

Analysis of ergonomic furniture made of wood and sub-products from renewable forests

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Abstract. The furniture ergonomic evaluation was carried out through the use of questionnaires and forms in industries. For the ergonomic product analysis, it was used the methodology “Object Ergonomics - Ergonomic System Technical Reading” (design goals and management actions), and measurements of products. The values achieved were compared with the standard dimensions, and the compliance or non-compliance of the furniture to it was assessed. In relation to the dimensions of the bed, the following variables did not comply with the norms: external and internal length, external and internal width, height and width of the sidebar and distance to the floor. The dimensions of these variables were above the recommended values. The double bed was inadequate for management actions and maintenance. Since the kitchen cabinet is a product that went through physical testing and follows national standards; the finish used is powder coating. The kitchen cabinet proved to be appropriate in all design requirements and for management actions. Both furniture pieces were inadequate, considering the difficulty for maintenance when a product or part of it was damaged. It was recommended the creation of regulatory standards for the production of safe and comfortable furniture.

Keywords: Furniture, design, bedding, kitchen cabinet

1. Introduction

1.1. Ergonomics and development of sustainable products

The search for ergonomic and environmentally friendly products, with technical quality, safety and comfort, has allowed sustainable and optimized use of natural resources. The rational use of energy and greater concern with end consumers led furniture companies to adapt to this new context. This is also a concern for academic institutions seeking to develop

research works to assess and even propose actions and methods that can facilitate these processes, also identifying the ergonomic compliance of products in the market.

According to Fialho [3], ergonomic evaluations are necessary for achieving quality, safety and comfort, including ease of use, handling, anthropometric adequacy, compatibility of movements and the availability of the user manual.

Therefore, the development of safe products must be performed through the cooperation among designers, ergonomists, engineers, architects, industry and users in order to gather the technical possibilities and the environmentally and ergonomically appropriate

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proposals to create new culturally and socially acceptable products [5].

Thus, it is important to uphold the principles of ergonomic and ecological use of wood and products from renewable forests, always considering the quality and safety of products, the sustainable and rational use of energy and life quality of workers in the production process [7].

1.2. Residential furniture

According to the IBGE 2003 quoted by SEBRAE [8], the furniture manufacturing sector mainly produces residential objects. Besides, economic stabilization of the furniture market has attracted new customers, mainly low-income families.

Regardless of the social status, furniture is essential for individuals in various activities in their homes and can reclassify spaces or modify them, giving them new qualities. Furniture can transform a room into a kitchen, laundry area or others [8].

Therefore, furniture must be safe and provide comfort to its users. Regulatory standards are important for this issue, but there are few regulatory standards for residential furniture, such as the case of bedroom furniture. However, kitchen cabinets are covered by NBR-140033 [2].

Thus, this study aims at analyzing furniture made of wood from renewable forests and their products, in accordance with the principles of ergonomic design and technical standards, in search for achieving the standard of the final certification of the APL of Ubá and surrounding region. Specifically, it aimed to analyze residential furniture and bedding and kitchen cabinets.

2. Method

This work was developed using data collected from furniture companies, located in the Uba county region, Minas Gerais state, Brazil. In this study, bed and kitchen cabinets sold both domestically and externally were chosen.

The furniture ergonomic evaluation was carried out by using questionnaires and forms in industries, while the ergonomic analysis of products used the methodology proposed by Gomes Filho [4]. “Object Ergonomics: Ergonomic System Technical Reading” (design goals and management actions) and measurements of the products.

Due to the lack of technical standards for double bed segment, the assessment of ergonomic compliance was carried out with the data recommended by Panero, and Zelnik [6] and ABIMOVEL [1].

The Brazilian technical norm [2] was used to verify the ergonomic compliance of the kitchen cabinet. The dimensions from the variables of the kitchen cabinet were compared with the dimensions proposed by the standard to verify the degree of compliance.

3. Results and discussion

3.1. Ergonomic evaluation of the double bed

3.1.1. Characterization of the bed material

The industry produced 300 double bed per month with the following characteristics:

- The raw material was “Embirema” wood (*Eschweilera ovata* (Camb.) Miers), Eucalyptus MDF boards and wooden blades;
- A hotmelt, polyvinyl acetate (PVA) was the adhesive used.

3.1.2. Dimensional assessment of bed

In Table 01 presents bed variables, their dimensions and the values recommended by ABIMOVEL [1], Panero and Zelnik [5]. The variables length, internal width, internal length, width of the sidebar, sidebar height and distance to the floor presented values higher than those recommended by the literature.

Table 01
Presentation of dimensional data of bed for couples

Variable	Product dimension (mm)	Recommended values Abimóvel ¹ [1] and Panero and Zelnik ² [5]
External height of the headboard	1,097	-
External height of footboard	425	-
External length	2,152	2,130 ²
Internal width	1,600	1,400 ¹
Internal height	390	-
Internal length	1,980	1,900 ¹
Width of the sidebar	30	18 ¹
Height of the sidebar	180	115 ¹
Length of the sidebar	1,980	-
Height from the bottom of the sidebar to the floor	210	-

Width of head	118	-
Height of head	1,097	-
Length of head	1,680	-
Head tilt angle (degrees)	7	-
Strip width of the pallet	50	-
Height of the bed slat	12	-
Length of the slat bed	1,950	-
Spacing between slats	60	-
Distance to the floor	240	152-203 ²
Width of the footboard	40	-
Overall height of footboard	425	-
Side width or thickness of the foot	45	-

Table 2 presents the results for the reading ergonomic systems for double beds. It was observed that only the item maintenance was inadequate, among the management actions.

Table 02

Results for the ergonomic system technical reading for the double bed

Ergonomic System Technical Reading	
Basic Ergonomic Factors	Product
Project design Requirements	
Task	Appropriate
Security	Appropriate
Comfort	Appropriate
Popular stereotype	Appropriate
Posture	Appropriate
Applying power	Appropriate
Materials	Appropriate
Management actions	
Handling	Appropriate
Cleaning	Appropriate
Maintenance	Inadequate
Spatial arrangement	Appropriate

3.2. Ergonomic evaluation of the kitchen cabinet

3.2.1. Characterization of the kitchen cabinet material

The industry produced 5,500 kitchen cabinets per month with the following characteristics:

- Steel was the raw material used.
- The joints were made of bolts, nuts, hinges and connectors.
- The furniture finishing was carried out by electrostatic painting.

3.2.2. Dimensional evaluation of kitchen cabinets

Table 3 presented the bed variables, their dimensions and the values recommended by the Norm NBR 14033:2005 [2].

Table 03

Presentation of dimensional data for kitchen cabinets

Variable	Product dimension (mm)	Values recommended by the Norm NBR 14033:2005 [2]	
		Minimum	Maximum
Module width of overhead cupboard	400-1200	-	-
Useful depth of the cabinet	290	240	-
Depth of worktop	500	500	-
Useful depth of work desk	470	450	-
Indent footer	-	30	-
Height of working desk	870	800	950
Work clearance	480	480	-
Depth of top support	450	350	499
Depth of useful of pans	290	240	-
Depth useful desk	450	400	499
Height cooking pans	1.930-2.070	950	-
Cabinet height	550-690	-	-
Clearance for the feet	200-1.000	100	-
Height of top support	-	750	-

The kitchen cabinet proved to be appropriate in all the design requirements and management actions, as shown in table 04. It was noted that all the variables are in accordance with the norms.

Table 04

Results for the ergonomic system technical reading for the kitchen cabinet

Ergonomic System Technical Reading	
Basic Ergonomic Factors	Product
Project Design Requirements	
Task	Appropriate
Security	Appropriate
Comfort	Appropriate
Popular stereotype	Appropriate
Posture	Appropriate
Applying power	Appropriate
Materials	Appropriate
Management actions	
Handling	Appropriate
Cleaning	Appropriate
Maintenance	Appropriate
Spatial arrangement	Appropriate

4. Conclusions

The main conclusions from furniture evaluations were:

The double bed presented inadequacies in management actions and maintenance.

The kitchen cabinet proved to be appropriate in all the design requirements and management actions.

The furniture industry needs better standards, norms and regulatory guidelines.

It was also evident that ergonomic evaluation, regulatory standards and consumer demand will allow furniture to develop characteristics related to aesthetics, safety and comfort.

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