CHAPTER 4

METHODOLOGY

This chapter covers the methodology of the study. Firstly, research questions are identified by referring to the aim of the study. Then, the participants, their distributions according to age, gender, profession, and education level are explained. Next, the study procedure with the instruments are presented, followed by the pilot study. Last, qualitative and quantitative data analysis are introduced.

As mentioned in Chapter 1, the present study aims to explore the different considerations contributing to the material selection process in interior architecture discipline and understand the designers' finishing material specifications for interior surfaces, also, examining designers' prioritizations that are considered for surfaces. By referring to the aims of the study, research questions are defined.

4.1. Research Questions

In reference to the aims of the study, the research questions are as follows;

RQ1: What are the designer's material selection considerations in interior architecture practice?

RQ2: (a) Which materials do designers' prefer as finishes for interior surfaces (namely floor, wall and ceiling)?

(b) What are the reasons to prefer these materials?

RQ3: (a) When selecting finishing materials for interior surfaces (namely floor, wall and ceiling), how are the considerations prioritized?

(b) Do these prioritizations differ for each surface?

While the first question is explored in general, the second and third questions are explored through focusing on a specific function, namely the entrance of a real-life and a controlled residential spaces. It was thought that material selections would be identified by designers clearly based on a specific function. Also, entrances are the most public spaces of residential projects (Mitton & Nystuen, 2016) and accepted as the areas where the material diversity is higher than the other parts of the residence (Kicklighter, Baird, & Kicklighter, 1990). Therefore, focusing on this specific area help to reach more diverse material preferences and accordingly, different material considerations for the context of the study. Also, while studying on the materials and discussing the considerations, there was a higher possibility to find experts contributing to residential design from beginning to end, compared to large scale public spaces. For example, with the same intention, Altay (2000) made a study by focusing on the residential design to understand designers' role, identities, and objectives towards clients and users.

4.2. Participants

To conduct the study, expert sampling method was used, which is a sub-type of purposive sampling that seeks for experts in a particular field to be the subjects of the study (Etikan, Musa, & Alkassim, 2016). With this method, based on the name lists obtained from Turkish Association of Architects in Private Practice and Chamber of Interior Architecture databases, 30 designers, 13 women and 17 men, specialized in residential projects with minimum 10 years of experience was selected. To access data documentation about materials and their considerations and to discuss the study findings with already existing ones in the literature, importance was given to select participants from both architecture and interior architecture disciplines. In that sense, within the participants, there are 16 interior architects and 14 architects, ranging between the ages of 35 to 56 and all are based in Ankara, Turkey. Demographic information about the participants is summarized in Table 6. They completed their education from universities in Turkey, such as Bilkent University, Middle East Technical University, and Hacettepe University.

Table 6. Demographic characteristics of participants

		Architect (n=14)		Interior Architect (n=16)		Total (n=30)	
Characteristic		n	%	n	%	n	%
Age (years)	35-45	9	64%	12	75%	21	70%
	46-56	5	36%	4	25%	9	30%
Sex	Female	4	29%	9	56%	13	43%
	Male	10	71%	7	44%	17	57%
Education Level	Bachelor	9	64%	9	56%	18	60%
	Master	4	29%	6	38%	10	33%
	Doctoral	1	7%	1	6%	2	7%
Experience	10-20	9	64%	10	62%	19	64%
	21+	5	36%	6	38%	11	36%

4.3. Instruments and Procedure of the Study

The study instrument consists of two sections. In the first section, the in-depth and semi-structured interview that is an open-ended, discovery-oriented method was chosen. In the second section, the questionnaire including both closed-ended, open-ended, and also, Likert type scale questions were used. All sections were conducted in the same session in Turkish and face to face with the participants (See Appendix B for Turkish, and Appendix C for English versions). In the same session, in-depth interviews conducted by the researcher were followed by the questionnaire handed out to the participants to fill. The study was done in participants' original working environment from February to March 2019 and took 40 minutes total on average per participant. Before conducting the study, a consent form was given to the participants (See Appendix A). They were given sufficient time to read the information in the letter and to decide if they wanted to participate in the study.

4.3.1. Interviews

In the first section, designers' considerations with the complexity of a project situated in their actual experiences, encompassing client and economic concerns were analyzed. During the interviews, also, designers' material preferences in the entrance area of real-life residential project and their related considerations were explored.

Interview questions prompted by the researcher were adapted from Wastiel's (2010) investigating the material selection considerations of architects. Although this study focused on the material considerations on building elements, the context of the questions concentrated more on the architects' consideration itself by eliminating the effects of disciplinary scale. Therefore, correspondingly, it provided an ideal base for the interviews.

Within the framework of the study, after some demographic questions like age, sex, education level, profession, and years of work experience, by referring the study aim, other questions were asked under two categories as Material Considerations and Material Specifications.

The category of Material Considerations sought answers to designers' general considerations toward materials in their real-life projects. The questions under the category of Material Specifications were asked about the designers' real-life residential projects and sought a detailed answer about their material preferences and related considerations for the entrance areas. Therefore, in order to avoid any missing detail, a picture of their mentioned project was requested before starting to ask the questions. Also, some project characteristics were sought to familiarize with the project and understand the project type and location. Moreover, to make their material preferences descriptively understandable and easily readable, a table list was constituted and added in the category Material Specifications in the interview sheets. This table list included mostly used material families for each interior surface (wall, floor, and ceiling) mentioned in the first chapter (See Table 2). During the interviews, designers' preferred materials were marked through the constituted table list by the researcher.

4.3.2. Questionnaires

In this section, a controlled project, which was an entrance area of a residence, was introduced and all questions were asked according to this project. This allowed investigating designers' material preferences, material related considerations and how these considerations were prioritized where contextual factors such as client and budget concerns were eliminated. The introduced project was conceptualized as a multi-housing project located in the town Çankaya in Ankara to decrease the multiple factors and diversity. In the questionnaire, three type of questions were used. Firstly, designers were asked to mark their material preferences with a closed-ended question constituted as a table list. This table list was the same as the one used in the first phase of the study. In this way, the obtained data for two design conditions became descriptively comparable with each other. In order to investigate designers' material related considerations, by referring to the preferred material, an open-ended questions was asked.

Also, in this section, five point Likert type scale was used to understand designers' prioritizations of considerations. The scale was from "Very Low Priority" (1) to "Extremely High Priority" (5). On the basis of the literature, designers' prioritizations were measured based on the five material properties that were summarized in Karana et al. (2008) (See Table 4). Although their study focused on the product designers' material considerations, they specified these five material properties by analyzing existing studies from different design disciplines on material consideration in the literature. Therefore, within the context of the thesis, these properties provided a good base to examine the designers' prioritizations. Based on the referred study, these properties were defined as follows; technical properties, sensorial properties, intangible properties, ecological properties, and manufacturing properties of materials. Since the economic properties were controlled in this study, it was not considered in the measurement.

To support the whole process and accordingly designers' material selection activity during this section of the study, a visual of the controlled project was provided. In order to check the legibility of the questions and also, to understand what kind of visual information the participants needed and how this information should be presented to them, a pilot study was carried out.

4.3.3. Pilot Study

The pilot study was carried out in February 2019 with two architects and one interior architect. The first section of the study was conducted as mentioned. For the second section, by using the online software program Homestyler, the project visual that constituted the basis of the mentioned questionnaire questions were created. This visual basically shows the entrance area of a conceptually created residential project. In doing this, to increase the perception that this is an entrance area, the attention was given to show the area by a corridor and an exterior door. Also, in order to eliminate the effects that guide designers to make certain material choices and to create a certain style like modern, minimal or classic, the visual was created with minimum detail and without color. All mentioned questions were asked to participants with reference to this constituted visual. Used visual can be seen in Figure 1.

Figure 1. The visual that was used for the pilot study

During the pilot study, all question in Section 1 and Section 2 were verified in terms of providing detailed answers for the study intention. However, while designers selected finishing materials on surfaces based on the provided visual, some considerable feedbacks were taken. One participant stated that a plan should be provided to understand the project as a whole and make design decisions accordingly. As an addition to this, some stated that showing more surfaces not as partial but as full finished surfaces is important since proportions of surfaces influence design activity. Also, all participants stated that in the given visual there are too many details like door handle and skirting which may directly affect their material preferences.

Based on these statements, the need for a plan and the importance of providing a less detailed and full finished visual was understood. With this sense, a plan was added to the present study and provided visual was revised. In the revised version, a plan that was taken from Kicklighter et al.'s book (1990) was used. This book covers the issues about layout and circulation of residential houses with construction, and some interior designing suggestions. The taken plan was adapted to the study context by eliminating some undefined spaces, in order not to limit the designer in their material selections and to identify the plan as a whole. The adapted plan included a living room with a dining area, a master bedroom with dressing room and water closet (WC), two other rooms, one main water closet, kitchen, garage, terrace, corridor and entrance spaces as shown in Figure 2.

In reference to the plan, visual of the project were revised with the same online software program. During the revision, attention was paid to show all the surfaces (wall, floor, and ceiling) as a whole, to identify the relations between the entrance area and other areas that shown in the provided plan, and to eliminate all the detail that affect designers' material preferences like skirting detail. Also, surfaces that covers the cabinet was simply removed from the provided visual and reference lines that show the place of the door and the cabinet in the entrance space was added to the visual. The revised version of the visual can be seen in Figure 3.

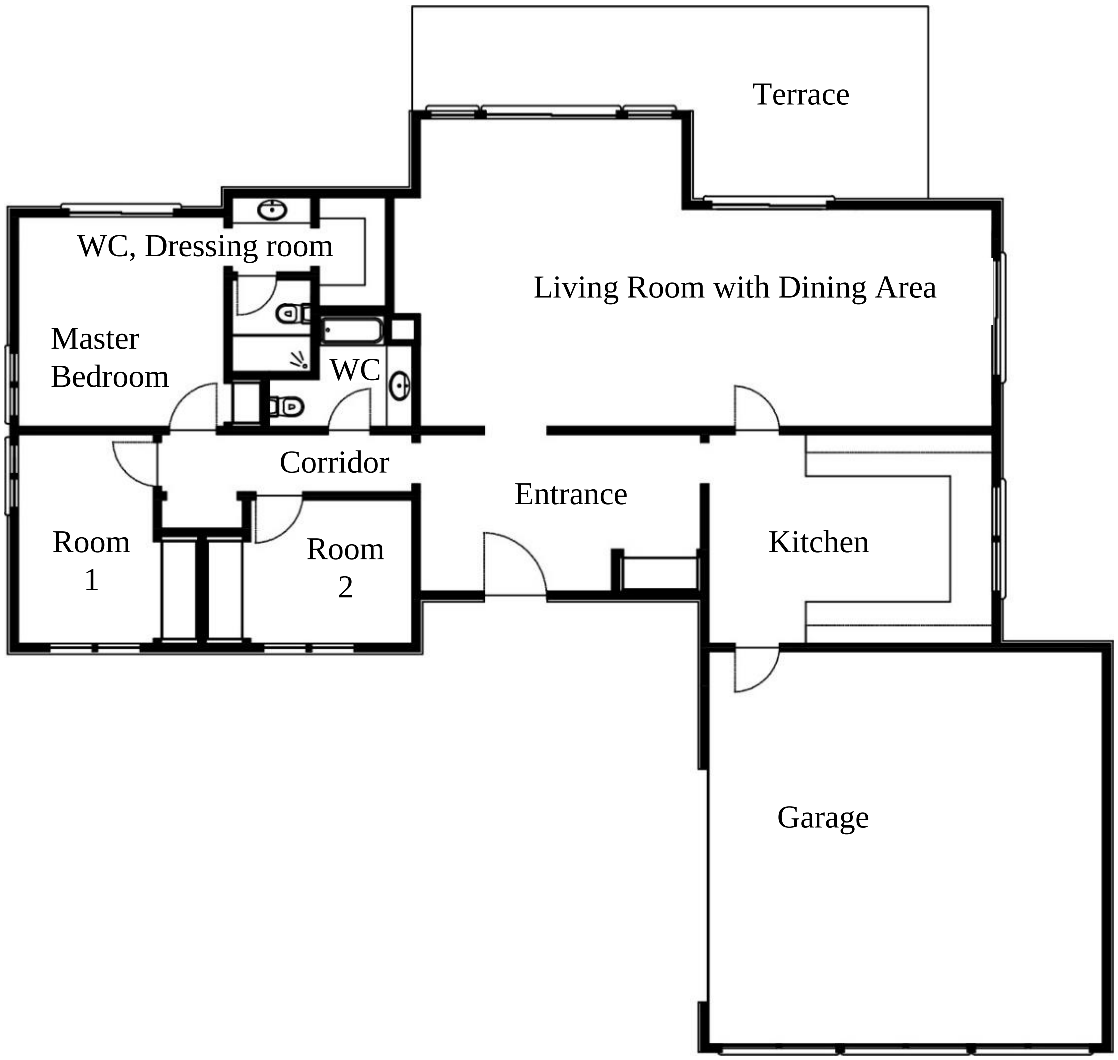

Figure 2. One single story residential plan (Adapted from Kicklighter et al., 1990, p.35).

Figure 3. The revised visual for the present study

The whole procedure and the questions (See Appendix B, C) related to research questions in Section 1 and 2 can be seen in Figure 4.

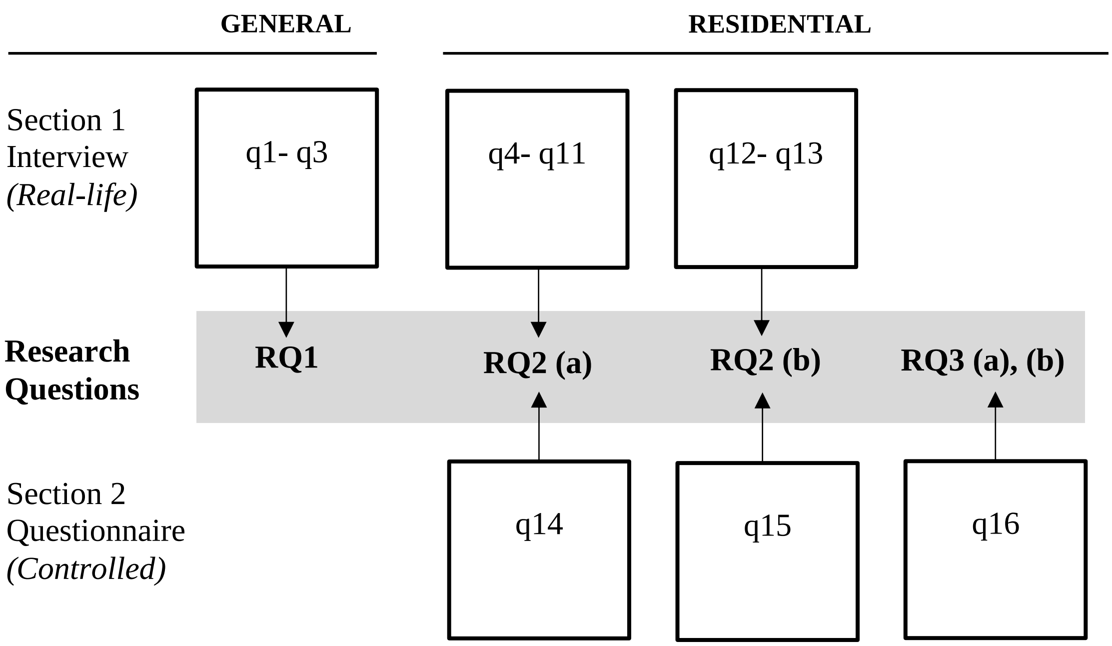

Figure 4. The questions related to research questions in Section 1 and 2 of the study

4.4. Data Analysis

For the study, two types of data analysis were conducted. First, all qualitative data were analyzed by following the thematic analysis protocol. The analyzed data were obtained from in-depth interviews in the first section and open-ended answers (q15) from the questionnaire in the second section of the study. Then, quantitative data analysis were conducted. During this process, designers' material preferences for floor, wall and ceiling surfaces were descriptively analyzed. The analyzed data were obtained from the provided table lists both in the first (q11) and second section (q14) of the study. Finally, designers' prioritizations were analyzed inferentially. The analyzed data were obtained from the Likert type 5 point scales in the second section (q16) of the study.

4.4.1. Qualitative Analysis

To understand the designers' general and material related considerations, qualitative analysis within the context of the study was carried out by referring the research question RQ1. To analyze the obtained data, thematic analysis procedures based on Braun and Clarke (2006) was used with an inductive approach. Thematic analysis is a method used for identifying, analyzing and reporting patterns or themes within the data set (Boyatzis, 1998).

Thematic analysis was conducted for two types of data in the study. One type of the data was obtained from the in-depth interviews during the first section of the study and the other was obtained from the open ended questions in the second section of the study. Based on the method, as the first step, in-depth interviews were transcribed into written form to familiarize with the data (Riessman, 1993). By reading and re-reading the transcribed data, and using line by line technique, some initial ideas within the study context were noted.

As a second step, some initial codes were generated across the entire data set and entered the Microsoft Excel Software. According to Boyatzis (1998), codes refer to the basic elements of the raw data that can be evaluated in a meaningful way according to the study interest. Therefore, during code extraction process, full and equal attention was given to each data item that may form the basis of themes in the following step. After having a long list of the different codes that were identified, analyzing process started to focus on searching for themes as the third step. In this step, different codes were combined with each other to form an overarching theme. During the process, while some initial codes were formed as main themes, some others were formed as sub-themes, and also, some codes that did not seem to fit into possible main themes were discarded. At the end of this step, a collection of candidate themes and sub-themes were extracted.

The fourth step involved the refinement of those candidate themes, and was divided into two parts as reviewing and refining themes. In the reviewing part, the candidate themes were checked to understand whether the candidate themes work in relation to the coded extracts or not. After having candidate themes adequately capture contours of the coded data, and accordingly having a candidate thematic map, the entire data set was re-read and checked whether there was any additional data within themes that have been missed in earlier coding stages. At the end of this step, the thematic map of the designers' considerations on finishing materials was generated. As the fifth step of the thematic analysis, clear definitions and names were given for each themes. And, for the last step, the report of involving a set of fully worked-out themes were produced. All procedure that was followed also can be seen in the Table 7.

Table 7. Phases of thematic analysis (Adapted from Braun & Clarke, 2006, p.87).

Phases	**Description of the process**
1) Familiarizing yourself with your data	In-depth interviews were transcribed into written form
2) Generating initial codes	Initial codes were generated across the entire data set
3) Searching for themes	Different codes were combined with each other to form an overarching theme
4) Reviewing themes	The candidate themes were checked to understand whether the candidate themes work in relation to the coded extracts or not
5) Defining and naming themes	Clear definitions and names were given for each themes
6) Producing the report	The report of involving a set of fully worked-out themes were produced

After analyzing the interviews and identifying designers' material selection considerations generally, to evaluate which considerations were made for which material in the context of entrance areas of residential spaces (RQ2(b)), the data obtained from the open-ended questions in the first and second section of the study was analyzed with the same analysis method. The coding process of the obtained data was carried out separately for each material by referring to the identified designers' considerations from thematic analysis of interviews.

4.4.2. Quantitative Analysis

4.4.2.1. Descriptive analysis

Descriptive statistics were provided the answer for the research question “(RQ2 (a)) Which materials do designers’ prefer as finishes for interior surfaces?” Within the thesis context, designers’ finishing material preferences were extracted by the mentioned table list for entrances of both real-life and controlled residential projects. The use of the same tables in both sections of the study made the obtained data descriptively comparable in terms of its frequency of preference.

Moreover, descriptive statistics were provided the answer for the research question “(RQ3 (a)) When selecting finishing materials for surfaces (namely floor, wall and ceiling), how are the considerations prioritized?” Likert type 5 point scale measurement was used to analyze the prioritizations within each surface. All descriptively data assessment was achieved through using the Statistical Package for the Social Sciences (SPSS) 23.0.

4.4.2.2. Inferential analysis

In order to investigate the research question RQ3 (b), inferential statistics were utilized. Thus, designers' prioritizations were analyzed inferentially to clarify whether the given material priorities which are technical, sensorial, intangible, ecological and manufacturing vary per surface. Likert type 5 point scale measurement was used to analyze the scores on the mentioned five material properties. Data assessment was achieved through using, Statistical Package for the Social Sciences (SPSS) 23.0. During the analysis, Friedman ANOVA were used. Also, Wilcoxon Signed Ranks with applying Bonferroni Correction was used as a post hoc test for Friedman ANOVA.

CHAPTER 5

RESULTS

The obtained results are presented by referring to the aim of the study. The results presented in this chapter correspond to data collected from thirty designers.

5.1. Material Considerations

By following the Thematic Analysis protocol in the first section of study, designers' material selection considerations were extracted (referring the research question RQ1). These extracts show that a wide range of considerations are made before selecting a material.

Based on the analysis of interviews, three primary determinants were identified to influence considerations made when selecting a material. These determinants are;

- Material Related Determinants (MRD)
- Project Related Determinants (PRD)
- Designer Related Determinants (DRD)

Each category also have several themes and subthemes that describe the considerations in more detail. These determinants are as shown in Table 8.

Table 8. Categorization of material selection determinants for considerations

MAIN CATEGORIES	THEMES and SUBTHEMES

1) Material Related Determinants (MRD)	• Material Properties
	  ○ Technical
	  ○ Sensorial
	  ○ Intangible
	  ○ Ecological
	  ○ Manufacturing
	• Market Properties
	  ○ Availability of materials
	  ○ Availability of skilled workmanship

2) Project Related Determinants (PRD)	• Physical • Functional • Client • Budget

3) Designer Related Determinants (DRD)	• Material Knowledge
	  ○ Theoretical
	  ○ Practical
	• Design Approach

Also, the findings show that every three determinant is directly related to each other. In some cases, the relation between them constitutes the main consideration in the context. The relation between the determinants can be seen in Figure 5.

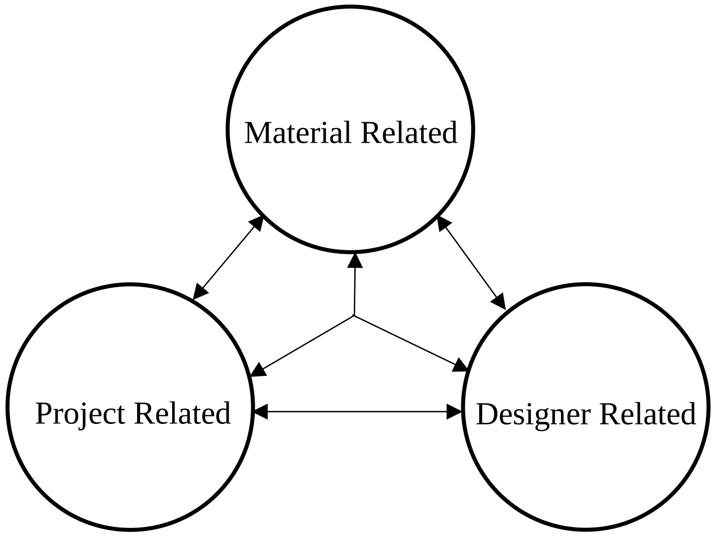

Figure 5. The relation between the determinants

During the data analysis of the presented determinants, the coding procedure used in the data analysis to reach these three main categories can be seen in Table 9, 10, 11.

In this part, only evaluated themes and subthemes were identified with their definition, the frequency of responses to the themes and subthemes of participants can be seen in Appendix D, Table D 1.

Table 9. Coding of data according to themes for material related determinants

1) Material Related Determinants (MRD)		
• **Material Properties***		
Technical	Definition	Describing the material behavior in terms of physical and mechanical properties
	Indicator	Comments such as “durability”, “strength”, “density”, “stiffness”, “thickness”
Sensorial	Definition	Describing the material properties that were experienced with senses
	Indicator	Comments such as “attractive”, “visual”, “color”, “appearance”, “texture”, “smell”
Intangible	Definition	Describing the meaning given to materials after the first sensorial input.
	Indicator	Comments such as “traditional”, “culture”, “trend”, “popular”
Ecological	Definition	Describing the material recyclability and sustainability
	Indicator	Comments such as “sustainable”, “recyclable”, “healthy”, “non-toxic”
Manufacturing	Definition	Describing the suitability of materials for assembly and finishing techniques, and also to cut according to desired shape and size
	Indicator	Comments such as easy “to apply”, “to modify”, “to cut”, “to shape”, “to form”, “to size”, suitable to “paint”, “to polish”
• **Market Properties**		
Availability of materials	Definition	Describing obtaining a material within the project schedule timeline and finding the selected material in the current market
	Indicator	Comments such as “cannot find”, “no suppliers in the market”
Availability of skilled workmanship	Definition	Describing who applied the preferred material
	Indicator	Comment such as “find a skilled laborer”, “labor who knows what he is doing”

*Theory Driven category

Material related determinants (MRD) consist of two subthemes which are material properties and market properties. The subtheme material properties concern the technical, sensorial, intangible, ecological and manufacturing properties of materials. Technical properties identify the material behavior in terms of physical and mechanical properties. Materials' density, stiffness, strength are examples to the technical properties. Especially, durability provided by these kind of technical properties of materials constitutes the most important and highly prioritized consideration within the findings of the study. Sensorial properties refer to the material properties that were experienced with senses. These properties thus are categorized according to the different senses as visual (color, gloss), tactile (roughness, warmth), and olfactory. Within these properties, participants mostly consider the visual, and less consider the olfactory properties of materials. Intangible properties describe the meaning given to materials after the first sensorial input. These properties cover the emotions, effects of cultural differences, trends, etc. Based on the extract of the interviews, intangible properties are also related to the current material trends in the period when designers designed a project. Ecological properties focus on the material recyclability and sustainability as well as non-toxicity. Therefore, these properties are also related to health issues. Manufacturing properties of materials describe the suitability of materials for assembly and finishing techniques, and also describe the suitability of materials to cut according to desired shape and size. Some related statements are,

> "I preferred marble because I wanted to create a pattern on the floor and marble is a very suitable (*MRD; Manufacturing)* and popular material *(MRD; Intangible)* for that. It can be cut according to the desired size and pattern. You can create your own pattern on the floor by just numbered the cut stone tiles *(MRD; Manufacturing)* and it is

> durable *(MRD; Technical)*. So… You know… This provides many options for us. For example, we can also use marbles of different colors and textures *(MRD; Sensorial)* within the same surfaces." (P28)

> "It is very important that a material does not harm human health. For example, I try not to prefer laminate flooring too much. Because there's a lot of chemical in them. I'm trying to prefer massive parquet instead." *(MRD; Ecological*)." (P1)

Another subtheme of material related determinants is market properties. This category concerns the availability of materials and availability of skilled workmanship. Availability of materials describes obtaining a material within the project schedule timeline and finding the selected material in the current market. This is one of the most significant considerations within the extracts of the study because it can be done at any time within the whole selection process. Therefore, an absence of materials leads to changes in material preferences for a project. Availability of skilled workmanship describes who applies the preferred material. The extracts show that if a material is applied for a particular project without skilled workmanship, this directly changes the material preferences even if the material has a desired visual and technical properties because it directly affects the quality of finishing on the surfaces. A related statement is,

> […] but in the market, we cannot reach the people who apply this material properly. For example, I am sure you are aware of the decorative paintings. Today we see too many examples of it. Especially, creating concrete appearance *(MRD; Sensorial)* on the walls is very popular today *(MRD; Intangible)*. However, if you cannot find a skilled laborer to create this appearance, you cannot have what you are expected to see *(MRD; Availability of skilled workmanship)*."(P18)

Table 10. Coding of data according to themes for project related determinants

2) Project Related Determinants (PRD)		
• Physical	Definition	Describing project location, project type, project plan and existing surface status
	Indicator	Comments such as “location”; “project type”, “renovation”, “newly built”; “narrow”, “small”, “big”, “proportion”, “layout”; “existing surface status”, “cracks”, “damages”
• Functional	Definition	Describing the considerations on the intended use and material maintenance
	Indicator	Comments such as “functional”, “suitable”, “proper”; “easy to clean”, “easy to repair”, “easy to maintain”
• Client	Definition	Describing the project owner taste and want
	Indicator	Comment such as “client wants”, “customer is”
• Budget	Definition	Describing the client investment to the ongoing project
	Indicator	Comment such as “expensive”, “cheap”, “cost”, “economic”

Project related determinants consist of four subthemes, which are: Physical, functional, client and budget. The subtheme physical defines the considerations such as project location, project type (newly built or renovation), project layout and existing surface status (existing materials on surfaces, wear of existing surfaces …). The subtheme function defines the considerations on the intended use. The study extracts show that for each space in a project, diverse considerations are made by designers before selecting a material. This subtheme is also directly related to material maintenance, such as ease of cleaning and repairing. The other project related determinants are client and budget. The findings show that most of the time, these determinants may dominate the whole material selection process in a negative way. In doing this, it restricts material preferences and affect the essence of considerations. A related statements within the extracts of the study is,

> “The customer's tastes are particularly decisive in residential projects *(PRD; Client)*. Because at every stage of the design process you have to meet them face to face. In some cases, as a result of these meetings, I sometimes have to choose materials that will not satisfy me visually *(MRD; Sensorial)*. However, I never choose a material that I know it is not proper for the function where the material is used *(PRD; Function)*.” (P5)

> “I like marble more *(DRD; Design approach)*, but unfortunately, it is an expensive material *(PRD; Budget)*. Therefore, in projects with a limited budget, I can prefer ceramic instead of marble.” (P11)

Table 11. Coding of data according to themes for designer related determinants

3) Designer Related Determinants (DRD)		
• **Material Knowledge**		
Theoretical	Definition	Describing the information acquired through sources like magazines, websites, and material data sheets
	Indicator	Comments such as “materials that I know”, “material samples”, “magazines”, “books”
Practical	Definition	Describing material based information regarding performance, applicability etc. and related to past experiences.
	Indicator	Comment as “my previous experiences”, “we can make”, “we can do”
• **Design Approach**		
	Definition	Describing the general design intentions
	Indicator	Comments such as “I like”, “I prefer”, “I love”

Designer related determinants consist of two subthemes which are material knowledge and design approach. Material knowledge describes both theoretical and practical information. Theoretical knowledge identifies the information that learned by sources like magazines, websites, and material data sheets. Practical knowledge describes material based information. Also these knowledges can be related with the designer past experiences. Some examples are knowing how a material performed on a wall, floor, and ceiling surfaces, which kind of finishing techniques can be used on a material surface, and what kind of additional applications can be made on materials according to expected performance. Design approach defines the general design intentions. Also, it is directly related to the consideration based on the concept that is created for a project. Considerations based on design approach evaluated in the study extracts such as,

> "For example, we love surfaces with lacquer *(DRD; Design Approach).* However, they are easily drawn and damaged and are not proper material for long-term use (*DRD; Practical knowledge)*. However, we can make these surfaces more durable by using some extra surface coatings or painting techniques *(MRD; Technical + MRD; Manufacturing)*. This eliminates the technical weaknesses and extends the life of the material so we can use lacquer surfaces without giving up our design *(Overall, DRD; Practical knowledge)*."(P12)

5.2. Material Preferences

In the present study, designers' finishing material preferences were extracted for both real-life and controlled residential projects by referring to the research question "RQ2 (a) Which materials do designers' prefer as finishes for interior surfaces?" Within the mentioned real-life project in Section 1, there are 22 villas and 8 apartment flats, completed in between 2008 to 2019 and all are based in Ankara. In these projects, the client and the user is the same. The descriptive analysis of preferred materials on floors, walls, and ceilings in these real-life projects and also, in the controlled project introduced by the researcher are as shown in Table 12, 13, 14.

Table 12. Frequency of preferred floor materials in real-life and controlled residential project

FLOOR	Real-life project	Controlled project
Ceramic	34.2%	20.0%
Wood	31.6%	19.0%
Marble	26.3%	29.3%
Epoxy	2.6%	12.2%
Granite	2.6%	9.8%
Textile	2.6%	0
Concrete	0	9.8%

Table 13. Frequency of preferred wall materials in real-life and controlled residential project

WALL	Real-life project	Controlled project
Paint	33.3%	22.9%
Wall Paper	27.1%	18.6%
Wood	25.0%	22.9%
Marble	6.3%	10.0%
Decorative Stone	4.2%	4.3%
Ceramic	2.1%	2.9%
Mirror	2.1%	12.9%
Epoxy	0	1.4%
Concrete	0	4.3%

Table 14. Frequency of preferred ceiling materials in real-life and controlled residential project

CEILING	Real-life project	Controlled project
Paint	81.8%	69%
Wood	9.1%	14.3%
Concrete	3.0%	4.8%
Wall Paper	3.0%	2.4%
Aluminium	3.0%	2.4%
Mirror	0	4.8%
Vinyl	0	2.4%

Based on the findings, among the real-life residential project and a controlled project where client and budget constraints are eliminated, mostly preferred materials are the same, but the percentages of the preferences shows some variety.

5.3. Considerations on Material Preferences

The qualitative findings showed that a wide range of considerations are leading to a selection a material (See Table 8). In fact, each consideration leads the designer to choose a certain material. By referring the research question RQ 2(b), designers' material related considerations for real-life and controlled project were extracted. The obtained considerations for the most preferred material in the previous part can be seen in Table 15.

Table 15. Material related considerations with identified determinants

Ceramic	MRD	• Material Properties	Technical	-Durability, strength
			Sensorial	-Visual
			Intangible	-Familiar
			Manufacturing	-Easy to apply
		• Market Properties	Availability of materials	
	PRD	• Function	Easy to clean	
		• Budget	Economic*	
Marble	MRD	• Material Properties	Technical	-Durability, strength
			Sensorial	-Visual, attractive, textured
			Intangible	-Popular, trendy
			Ecological	-Non-toxic
			Manufacturing	-Suitable for dimensioning
	PRD	• Function	Easy to repair, to clean, to maintain	
Wood	MRD	• Material Properties	Technical	-Durability
			Sensorial	-Visual, textured
			Intangible	-Homelike
			Ecological	-Recyclability
			Manufacturing	-Easy to form
	PRD	• Client	Client wants*	
		• Budget	Economic*	
Paint	MRD	• Material Properties	Technical	-Durability
			Sensorial	-Visual, colored, textured
			Intangible	-Traditional
			Ecological	-Non-toxic
			Manufacturing	-Easy to apply, to form
		• Market Properties	Color alternatives (Availability of materials)	
	PRD	• Function	Functional, easy to clean and to repair	
		• Client	Client taste*	

*Stated for only real-life residential project

Table 15 (cont'd)

Wall Paper	MRD	• Material Properties	Technical	-Durability
			Sensorial	-Visual, textured
			Intangible	-Popular
			Ecological	-Non-toxic
			Manufacturing	-Easy to apply, to clean
		• Market Properties	-Variety alternatives (Availability of materials)	
	PRD	• Function	-Easy to maintain, to clean, to repair	

5.4. Designers' Prioritizations of Considerations

Within the section, the following questions were inferentially analyzed,

RQ3: (a): When selecting finishing materials for surfaces (namely floor, wall and ceiling), how are the considerations prioritized? (b) Do these prioritizations differ for each surface?

The data was obtained for controlled project given in the second section of the study.

5.4.1. Considered prioritization within each surface

Descriptive statistics were carried out to understand the prioritizations considered for each surface by referring the research question RQ3 (a). The descriptive statistics for floors show that sensorial properties were prioritized highest (M=4.57, Mdn=5, SD=.62), followed by technical properties (M=4.23, Mdn=4, SD=.81), manufacturing properties (M=3.77, Mdn=4, SD=1.13), intangible properties (M=3.70, Mdn=4, SD=.95), and ecological properties (M=2.90, Mdn=3, SD=1.06) (See Appendix E, Table E 1).

The descriptive statistics for walls show that sensorial properties were prioritized highest (M=4.83, Mdn=5, SD=.62) as in the floor, followed by technical properties (M=4.00, Mdn=4, SD=.91), intangible properties (M=3.83, Mdn=4, SD=.98), manufacturing properties (M=3.77, Mdn=4, SD=1.38), and ecological properties (M=2.93, Mdn=3, SD=1.11) (See Appendix E, Table E 2).

The descriptive statistics for ceiling show that as in the other two surfaces, sensorial properties were prioritized highest (M=4.20, Mdn=4, SD=.80) and ecological properties (M=2.97, Mdn=3, SD=1.03) prioritized lowest. Means of technical properties (Mdn=4, SD=.94) and manufacturing properties (Mdn=4, SD=1.14) were the same (M= 3.93), and mean of intangible properties was 3.33 (Mdn=3, SD=1.15) (See Appendix E, Table E 3).

An overview of comparison of material priorities per surface can be seen in Figure 6.

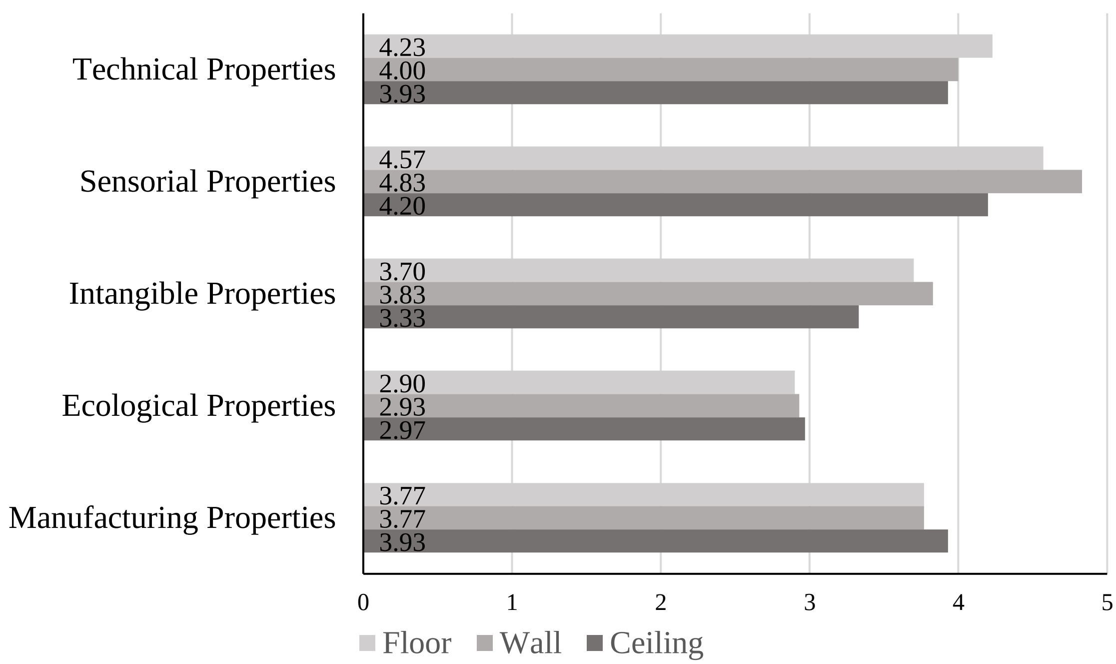

Figure 6. An overview of mean ranks of scores given for material properties for each surface

Findings shows that sensorial properties were prioritized highest and ecological properties were prioritized lowest within each interior surface. Also technical properties were found as a secondary priority. The other considerations which are intangible and manufacturing properties of materials shows differences within each surface. Intangible properties were found to be more prior than manufacturing properties in walls and less prior in floor and ceiling surfaces.

5.4.2. Comparison of material priorities per surface

Inferential statistics were carried out to understand whether the considered prioritizations differ for each surface, by referring the research question RQ3 (b). To answer the question, Friedman ANOVA was carried out. The test findings show that there is no significant difference between the prioritizations of technical, ecological and manufacturing properties in wall, floor and ceiling surfaces (See Appendix E, Table E 4, 7, 8)

On the other hand, a significant difference was found between the prioritizations of sensorial properties in wall, floor and ceiling surfaces ($\chi 2(3)=19.70$, $df=2$, $p<.01$). Therefore, Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction to compare the differences between items. The test shows a statistically significant difference between prioritizations made for material sensorial properties on wall and floor ($p<.05$), on ceiling and floor ($p<.05$), ceiling and wall

($p<.001$). Mean ranks of scores are 2.03 for floor, 2.37 for wall and 1.60 for ceiling. (See Appendix E, Table E 5 (a), (b)).

Also, significant difference was found between the prioritizations of intangible properties in wall, floor and ceiling surfaces ($\chi2(3)=9.59$, df=2, $p<.05$). Therefore, Post-hoc analysis with Wilcoxon signed-rank test after applying a Bonferroni correction was conducted to see the differences between items. The test shows a statistical difference between prioritizations made for material intangible properties on ceiling and wall ($p<.05$). However, there was no significant difference between prioritizations on wall and floor, ceiling and floor (See Appendix E, Table E 6 (a), (b)).

Overall, the inferential analysis showed that there is no significant difference between the prioritizations of technical, ecological and manufacturing properties per surface. However, there was found to be a significant difference between prioritizations of sensorial properties in wall, floor and ceiling surfaces. Based on obtained data, sensorial properties were found to prioritize higher for the wall, then the floor and then the ceiling. Also, there was found to be a significant difference between prioritizations made for material intangible properties on ceiling and wall, but there was no significant difference between prioritizations on wall and floor, and ceiling and floor. Similarly to sensorial properties, intangible aspects were found to prioritize higher for the wall, then the floor and then the ceiling.

5.5. Discussion

The considerations made for selecting finishing materials in interior spaces show a great variety within the findings of this study. The study clarifies that there are three primary determinants for considerations. These are material related, project related and designer related determinants. Each determinant identified so far almost correspond to what is described in the literature in architecture and product design (See Chapter 3.2.2). The differences can be found in the configuration of themes and subthemes of the studies.

In an architectural context, Hegger et al. (2007) emphasize five main criteria while selecting materials in construction, which are perception, technical performance, functional attributes, and ecological and economic aspects. The themes were extracted from the in-depth interviews correspond closely to the criteria specified by Hegger et al. (2007) Small differences were found in the technical performance criteria including both manufacturing as well as technical properties of materials, and in perception criteria including sensorial properties of materials. In the present study, these properties were categorized as material properties under the category of material related determinants rather than a separate category, since the study findings showed that each mentioned property was directly or indirectly related to each other and the combination of them constituted the main consideration. Additionally, in Hegger et al.'s (2007) study, the category of the functional attributes is about cleaning and maintenance oriented properties of materials and also the suitability of the material for the intended use, therefore, in terms of the present study context, it shows similarities with function which is the subtheme of project related determinants. Similarly, economic aspects were also extracted in the study and categorized under the project related determinants as the subtheme budget because participants stated that budget is an issue that change according to project and its requirements.

As another approach, Wastiels and Wouters (2012) emphasize four main considerations which are context, manufacturing process, material aspect and experience while selecting materials. Similarly, the extracted themes from qualitative analysis correspond closely to the specified considerations. The differences can be found in the configuration of considerations. In their study, the context defines the architects' consideration culturally, physically, and in terms of use. In the present study, rather than creating such a comprehensive category, each mentioned consideration in the category context were separated from each other based on their relations in order to be more specific about the designers' considerations. Accordingly, project related determinants were evaluated, and physical and functional considerations were added as a subtheme under these determinants. Also, the findings showed that ecologic considerations were mostly related with materials inherent properties like non-toxicity, recyclability and sustainability. Therefore, these considerations were categorized as a factor of the subtheme material properties in the study. Wastiels and Wouters' (2012) examine materials' technical and sensorial properties examines under the category of material aspect, manufacturing properties are categorized as a distinct category, and intangible properties of the material are discussed separately under the category of experience. However, with the same intention (the relation between each determinants), all mentioned separate categories were discussed together under the category of material properties as a subtheme of material related determinants. Their study also confirm the impact of the budget on material considerations. Different from the present study, they discuss it under the cultural and social context of the project.

Evaluated themes and subthemes in the study also show some similarities in the product design field. Van Kesteren et al. (2005) focuses on five dimensions which are engineering, the use, environmental, aesthetical and personality while defining the considerations. In the evaluated findings, under the subtheme material properties, technical properties of materials refer to van Kesteren et al.'s (2005) engineering dimension; ecological properties refer to environmental dimension; sensorial properties refer to the dimension aesthetic; and intangible properties refer to the dimension personality. However, although in the present study, there is a category function which defines the intended use, this category has a different definition in their study. It is mostly related to product interface.

The considerations by Karana et al. (2008) was used as theory driven data in the study, therefore, the evaluated findings show similarities. They emphasize five material properties which are technical, sensorial, intangible, ecological, manufacturing and economical. Accordingly, they represent a type of data list including fundamental considerations of designers in material selection. In the present study, all properties except economical was constituted the subtheme of material properties and the economical properties were investigated under the project related determinants. Also, similarly to findings of the present study, the importance of availability of the material in the market are emphasized as a significant consideration in their study.

One of the most appeared difference between the present study findings and other studies concerns the market properties that were addressed under the category of material related determinants. In the present study, considerations on market properties covers the concerns about availability of materials and availability of skilled workmanship. The availability of materials were extensively addressed in product design (Karana et al., 2008), and engineering design field (Budinski, 1996). However, in the literature, this consideration appears to be limited in the studies examining the materials in architecture context. Hegger et al. (2007) defined availability as a significant concern for regional building methods and refer to local availability of natural resources like stone and wood. Wastiels and Wouters (2012) defined availability as the time of delivery, but the significance of finding the selected materials in the market was not discussed. Also, in both studies, this material consideration is not categorized as a distinct variable and is only stated as a factor that has to be considered. Additionally, none of the studies from different design disciplines emphasize the significance of the availability of skilled workmanship. However, the study findings show that without skilled workmanship, a quality finish cannot be achieved on surfaces even if the material has desired properties. Therefore, the availability of skilled workmanship was categorized as a distinct category with the availability of material.

Another appeared difference between the present study findings and other studies is the category of designer related determinants. These determinants cover the issues about material knowledge and design approach. Although some studies mention about the design approach (e.g. Karana et al., 2008; Wastiels & Wouters, 2012)there is no study that categorizes the different approaches as a separate category. In this study, the design approach is contextualized for material selection consideration and categorized as a determinant for considerations. Also, none of the studies emphasize the role of material knowledge that can be gained by designer theoretically and practically. However, according to study findings, knowing how a material performed, which kind of finishing techniques can be used on a material surfaces, or what kind of additional applications can be made on materials according to expected performance is significant while selecting a material. Therefore, within the study context, these considerations were addressed under the theme designer related determinants.

Within the study context, designers' material preferences were studied with and without budget constraints, because in the literature and in the presented studies the budget constraints defined as the factor that affect and sometimes restrict the exact material preferences of designers (Hegger et al., 2007; Wastiels, 2010; Wastiels & Wouters, 2012). According to the findings, differently to what is discussed in the literature, exact material preferences does not change based on the budget because selected or preferred materials are mostly the same under two circumstances. The reason may be due to differences in the scale of the projects in literature because, in the present study, there was a very modest consideration only the entrance of a residence.

Based on the study findings, designers frequently prefer ceramic, wood and marble for floor; paint, wallpaper and wood for wall; and prefer paint and wood for ceiling surfaces as a finishing material in their projects. However, the effects of budget can be seen in the preference percentages of these materials (See Table 10, 11, 12). For example, participants specified marble as a high profile material and defined ceramic as an alternative to marble in low budget project. Therefore, in a controlled environment, they mostly preferred to use marble. Additionally, although, there were some standout materials for each surface, in detail, while the walls were evaluated as the surface with the highest variety of material, the ceilings were evaluated as the lowest.

Within the context of the study, by examining the designers' considerations for most preferred materials (See Table 13 for considerations with related materials), some outstanding factors within the identified determinants were found. According to the findings, within the subtheme material properties, for technical properties, durability, strength; for sensorial properties, visual and tactile aspects; for intangible properties; trend and traditional aspects; for ecological properties; non-toxicity; and for manufacturing properties, easy to apply, easy to form, and being suitable for dimensioning was emphasized for each surface. Also, within the subtheme function, easy to clean, easy to maintain and easy to repair were mostly mentioned. For the other subthemes, there was no specific outstanding factor; rather than this there was a huge variety. Therefore, any factor was not specified.

The quantitative analysis show that the prioritization of considered material properties mostly focus on material sensorial properties within each surface. However, a difference can be found when a comparison made between surfaces. Designers mostly prioritized sensorial properties for walls, followed by floors and ceiling. Based on the designer statements during the study, walls were the first to attract attention visually when entering an interior space. Therefore, they had to be considered carefully. However, floors were always layered with furniture, and in terms of the ceilings, especially in residential spaces, there was no expectation by users or clients. The only requirements for ceilings were to provide a light base for lighting equipment and hide the light source. These kinds of statements provide an understanding of the sensorial prioritizations made by designers. Correspondingly, throughout the study, another difference was found in the intangible properties in terms of the prioritizations on ceiling and wall, but there was no significant difference between prioritizations on wall and floor, and ceiling and floor. The expectancies towards walls and ceilings in the residential spaces may constitute this difference in findings.

Technical properties were found as a secondary priority within each surface and there was no significant difference when a comparison made between surfaces. Correspondingly, although the prioritizations of manufacturing properties showed some differences within surfaces, there was no significant difference per surface. Throughout the study, the statements about the manufacturing properties of materials were defined by making emphasis on material technical properties. Therefore, in contrast to some studies in literature (Hegger et al., 2007; Wastiels & Wouters, 2012), both were categorized under the same subtheme as a result of qualitative analysis and also, these quantitative findings shows their relation.

In contrast to sensorial, ecological properties were at the least priority within each surface. Although the participants mentioned the importance of the ecological properties, they prioritized these properties less when asked to make a comparison with others. Based on the statements, the effect of the budget was evaluated as a factor that affects the prioritizations made for ecological properties of materials, also, in some cases, the lack of knowledge of designer might be the factor that affects the considerations within the same context.

CHAPTER 6

CONCLUSION

In this thesis, designers' finishing material selection considerations in interior spaces were studied. While the study investigated general considerations of designers; for actual material preferences and prioritization of designers, the focus was the entrance of residential projects. Within the study context, interior spaces were analyzed referring to interior surfaces which are floor, wall and ceiling. Accordingly, finishing materials were described as the final layer that fixes and protects these surfaces.

The study was conducted in two sections. In the first section, the in-depth interview that is an open-ended, discovery-oriented method was chosen and prompted by the researcher. During this section, designers' general considerations, as well as those regarding a chosen residential project situated in their actual experiences, were analyzed. In this section, the real-life condition thus encompassed client and economic concerns. In the second section, the questionnaire including both closed-ended, open-ended questions, and also Likert type scale measurements was given to participants to fill. During this section, all questions were asked based on an introduced controlled project where contextual factors such as client and budget concerns were eliminated. All sections were conducted in the same session in Turkish and face to face with the participants. The data analysis were done both qualitatively and quantitatively.

Based on the study aim, different considerations contributing to the material selection process in interior architecture discipline were explored, and designers' finishing material preferences for wall, floor and ceilings surfaces and their related considerations was discussed with and without client and budget constraints. Also, in reference to literature, with a focus on residential entrance spaces, some material properties were identified to examine how the considerations are prioritized and if these prioritizations differ for each surface. The identified properties were technical, sensorial, intangible, ecological and manufacturing properties of materials.

In the study context, three primary determinants were identified and categorized to describe which kind of consideration was made when selecting a material. These determinants were material related, project related and designer related and they were directly related to each other. In some cases, the relation between them constituted the main consideration in the context. These identified themes almost correspond to what is described in the international literature in architecture and product design with some differences in the configuration of themes and subthemes.

One of the most appeared differences between the present study findings and other studies concerns the availability of materials and availability of skilled workmanship discussed under the subtheme of material properties and theme of material related determinants. Moreover, the aspects about material knowledge and design approach discussed under the designer related determinants within the study context is another difference.

Designers have different considerations for each material and directly for each surfaces. For all surfaces, having a material which is attractive in terms of its visual and tactile features, which is durable based on its intended use, and which is easy to clean and to repair is very important for them. Based on these considerations, their mostly preferred material types was found to be the same with and without client and budget constraints.

During the study, designer prioritizations mostly focused on sensorial properties of materials especially in terms of the visual properties. Walls were evaluated as the surfaces where these properties were emphasized highest. Floors were prioritized at a secondary degree and were identified as the surfaces always layered with interior furniture that limit to understand the surface visually. In terms of the ceilings, sensorial properties had lowest degree because especially in residential spaces, there was no expectation for these surfaces. Ceilings were only identified as a surface to hide the lighting sources. Accordingly, while some variety was shown in material preferences for the floors and walls, throughout the study, the ceiling was the surface with the least variety of materials. Correspondingly, in terms of the intangible properties, the prioritization sequence was found as the same with walls. However, a significant difference was only identified between the ceilings and walls.

In the study, for each surface, ecological properties were prioritized lowest when a comparison made with other properties. Based on the designers' statements, the project budget and in some cases, designers' lack of knowledge was found as the reasons for the lower prioritizations.

Overall, technical properties were found as a secondary priority, and manufacturing properties shows some differences within each surface, however, there was no significant difference when a comparison was made between surfaces for each property. Moreover, throughout the study, these properties were emphasized with a relation and most of the time, one provided the basis for the other.

Overall, this is to our knowledge the first study that explores material selection considerations of designers for interior surfaces and for finishing materials. It is also the first to differentiate and explore the different selection considerations for each surface that composes an interior space: namely wall, floor, and ceiling. Also, it is the first study to explore and compare both actual selection material preferences and controlled environment preferences that budget and client constraints not presented, with a focus on residential spaces, namely the entrance. This study may help to improve material knowledge in interior architecture and to disseminate material education. It also contributes to implication to the practice of designers while selecting materials, and to the practice of material manufacturers while designing finishing materials.

There are limitations to this study. The study was conducted with 30 designers all based in Turkey and was done by focusing on one function statistically. For future studies, different functions such as schools, hospitals; or different functions within a residence such as dining, sleeping or working areas can be studied. In the study, ceilings were not analyzed with the lighting elements and suspended ceilings. This limitation and designers' expectations toward ceilings in residential spaces may have limited the material variety on these surfaces. However, studying public spaces like shopping malls or hotels may provide different results. In terms of the ceilings, also some other studies may be conducted in education literature to understand how the awareness toward these surfaces may be increased.

In the study, widely accepted and mostly used traditional material families were discussed and analyzed. As another suggestion, in future studies, innovative materials may be examined in an interior architectural context.

Moreover, in the study, visual and tactile aspects of materials were found as the highly prioritized material properties. In future studies, these properties may be analyzed in detail from both users and designers point of view to increase the quality of interior design. Also, in the design education, future studies may be conducted to enhance the understanding and ability to design with these material properties. Additionally, in the study, materials’ ecological properties were prioritized lowest. In the future, some studies may be carried out to encourage designers about considering these properties when selecting materials.

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APPENDICES

APPENDIX A: CONSENT FORM

Bilgilendirme Formu:

Bu çalışma, Bilkent Üniversitesi İç Mimarlık ve Çevre Tasarımı bölümü öğretim üyelerinden Dr. Burçak Altay ve Yüksek Lisans öğrencisi Elif Salcı tarafından yürütülmektedir. Deney öncesinde, sırasında ve sonrasında istediğiniz zaman sorularınızı araştırmacı Elif Salcı'ya yöneltebilirsiniz, herhangi bir sorun ya da sorunuz olma durumunda Elif Salcı'ya (elif.salci@bilkent.edu.tr) ya da Dr. Burçak Altay'a (burcak@bilkent.edu.tr) e-mail adreslerinden ulaşabilirsiniz.

Çalışmaya gönüllü olarak katılmanız durumunda, anket boyunca paylaştığınız hiçbir kişisel veri (ad, soyadı, e-mail adresi, vb.) sizin yazılı izniniz olmaksızın paylaşılmayacaktır. Anketlerden elde edilen veriler akademik amaçlarla kullanılacak ve araştırmacılar ve üniversitelerindeki konuyla ilgili diğer profesyoneller dışında kimse ile paylaşılmayacaktır. Çalışmada size göstertilen görselleri size verilen anket üzerinden değerlendirmeniz istenecektir ve çalışmanın bilinen ve/veya tahmin edilen hiçbir yan etkisi yoktur. Çalışmanın herhangi bir aşamasında, çalışmaya katılımınızı sonlandırabilirsiniz. Çalışmaya katılmayı reddetmenizin veya katılmaktan vazgeçmenizin üniversiteyle olan ilişkilerinizi etkileyemeyeceğini belirtmek isteriz.

Katılmakta olduğunuz bu çalışma Bilkent Üniversitesi İç Mimarlık ve Çevre Tasarımı Bölümü yüksek lisans tez kapsamında yapılmaktadır, bu nedenle, deney sırasında sizin cevaplarınızdan elde edilen verilerin, anonim olarak (isimsiz bir şekilde) ilerleyen zamanlarda yazılı ve sözlü olarak yayınlanması öngörülmektedir.

Onam Formu:

Çalışmaya katılmak için 18 yaşından büyük olmanız gerekmektedir.

Yukarıda yazılan bilgilendirme yazısını okudum ve anladım. Bilgilendirmeyi okumak ve düşünmek için yeterli zamanım oldu ve sorduğum sorulara araştırmacılar tarafından tatmin edici cevaplar verildi. Bu çalışmaya gönüllü olarak katılıyorum ve çalışma sırasında toplanan verilerin, anonim olmak koşulu ile araştırmacılar tarafından kullanılmasına ve yayınlanmasına izin veriyorum.

Ad-Soyadı:

E-mail adresi:

Tarih:

İmza:

Çalışmaya katkılarınız için teşekkür ederiz.

Dr. Burçak Altay

Elif Salcı

APPENDIX B: INTERVIEW QUESTIONS AND QUESTIONNAIRE (TURKISH)

1. KISIM
GÖRÜŞME SORULARI

Yaş:

Cinsiyet: K ☐ E ☐

Eğitim Derecesi: Lisans ☐ Yüksek Lisans ☐ Doktora ☐

Branş: İç mimar ☐ Mimar ☐

Deneyim (yıl):

<u>MALZEME HUSUSLARI</u> (GENEL)

1. Projenin hangi aşamasında malzemeleri seçiyorsunuz?
2. Projeleriniz için malzemeleri nasıl seçersiniz?
3. Projeniz için malzeme seçerken genellikle malzemenin hangi özelliklerine bakıyorsunuz?

<u>MALZEME SPESİFİKASYONLARI</u> (SEÇİLMİŞ KONUT PROJESİ İÇİN)

4. Bu proje nerede?
5. Ne zaman yapıldı?
6. Projeyi kim için tasarladınız?
7. Kısıtlamalar nelerdi?
8. Bu projede hedefiniz neydi?
9. Hedefinize projenin en çok hangi kısmında ulaştığınıza inanıyorsunuz?
10. Bu projede nasıl bir mekan/alan yaratmayı hedeflediniz?

1

11. Konuşmuş olduğumuz projenin giriş alanı için malzeme tercihleriniz nasıl?

ZEMİN	
Malzeme	Spesifikasyon *(Tür, boyut, doku...)* *Eğer varsa*
Beton	
Ahşap	
Seramik	
Mermer	
Granit	
Tekstil	
Epoksi	
Vinyil	
Diğer…	
…	

DUVAR	
Malzeme	Spesifikasyon *(Tür, boyut, doku...)* *Eğer varsa*
Beton	
Ahşap	
Seramik	
Mermer	
Doğal Taş	
Tekstil	
Duvar Kağıdı	
Boya	
Vinyil	
Diğer…	

TAVAN	
Malzeme	Spesifikasyon *(Tür, boyut, doku...)* *Eğer varsa*
Beton	
Ahşap	
Alüminyum	
Duvar Kağıdı	
Vinyil	
Boya	
Diğer…	

12. Neden zemin, duvar ve tavan için bu malzemeleri seçtiniz?

13. Diğer ana alternatifleriniz nelerdi? Neden?

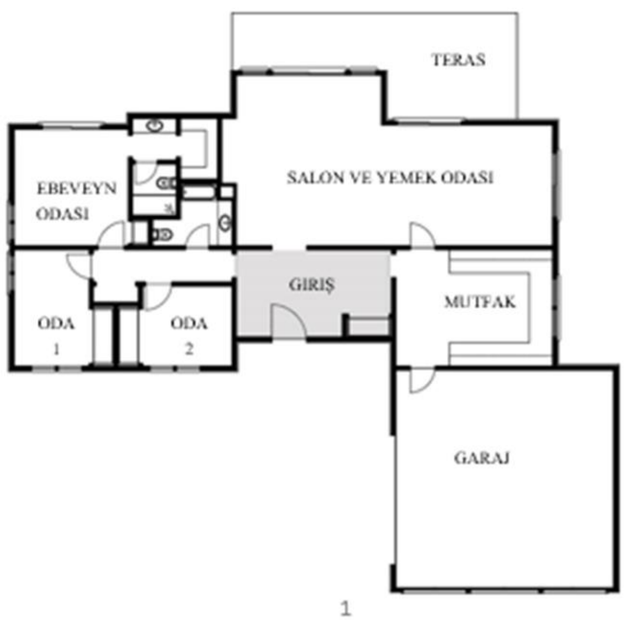
Notlar,

2

2. KISIM
ANKET

Ad Soyad:

Bu görselin Çankaya ilçesine bağlı, şehir merkezine yakın ve mimari projesi tamamlanmış bir toplu konu projesinin giriş alanı olduğunu varsayınız.



1

14. **<u>Bir bütçe kısıtlaması gözetmeksizin</u>** verilen bu alan için malzeme tercihleriniz nasıl olurdu?

Lütfen her bir yüzey için bir veya daha fazla malzeme seçiniz. Seçilen yüzeyler üzerinde farklı malzemeler için alan tanımlamaları yapabilir ve bunları eskiz yaparak yukarıdaki görselin üzerinde işaretleyebilirsiniz.

ZEMİN	
Malzeme	Spesifikasyon *(Tür, boyut, doku...) Eğer varsa*
Beton	
Ahşap	
Seramik	
Mermer	
Granit	
Tekstil	
Epoksi	
Vinyil	
Diğer…	
…	

DUVAR	
Malzeme	Spesifikasyon *(Tür, boyut, doku...) Eğer varsa*
Beton	
Ahşap	
Seramik	
Mermer	
Doğal Taş	
Tekstil	
Duvar Kağıdı	
Boya	
Vinyil	
Diğer…	

TAVAN	
Malzeme	Spesifikasyon *(Tür, boyut, doku...) Eğer varsa*
Beton	
Ahşap	
Alüminyum	
Duvar Kağıdı	
Vinyil	
Boya	
Diğer…	

15. Neden bu malzemeleri seçtiniz?

ZEMİN	DUVAR	TAVAN
a. … b. … c. …	a. … b. … c. …	a. … b. … c. …

2

16. Yukarıda verilmiş alanı tasarlarken, **önceliklerinizi** aşağıda listelenmiş malzeme özelliklerine göre çok yüksek/yüksek/orta/az ve çok az olarak derecelendiriniz.

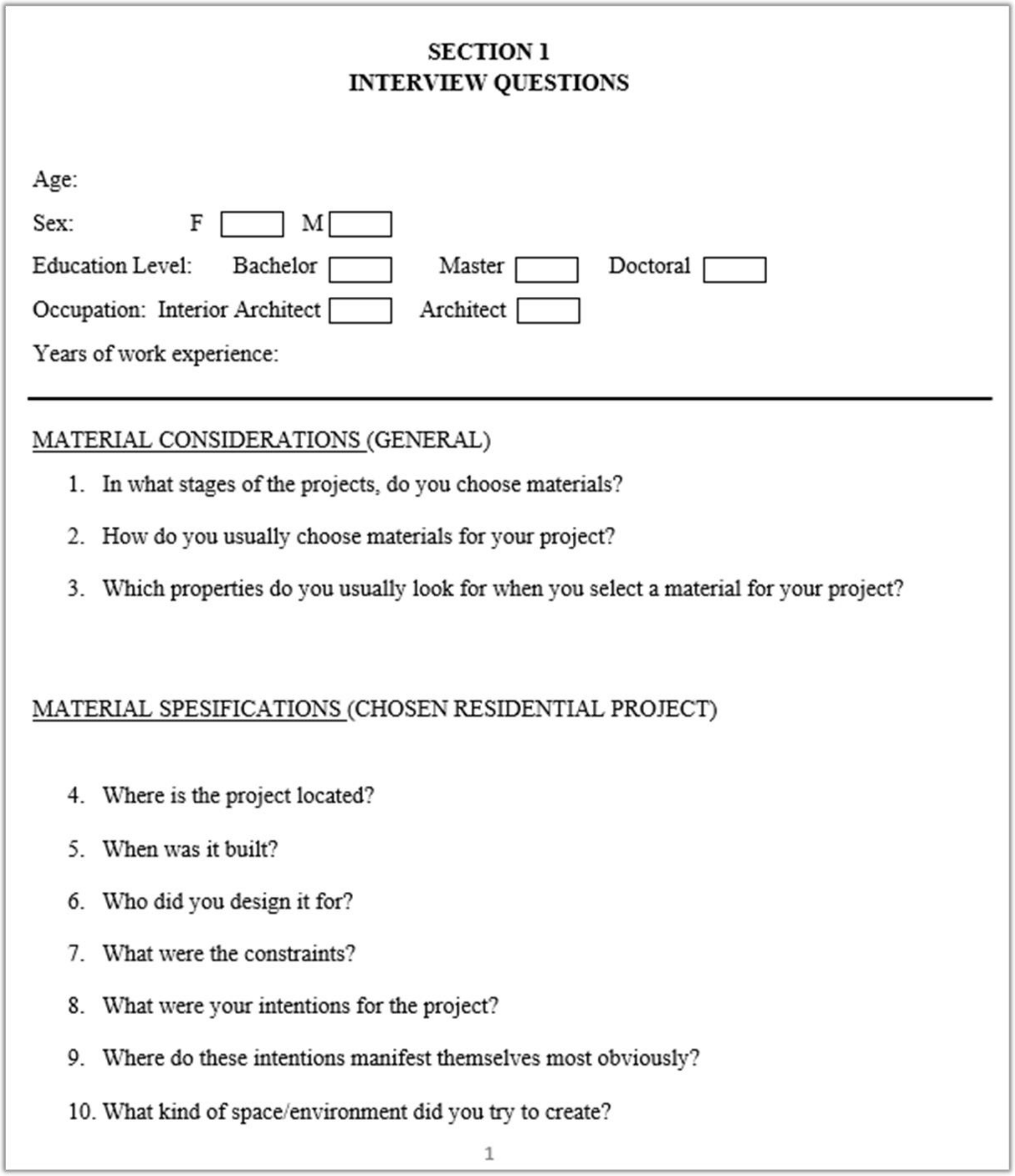
ZEMİN	Çok Yüksek Öncelikli	Yüksek Öncelikli	Orta Öncelikli	Az Öncelikli	Çok Az Öncelikli
Malzemenin teknik özellikleri (dayanıklılık, güç, iletkenlik, yoğunluk, …)	○	○	○	○	○
Malzemenin duyumsal özellikleri (renk, doku, koku, …)	○	○	○	○	○
Malzemenin soyut özellikleri (duygu, anlam, trend, kültür, …)	○	○	○	○	○
Malzemenin ekolojik özellikleri (geri dönüştürülebilir, sürdürülebilirlik, . . .)	○	○	○	○	○
Malzemenin imalatı (mevcut teknikler ile kolay imal edilebilirlik, montaj ve yüzey kaplama teknikleri, …)	○	○	○	○	○

DUVAR	Çok Yüksek Öncelikli	Yüksek Öncelikli	Orta Öncelikli	Az Öncelikli	Çok Az Öncelikli
Malzemenin teknik özellikleri (dayanıklılık, iletkenlik, yoğunluk, …)	○	○	○	○	○
Malzemenin duyumsal özellikleri (renk, doku, koku, …)	○	○	○	○	○
Malzemenin soyut özellikleri (duygu, anlam, trend, kültür, …)	○	○	○	○	○
Malzemenin ekolojik özellikleri (geri dönüştürülebilir, sürdürülebilirlik, . . .)	○	○	○	○	○
Malzemenin imalatı (mevcut teknikler ile kolay imal edilebilirlik, montaj ve yüzey kaplama teknikleri, …)	○	○	○	○	○

TAVAN	Çok Yüksek Öncelikli	Yüksek Öncelikli	Orta Öncelikli	Az Öncelikli	Çok Az Öncelikli
Malzemenin teknik özellikleri (dayanıklılık, iletkenlik, yoğunluk, …)	○	○	○	○	○
Malzemenin duyumsal özellikleri (renk, doku, koku, …)	○	○	○	○	○
Malzemenin soyut özellikleri (duygu, anlam, trend, kültür, …)	○	○	○	○	○
Malzemenin ekolojik özellikleri (geri dönüştürülebilir, sürdürülebilirlik, . . .)	○	○	○	○	○
Malzemenin imalatı (mevcut teknikler ile kolay imal edilebilirlik, montaj ve yüzey kaplama teknikleri, …)	○	○	○	○	○

3

APPENDIX C: INTERVIEW QUESTIONS AND QUESTIONNAIRE (ENGLISH)



SECTION 1
INTERVIEW QUESTIONS

Age:

Sex: F ☐ M ☐

Education Level: Bachelor ☐ Master ☐ Doctoral ☐

Occupation: Interior Architect ☐ Architect ☐

Years of work experience:

MATERIAL CONSIDERATIONS (GENERAL)

1. In what stages of the projects, do you choose materials?
2. How do you usually choose materials for your project?
3. Which properties do you usually look for when you select a material for your project?

MATERIAL SPESIFICATIONS (CHOSEN RESIDENTIAL PROJECT)

4. Where is the project located?
5. When was it built?
6. Who did you design it for?
7. What were the constraints?
8. What were your intentions for the project?
9. Where do these intentions manifest themselves most obviously?
10. What kind of space/environment did you try to create?

1

11. What is your material preferences for the entrance area of the mentioned project?

FLOOR	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Ceramic	
Marble	
Granite	
Textile	
Epoxy	
Vinyl	
Other…	
…	

WALL	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Ceramic	
Marble	
Decorative Stone	
Textile	
Wall Paper	
Vinyl	
Paint	
Other…	

CEILING	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Aluminium	
Wall Paper	
Vinyl	
Paint	
Other…	

12. Why did you prefer these materials for wall, floor and ceilings?

13. What were the main alternatives? Why?

P.S.

SECTION 2
QUESTIONNAIRE

Name:

Assume that this image is the entrance area of a multi-housing project in Çankaya, close to the city center and whose architectural project has been completed.

1

14. What would be your material preferences for the given space **without any budget constraints**?
Please choose one or more material for each surface. You can also create some zones on the selected surfaces and show them by doing sketches on the above figure.

FLOOR	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Ceramic	
Marble	
Granite	
Textile	
Epoxy	
Vinyl	
Other…	
…	

WALL	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Ceramic	
Marble	
Decorative Stone	
Textile	
Wall Paper	
Vinyl	
Paint	
Other…	

CEILING	
Material	Specifications *(Type, size, texture...) If it is available*
Concrete	
Wood	
Aluminium	
Wall Paper	
Vinyl	
Paint	
Other…	

15. What were the reasons for your preference of these materials?

FLOOR	WALL	CEILING
a. … b. … c. …	a. … b. … c. …	a. … b. … c. …

2

16. When designing the space given above, rank **your priorities** as Extremely High / High / Moderate / Low and Very Low priority according to the material properties listed below.

FLOOR	Extremely High Priority	High Priority	Moderate Priority	Low priority	Very Low priority
Technical properties of materials (durability, strength, conductivity density, . . .)	○	○	○	○	○
Sensorial properties of materials (color, texture, smell. . .)	○	○	○	○	○
Intangible properties of materials (emotions, meanings, culture, trends. . .)	○	○	○	○	○
Ecological properties of materials (recyclability, sustainability. . .)	○	○	○	○	○
Manufacturing of materials (easy to manufacture with existing manufacturing facilities, assembly and finishing techniques, . . .)	○	○	○	○	○

WALL	Extremely High Priority	High Priority	Moderate Priority	Low priority	Very Low priority
Technical properties of materials (durability, strength, conductivity density, . . .)	○	○	○	○	○
Sensorial properties of materials (color, texture, smell. . .)	○	○	○	○	○
Intangible properties of materials (emotions, meanings, culture, trends. . .)	○	○	○	○	○
Ecological properties of materials (recyclability, sustainability. . .)	○	○	○	○	○
Manufacturing of materials (easy to manufacture with existing manufacturing facilities, assembly and finishing techniques, . . .)	○	○	○	○	○

CEILING	Extremely High Priority	High Priority	Moderate Priority	Low priority	Very Low priority
Technical properties of materials (strength, conductivity density, . . .)	○	○	○	○	○
Sensorial properties of materials (color, texture, smell. . .)	○	○	○	○	○
Intangible properties of materials (emotions, meanings, culture, trends. . .)	○	○	○	○	○
Ecological properties of materials (recyclability, sustainability. . .)	○	○	○	○	○
Manufacturing of materials (easy to manufacture with existing manufacturing facilities, assembly and finishing techniques, . . .)	○	○	○	○	○

APPENDIX D: CONSIDERATIONS OF PARTICIPANTS

Table D 1. Frequency of considerations revealed through thematic analysis

DETERMINANTS FOR CONSIDERATIONS	PARTICIPANTS																														Frequency of Occurance	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
MATERIAL RELATED DETERMINANTS																																
Material Properties																																
Technical properties																																
Durability		x	x			x	x	x				x		x	x				x	x	x	x	x	x	x	x		x		x	18	60%
Strength								x				x			x	x							x	x	x		x				8	27%
Density			x		x		x	x								x												x			6	20%
Stiffness												x		x					x	x		x									5	17%
Thickness		x				x	x	x								x			x			x			x			x			9	30%
Sensorial properties																																
Visual / Attractive / Color / Appearance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x		x	x	x		x			x	x	x	x	24	80%
Texture	x							x				x	x	x					x	x		x	x			x	x	x	x		13	43%
Smell		x																													1	3%
Intangible properties																																
Traditional		x							x		x	x							x							x	x				7	23%
Cultural		x	x							x			x		x	x						x									7	23%
Popular / Trend	x						x							x				x	x	x	x		x				x	x	x		11	37%
Ecological Properties																																
Recyclability and sustainability							x																					x			2	7%
Non-toxic / Healthy		x	x				x	x	x	x		x	x	x		x	x		x			x						x			14	47%
Manifacturing Properties																																
Easy to apply	x									x			x					x		x		x	x	x	x			x			10	33%
Easy to modify, cut, shape, form, size		x		x		x	x	x			x		x	x								x		x	x	x		x	x	x	15	50%
Suitable to paint, polish			x				x		x			x		x		x		x													7	23%

Table D 1 (cont'd)

DETERMINANTS FOR CONSIDERATIONS	PARTICIPANTS																														Frequency of Occurance	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Market Properties																																
Availability of materials																																
Cannot find/ no suppliers in the market	x						x			x					x			x	x		x				x	x					9	30%
Availability of skilled workmanship																																
Finding a skilled laborer, labor who knows what he is doing	x		x				x		x	x	x	x				x	x	x	x						x						12	40%
PROJECT RELATED DETERMINANTS																																
Physical																																
Project type / Newly built / Renovation							x						x	x					x	x	x	x	x	x	x	x	x	x	x	x	15	50%
Project Location		x		x			x								x	x	x			x				x		x					9	30%
Narrow / Small / Big / Proportion / Layout			x		x	x												x							x	x					6	20%
Existing Surface Status / Surface cracks, damages	x	x	x		x	x	x		x		x	x	x		x				x	x	x	x	x			x	x	x		x	20	67%
Functional																																
Easy to clean , to repair, to maintain	x	x	x				x	x	x	x	x	x	x	x		x	x		x	x	x	x			x		x	x			20	67%
Functional / Suitable / Proper			x	x			x	x	x		x	x	x	x		x	x		x		x	x							x		15	50%
Client																																
Client wants / Customer is	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	29	97%
Budget																																
Expensive / Cheap / Cost / Economic	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	30	100%

Table D 1 (cont'd)

DETERMINANTS FOR CONSIDERATIONS	PARTICIPANTS																														Frequency of Occurance	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
DESIGNER RELATED DETERMINANTS																																
Material Knowledge																																
Theoratical																																
Materials that I know / Material samples / Magazines	x	x	x	x		x	x	x			x			x				x		x	x	x	x	x		x		x		x	18	60%
Practical																																
My previous experiences / We can make, we can do	x	x	x				x			x		x		x	x			x	x					x				x		x	13	43%
Design Approach																																
I like / I prefer / I love	x	x	x	x	x		x	x	x	x			x	x	x	x	x	x	x		x	x	x	x	x	x	x		x		24	80%

APPENDIX E: STATISTICAL ANALYSES

Table E 1. Mean values and the outcomes of material properties ratings for the floor

	Technical Properties	Sensorial Properties	Intangible Properties	Ecological Properties	Manufacturing Properties
Mean	4.23	4.57	3.70	2.90	3.77
Median	4.00	5.00	4.00	3.00	4.00
Std. Deviation	.81	.62	.95	1.06	1.13
Minimum	2	3	2	1	1
Maximum	5	5	5	5	5

Table E 2. Mean values and the outcomes of material properties ratings for the wall

	Technical Properties	Sensorial Properties	Intangible Properties	Ecological Properties	Manufacturing Properties
Mean	4.00	4.83	3.83	2.93	3.77
Median	4.00	5.00	4.00	3.00	4.00
Std. Deviation	.91	.46	.98	1.11	1.38
Minimum	1	3	2	1	1
Maximum	5	5	5	5	5

Table E 3. Mean values and the outcomes of material properties ratings for the ceiling

	Technical Properties	Sensorial Properties	Intangible Properties	Ecological Properties	Manufacturing Properties
Mean	3.93	4.20	3.33	2.97	3.93
Median	4.00	4.00	3.00	3.00	4.00
Std. Deviation	.94	.80	1.15	1.03	1.14
Minimum	1	2	2	1	1
Maximum	5	5	5	5	5

Table E 4. Friedman ANOVA outcomes of technical properties for each surface

Surfaces	N	Mean	Mean Rank	Median	Min	Max	Std. Deviation	Friedman ANOVA		
								$\chi2$	df	p
Floor	30	4.23	2.20	4.00	2	5	.817			
Wall	30	4.00	1.90	4.00	1	5	.910	4.235	2	.120
Ceiling	30	3.93	1.90	4.00	1	5	.944			

Table E 5 (a). Friedman ANOVA outcomes of sensorial properties for each surface

Surfaces	N	Mean	Mean Rank	Median	Min	Max	Std. Deviation	Friedman ANOVA		
								χ2	df	p
Floor	30	4.57	2.03	5.00	3	5	.626			
Wall	30	4.83	2.37	5.00	3	5	.461	19.704	2	.000
Ceiling	30	4.20	1.60	4.00	2	5	.805			

Table E 5 (b). Wilcoxon Sign Ranks, p value of 2 related sample tests for sensorial properties without Bonferroni test correction

	Wall - Floor	Ceiling - Floor	Ceiling - Wall
Z	-2.530	-2.399	-3.578
p	.011	.016	.000

Table E 6 (a). Friedman ANOVA outcomes of intangible properties for each surface

Surfaces	N	Mean	Mean Rank	Median	Min	Max	Std. Deviation	Friedman ANOVA		
								χ2	df	p
Floor	30	3.70	2.03	4.00	2	5	.952			
Wall	30	3.83	2.25	4.00	2	5	.986	9.593	2	.008
Ceiling	30	3.33	1.72	3.00	2	5	1.155			

Table E 6 (b). Wilcoxon Sign Ranks, p value of 2 related sample tests for intangible properties without Bonferroni test correction

	Wall - Floor	Ceiling - Floor	Ceiling - Wall
Z	-1.069	-1.826	-2.830
p	.285	.068	.005

Table E 7. Friedman ANOVA outcomes of ecological properties for each surface

Surfaces	N	Mean	Mean Rank	Median	Min	Max	Std. Deviation	Friedman ANOVA		
								χ2	df	p
Floor	30	2.90	1.93	3	1	5	1.062			
Wall	30	2.93	2.02	3	1	5	1.112	.703	2	.704
Ceiling	30	2.97	2.05	3	1	5	1.033			

Table E 8. Friedman ANOVA outcomes of manufacturing properties for each surface

Surfaces	N	Mean	Mean Rank	Median	Min	Max	Std. Deviation	Friedman ANOVA		
								$\chi 2$	df	p
Floor	30	3.77	1.92	4	1	5	1.135			
Wall	30	3.77	1.95	4	1	5	1.382	1.922	2	.383
Ceiling	30	3.93	2.13	4	1	5	1.143			