RELISE

COMPARATIVE ANALYSIS OF WOOD AND METAL ROOF STRUCTURES FOR RESIDENTIAL BUILDINGS: COST-BENEFIT AND DECISION-MAKING FACTORS[1]

ANÁLISE COMPARATIVA DE ESTRUTURAS DE TELHADO EM MADEIRA E METAL PARA CONSTRUÇÕES RESIDENCIAIS: CUSTO-BENEFÍCIO E FATORES DECISÓRIOS

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ABSTRACT

This study compared wooden and metal roof structures, focusing on the cost-benefit for residential buildings in Unaí, Minas Gerais. The research was exploratory, utilizing both quantitative and qualitative approaches, with expert interviews and budget analysis. The results showed that, while the wooden structure has a lower initial cost, the metal structure stands out for its greater durability, strength, and shorter construction time. The choice of the most suitable material depends on a careful analysis of factors such as costs, construction time, and required durability, considering the specific needs of each project.

Keywords: residential construction, roof, metal structures, wooden structures, cost-benefit.

RESUMO

Este estudo comparou as estruturas de telhado de madeira e metal, visando o custo-benefício para construções residenciais em Unaí, Minas Gerais. A pesquisa foi de caráter exploratório, utilizando abordagens quantitativas e qualitativas, com entrevistas com especialistas e análise de orçamentos. Os resultados indicaram que, embora a estrutura de madeira apresente um custo inicial menor, a estrutura metálica se destaca pela maior durabilidade, resistência e menor tempo de construção. A escolha do material mais adequado depende de uma análise cuidadosa de fatores como custos, tempo de execução e a

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durabilidade necessária, considerando as necessidades específicas de cada projeto.

Palavras-chave: construção residencial, telhado, estruturas metálicas, estruturas de madeira, custo-benefício.

INTRODUCTION

In the construction industry, an increase in competition among suppliers of materials and inputs is noticeable, due to transformations in market relations, the pursuit of excellence aiming at economic success, and environmental impact. There is an increasing effort to understand processes that may, in some way, contribute to transformations in the industry, as they often represent savings in time, money, labor, and maintenance.

Still regarding the sector, steel and wood have triggered strong market competition. Wood, being a popularly known raw material, is adopted as a traditional solution; however, it causes environmental damage during the extraction process, in the case of deforestation, which is often difficult to recover from, and also due to the unlimited demand for high-quality raw material. Meanwhile, the use of steel, considered an innovative solution, is gaining more and more space in the market, allowing for greater savings and lower environmental impact.

With regard to the construction of a residential roof, given the project, it is necessary to decide which material will be used for assembling the structure, which may be steel or wood. Before that, a cost-benefit analysis of each structure becomes indispensable so that it meets the needs desired by the client.

The roofing, also known as the roof, plays a fundamental role. Its objective is to protect the building from the action of weather conditions; in indoor environments, it plays the role of a thermal regulator, being considered an excellent thermal insulator, in addition to performing its aesthetic function together with the masonry and other external components [1].

It is noteworthy that the roof must support, in addition to the elements supported or fixed to the structure, the weight of suspended ceilings, roof coverings, insulation materials, natural elements such as wind loads, and also the self-weight of its components [2]. The roof must be appropriate according to the entire building.

Several studies highlight the advantages and disadvantages of using wood for roofing, such as [3] [4] [5] [6] [7] [8] [9]. Studies [5] [7] [8] [9] [10] [11] highlight the advantages and disadvantages of using steel in residential roofing projects. It is worth noting that the choice between steel and wood should take into consideration not only the advantages and disadvantages, but also the location where the construction will take place.

The use of wood as a constructive element for roof structures is quite traditional, being an essential material for human existence since the beginning of civilization. Regarding cost, it becomes increasingly higher due to the scarcity of raw material and, with this, in the search for new species, reforestation wood becomes an option for the wood industry. However, in the construction market there has been an expansion in the use of steel structures as a construction technology, due to this material presenting greater durability and resistance. In addition, it presents itself as a competitive option in the construction of roof structures, since, in an ecological way, its use contributes to the preservation of native forests.

Given the evidence, the problem question, which will serve as the basis for the research, is: through a comparison in terms of cost-benefit, which structure, metallic or wood, will have a better cost-benefit in the construction of a residential roof in the city of Unaí-MG?

Before starting the execution of a roof project, various existing factors must be compared in order to decide which construction method will be used. Increasingly, users seek a precise cost-benefit that is limited by various factors

such as material costs, labor, and execution time. These factors are considered unique to each project, making the study for choosing the type and construction method of the structure essential.

The importance of this research for the academic environment is emphasized, as it will serve as a source for the development of future studies, as well as its contributions to the construction market, since from this study it will be possible to work with the appropriate material for the project in question.

In this sense, this study is justified by the need to point out, in the choice of the structure of a roof, the correct material in order to obtain a better cost-benefit, whether metallic or wood.

The development of the present study aims to identify the best cost-benefit between steel and wood structures for roof constructions in the municipality of Unaí, Minas Gerais. The study presents a comparison of the costs of steel and wood structures in roof construction, seeking to identify the best cost-benefit.

LITERATURE REVIEW

The following sections present key information regarding steel and wood, including their history, applications, advantages and disadvantages, as well as the cost-benefit analysis of using these materials.

Wooden structures

The wooden structure for roofs is considered as the set of components connected to each other, with the function of supporting the roof [12]. The author also states that among the constituent components of roof structures are the trusses (beams), rafters, battens, and also the connection elements.

For roof structures, the wooden elements used must be treated to become resistant to external agents. For this purpose, wood should only be

treated when it does not present natural resistance against insect attack and decay [13]. It is emphasized the need to use oil-based paints or enamels (waterproofing coating) for treating elements with surfaces subject to weather action. Furthermore, according to [13], elements should not be used in the structure if they: a) have suffered crushing or other damage that may compromise the safety of the structure; b) have high moisture content, that is, green wood; c) present defects such as loose knots, knots that cover a large part of the cross-section of the element, excessive cracks, pronounced warping, etc.; d) do not fit perfectly in the connections; and e) show signs of deterioration due to fungus or insect attack.

Regarding sawn wood elements (primary transformation of raw wood), NBR 14807:2002 [14] presents the dimensions and identification of each element (Table 1). It is recommended to use elements with commercial sections, aiming not to affect the price of the roof structure, making it more expensive [15].

Table 1: Dimensions of sawn timber pieces

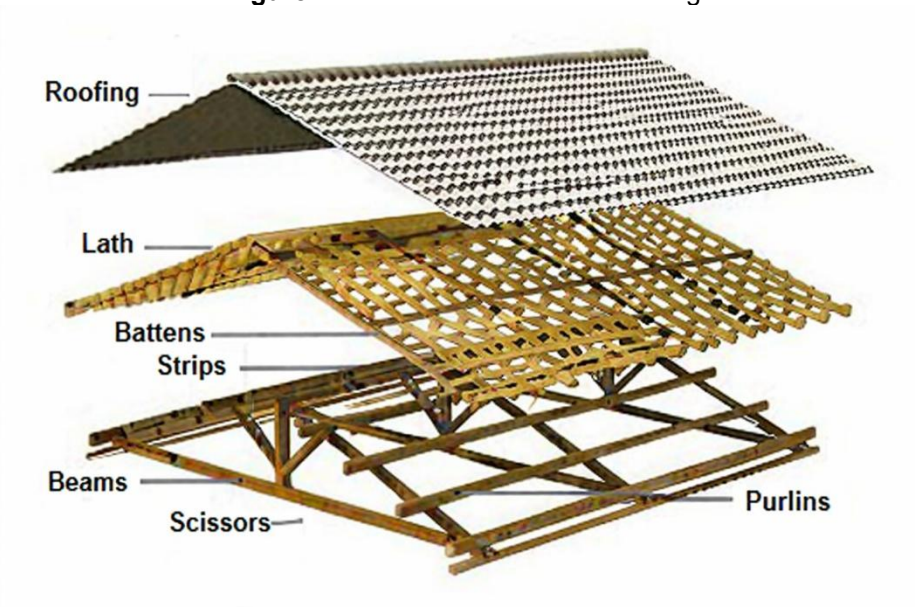
Part Name	Thickness	Width
Large plank	From 71 to 161	161 and above
Plank	From 39 to 70	161 and above
Small plank	38	100 and above
Beam	From 40 to 80	From 81 to 160
Joist	From 40 to 80	From 50 to 80
Board	From 10 to 37	100 and above
Batten	From 21 to 39	From 20 to 99
Strip	From 10 to 20	From 20 to 50
Large strip	From 15 to 20	From 51 to 70
Shoring	From 70 to 80	From 70 to 80
Small square	25	25
Square	Side: 100 and above	

Notes
1 For the purpose of using the table, any decimal places obtained in the measurements should be disregarded.
2 A shoring is always square in cross-section.

Source: Adapted from NBR 14807:2002 [14].

In Brazil, the traditionally used roof structure originated from the Portuguese ceramic tile roof. The sawn wood structure is characterized as discontinuous (a system of successive grids, in which the spacing and strength of the linear elements decrease as the level increases), being composed of trusses (main structure) and also purlins, rafters, and battens (secondary structure) [13], represented in Figure 1.

Figure 1: Traditional ceramic tile roofing



Source: Adapted from [16].

To execute such a structure, specialized labor from a carpenter or a team of these professionals is required. In an artisanal manner, the structure is assembled using sawn wood elements of standard length.

However, the structural design is not always carried out by a professional with specific knowledge for such, and in this case, the executor responsible for building the roof structure must have the necessary knowledge to perform the task, with the roof structure being entirely dependent on them. If modifications need to be made at the construction site, this construction system proves to be quite flexible.

Wood presents advantages such as good strength, low density, thermal and acoustic insulation, as well as ease in assembling a structure without the requirement of special tools, making it the most sought-after material in construction associated with roofs. Other advantages include the ease of finding and handling wood; being a reusable and renewable resource; relatively low purchase and installation costs; among others [7]. Among these advantages, it is important to highlight the use of non-specialized labor for project execution. For structures, sawn wood is used, which can be compared to a prefabricated element, easy to assemble. However, regardless of its species, this material also presents some disadvantages. Regarding its use, one of the main ones is its deterioration due to attack by xylophagous organisms, and it is also a material sensitive to moisture and weather conditions.

The use of wood in roofing for residential projects tends to become increasingly less advantageous, since its production is much slower and has a series of limitations compared to industrialized materials [5]. The list of disadvantages in the use of wood includes: the use of wooden beams requires cutting a large tree, and its use promotes deforestation; it is necessary to provide fire-retardant treatment; it is necessary to handle it to protect it from insects and fungi; wood easily absorbs and loses moisture; expansion and contraction also occur frequently, which can alter its size; and wood is an organic and non-homogeneous material, which means there are many differences between pieces of wood [7].

Steel structures

From the end of the 18th century in England, ferrous metals began to be introduced into large structures. To withstand compressive forces, metals were used in bridges with cast iron elements [17]. With regard to construction, steel is considered the most important ferrous metal when compared to cast iron and

wrought iron, since, being characterized as an alloy of iron and carbon, it may also contain silicon, manganese, phosphorus, sulfur, among other elements. According to the same author, regarding the carbon present in the composition of steel, it can vary from 0% to 1.7%. It is noteworthy that steel presents greater strength, hardness, and brittleness according to the increase in its carbon content.

The use of cast iron and steel in Brazil began in the early 19th century, when they started to be introduced in the first works carried out in the country [18]. However, in the construction sector, the steel industry, as well as its participation in the market, only showed growth in 1946, with the beginning of operations of the Presidente Vargas plant of Companhia Siderúrgica Nacional.

In 2011, Brazil was recognized as the ninth largest steel producer in the world, with about 47.8 million tons per year of installed production capacity. In that same year, the country had a total of twenty-nine steel mills [19].

According to NBR 8800:2008 [20], for specific use in structures, the following standard states that: the steels approved for use in this Standard for profiles, bars, and plates are those with structural qualification ensured by a Brazilian Standard or a foreign standard or specification, provided that they have a maximum yield strength of 450 MPa and a ratio between ultimate strength (fu) and yield strength (fy) not less than 1.18.

The steel structure for roofing is similar to wooden structures, being composed of trusses, purlins, rafters, and battens made of galvanized steel profiles. The elements are connected to each other to support the roofing tiles of a building.

The use of steel in construction has been growing in Brazil, which is due to the numerous advantages that this type of structure presents, and it can be used in any type of construction, such as residential buildings, hospitals, restaurants, sports court coverings, residential houses, gas station canopies,

among others [21]. Metallic structures are very common in commercial and industrial buildings, generally warehouses, as they allow the construction of large clear spans [22].

The advantages of steel in construction include: the simplicity and practicality of metal construction ensure efficiency, with better use of inputs and labor; assembly occurs in an organized and fast manner, consequently steel construction provides shorter deadlines; the steel structure easily adapts to other materials, which allows a varied use of products in enclosure, roofing, and finishing of the work; it has a recyclability potential above 90%; steel construction allows greater organization and use of the available space at the construction site, avoiding waste and debris [23]. In addition, it is always a clean construction, ensuring better safety and lower risk of work accidents; the use of steel in construction allows easy adaptation in the case of renovations and expansions, providing greater flexibility in the design; it has high mechanical strength, making the steel structure very light, thus easy to handle and with reduced cost for handling equipment, as well as reduction of loads on the foundation; steel structure is said to be a design-based construction, that is, all details and possible problems are resolved on paper, even before starting construction; a steel project ensures millimetric precision of levels and plumb, facilitating assembly and the installation of doors, windows, and walls; and the guarantee of steel quality is the result of strict control within the steel plant. This process ensures the quality of the project and the construction.

The execution of steel roofing, in addition to being very practical and durable, has another characteristic, where the material is fully recyclable, being able to return to furnaces in the form of scrap and become new steel, without loss of quality [24]. The steel roof structure represents a new technology in construction, due to the lightness, aesthetics, and comfort of this structure. Figure 2 presents a steel structure.

Figure 2: Steel roof structure

Source: Adapted from **[25]**.

Steel also presents some disadvantages in its use, such as: limitations in factory execution due to transportation to the site of final assembly; the need for surface treatment of elements against oxidation due to contact with atmospheric air; the need for specialized labor and equipment for its fabrication and assembly; and limitations in the supply of structural profiles [25].

Other disadvantages include the requirement for qualified labor, which is not easily found in Brazil; since fabrication and assembly are fast activities, payment for the structure must be made within a shorter period than that of a wooden structure; and steel requires special treatment with painting to ensure its anticorrosive protection and guarantee its durability [7].

Despite presenting disadvantages like any other material, steel still offers advantages that make it an attractive material to be used in certain structures. According to [5], steel is still little explored in roofing in the residential segment, thus showing great growth potential in this important market.

In addition to the disadvantages mentioned, another important factor to be observed in the use of steel is corrosion, a physicochemical alteration suffered due to its reaction with the environment; these alterations transform steel into chemical compounds similar to iron ore, causing the material to lose essential characteristics such as mechanical strength, elasticity, ductility, among others, in addition to the reduction of the resistant section [26].

Cost-benefit analysis

Used as an essential tool for decision-making, cost-benefit analysis, which compares costs and benefits in financial terms, allows obtaining favorable information about effects considered positive or negative in the execution of a given project. Through this analysis, it is possible to determine whether such a project is advantageous or not; for this, it is necessary to establish quantitative values and thus proceed with comparisons.

Cost is defined as the amount required to obtain a certain good or service [27]. Through this definition, the word “amount” means “sum,” that is, the financial resource necessary to obtain a good or service.

The concept of cost is also expanded, referring to any expenditure, monetary or not, to produce a given good or service, resulting from the use of various inputs such as raw materials and direct labor [28]. Indirect activities must also be considered in the composition of costs, that is, those not directly related to the production of these goods or services.

To determine or estimate the costs for carrying out a project, even before its execution, is the necessary process for preparing a budget [27].

Budgeting in civil construction

The term budget, recorded in one of the most important dictionaries of the Portuguese language, “is the calculation of expenses for carrying out a work” [29].

The budgeting process consists of a technique that involves identifying, describing, quantifying, and analyzing the values of the items that will make up the selling price of a project. According to the same author, the survey of materials and services, obtaining service indices, team sizing, economic feasibility

analysis, among others, are applications that also benefit from the budgeting process [30].

The budget is an approximate calculation based on forecasts; therefore, it must be carried out carefully and accurately. It is noteworthy that the results of a budget must present a certain level of precision, even if they are not exact, without deviating from the effective cost, presenting a smaller margin of error.

According to Technical Standard No. 01/2011 [31], among the types of budgets used for the preparation of construction project budgets, cost estimation budgeting is shown as a widely used method. This method corresponds to the cost evaluation obtained through market price research with the aid of a project specifying the area to be built and other preliminary data, quantity of materials, and services involved. Through this research, it becomes possible to achieve a closer approximation to the real value of the project.

MATERIALS AND METHODS

The present research has an exploratory nature, seeking to provide relevant information for a more precise analysis based on the exploration of the subject under study. This research model involves, in its initial stage, a bibliographic survey, requiring consultation of existing materials to form the necessary knowledge base for the development of the work, as well as interviews with people who have had practical experiences and analysis of examples that stimulate understanding [32].

However, this research is also characterized as bibliographic, since it is necessary to review the literature regarding the main theories that guide scientific work. This review is called a bibliographic survey or literature review and can be carried out using books, journals, newspaper articles, among various other research sources. Bibliographic research seeks to solve a problem (hypothesis) through published theoretical references, analyzing and discussing the various

scientific contributions [33]. This type of research provides support for understanding what has been studied, how, and under what approach and/or perspectives the subject has been addressed in scientific literature. Therefore, it is of utmost importance that the researcher carries out systematic planning of the research process, from defining the theme, through the logical construction of the work, to deciding on its form of communication and dissemination.

Finally, the case study is also present in this research. As a qualitative method, this tool is used for the proper understanding of the reasons that influenced decision-making. The case study is a research strategy that seeks to understand a method responsible for encompassing everything in specific approaches to data collection and analysis [34].

This study aims to compare the cost-benefit of using two materials (steel and wood) for the execution of a residential roof structure. It is known that the type of material to be chosen will depend on the needs of each client, as well as cost, labor, and consequently, execution time. The cost-benefit will be analyzed after determining the respective costs of the structures, obtained through a cost estimation budget. For this purpose, interviews and telephone contacts were conducted with managers of two companies specialized in wood structures and steel structures, located in the city of Unaí-MG, in order to understand which criteria influence the final price of residential roof structures.

The software used were AutoCAD® (computer-aided design), for the creation of the roof structure project, and Microsoft Office Excel® for the preparation of cost tables.

The analyzed residential roof has two slopes, is embedded, and supported on a roof slab, with an area of 153.38 m². Due to the roof slab supporting the elements that make up the roof, in this case the purlins, a propped structure was used in place of trusses (main structure).

A high-strength wood known as Jarana was chosen for the wooden structure. For steel, it was decided to work with stiffened UDC profiles, as this specific type of steel has homogeneity as its main characteristic, allowing precise assembly, ideal for those seeking robustness and strength. In addition, it has a lightweight structural finish and solidity.

Due to the use of larger metal roofing sheets, only beams were used in place of trusses and purlins for both structures, making rafters and battens unnecessary. For the steel structure, elements with a thickness of 75 millimeters were chosen, with spacing ranging from 2 to 2.5 meters between beams, while for the wooden structure, elements with dimensions of 5x10 centimeters were used, with a maximum spacing of 2 meters between beams.

RESULTS AND DISCUSSION

For this budget, only the costs related to the elements that make up the metal roof structure were considered, such as props, metal beams, and purlins. Other elements such as roofing sheets, fastening screws, and expenses related to the use of welding for connecting the elements were not considered. It should be noted that the prices of inputs from the local market served as a reference for the final cost of each structural model.

According to the roof area, with 153.38 m², on which the metal structure will be assembled, the estimated execution time of this service, through specialized labor of two workers, will be three days. Based on Table 2, the budget related to the metal structure can be observed, which was carried out by the specialized company.

With regard to the wooden structure, Table 3 shows the budget carried out for this structure, consisting of purlins, wooden beams, and props. The roof on which the wooden structure will be assembled has an area of 153.38 m², and

the estimated time for its assembly, with the labor of three workers, will be seven days.

Table 2: Metal Structure Budget

Description	Quantity (m)	Number of parts	Unity price (R$)	Total value (R$)
PURLINS (UDC 75x40x17 Reinforced Profile – 14mm sheet) – 6m	123,11	21	88,60	1860,60
SUPPORTS (UDC 75x40x17 Reinforced Profile – 14mm sheet) – 60	58,27	10	88,60	886,00
SHORINGS (UDC 75x40x17 Reinforced Profile – 14mm sheet) – 60	12,64	2,1	88,60	186,06
Total (R$)				2932,66

Source: Research data.

Table 3: Timber Structure Budget

Description	Quantity (m)	Number of parts	Unity price (R$)	Total value (R$)
PURLINS (Jarana wood 5x10cm) – 3m	125	42	33,00	1386,00
SUPPORTS (Jarana wood 5x10cm) – 3m	73	24	33,00	792,00
SHORINGS (Jarana wood 5x10cm) – 3m	16,35	5,5	33,00	181,5
Total (R$)				2359,50

Source: Research data.

According to the data presented, a lower total cost was observed for wood when compared to the steel structure. However, in addition to costs, the benefits of each material were also considered in choosing the most viable structure. It is noteworthy that a product with a lower cost will not necessarily present better benefits over its service life.

When sizing the structure for the roof under study, carried out by a professional specific to each structure, it was reported that there was no need to use elements with different dimensions for both structures, since the roof will be

embedded (lower slope) and supported on a roof slab; therefore, the loads received and distributed in the structure will be smaller.

First analyzing the purlins required for the structure using stiffened UDC profiles (75X40X17), it was found that the quantity of these elements will be smaller for the metal structure compared to the elements required for assembling the wooden structure, due to the metal elements supporting a larger span. For wood, elements with dimensions of 5x10 cm were used, employing Jarana wood. The total cost for the metal purlins was R$1,860.00, while for the wooden purlins the value was R$1,386.00.

Due to the fact that steel presents millimetric precision and is also an industrial product requiring precision in assembly, it becomes possible to order the required quantity more accurately compared to wood, thus avoiding waste and unnecessary expenses.

Regarding the beams, which perform the role of the top chord, there was a clear increase in the quantity of elements when using wood, due to the fact that the spans for the wooden structure will be smaller, approximately two meters apart. For the metal structure, spans between two and a half and three meters were recommended by the professional, reducing the amount of raw material. The total cost of the metal beams for approximately 58 linear meters of elements, considering the unit value of R$88.60 (elements sold in 6-meter bars), will be R$886.00. For the wooden beams with 78 linear meters (elements sold in 3-meter bars), the total value will be R$792.00, considering the unit price of R$33.00.

Finally, in calculating the elements that will serve as props or posts (main structure), 12.64 linear meters of metal elements will be used, approximately two elements of six meters each, resulting in a total value of R$186.06. The wooden elements, each three meters long, totaling approximately 5.5 elements, presented a total value of R$181.50, considering 16.35 linear meters in wooden elements.

The props are also used as the main structure in place of trusses. In turn, they are vertically arranged elements, usually fixed to a wooden or metal element, supported on main beams or slabs, distributing the received load. As an advantage, this structural model presents a lower cost; however, attention must be paid to some issues such as the arrangement of the props, since in solid slabs they can be distributed at any point, but in precast slabs they cannot be supported on their structure, only in the direction of the walls or by using inverted beams or wooden beams for smaller spans [35].

For embedded roofs, fiber cement tiles, zinc sheets, or precast concrete panels are generally used as sealing elements, being protected by a masonry elevation above the ceiling line that forms a small structure known as a parapet [36].

Metal structures are pointed out as an alternative to wood, mainly due to the rising price and scarcity of this material. According to the same author, environmental preservation driven by social pressure, as well as the fact that industrialized elements bring quality to construction and productivity, are factors that favor the use of metal structures [37].

Although associated with industrial constructions, the use of metal structures is allowed in any type of building; however, it is often disregarded in relation to wood due to the difficulty of finding specialized labor, which, in the case of wood, can be found more easily.

It is emphasized that the assembly of metal structures requires specialized labor, since steel, being an industrialized material, has uniformity in metal profiles, ensuring greater structural resistance compared to wooden structures [18]. In addition, a higher quality in the final product is observed.

Thus, metal roof structures, when compared to wooden ones, require specialized labor [38]. Generally, the carpenter who builds the wooden structure

also installs the roof, reducing labor costs; furthermore, this service is easier to find in the market [39].

However, the same professional performing multiple tasks on the construction site does not always represent a guarantee of quality. Therefore, specialized labor is understood as an investment, and not as an additional expense for assembling the metal structure.

Due to presenting various qualities, wood is marketed with price variations, and thus, the cost of roofs executed in wood may be equivalent to those made of steel, or even more expensive [38].

With regard to the cost-benefit relationship, metal structures become more economical in the long term, since, unlike wooden structures that are subject to termite attacks, climate, humidity, and other natural factors, metal structures only need protection against rust and therefore will have a much longer service life than wooden structures. Table 4 presents a qualitative comparison between the structures.

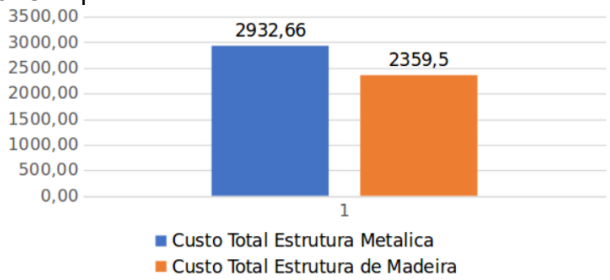
Through the analyzed comparison, it is possible to more clearly perceive some important characteristics that differentiate the two materials and that may influence the decision-making process. In the graph of Figure 3, the total estimated cost for both structures is presented.

Table 4: Comparison between structures

Item	Steel structure	Wooden structure
Labor	Qualified	Not Qualified
Assembly	Fast	Slow
Cost	Larger	Smaller
Structure weight	Lightweight	Heavy
Construction precision	High	Low

Source: Research data.

Figure 3: Comparative chart of the total cost between the structures



Source: Research data.

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The graph above shows a comparison between the total costs of the structures, where the total cost of the wooden structure proved to be the most viable. However, this section sought to highlight other factors that were essential for a correct analysis, and therefore, the metal structure was emphasized.

FINAL CONSIDERATIONS

The purpose of this study was to carry out a comparative economic analysis between metal structure systems and wooden structures to evaluate which is more suitable for the execution of a residential roof. It is known that the choice of one material over another depends greatly on the purpose of the building to be constructed. The reduction of time has also become a decisive factor in project execution, since execution time directly influences financial return.

The use of metal structures in roofing projects has become a fundamental alternative in construction due to aspects such as durability, practicality, and speed. In addition, metal structures offer ease of maintenance and repair and generate little waste. Wood has also been commonly used over the years in the execution of residential roof structures due to its ease of acquisition and its mechanical and physical properties.

From the comparative analysis of the costs and benefits provided by such roofing systems applied in the project, it can be observed that the budget for the wooden structure was more economical, based on the findings of the research.

In this study, wood proved to be economically viable due to the location of the construction, among other factors. As the objective of the work was to identify the best cost-benefit, wood stood out compared to metal structures.

Therefore, it is concluded that the economy of a roof with a metal structure depends on different factors when compared to a wooden roof; thus, both alternatives should be analyzed in order to achieve the best cost-benefit in the choice of the construction system. The limitations of this study refer to the measurement of labor to compose the budgeting. Finally, it is suggested for future studies a broader analysis involving other types of budgeting, considering the construction of a residence using metal and wooden structures, in order to obtain another parameter to evaluate the cost-benefit between these structures.

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