Analyzing Accidents in Civil Construction for Safety Work at Height

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Abstract

In civil construction any and all services must be performed objectively and safely, especially the services at the height of the painter, where the employee is more exposed to the risk of falls and impacts of the user's own objects on lower limbs. Both the employee and the employer are responsible for everything that happens at the construction site, the employer providing safety devices and plans to minimize the rich of accidents while performing the services and the employee must obey any and all safety orders and plans aimed at not only your physical integrity but that of your colleagues doing services around you. Therefore this work will address the NR-6 regulations dealing with single use equipment, NR-18 which work conditions and environment in the construction industry and NR-35 work at height, which regulate service at height with the main focus.

Keywords: Risk of falls; Safety; Brazilian Regulatory Norm;

1. Introduction

The most frequent accidents are those associated with the Construction industry, especially those involving falls of workers such as bricklayers, carpenters, janitors and painters, who were performing services on stairs, roofs, scaffolding and facades. Civil Construction in Brazil will always be a good indicator of the country's economic growth, in the 70's the average Gross Domestic Product (GDP) reached 8.8% [1] ,but together with this growth. , there is a sharp increase in the number of accidents at work, especially those related to fall in height, for various reasons.

Falls are said to be responsible for the largest number of fatal accidents, along with accidents caused by electric shock and burial, associated with various activities in the construction of buildings, such as coatings, painting, maintenance and conservation of building facades, in addition to shape assemblies, concreting and deforming in the phase of structures developed by carpenters, masons and blacksmiths.

Most deaths are the result of falls at frequent times in construction, and from these occurrences the Ministry of Labor and Employment has updated the regulatory standards, and is applied to any above-ground activity established by rule [2].

According to Law 8.213 / 91, art. 20, of the National Institute of Social Welfare [3], an occupational accident is what occurs when working at the service of the company or the work of special insured persons, causing bodily injury or functional, permanent or temporary disturbance that causes death, loss or reduced ability to work. They are also considered as an accident at work.

Accident and the injury agent, concluding that the accident involving fall in service in height is in 1st place in the frame of accidents. One study found that technological advances, when associated with workers' well-being and safety, greatly reduce accidents on construction sites, and consequently the cost of production, leading to the conclusion that the amount invested in occupational safety and workers' welfare are rewarding to the company [4].

Therefore in this sense the work will address the painter's risks at height, alerting the dangers and informing the regulatory norms such as the NR 35 [5] of work at height, NR 18 of conditions and environment of the construction industry, besides the NR 6 equipment for individual use to establish the duties of the employee and the employer. Demonstrating devices for collective and individual use to minimize the risk of accidents that can lead to death.

2. Theoretical References

These activities are performed above two meters above ground level, containing risks of falls, and are called height work according to [5] .These are activities that require the assistance of ladders, ropes, platforms or scaffolding, such activities require more care and planning from the employer as it is he who should look for ways to analyze alternatives in order to avoid any risks, and if any, make use of all resources. to avoid as much as using PPE while raising awareness.

Accidents caused by a fall in construction occur for several reasons, among them the collaborator, often having a vicious cycle, that is, after doing so in an improper way ends up not obeying the rules of use and safety, and also the work environment itself, because many of them, are not able to work with low lighting, slippery floors, lack of signage of slab openings, floors among others, lack of collective protection and

when there is protection is not installed correctly as defined by the norm [4].

The [6] is responsible for regulatory standards, which aim to prevent risks to the life and health of workers when performing their activities in the field, comprising in each standard the technical procedures and minimum safety measures that must be strictly followed. The NRs have another function than teaching CLT (Consolidation of Labor Laws) in order to fulfill them correctly.

According to [7], personal protective equipment is important in reducing injuries and illness, but its distribution is not enough, making them sometimes inefficient due to lack of knowledge on the part of the patient. even claim that the risks are minimal and that they are sufficiently prepared to perform that activity, which they have been doing for a long time without the use of PPE, in their view they believe that the use of PPE will only hinder productivity by limiting their movements.

According to [8] it is extremely important to observe and predict any type of risk in order to eliminate them early on, so it is necessary to have a quality management that can plan the use and how To guide the employee about its use and its importance for occupational safety and health, in which the use of EPI involves three actions: technical, educational and psychological. Technical action encompasses technical understanding and understanding for the type of use; educate workers about how PPE works properly; and the psychological is to make the worker aware of the importance of its use in the safety of their physical integrity.

The construction conditions and environment programs (PCMAT) should be prepared prior to the commencement of work, but as a safety management program, it should not be viewed as a static document; It may change as the work progresses. However, no stage of the work should be performed without identifying the risks involved and their control measures. And this forecast must be included in PCMAT, it is mandatory to elaborate and comply with establishments with more than 20 (twenty) workers or more. It must be prepared by a legally qualified professional in the area of occupational safety, its implementation in the establishments must be done by the employer or owner, and the PCMAT must be kept in the establishment at the disposal of the regional agency of the ministry of labor, according to [9].

3. Methodology

The method chosen in this research was the case study, which aims at a qualitative approach, aiming to interpret the information in order to build a solution to the problem. The research instrument applied is the observation and a questionnaire designed with 9 questions, intended to describe the painter's activities and the risks of accidents in the construction industry, aiming at safety at work, with the purpose of showing the importance of equipment and devices. , collective and individual do within the scope of the work.

To perform the research steps was divided into 4 phases:

The first phase was the definition of the place having as criteria what happens most often, that is, what is present with daily life of the Amazonians, after defining the place, the collaborator answered some careful questions in order to verify its use and understanding, then the observation of the act itself, concluding all the study methods, gathered the collected statements, finally analyzing, arguing and interpreting the data in order to propose appropriate solutions for both the employee and the employee. employer, presented in table 1.

1ª Phases	**Definition of analysis site Preparation of the interview**
2ª Phases	Interview with the employee
3ª Phases	Application of research instruments; Gather all collected materials.
4ª Phases	Analyze, argue and interpret the data collected during the research in order to present possible solutions to avoid risks.

Table 1: Research Phases
Source: Own Author

3.1 Case Study

Held in a confectionery, Bolo e Cia, located at Avenida Camapuã, 2332, east of Manaus-AM. The work performed is privately linked, being only the agreement between employer and employee, a service in a short period, as well as many that exist in the city.

At the beginning of the painting work, images were recorded and the procedures performed were annotated, and all the details of the execution were observed, for a better detail at the end of the process, and could reach a conclusion to propose appropriate solutions to both the worker and employer.

4. Results and Discussion

At the end of the execution a set of questions was asked to the worker, composing 9 questions, in order to understand why he does not use PPE or question his employer of the availability of this equipment. The table 1 below shows the painter's answers to be analyzed and discussed.

Table 1. Employee Interview

1. Age?	**38**
2. What is your education?	High school
3. How long in this branch?	About 19 years old
4. Do you have a qualification course? Which are?	No, what I know I learned in practice.
5. Was there a PPE available at the places you worked? Which are? In some places yes.	Gloves, and helmet.
6. Do you have any guidance on how to correctly use PPE?	Not
7. When working, are some fall protection devices used?	Not
8. Have you had an accident?Was using PPE?	Once the scaffolding I used was misplaced, the floor was uneven, I ended up falling. He wore only his boots and gloves.

9. What do you think about PPE?	I think it's important sometimes and sometimes it's unnecessary, it doesn't help, it gets in the way of work and it bothers you,

Source: Own Author

It is notorious that the lack of responsibility, the non-compliance with the laws and the self-confidence acquired over the years, even after accidents occurred, continued to commit the same recklessness as observed in Figure 1, one can notice the lack of signs in which the Standard Regulatory 26 [11], in item 26.1.1, establishes the use of colors for safety in establishments or workplaces, in order to alert the existing risks to the people who travel nearby and the employee himself, even in the use of this device that not being used, the use of this resource does not dispense with the use of other preventive means in accordance with NR 26 [11], item 26.1.3. The need to isolate and signal the site is to try to minimize risks and accidents.

Scaffolding shall consist of shims, fixed base, diagonal, ladder, safety ring, railing, floor, baseboard and screen. According to norm NR-18 [12], item 18.15.6 states that scaffolding should have a railing and skirting system, including headboards, all around the perimeter, reducing the risk of falling objects and the employee himself, obeying the protective measures are the height of 120 cm for the upper crossbar and 70 cm for the intermediate, a footer with a height of 20 cm, in addition to the screen fills ensuring the safe closing of the gaps (item 18.13.5). In item 18.15.7 it is forbidden to remove any safety device from scaffolding or to nullify its purpose.

The scaffolding used by the employee is the simply supported fixed scaffolding without baseplate, used outdoors, which is where the structure remains rigid preventing its displacement, for each type of scaffolding can be modified as for facade, is the scaffolding fachadeiro therefore allows the access of people and materials to the work. The used note the lack of a baseboard and the lack of regularity of the floor, making it even more necessary to use shims to increase strength and ensure more stability, which according to NR 18 [12], in Item 18.15.10 which states that the scaffolding risers must be supported by solid and level base shoes capable of withstanding the stresses and loads transmitted.

Figure 1. Irregularities
Source: Own Author

According to NR-18 [12], Item 18.15.3 The working floor of scaffolding shall be completely lined, non-slip, level and securely fixed and locked, and the floor may be all metal or mixed with metal structure. and synthetic material or wood or all wood, item 18.15.3.1, the sizing should be done by a qualified professional, according to item 18.15.3.2. The use of wood shavings in scaffolding is also prohibited, item 18.15.5.1, that is, it is not possible to use leftovers of wood that are in bad condition, with cracks and wet, compromising its resistance and cannot be painted. in order to hide the deformities, item 18.15.5, the user being totally irregular according to the safety standard as shown in figure 2.

Figure 2. Scaffolding floor
Source: Own Author

In addition to all the mentioned items there is still the risk of scaffolding close to the wiring of electric wires as seen in figure 3, the NR-18 standard [12], in item 18.15.4 informs that precautions should be inserted in PCMAT. Taken when assembling, disassembling, and moving scaffolding near power grids, due to the risk of shock, parts of a scaffolding frame carry electricity and may be hazardous if exposed to power cords or conductors.

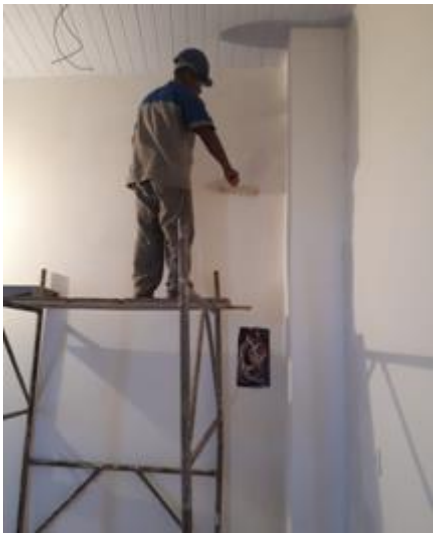


Figure 3. Worker near electricity
Source: Own Authorship, 2019.

The work had several nonconformities such as lack of PPE, irregular scaffolding, no supervision, no training or guidance from employer to employee, or any risk assessment that might have been made, contrary to NR- 6 [13], Item 6.6.1, related to work safety at height, characterizing a serious and imminent risk, which may cause accidents and even lead to death of the worker.

According to [14], to some extent the risk may be acceptable or not, to obtain this response is passed through the risk assessment process, it is considered the use of preventive means. Risks are considered a combination of possibilities that exist in that activity, and may lead to the worker the occurrence of serious accidents with injuries, illness or death. The way to avoid accidents is with preventive and corrective actions, preventing actions and avoiding new events. The main causes are human or material, for lack of knowledge of its importance, use PPE not corresponding to the risks etc.

Figure 4. Worker at eminent risk
Source: Own Authorship, 2019.

The image shows that the employee does not have the proper PPE, because the user was at a height of approximately 2.5 meters and were totally of the standard that the NR-35 standard [5] determines to have the minimum safety, in which If activities above 2 meters are already considered work at height, it is of fundamental importance to strictly follow the established law, because most of the accidents registered are work at height. As shown in figure 4, when wearing a helmet, he does not use it with a jugular, risking that he detaches if his head, also has no seat belt, protective glove, lanyards or parachute, going against all safety laws.

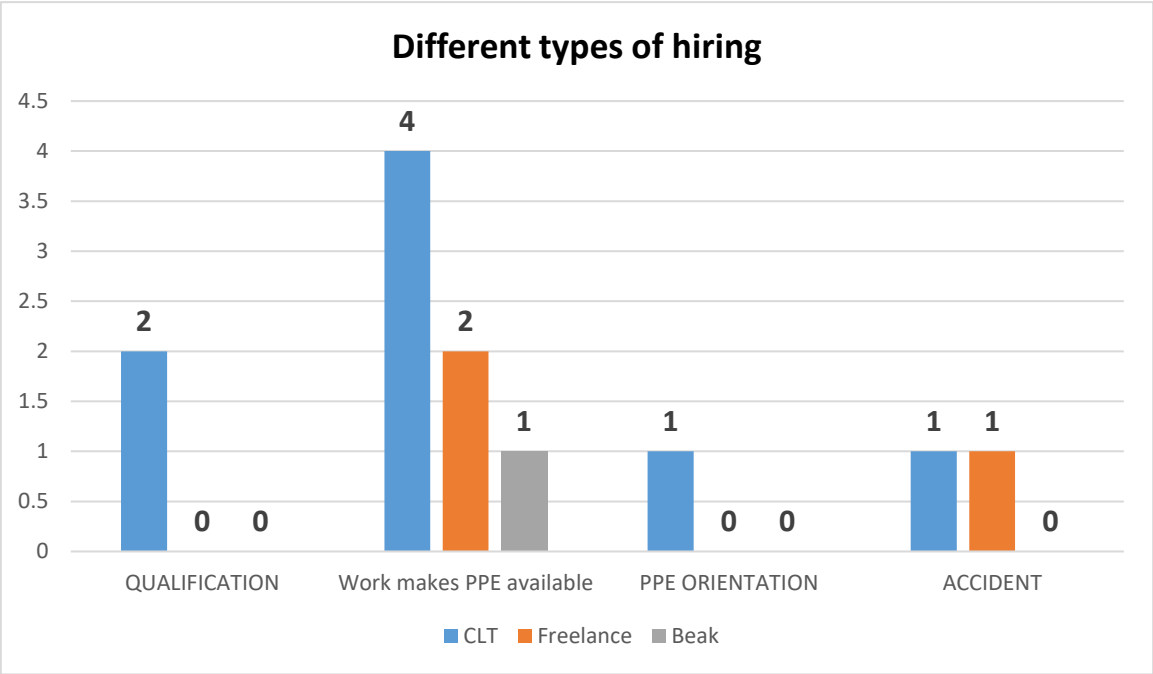
4. Comparison of Painters in Different Conditions

For a better view of working conditions, comparisons were made of different types of working conditions,

the first is CLT (Consolidation of Labor Laws) that supports the worker, safeguarding all his rights by law; the second is self-employed, but has no signed wallet, has been working for a long time with painting; and lastly it's the nozzle worker, it's not his only job, he does anything that comes along.

For each item a weight was placed, for example, in question number 5, in which the PPE is questioned the employee answers the equipment such as helmet, glove, mask and boot, thus 4 EPIs being placed the number 4, already For accident the number 1 is the maximum.

The comparison was shown in graph 1 below, made only with 3 employees who work in this area.

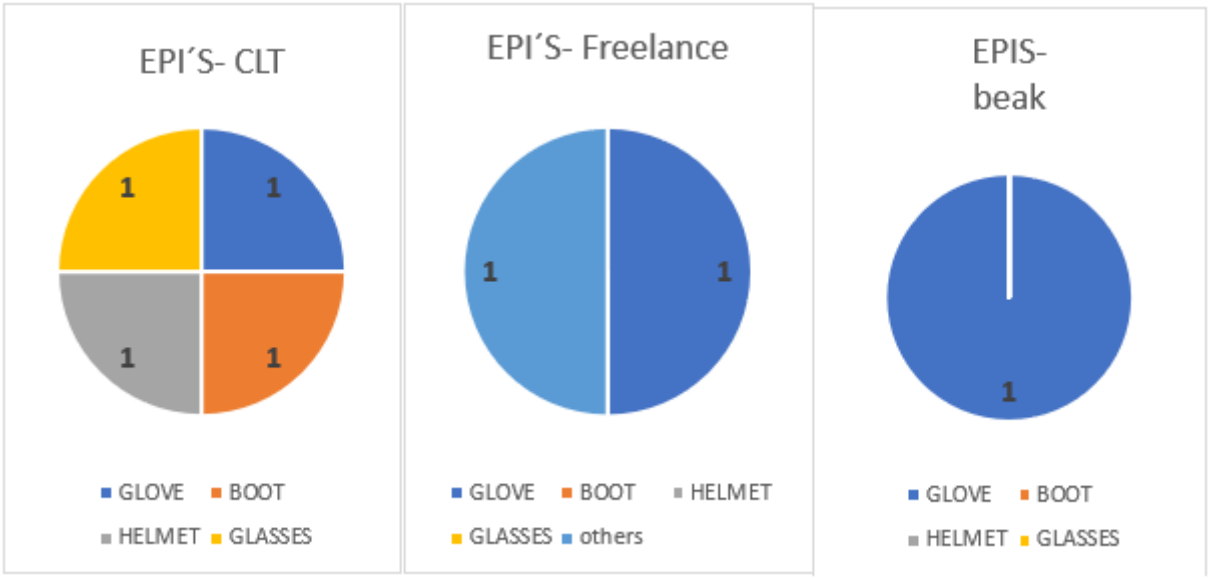


Graph 1. Comparison

Source: Own author

It can be observed that in the three cases only the contractor with a formal contract has qualification, which according to norm is necessary to avoid the risk of falling by owning knowledge. The equipment available is the minimum, being only gloves only, and the employer should provide the equipment should provide guidance on how to use it. In the above cases only the signed card has guidance, leaving the other two respondents without, because such laws and regulations are not disclosed, nor is there a strict supervision on renovations or even construction, leaving many at the mercy of luck and taking risks. serious. In the following pie chart 2, you compare the PPE.

According to [7], personal protective equipment is important in reducing injuries and illness, but its distribution is not enough, making them sometimes inefficient due to lack of knowledge on the part of the patient. even claim that the risks are minimal and that they are sufficiently prepared to perform that activity, which they have been doing for a long time without the use of PPE, in their view they believe that the use of PPE will only hinder productivity by limiting their movements.



Graph 2. Comparison of employer-provided PPE
Source: Own Author

The lack of commitment between the parties diminishes the responsibility of both employer and employee, leaving both and especially the employee at risk. The use of this equipment is not for decoration, but for life protection, but should be used correctly, its misuse or misuse, makes the epi useless according to what the manufacturer informs.

5. Solutions for Possible Identified Risks

During this research several factors were demonstrated that influenced to increase the risks of falling of the collaborator, of objects, besides the dangerous access, electric shocks and collapse of the structure. For each danger there is a prevention solution which are:
Risk of falls: the use of devices as a railing; avoid leaning over it; avoid working in bad weather; close any opening; comply with current safety standards; possess knowledge; maintenance.
Falls of objects: signaling; accumulate things on scaffolding; use of protective equipment such as skirting boards, nets and flooring in good condition.
Dangerous access: Must be signposted and in accordance with regulatory requirements.
Electric shock: keep distances from mains because the scaffolding are conductors of mains; use of inappropriate equipment.
Structure collapse: Risk of scaffolding load: the floor must be in good condition; drag and drop materials; overload the structure and floor; On loads: know the limit of scaffolding; do not put unnecessary things;

5.1. Training

Training is another factor that contributes to the reduction of accidents, the skydiver training indicated by giving skills to the employer, and the employee must know their equipment, procedures that control and minimize the risks.

Courses and Techniques of Work at Height According to the norm, it is the employer's duty to promote a program to train workers to perform work at height.With a minimum workload of eight hours, the theoretical and practical training must include presentation of the rules and regulations, risk analysis, collective protection systems, equipment and procedures, personal protective equipment, typical accidents and emergency conduct, including rescue and first aid.

Work at Height for Facade Painting: Work at heights as an activity that should be planned, avoiding, if possible, exposure of the worker to risk, either by performing the work in another way, by measures that eliminate risk of falling or even measures that minimize its consequences when the risk of falling with level differences cannot be avoided by applying the standard and enabling the painter to perform a certain service.

5.2. Technological Innovations

According to CIPA [15], he published an article on innovation in the PPE management system: 3M Connected Safety - Inspection and Management Module, which includes the emergence of a management system for workers' health and safety in the complexity of their work. activities. 3M has developed an information control of equipment, users of PPE and work areas, aims to provide a control placed information in a software that stores the data in a cloud, its access can be made through mobile phones and computers.

In this tool you can have information such as manufacturers, type, validity, exchange routine, among others, about the PPE. For users puts the right equipment for activity, proper training and exams.

The main advantage is an up-to-date report, helping to make the best decision any time you are asked. They are easy to store, as well as being able to control users' access to PPE, ensuring that they know how the equipment is being used correctly so that its useful life is as determined by the manufacturer without waste. It informs about the best equipment for activity to be performed and its mode of use.

6. Final Considerations

Because of the facts mentioned, knowledge and information can save lives, possessing them reduces the risk of accidents and prevents them. The standard NR-35 [5] is related to work at height, in this work refers to the service of the painter, in which they must understand and understand all the risks that he is exposed by not using protective equipment or devices. Not only should the employer be aware of his duties, but as the employer who is obliged to pass the knowledge on to him, despite this one of the contributing factors is the lack of supervision becoming something of concern for the amount of works that exist.

Besides presenting the risks, the necessary equipment was placed and its importance, but the improper use to what the manufacturer recommends, ends its purpose and the user continues with the risk. These devices are put in a preventive way one of them is the human factors because it is unpredictable, as some of them end up not wanting to use it because they believe it hinders the execution of their activities. Also for better visualization were made comparisons of different types of employability one being CLT, Autonomous and Nozzle, showing the differences they have and the distribution of PPE.

In this course completion research, risk protection devices and equipment have been shown for activities at heights, seeking to show the problems and measures required in accordance with current regulations for

work at heights. Therefore it is necessary to give priority to lectures, accident reduction measures, availability of equipment and individual and collective devices, so that the activities performed occur safely and in accordance with the planned.

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