frontiers | Frontiers in Built Environment

TYPE Perspective
PUBLISHED 30 July 2025
DOI 10.3389/fbuil.2025.1623281

OPEN ACCESS

EDITED BY
Assed N. Haddad,
Federal University of Rio de Janeiro, Brazil

REVIEWED BY
Aylson Costa Oliveira,
Federal University of Mato Grosso, Brazil
Melek Elif Somer,
Bahçeşehir University, Türkiye

*CORRESPONDENCE
Gustavo Henrique Nalon,
gustavo.nalon@ufjf.br

RECEIVED 05 May 2025
ACCEPTED 14 July 2025
PUBLISHED 30 July 2025

CITATION
Gomes RM, Gonçalves Tibiriçá AC, Franco de Carvalho JM, Nalon GH, Pedroti LG and Oliveira de Paula M (2025) Wood waste quantification from the furniture industry in Ubá (Brazil) and its reuse prospects in civil construction.
Front. Built Environ. 11:1623281.
doi: 10.3389/fbuil.2025.1623281

Wood waste quantification from the furniture industry in Ubá (Brazil) and its reuse prospects in civil construction

Roziani Maria Gomes[1], Antônio Cleber Gonçalves Tibiriçá[2], José Maria Franco de Carvalho[1], Gustavo Henrique Nalon[3]*, Leonardo Gonçalves Pedroti[1] and Marcos Oliveira de Paula[4]

[1]Department of Civil Engineering, Universidade Federal de Viçosa, Viçosa, Brazil, [2]Department of Architecture and Urbanism, Universidade Federal de Viçosa, Viçosa, Brazil, [3]Department of Applied and Computational Mechanics, Universidade Federal de Juiz de Fora, Juiz de Fora, Brazil, [4]Department of Forest Engineering, Universidade Federal de Viçosa, Viçosa, Brazil

The furniture hub of Ubá, one of the foremost furniture production centers in Brazil, generates substantial volumes of unmanaged wood waste. This study quantifies the generated waste and evaluates its potential for reuse in the production of composite wood panels for eco-efficient buildings. Data from 17 different companies were analyzed in terms of production demand, quantities and types of raw materials, procedures to prevent storage losses, consumption and types of wood waste, waste disposal methods, etc. The total raw material consumption across all companies amounted to around 9,843,137 kg, with solid wood accounting for 662,375 kg (6.73%) and panels for 9,180,762 kg (93.27%). The total waste generated was 884,858 kg, including 458,058 kg (51.77%) of chips and 426,800 kg (48.23%) of sawdust, resulting in an overall waste generation of 9.0% by weight. These quantitative projections indicated sufficient availability of wood waste to sustain local manufacturing of composite panels, woodcrete, bio-based insulation materials, lightweight composites, and other sustainable solutions for civil construction. Eucalyptus and pine residues, predominant in the region, demonstrate high suitability for incorporation into recycled panels, enhancing resource efficiency. These findings highlight the strong potential for integrating wood waste recycling into the local construction industry, promoting environmental sustainability and circular economy practices in the region.

KEYWORDS

wood residues, furniture industry, recycled panels, housing, sustainable buildings

1 Introduction

The historical application of wood-based materials in structural elements is primarily related to the construction process of dwellings, infrastructures, machines and ships. Wood presents interesting characteristics for application in the construction industry, such as high mechanical strength, thermal insulation, low-carbon advantages, suitable aesthetic characteristics, and easy handling for the fabrication of components (Augustin, 2008; Luo et al., 2013; Zhang et al., 2022). Solid wood is frequently used in load-bearing elements such as beams, columns, and trusses. Wood-based panels are widely used for wall and roof sheathing. Moreover, wood materials are often used for interior finishes, including wall cladding, ceilings, and built-in furniture, enhancing the aesthetic, acoustic and thermal comfort of indoor spaces (Blanchet et al., 2023).

Industrial processes in which wood is one of the raw materials have produced significant quantities of residues. For example, China generates approximately 300 million tons of wood waste annually (Yuan et al., 2025). The United States generated approximately 18.1 million short tons of wood waste in 2018 (Nguyen et al., 2023). Pinho et al. (2023) report that approximately 30 million tons of wood waste are generated annually in Brazil. Consequently, the proper management of wood waste has become a critical objective worldwide.

Frequently, wood wastes are inappropriately placed in the environment or burnt in open spaces, which causes serious impacts on the environment and human health (Sangodoyin and Ipadeola, 2000; Gupta and Kua, 2020; Pinho and Calmon, 2023). For example, the furniture industry comprises small and medium-sized companies that use solid wood and composite wood panels as base raw materials in their products. Consequently, these industries commonly generate cumulative volumes of wood waste that conflict with social and environmental issues. In addition, the thermal decomposition of wood panels can generate not only greenhouse gases but also toxic pollutants, owing to the presence of polymeric adhesives (e.g., formaldehyde, urethane, or melamine) used in their production (Rybiński et al., 2021).

Within this context, the furniture industry needs to better manage the large volume of forest raw materials it processes. A better management comprises the adoption of more efficient production processes, optimization of material use, reduction of waste generation, and implementation of circular economy practices such as recycling wood residues into new products or energy sources (Kravchenko et al., 2016). Since furniture industries mainly deal with wood-based products, they did not receive the required attention in terms of environmental issues (Maffessoni, 2012; Hartini et al., 2020; Szczurek et al., 2021). This lack of attention is attributable to a limited awareness and quantification of environmental impacts, limited investment in clean and sustainable technologies, and failure to recognize the importance of involving qualified professionals in product design (Lopes and Azevedo, 2014).

Wood-based panels are attractive materials for use in building envelope systems, which are responsible for ensuring structural performance, environmental protection, and overall building efficiency. Wood panels have become a viable alternative for replacing solid wood in integral parts of buildings. With the technological development in the construction sector, new wood-based products have been able to meet many specific demands for housing applications, such as improved dimensional stability, higher mechanical strength and stiffness, enhanced moisture resistance, better thermal and acoustic insulation, etc. (de Carvalho Araújo et al., 2019). Recent research (Amarasinghe et al., 2024) demonstrates that wood-based panels can be effectively manufactured using waste feedstocks. For instance, different types of recycled wood (e.g., sawmill offcuts, demolition debris, or manufacturing scraps) can be incorporated during production through the so-called 'dry process', which involves mixing dried wood particles with small amounts of adhesive before forming and steam-pressing. This process yields panels with relevant mechanical performance and dimensional stability, thereby reinforcing the circular economy paradigm in the construction industry.

Ubá is located in the Zona da Mata area of the State of Minas Gerais (MG) State, Brazil. The map showing the municipality of Ubá is available in Torres et al. (2014). The population of this city is approximately 104,000 inhabitants, and the place has many furniture industries (IBGE, 2021). In fact, Ubá's furniture industry is very significant for the regional economy, being responsible for creating approximately 13,000 jobs and highlighting MG in the national scenario of the furniture industry. Although specific data on the exports of companies from Ubá is lacking, the city plays a crucial role in the Brazilian furniture industry. With a large number of manufacturers and a strong tradition in furniture production, many companies in Ubá primarily serve the domestic market. However, the largest firms also participate in exporting to markets in Latin America, the Middle East, and Europe.

The local industries lack systematic research in quantifying and evaluating viable alternatives for recycling wood waste. In this context, viable alternatives are defined as methods or processes that ensure efficient resource recovery and waste reduction, while meeting criteria of economic feasibility, environmental sustainability, and alignment with the industrial capacities of the furniture industry in Ubá. In fact, few previous papers reported the perspective of recycling of residues from Ubá's furniture industries. Actually, they only focused on their reuse for the production of briquette (Farage et al., 2013), small wood board objects (Abreu et al., 2009b; Abreu et al., 2009a), kitchen cutting boards (Moreira and Cerqueira, 2020), and upholstery production or sale to farms (Couto and Franco, 2020).

There is no previous work focused on quantifying and evaluating the potential application of wood wastes from Ubá's furniture industries in the civil construction sector. Thus, this research aimed to answer the following primary questions: What types of raw materials are used? What procedures are implemented to minimize storage losses? What is the consumption percentage of each raw material type? What are the types of wastes generated? Which disposal methods are currently applied for wood wastes? And how can the recycling of wood waste contribute to circular economy strategies within the construction sector? Although previous studies have addressed wood waste characterization in general manufacturing contexts, there remains a clear gap in the literature regarding the quantification of waste generated specifically within furniture industry clusters and its potential for valorization in the civil construction sector. This study aims to fill that gap by proposing a structured methodology for quantifying waste generation in furniture industries and by evaluating the potential

Abbreviations: ABIMOVEL, Brazilian Furniture Industry Association; INTERSIND, Intermunicipal Union of Furniture Industries of Ubá; EMI, electromagnetic interference; MDP, Medium-Density Particleboard; MDF, Medium-Density Fiberboard; MG, Minas Gerais (State, Brazil); OSB, Oriented Strand Board; WPC, Wood-Polymer Composite.

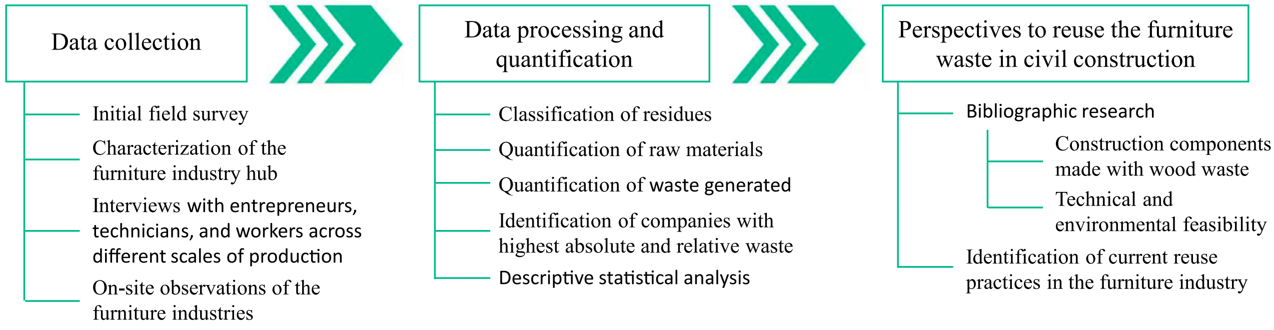

FIGURE 1
Flowchart illustrating the overall framework proposed in this research.

integration of civil construction recycling strategies into circular economy policies in furniture-producing regions worldwide.

The following original contributions derive from this study and reflect its broader relevance beyond the local context: (i) the development of a systematic and replicable method to quantify wood waste generated by furniture industries, using real data from a representative industrial hub; (ii) a detailed assessment of multiple valorization routes of furniture industry residues in civil construction, considering both technical and environmental feasibility; and (iii) elaboration of a transferable framework for waste recycling applicable to other emerging furniture production clusters globally.

2 Methods

A structured methodological approach is proposed in the present research to quantify the waste generation in furniture industry clusters and evaluate perspectives for waste reuse in civil construction applications. As illustrated in Figure 1, the methodology was divided into three main stages, comprising systematic data collection, analysis, and assessment of reuse scenarios aligned with sustainability goals. This methodological approach provides a transferable framework for assessing waste recycling opportunities in similar industrial contexts around the world.

2.1 Data collection

A survey related to Ubá's furniture industry and the waste generation in this sector was developed in the present article. Data from ABIMOVEL (Brazilian Furniture Industry Association), INTERSIND (Intermunicipal Union of Furniture Industries of Ubá) and different companies were obtained and examined. ABIMOVEL is an institution that has operated for nearly 5 decades to support the development of the furniture production chain in Brazil, also disseminating data on the national furniture and mattress industry. INTERSIND provided regional information and access to member companies.

Qualitative and quantitative information regarding the types, quantities, and disposal methods of raw materials and wood waste generated during production were collected in 2018 from 17 companies associated with INTERSIND. These 17 companies were selected because they work specifically with solid wood and wood-based panels as their main raw materials, which aligns with the focus of this study. For confidentiality, these companies were designated as "A", "B", "C", …, "P" and "Q".

The collection of data from the companies allowed the identification of the main stages of the process of wood waste generation in the production processes of the furniture industries, in which the wood undergoes the stages of raw material conditioning and preparation, lamination, cutting, sawing, gluing, varnishing, and painting. These steps represent the common manufacturing processes across the companies. The typical inputs, operations, and outputs of a Brazilian furniture industry are illustrated by Aguilar et al. (2017). The technical data were collected during field visits to companies in the furniture industry, through interviews with professionals directly involved in the production processes relevant to this study, such as entrepreneurs, technicians, and workers across different scales of production.

2.2 Data processing and quantification

To comprehensively characterize the furniture manufacturing process in these companies, the following information was processed and quantified in this research: materials with greater manufacturing demand, types of raw materials, procedures to avoid storage losses, consumption percentage for each type of raw material, percentage waste generation, types of wood wastes and disposal methods. The data were analyzed using descriptive statistical methods.

2.3 Perspectives to reuse the furniture waste in civil construction

Since this work aimed to present a perspective of application of wood waste in the civil construction sector, bibliographic research was carried out to identify limitations and possibilities for producing different types of construction components with wood waste as constituent parts of buildings, focusing on the characterization of building components made with furniture industry waste, and discussions on thetechnical and environmental feasibility of different types of recycling strategies. In this case, different references were evaluated, such as articles, standards, book chapters, theses/dissertations and technical reports. Current reuse practices in the furniture industries were also evaluated, based on the revised literature.

3 Results

The initial survey on the characteristics of the furniture hub of Ubá highlighted that it is among the main ones in Brazil. In 2013, they employed 330,000 people, producing 11.8 million items, and presenting revenues of R$ 2.9 billion (Abimovel, 2025). INTERSIND covers not only Ubá but also the municipalities of Guidoval, Guiricema, Piraúba, Rio Pomba, Rodeiro, São Geraldo, Tocantins and Visconde do Rio Branco. As a member of ABIMOVEL, INTERSIND detects and directs new strategies to enhance the performance of industries on the national scene, acting in the management and coordination of actions aimed at the growth and strengthening of the industries of Ubá region. Images and graphics of products manufactured in the Ubá furniture sector are available on the official websites of Abimovel (2025) and INTERSIND (2025).

The city of Ubá consistently stood out as the most productive furniture and mattress manufacturing hub in Minas Gerais. In 2014, Ubá was responsible for producing 30,405 units, accounting for 45.2% of the state's total output. This dominance was maintained in 2015 and 2016, with 28,181 units (45.2%) and 27,013 units (46.2%), respectively. In comparison, Belo Horizonte contributed 11.6% in 2014, 12.1% in 2015, and 10.9% in 2016, while Carmo do Cajuru's participation was lower, ranging from 5.8% to 5.9% over the same period. The remaining furniture hubs in the state collectively accounted for approximately 37% of production annually (BRASIL MÓVEIS, 2017).

Table 1 shows the results obtained from the field investigation on the wood-based products of the 17 INTERSIND member companies analyzed in this study. In addition to the products indicated in Table 1, the furniture industries also produce custom furniture, bases and feet for chairs and bed bases for bedrooms. The outsourced products are sold to other furniture companies.

The most used types of wood products and/or their derivatives were solid wood (eucalyptus and pine), MDF (medium-density fiberboard) and MDP (medium-density particle) panels, as also indicated in Table 1. Solid wood and its different derivatives are used in the main part of the furniture, the structure. Table 1 shows the percentages of use of these materials in the manufacture of products by each different company.

Different considerations on these raw materials were collected during the field investigation, based on information provided by professionals from the companies, as presented below.

- Given the scarcity of native wood, the cost of industrialized wood becomes more viable. In addition, it has fewer purchasing formalities in the environmental agencies and also meets beauty and furniture quality criteria.
- The use of panels is justified because the furniture is manufactured in series, and the panels better meet the cutting processes in the company's production line.
- Reforested eucalyptus wood was the most used material in producing chairs, the most manufactured products. This raw material is beneficial for being a reforested wood, having greater economic interest.
- The promising use of the eucalyptus species can be attributed to the fact that it is a strong wood with the greatest demand in the furniture hub's region;
- Quality and practicality of the production process and reduction in the cost of the final product are mandatory factors.

Wood and its derivatives are subjected to dimensional changes (twists, warping, etc.) that can cause waste generation by discarding useless items. In these cases, it is important to observe transport, storage, production, and drying procedures. Various measures were identified in the 17 companies evaluated in the present study. Due to the heterogeneity of contexts, these measures were obtained through technical discussions during field visits with professionals from the companies, without the use of closed questions.

- The solid wood undergoes outdoor drying, followed by storage in a covered shed, controlling warping and reducing losses. This procedure is performed in wood boards, which are ready to be slatted after reaching a moisture content of 12%–16%. It takes about 90–180 days to reach such moisture content. After that, the preparation process is carried out, in which the wood is sawn to the desired dimensions.
- Wood and laminated MDF arrive at the factory by outsourced transport and are stored in a closed warehouse, avoiding weathering.
- Rails are used to transport the pieces, which are arranged in a horizontal position to avoid warping. Storage is done on pallets. Finished products are stored in a vertical position.
- Stacking on a level floor at the maximum height determined by the manufacturer;
- All materials are stored inside the factory in a clean place supported by a reinforced concrete industrial floor.
- The companies reported ongoing efforts to optimize storage conditions, including monitoring humidity and temperature, upgrading infrastructure with climate control and ventilation, and implementing practices to reduce wood deterioration.
- The companies prioritize purchasing kiln-dried wood to ensure uniform moisture content and minimize dimensional instability during handling and processing.
- Option for disposal in volumes with smaller quantities of pieces.
- The eucalyptus is dried and then thinned to obtain standard wood.
- The pieces are layered and then locked using a bending machine to prevent warping.
- The wood arrives at the factory in bales with a protective cover, tied and packed in covered places, without exposure to sunlight and dampening factors, with controlled stacking.
- Appropriate standards are applied to transportation companies, preventing panels from arriving defective and being returned.

TABLE 1 Size, product types, raw material composition, and waste destination practices of all companies evaluated in this study.

Parameter		Company [a]																
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Company size [b]		L	L	M	M	M	M	S	S	S	S	S	S	M	S	M	L	L
Product	Dining room	-	✓	✓	-	✓	-	✓	-	✓	-	-	-	-	✓	-	-	✓
	Upholstery	✓	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-	-
	Children's furniture	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
	Dormitory	-	-	✓	✓	-	✓	-	-	✓	-	✓	-	✓	-	-	-	✓
	Decorative furniture	-	-	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-	-
	Kitchen furniture	-	-	-	-	-	✓	-	-	-	-	-	-	-	✓	-	✓	-
	Frames	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
	Furniture for office	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
Raw material consumption (%) [c]	Solid wood (eucalyptus)	40	60	5	5	-	5	60	-	5	100	50	80	-	85	-	-	-
	Solid wood (pine)	40	-	-	5	-	-	-	-	5	-	-	-	-	-	5	-	-
	HDF panels	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	10
	MDF panels	15	30	70	40	100	5	30	-	55	-	50	-	-	10	55	-	45
	MDP panels	-	-	25	50	-	90	10	-	35	-	-	-	90	-	45	-	45
	MDP Cru panels	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
	MDP BP panels	-	-	-	-	-	-	-	90	-	-	-	-	-	-	-	3	-
	MDF BP panels	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
	Plywood	-	-	-	-	-	-	-	-	-	-	-	20	-	5	-	-	-
	Other wood materials	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste destination	Direct disposal in the environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Burning/fuel	✓	-	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	✓	-
	Charcoal production	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Recycling (new materials)	-	-	-	-	-	✓	-	✓	-	-	-	-	-	-	-	-	-
	Disposal with incineration	-	-	-	✓	-	✓	✓	-	✓	-	✓	✓	-	-	-	-	✓
	Others	-	-	✓	-	✓	-	-	-	-	✓	✓	-	-	-	✓	-	-

Notes.
[a]Company P uses different raw materials to manufacture its products, such as steel, glass, polymers, etc. The use of wood in manufacturing its products is restri*cted to 5%*.
[b]Company Size is indicated by the letters: L for large, M for medium, and S for small.
[c]HDF: high-density particle; MDF: medium-density fiberboard; MDP: medium-density particle.

- The companies use panels in temporary storage rooms that are ventilated, with a waterproof floor to prevent moisture accumulation and consequent damage.

Another research question refers to the quantity of raw materials lost in waste, with or without adequate destination. As a basis for calculating the amount of waste, 16 companies provided data on the amount of raw material purchased and the types of wood waste from industrial processes. Chips and sawdust were the most common types of wood waste reported by the companies.

The total raw material consumption across all companies amounted to 13,731 m^3 (9,843,137 kg), with solid wood accounting for 947 m^3 (662,375 kg) and panels for 12,784 m^3 (9,180,762 kg). The total waste generated was 3,518 m^3 (884,858 kg), consisting of 1,966 m^3 (458,058 kg) of chips and 1,552 m^3 (426,800 kg) of sawdust, representing an overall waste generation of 9.0% by weight. Among the companies, the highest waste producer in absolute terms was Company Q, with 2,443 m^3 (608,573 kg) of waste, while Company K exhibited the highest waste generation rate at 47.0%, generating a total of 40 m^3 (10,160 kg) of residues.

In addition, data on wood waste destination were collected through open-ended technical discussions with company professionals during the field visits. Five companies reported selling of wood wastes at the values of R$ 5.00/m^3, R$ 10.00/m^3 or R$ 15.00/m^3. Another five companies pay for removing the wood waste. Another seven companies donate the material (transport costs have been paid by the companies that generate the residues). Moreover, two companies reported that wood waste was used in their own production processes as fuel. Sometimes, they even buy wood waste from other industries for the same purpose.

The companies reported that some wood wastes had been used as fuel sources in the Ubá's ceramic industry, other residues have been donated to ceramic paving factories in the state of Rio de Janeiro and other wastes have been sent to Pedro Leopoldo (MG) to generate energy in the process production of cement.

4 Discussion

The generation of wood waste is governed by the characteristics of manufacturing processes and the efficiency of material utilization. The waste generation rate of 9.0% by weight, as reported in the previous section, is slightly lower but remains consistent with findings from other regions, as previous studies have indicated that 10%–20% of raw materials are typically lost as wood waste during manufacturing (Pinho et al., 2023). Hence, the assumptions regarding wood waste generation in furniture production were confirmed by empirical data collected from the Ubá furniture hub, ensuring both the representativeness of regional practices and consistency with data from other furniture clusters. These empirical comparisons help to validate the data-collection methodology proposed in this work, demonstrating its suitability and importance for accurately quantifying waste flows in furniture clusters.

The highest absolute waste generation was recorded by Company Q, while the highest waste generation rate occurred in Company K. This result can be explained by the fact that Company Q is a large company (Table 1), with higher production capacity and consequently larger amounts of raw material consumption, leading to the highest waste generation in absolute terms. On the other hand, Company K is a small company (Table 1), which typically operates with less optimized machinery and lower production scales. These factors can lead to less efficient material utilization, explaining the high percentage of waste relative to its total input. These findings indicate that the benchmarking approach used in this research can be replicated by other furniture hubs to quickly identify priority companies and tailor waste-reduction strategies.

The need to incorporate wood waste in sustainable construction materials is highlighted in this context. The large volume of waste generated by the companies investigated in this work is an environmental challenge that demands viable solutions from the technical, economic and socio-environmental perspectives. A possible application of the wood wastes is their use as raw materials for manufacturing recycled wood panels for housing construction. Since this research captured both quantitative and qualitative production data, it provides a ready-to-use template for municipalities seeking to map furniture waste generation and design circular-economy interventions in the construction area.

Alencar and Moura (2014) reported that composite panels can be constructed with various types of wood, which defines the strength of the material. Eucalyptus and pine wastes have great potential for use in recycled panels, as these wood types are often used by Ubá's industries. Also, recycled composite wood panels such as recycled MDF, MDP, OSB and WPC (wood-polymer composite) can be produced with waste generated from production processes in furniture industries. Their main characteristics will be directly related to the constituents (wood, resin, wastes) and production processes.

MDF panels are produced in a continuous process with wood fibers bonded with a thermoset resin, which are joined under pressure and heat. The result is a composite panel with a highly homogeneous isotropic structure, of high quality and density in the range of 500–800 kg/m^3 (Zenid, 2009). The main characteristic of the panels is the good structural performance in all directions, as they are built by overlapping layers of wooden pieces in transverse directions in order to increase rigidity and stability. Blanchet et al. (2000) verified that producing recycled composite wood panels with milled black spruce bark residues is technically feasible.

Recycled MDP panels can also be produced with wood waste particles introduced together with urea-formaldehyde resin and consolidated through heat and pressure. In this type of panel, the finer particles are deposited on the surface, while the larger ones are deposited on the inner layers (Soratto et al., 2013). In Australia, a life cycle assessment of engineered wooden boards conducted by Farjana et al. (2023) revealed that thinner panels have a lower environmental and social impact, as thicker boards contain a higher proportion of urea-formaldehyde resins relative to other components.

In contrast, recycled OSB panels must be produced with three to five layers of particles or bundles of thin and long fibers of wood waste oriented at 90° with each other, bonded in structural uses with phenolic resins resistant to moisture (phenol-formaldehyde and melamine-formaldehyde) and in semi-structural applications with composite resins (melamine-urea-formaldehyde and phenolmelamine-urea-formaldehyde) and consolidated by hot pressing. This arrangement gives the panel mechanical strength for structural purposes and water resistance (Setubal, 2009; Zenid, 2009).

Another alternative to conventional wood is the WPC panel produced with wood wastes, due to its efficiency in several applications and environmental benefits. It has been established as a sustainable, versatile, and flexible material in the construction sector, consisting of a polymer matrix reinforced with a mixture of fibers and wood particles (Clemons, 2002; Caulfield, 2005; Chindaprasirt et al., 2015). In addition to reducing impacts associated with the depletion of natural resources, it can be considered a sustainable approach for giving a destination to waste materials of the wood industry (Sabino and Netto, 2014). In Slovakia, three-layer particleboards bonded with urea–formaldehyde and made from furniture wastes demonstrated adequate mechanical properties and met the standard requirements for particleboards (Iždinský et al., 2020), indicating that the proposed reuse of wastes of the Ubá's furniture industry has the potential for global application. In this sense, it is important to highlight that the performance evaluation of the proposed recycled materials must rely on standardized testing protocols, validating their use through comparisons with conventional construction materials and enhancing the generalizability of results.

Recycled wood waste can be repurposed into various composite panels for construction, each with distinct properties and applications. Recomposed MDF panels can offer a smooth surface, suitable for painting or varnishing, and are ideal for walls, frames, doors, and floors. Recomposed MDP panels can provide high flexural strength and dimensional stability, making them suitable for partitions and wall coverings. Recomposed OSB panels can be durable, impact-resistant, and moisture-stable construction materials, effectively replacing plywood in structural applications such as mezzanines, scaffolding, and decorative panels. Recomposed WPC panels can offer superior resistance to weather, biological attacks, and mechanical stress, making them ideal for outdoor structures like facades, decks, fences, and playgrounds.

Beyond composite panels, wood waste can also be effectively incorporated into the production of woodcrete, a lightweight composite material created by mixing wood residues with cement or lime binders (Fadiel et al., 2022). Woodcrete offers reduced density compared to traditional concrete, making it particularly suitable for non-load-bearing walls and insulating panels in eco-efficient buildings (Aigbomian and Fan, 2013). In China, Guo et al. (2022) reported that replacing different types of cementitious binders with pine wood chips yielded lightweight composites with a compressive strength of 13.5 MPa, a dry density of around 942 kg/m^3, and a thermal conductivity of 0.15 W/m·K, confirming the worldwide feasibility of the recycling strategy proposed in the present research. By integrating wood waste into cementitious matrices, this material valorizes residues while contributing to a lower carbon footprint for construction materials.

In addition to woodcrete, wood waste serves as an excellent raw material for manufacturing bio-based thermal insulation products (Li et al., 2024). These natural fiber-based insulations provide sustainable alternatives to synthetic materials by improving indoor air quality and reducing energy consumption (O'Brien et al., 2025). Consequently, their renewable nature, combined with effective insulating properties, supports the development of environmentally friendly building envelopes aligned with green construction standards. In the United States, Siciliano et al. (2023) developed a wood-waste-based thermal insulation foam whose thermal conductivity dropped to 0.038 W/m·K while, illustrating the high-value insulation potential of chips similar to those discarded in Ubá.

Wood residues can further be processed and used as a partial replacement for mineral aggregates in lightweight composites for buildings (Gu et al., 2024). This substitution reduces the overall density of construction elements, improve electromagnetic interference (EMI) shielding and ease of handling without compromising structural integrity for specific applications (Akbar et al., 2024). Utilizing wood waste in this way not only diverts residues from landfills but also decreases the demand for non-renewable natural aggregates, thereby promoting resource efficiency in concrete production.

Finally, wood fibers derived from waste can be employed to manufacture acoustic panels and soundproofing materials for building interiors (Korjakins et al., 2025). Leveraging the natural porosity and fibrous structure of wood, these products effectively absorb sound and reduce noise transmission (Hemmati et al., 2024). Thus, the reuse of wood waste in acoustic applications aligns with sustainable building design by offering renewable and low-impact solutions that improve indoor environmental quality.

According to the investigation carried out in the present article, the reuse of wood wastes in the civil construction sector has not been applied in the furniture industry of Ubá. Other different types of destination for wood wastes were reported. Table 1 also shows that these residues are currently used as fuel for burning, generation of energy, recycling (obtaining other types of materials), production of charcoal, or disposal with incineration. However, it is noteworthy that processes of combustion of wood-based materials are associated with the release of harmful gases to human health and the environment (Caldas et al., 2021; Heidari et al., 2022; Rahmani Mokarrari et al., 2023). The previously mentioned production of recyclable wood panels would avoid this combustion processes, which would benefit human health, the environment, and the construction industry.

In summary, this work highlights a perspective for promising reuse of wood wastes generated from Ubá's furniture industries for production of recycled construction materials. Quantitative data on the furniture production and wood waste generation of different companies of the furniture hub of Ubá were obtained and analyzed, which provided important information regarding the industries production demand, quantities and types of raw materials, procedures to avoid storage losses, consumption and types of wood wastes, and procedures for waste disposal used by the Ubá's furniture hub. Although the study focused on Ubá, its methodological framework can be applied to similar furniture-producing regions, with validation strengthened by similar stakeholder consultations and on-site visits to the furniture industries, confirming the practical relevance and feasibility of the proposed applications.

The recycling of wood wastes to construct different types of recycled composite panels (e.g., recomposed MDF, MDP, OSB and WPC panels), woodcrete, bio-based insulation materials, lightweight composites, and other sustainable solutions for civil construction was found to be a promising destination for the residues. Eucalyptus and pine wastes have great potential for use in recycled panels, as these wood types are often used by Ubá's industries. This approach would avoid the incineration of these materials and decrease the release of harmful gases to human health and the environment.

The results of this study are promising because the construction sector requires large amounts of raw materials, creating strong demand for wood waste. Realistic expectations suggest that a considerable fraction of the 9.0% waste by weight could be redirected into building elements, thereby reducing environmental impact and generating added value within a circular economy framework. Moreover, these applications leverage the wood types commonly used in the region, facilitating adoption by industries in Ubá. Despite this, the typologies of wood waste, energy consumption, and potential reuse pathways identified in this study reflect production characteristics common in many countries. Therefore, the methodological framework and decision-support metrics presented can be adapted to furniture clusters worldwide, enabling cross-regional comparisons and improving the sustainability of construction and furniture companies.

Future policy decisions are needed to instigate the use of wood waste recycling in the construction industry, based on the motivation of the collaboration and transfer of knowledge between researchers, furniture industries and the construction sector; increases in the evidence of recycled panels incorporating wood residues in green building certifications; and provision of technical services to stimulate the practical use of wood residues in the construction industry. The present work focused on analyses of the furniture hub of Ubá. Future research is recommended to reproduce similar analyses for other furniture hubs with promising applications of wood wastes.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

RG: Methodology, Data curation, Writing – original draft, Conceptualization, Investigation. AG: Writing – original draft, Supervision, Methodology, Conceptualization, Project administration. JF: Formal Analysis, Writing – review and editing, Visualization, Validation. GN: Formal Analysis, Validation, Visualization, Writing – review and editing. LP: Writing – review and editing, Formal Analysis, Visualization, Validation. MO: Formal Analysis, Validation, Visualization, Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Acknowledgments

The authors would like to thank the support provided by the Department of Architecture and Urbanism and the Department of Civil Engineering of the Federal University of Viçosa.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

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