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An Analysis Of Solid Waste Management At A Civil Construction In The City Of Manaus-Am.

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Abstract:
Background: *The increase in the generation of solid waste worldwide is the result of growing urbanization and industrialization, and construction stands out as one of the main sources of waste, generating a substantial amount of rubble and discarded materials. This study proposes an analysis of solid construction waste management at a construction site in the city of Manaus.*
Materials and Methods: *An exploratory study was carried out in the field, through observational analysis of the construction process. This research is descriptive, as it describes the particularities and facts of the company, and exploratory, as it identifies the waste generated and draws up a manual of good practices.*
Results: *The company does not have an official construction waste management plan, but it is looking for integrated solutions, where the destination of construction waste can be recycling or reuse on the construction site itself. The company has adopted strategic guidelines aimed at sustainable development. The company is on the lookout for innovative solutions to improve its processes, especially those linked to construction methods, with a view to more sustainable management of the entire business.*
Key Word: *segregation; recycling; innovative solutions; good practices*

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I. Introduction

The Civil Construction Industry (CCI) is one of the biggest drivers of global development, as it contributes directly to the growth and transformation of cities. It has an impact on people's lives, those who make their living from this sector, those who benefit from its works and products and, more indirectly, all the other citizens who benefit from an economy strongly boosted by the sector [1].Construction is important for generating employment and income and plays a vital role in the Brazilian economy, contributing significantly to the Gross Domestic Product (GDP). It has been found that every real invested in building a new home represents a total investment of R$2.46, according to a study carried out by the Brazilian Chamber of the Construction Industry [2].

During construction and renovation, construction waste is generated, while demolition waste originates from dismantled structures [3]. According to [4] materials from C and D waste result in various products, such as plasterboard, stones, asbestos, metals, masonry, sand, asphalt and paper.

As society continues to prioritize environmental sustainability, it is likely that C and D waste management will have increasing relevance in the construction waste industry in the future [5].

Therefore, efforts to reduce, reuse and recycle C and D waste are essential to mitigate its impact and promote more sustainable construction waste management [6].

This study proposes an analysis of the management of solid construction waste at a construction site in the city of Manaus, seeking to understand the challenges faced by the construction sector and propose effective strategies to improve the management of this waste. In doing so, the aim is to promote sustainable development, ensuring that current demands are met without jeopardizing the ability of future generations to meet their own needs.

II. Material And Methods

This study is characterized as a case study of a mixed nature, combining quantitative and qualitative approaches, with a descriptive and exploratory perspective. The choice of a case study stems from the interest in identifying possible improvements in the waste management process, guided by current legislation.

Study Design: An exploratory study was carried out in the field, through observational analysis of the construction process. This study is descriptive, as it describes the particularities and facts of the company, and exploratory, as it identifies the waste generated and draws up a manual of good practices.

Study Location: The study was carried out on the construction site of a company that was founded in 1979 in Belo Horizonte, Minas Gerais; the company has 21,000 employees in Brazil. It arrived in Manaus in 2018. The site under study has a total area of 10,000 m2, 24 apartment blocks, with 04 floors per block, and 04 apartments per floor. The construction method used is structural concrete walls.

Subjects & selection method: observational research was carried out using checklists for on-site observation of waste management and disposal practices. Cameras and mobile devices were used to record the conditions of the works and the practices observed.

Procedure methodology: Initially, a bibliographic and documentary survey was carried out on the main types of waste generated on construction sites, classified as recyclable, reusable and rejects, followed by visits to the sites to collect samples and directly observe the waste generated. The images were analyzed using the knowledge of a construction professional and the waste was categorized according to ABNT NBR 10004 (hazardous and non-hazardous) [7] and CONAMA classification no. 307/2002 [8].

Statistical analysis: Data from the checklists was tabulated to check that practices complied with technical standards and environmental regulations, and the waste observed was categorized by type and volume, associating it with the management practices adopted.

III. Result And Discussion

The field research showed that the company has adopted strategic guidelines aimed at sustainable development. The company is on the lookout for innovative solutions to improve its processes, especially those linked to construction methods, with a view to more sustainable management of the entire business.

The project under study has a total area of 10,000 m2, 24 apartment blocks, with 04 floors per block, and 04 apartments per floor. The construction method used is structural concrete walls.

Construction companies first build the apartment blocks and then carry out the surrounding work, such as the infrastructure and general facilities for the entire construction site. However, as the company is looking for more sustainable solutions, it thought it would be more efficient to reverse the order of production. In other words, before starting the construction of the buildings, the infrastructure of paving, drainage and general installations of the entire construction site is carried out and the external areas and parking lot are developed. This reduces the loss of materials, as well as increasing productivity, cleanliness and organization on site. The company claimed that in the traditional way, materials were lost in the rain due to the mud that formed on the ground.

The company does not have an official construction waste management plan, but it is looking for integrated solutions, where the destination of SWW can be recycling or reuse at the construction site itself. According to [9], most of the construction waste is generated on the building site, as this is where the work and all its operational processes take place and where the materials and waste generated are stored. On construction sites, there is a lack of environmental management and neglect of environmental issues, where most companies are not concerned about the damage caused to the environment, looking only at the profit of the work or enterprise [10]

The company classifies its generated RCC according to CONAMA resolution 307/2002 as follows:
- Class A: waste that can be reused or recycled as aggregates, such as: construction, demolition, renovation and repair of paving and other infrastructure works, including soil from earthworks.
from the construction, demolition, renovation and repair of buildings: ceramic components (bricks, blocks, tiles, cladding slabs, etc.), mortar and concrete; from the manufacturing and/or demolition process of precast concrete parts (blocks, pipes, curbs, etc.) produced on construction sites.
- Class B: waste that can be recycled for other uses, such as: plastic, paper/cardboard, plastic, metal, glass, wood, plaster, polystyrene, wood and others.
- Class C: waste for which no economically viable technologies or applications have been developed to enable it to be recycled/recovered - contaminated sacks.
- Class D: Hazardous; this is hazardous waste from the construction process, such as paints, solvents, oils and others, or contaminated waste from demolition, renovation and repair of radiology clinics, industrial facilities and others.
Unclassified: Mix (materials of different compositions that have not been segregated); CONAMA resolution no. 307/2002 does not classify mix, and this nomenclature is used by the company to differentiate waste that it is unable to segregate.

Segregation is carried out by employees and the materials are placed in bays with identification of the type of waste or boxes identified by color and the type of material each one should contain and are located in strategic places on the site. Figure 1 shows that the site does not have strict waste separation in all areas of the construction site. The waste is mixed with wood waste from the forms and frames mixed with waste from the sealing masonry blocks in the common social areas.

Figure 1. Unsegregated construction waste. Source: Author, 2024.

Figure 2 shows the company's good practice in the finishing phase, with a view to reusing ceramic tiles and fillets for new living areas in future projects. According to CONAMA Resolution 307 of 2002, the management of construction waste must include direct or indirect actions in the stages of collection, transportation, transshipment, treatment and environmentally correct final disposal of solid waste. At the same time, article 18 of the National Solid Waste Policy (PNRS) requires municipalities to draw up a Municipal Integrated Solid Waste Management Plan as a requirement for obtaining financial transfers for municipal cleaning services.

Figure 2: Construction waste segregated at the construction site. Source: Author, 2024.

After analyzing the Solid Construction Waste (SWW) at the construction site studied, it was found that a specific set of waste products is responsible for a large proportion of the materials wasted. According to [11], it is essential not only to implement legislation, but also to ensure that sustainable practices are adopted in a uniform and effective manner.

Based on this context, this guide presents a set of recommendations to guide decision-makers in the area of waste management, whether in the planning or management of these materials on site.

The following are specific recommendations for reducing and preventing the generation of the main types of Solid Construction Waste (SWW) observed on site.

a) Wood waste
- Train workers to separate contaminated and uncontaminated wood waste.
- Form partnerships with companies specializing in the reuse or recycling of wood waste.
- Organize the cutting and sizing of wood pieces according to project specifications.
- Designate specific areas to separate and store the different types of wood, facilitating their reuse and recycling.

b) Paper waste
- Establish collaborations with companies specializing in paper recycling.
- Invest in scanning and storing documents electronically to minimize paper consumption.
- Use specific containers to store paper waste, facilitating the recycling process.
- Develop strategic partnerships with organizations dedicated to paper recycling.
- Promote the reuse of paper whenever feasible.

c) Scrap
- Sort and store scrap according to the type of material, such as iron, steel, aluminum, among others.
- Establish partnerships with companies specializing in metal recycling.

- Promote the reuse of metal materials whenever possible.
- Encourage the reuse of broken blocks and ceramics for landfills.

d) Broken blocks and ceramics
- Set aside an exclusive space for storing broken blocks and ceramics, avoiding mixing them with other types of waste.
- Train workers to recognize materials that can be reused.
- Form partnerships with companies that specialize in recycling or reusing blocks and ceramics.

IV. Conclusion

The research looked at the sustainable management of construction waste, with a focus on understanding the related concepts and practices. The studies covered in the systematic review helped to understand Brazilian regulations, the practices adopted by companies and the challenges in managing construction waste.

It was observed that the company tries to separate waste and store it in bins by class, in accordance with CONAMA 307/2002, but there is no concern about the practice of handling and disposing of it, leaving something to be desired in terms of the management of solid construction waste.

The results of the survey showed that waste such as ceramics, mortar, cardboard, wood and blocks are the most prevalent. However, the generation of this waste is generally associated with inadequate management, resulting in the waste of materials that could be reused.

Proper management of construction waste on the building site is essential for minimizing environmental impacts, optimizing the use of resources and promoting sustainability in the sector. Implementing sustainable management strategies on construction sites not only encourages companies to be environmentally responsible, but also adds value to the work, meeting the growing demands for more conscious and responsible practices in the construction market.

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