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Sustainability
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Materials Classification in Furniture Design

Focus on Sustainability

Introduction

The materials classification increases in complexity as new materials are constantly released on the market. The furniture designer, usually a designer or architect, needs to stay current with the emergence of new wood panels, new composites, new metal alloys, and so on. The choice of materials is a crucial moment in the project, as it marks the transition between the conceptual design for the actual project. The currently available classifications are generalist and, strictly speaking, fit for any product. However, the practice shows a difficulty in selecting the most appropriate materials considering the specific area of each project. The present article initially demonstrates the difficulty of the available tables, shows case studies in furniture projects and finally presents a classification proposal focused on furniture design.

Materials in Design

Authors like Callister Junior and Rethwisch (2016) present a detailed and complete overview of materials, for the authors, the traditional classification begins by grouping the materials into three large groups: metals, ceramics and polymers. This initial way is based mainly on the chemical composition and the atomic structure of the base materials. In the part referring to polymers, the authors divide into synthetic and natural, including in this second subgroup those derived from plants or animals such as wood, bamboo, rubber, cotton, leather, silk, wool, natural fibers of ramie, hemp, coconut, etc. .

The difficulty of the material classification can be exemplified with the steel element. Being a binary alloy of Iron and Carbon, itself is divided into several types according to the quantity of iron and carbon, with different characteristics of hardness, mechanical strength, malleability and ductility, among others. By adding other elements to the steel, the alloy steels originate. It is estimated that in 2017, more than 300 new types of steel were tested.

Ferroli et al. (2017) present a classificatory table of materials, in order to facilitate the selection process. It serves as the basis for the beginning of the process, whose method is demonstrated in the website: Sustainable Materioteca of UFSC that is in constant adaptation. Establishing a relationship with the systematics used in design projects (pre-conception, design and post-conception), the tables are more suitable for the methodological stages of conception.

Table 1	Natural, processed and coated woods	Table 2	Paper, cardboard and cardboard
Table 3	Ferrous metals (cast iron and steel)	Table 4	Non-ferrous metals (alloys)
Table 5	Sintered materials - Powder metallur	Table 6	Polymers - plastics
Table 7	Polymers - blends	Table 8	Polymers - adhesives
Table 9	Cement, concrete and aggregates	Table 10	Ceramics (common) and Glass
Table 11	Natural materials (stones, leather, w	Table 12	Natural fibers and artificial fibers
Table 13	Rubber and plastic - processing	Table 14	Oils and greases
Table 15	Paints and varnishes	Table 16	Nano technology materials
Table 17	Advanced composites	Table 18	materials not included in the previous tables

[Table 1] Classification of materials based on FEM - Material Choice Tool. Source: Ferroli and others (2017)

The tables are complemented by physical samples, which allow the user to a tactile experimentation and data sheets of each material that present a brief introduction of the material, focusing on the Life Cycle Analysis (LCA). They follow basic concepts, properties, characteristics, a brief history of the material and main types, classified according to national and international standards.

Proposal for Classification of Materials for furniture

It is verified in the research that the way the materials are classified does not meet the expectations and needs of the furniture designers. The classification tables are in general very complex and approach materials that are not used for the specific purpose studied here. The first moment for the proposal of the classification was the division between the furniture categories previously described: residential, condominial internal, condominial external and urban.

For the classification were studied properties, general characteristics, strengths, limitations and everyday examples of use of each material. As far as possible, physical samples of the materials were analysed whenever possible to verify subjective characteristics such as tactile issues (softness, roughness, thermal sensation), beauty, smell, etc.

For the final composition of the tables, it was made a survey of the materials supply market, considering factors such as ease of manufacturing, the degree of specialization of labour, machinery, direct acquisition costs and transport, indirect costs, quantity of suppliers, supply, demand, environmental legislation, recycling factor, life cycle analysis, aesthetic issues (texture, gloss, etc.), and comfort and safety in use (ergonomic aspects). The tables shown in table 1 were used as a starting point for the preparation of the proposal. The primary analysis reduced from 18 to 7 tables. After this first step, the materials were classified according to the suggested group and subjective criteria were adopted to determine the factors. The factors originated from the FEM tool: Auxiliary Tool for Material Selection, by Ferroli and Librelotto (2012), which are: manufacturing and productive; marketing and social services; economic and financial, aesthetic and product presentation, ergonomic and safety and ecological (environmental).

Natural and transformed wood							
Residential furniture							
Determinant factors		Manufacturing	Marketing	Economic	Aesthetics	Ergonomic and safety	Environmental
Natural Conífera	Pinus	******	*****	******	**	***	***
	Cipreste	****	****	****	***	***	***
	Cedrinho	****	****	****	***	***	***
	Zimbro	**	**	**	****	**	**
Natural frondosas	Pau-marfim	******	****	***	***	***	***
	Peroba-rosa	****	***	***	****	****	**
	Canela	***	***	****	***	***	***
	Amendoim	***	***	***	***	***	***
	Cedro	**	***	***	****	****	***
	Cerejeira	*****	*	*	*****	****	*
	Uva do Japão	*****	***	***	****	***	****
Transformada	Compensado laminado	****	****	****	***	***	***
Compensada	Compensado sarrafiado	******	****	****	**	***	***
	MDP	**	*****	*****	****	***	***
Reconstituída	Sofboard núcleo de PU	***	**	****	***	****	**
inflada	Sofboard de EPE	***	**	***	***	***	***
Madeira	Aglomerado BP	***	****	*****	**	**	**
aglomerada	Aglomerado especial	***	****	****	***	***	**
Aglomerado	MDF ST	*****	*****	****	****	***	***
de média	MDF MR (umidade)	*****	****	***	****	****	***
Densidade	MDF FR (contra chama)	*****	****	***	****	***	***
	MDF HD (resistência)	*****	****	****	****	****	***
OSB	OSB3	***	***	****	**	***	***

[Table 2] Classification of materials for furniture - natural and processed woods - part 1 - residential furniture. Source: prepared by the authors.

Final considerations

The purpose of this article was to show the development of tables to choose materials with a focus on furniture design, considering four types: residential, condominial internal, condominial external and urban. It initially demonstrated a history of the use of traditional materials in furniture design, gradually being replaced or supplemented by alternative materials. This created a problem for material selection because of the difference in relevant and reliable informational data between the various material groups.

Based on previous applications, the authors developed seven practical tables that seek to guide the designer in the choice of materials, establishing correlations with factors of fabrication, productivity, aesthetics, market, society, environment, ergonomics, safety and costs. Preliminary application studies conducted to date indicate the need to test the tables in the four furniture groups in at least three to five different project design situations. These tests have already been started with the application of university product design classes

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