

## Analysis of safety items in works of the Minha Casa Minha Vida program in the municipality of Dois Vizinhos – PR



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### ABSTRACT

Occupational safety is an area of great importance in civil construction, as it is an activity of repetitive exercises, risky practices that demand a lot from the worker involved techniques and control practices were created in the civil construction work environment. There are numerous safety assessment and control techniques, among which the inspection checklist stands out, a quick and efficient way to survey and identify points of non-

conformities, as well as risk areas and situations, with approaches and frequencies of use determined according to the scenario in question. In this work, the use of safety was addressed, considering inspection of Personal Protective Equipment (PPE), Collective Protection Equipment (CPE), construction site conditions, machine and tool conditions, as well as work practices employed. To this end, a checklist was developed for the application of small-scale works (OPP) of the Minha Casa Minha Vida Program (PMCMV). To verify the effectiveness and approach of the inspection checklist, 28 works were visited in the municipality of Dois Vizinhos - PR in the phases of execution of foundations, masonry survey and roofing, and then an analysis report was made. With this, it was possible to identify that safety at work in works of the Minha Casa Minha Vida Program (PMCMV) with the application of the inspection checklist reached an average of the three phases analyzed that 71.67% make use of good practices, as a result, most of the points of improvement are due to the orientation of employees to good practices of work safety.

**Keywords:** Occupational safety, Checklist, Minha Casa Minha Vida Program.

## 1 INTRODUCTION

With the population growth and development of humanity, the growing demand for services in civil construction became evident. Especially after the industrial revolution, the concepts of accelerated production were leveraged, often leaving aside the condition in which work was developed, so occupational diseases began to emerge and increase in large proportions, following the potentialization of the means of production, and the unbridled growth of cities. (SAPUCAIA, 2014).

As a result, there was a need to seek ways to improve working conditions to avoid damage and losses for workers, giving rise to organizations focused on workers' health and safety. Occupational safety is defined as the set of measures aimed at minimizing work accidents and occupational diseases,



as well as maintaining the physical, psychological, social integrity and work skills of the worker (PEIXOTO, 2011).

Thus, this work intends to verify the safety conditions of work in the area of civil construction, thus being one of the most important activities NR-18 (BRASIL, 2009), so that the health and safety of work are ensured from the performance of civil engineers.

## 2 LITERATURE REVIEW

In the present study, the literature review will be subdivided into the following topics: Occupational safety, which is the study of this work, regulatory norms, which are the Norms (NR), which are the guidelines for occupational safety, and the Minha Casa Minha Vida Program (PMCMV) in which the study will be applied, in works that are considered small works (OPP).

### 2.1 OCCUPATIONAL SAFETY (OS)

According to Bozza (2010), safety at work has become a conjunctural requirement, as companies seek to reduce the risks of accidents to which their employees are exposed. The lack of an effective security system can lead to problems such as productivity, quality of service and increased costs.

According to data from the International Labor Organization (ILO) (2017), occupational accidents in the most diverse areas cause about 2.3 million deaths per year, among them, 350 thousand resulting from occupational accidents themselves and the vast majority, about 2 million, as a result of work-related diseases. Added to this data are the more than 313 million accidents that employees are absent for at least four days from their work activities.

Occupational accidents generate negative impacts within companies, leading to a decrease in production, bringing material losses, requiring the hiring of new employees, and generating expenses with compensation to family members or victims (MOTERLE, 2014). Therefore, it is required that each service sector has its own equipment and necessary care to prevent accidents.

According to Borges *et al.* (1999), in civil construction, as well as in any other area, occupational accidents can occur. The main reasons are the undue outsourcing of poorly trained professionals and the lack of use of safety equipment, placing safety as an unnecessary cost (BORGES *et al.*, 1999). In order to reduce these rates, regulatory standards (NR) were created.

### 2.2 REGULATORY STANDARDS (NR)

The regulatory standards (NR) are information on mandatory safety and protection procedures for the professional, they are prepared by a committee of representatives of the government, employers



and workers. In total, there are 36 NRs, each with specifications, parameters and requirements that help in the safety and protection of the worker's environment (BRASIL, 1978).

Giving context, the following NRs stand out:

- NR-06 discusses the use of Personal Protective Equipment (PPE), which is essential for workers working in the construction area. They are provided by the companies in perfect conditions of conservation, for each risk that the worker will exert (BRASIL, 1978).
- NR-09 deals with the prevention of environmental risks in the workplace. It presents the need to prevent and evaluate possible problems that may occur in a given place, with a view to protecting and controlling the environment. The PPRA, an environmental risk prevention program, is an action that is part of a set of initiatives by companies to preserve the health and integrity of workers. The main objective of the PPRA is to establish measures aimed at eliminating, reducing or controlling the physical and mental risks of workers (BRASIL, 1978).
- NR-18 is more directed to the civil construction industry, in which it establishes prevention and control throughout the process of each work environment (BRASIL, 1978).

Based on the regulatory norms (NR), it was determined which aspects are applicable to small works (OPP), in the Minha Casa Minha Vida Program (PMCMV).

### 2.3 MINHA CASA MINHA VIDA PROGRAM (PMCMV)

The Minha Casa Minha Vida Program (PMCMV) for popular housing, formed in April 2009, by an initiative of the federal government, with a simple objective of enabling a dwelling being a small dwelling, such as a single-storey residence and/or multifamily unit, existing for urban and rural areas. In recent years, it has become the largest housing program in the country, serving more than 14 million low-income families, ensuring them decent and safe housing, with a portion appropriate to their budget (CAIXA, 2019).

For Griffith (1992), a definition for small construction works is characterized by several perceptions and interpretations. The perception in a general context in the construction industry is considered small works such as, alterations, modifications, improvements and maintenance work aspect.

On the other hand, for Libânio *et al.* (2004), small works are considered to be those with simple regular structures that indicate the absence of protection, have up to four floors and use loads of less than 3kPa.

Due to the rapid execution, small works often go unnoticed, with no inspection, due to the low risk in terms of work safety (GOMES, 2012).



### 3 METHODOLOGY

The present work consists of a case study, based on bibliographic research in literary works, which discuss the theme focused, in addition to articles published on the internet, books and theses. The case study is defined as an in-depth study of one or more objects, seeking broad and detailed knowledge, a study widely used by social researchers, since it can be used in explanatory, exploratory and descriptive research (GIL, 2008). Thus, the data collection of small works (OPP) that are part of the Minha Casa Minha Vida Program (PMCMV) in the municipality of Dois Vizinhos - PR was carried out, the data were obtained from consultation with the City Hall.

In the municipality of Dois Vizinhos - PR, from the emergence of the PMCMV, which occurred in 2009, to 2019, 4,350 permits were issued for the construction of popular housing, according to data provided by the Department of Urban Management of the City Hall (LATREILLE, 2019).

Based on the PMCMV works that had the approval of construction permits since June 2019 in the municipality of Dois Vizinhos-PR, visits were carried out to apply the *checklist* in 28 works, considering the stages of foundation, masonry survey and roofing.

Regarding *the application of the checklist and analysis of the results in small works (OPP) having as limitation the dimensions of the Minha Casa Minha Vida Program (PMCMV), it is inferred that the checklist used was developed in accordance with NR-9 – Environmental Risk Prevention Program, not considering items that presented little application in small works (OPP). Thus, changes were made to the inspection checklist due to the number of workers on the service front and their daily activities. In the preparation of the checklist, the steps presented in the PPRA were taken into account, according to NR-9 (BRASIL, 2014):*

- Anticipation and recognition of risks;
- Establishment of priorities and goals for evaluation and control;
- Assessment of risks and exposure of workers;
- Implementation of control measures and evaluation of their effectiveness;
- Monitoring of exposure to risks;
- Recording and disclosure of data.

In order to obtain the details of the items to be incorporated into the *checklist*, depending on the activities being carried out on site, the following items were observed as the basis of the work plan:

- Identification of risks in the activities performed;
- Determination and location of possible sources of risk;
- Identification of possible trajectories and means of propagation of agents in the work environment;
- Identification of functions and determination of the number of workers exposed;
- Control and follow-up of existing control measures.



Based on the management topics used in NR-9, along with the analyzed services of foundations, structural, masonry, finishes and organization, an analysis of the existing risks in the works was initially carried out (BRASIL, 2014). Then, the stage of locating the generating sources and means of propagation was developed, considering small-scale works (OPP) of the Minha Casa Minha Vida Program (PMCMV) in the municipality of Dois Vizinhos - PR. Based on this information, the detailed inspection *checklist* was prepared in Appendix A.

The items analyzed in the *checklist* were grouped into five (5) categories: Employee Practice / PPE, Employee Practice / EPC, Employee Practice / Service Execution, Employee Practice / Environmental Conditions and Employee Practice / Tools and Machines.

With the collection of the data obtained from the application of the *checklist*, the data were computed so that it was possible to present a solution that will raise the indices of health and safety at work. The data obtained were discussed based on NR-9, in order to obtain more accurate and normative results (BRASIL, 2012).

For a better understanding, graphs were elaborated in order to highlight the results found.

## 4 RESULTS AND DISCUSSIONS

Visits were made to 28 works of the Minha Casa Minha Vida Program (PMCMV), the works are located in allotments opened in the last 3 years in the municipality of Dois Vizinhos – PR, for the application of the *checklist* in the stages of foundation, masonry survey and roofing, during their execution.

With the application of the *checklist* elaborated, the behavior of the workers in each phase of the work was verified, which was verified in relation to the use of personal protective equipment, collective protective equipment, execution of services, environmental conditions, tools and machines.

Thus, the results were divided into distinct sections, enabling the evaluation based on the phase of the work in which the *checklist* was applied.

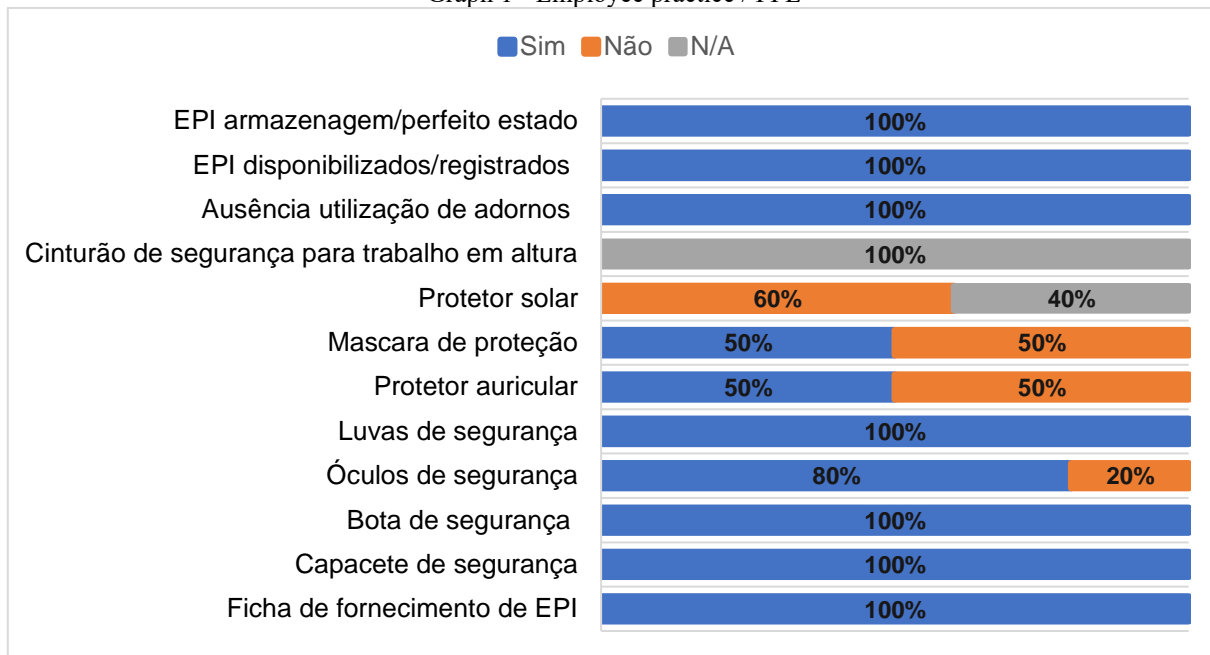
### 4.1 FOUNDATION

The foundation consists of the initial stage of a work, consisting of the execution of the piles, footings and baldrame beam. The excellence in its execution will dictate the pace of the work, therefore, its execution requires attention because it is a work of moving soil and hardware. Thus, in graphs 1, 2 and 3 the results of the inspection *checklist* applied to works that were in the foundation stage will be presented.

The employees' practice regarding the use of PPE is shown in Graph 1.



Graph 1 - Employee practice / PPE



Source: Survey data (2020).

From the analysis of graph 1, it was observed that 7 (seven) items analyzed were observed in 100% of the works: "PPE storage/perfect condition", "PPE available/registered", "Absence of use of adornments", use of "Safety gloves", use of "Safety boot", use of "Safety helmet" and "PPE supply form".

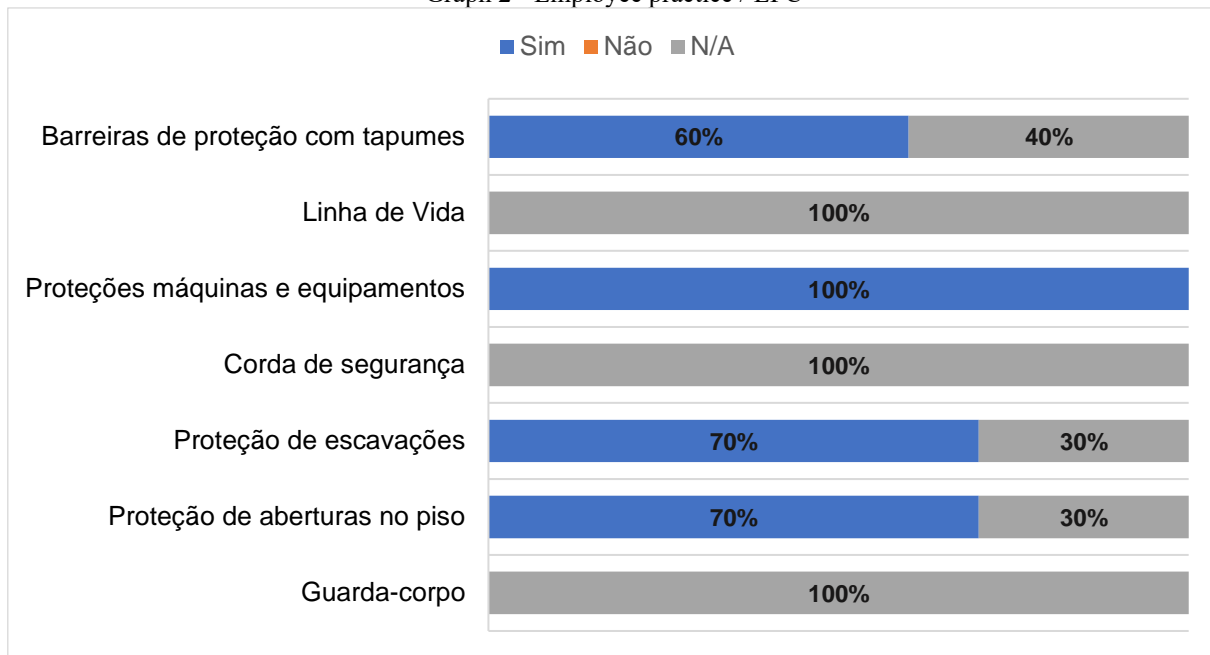
Being 60% of the works analyzed in the foundation stage do not provide "Sunscreen" to its employees. The provision of "Protective mask" and "Ear protector" was identified in only 50% of the works analyzed. "Safety glasses" were provided in 80% of the works.

Regarding the "Safety belt for working at height", it is inferred that it does not apply to this phase of the works, since any activities carried out above 2 meters in height of the main base are considered work at height.

Graph 2 refers to the practice of employees in relation to the use of CPE.



Graph 2 - Employee practice / EPC



Source: Survey data (2020).

Graph 2 shows that the non-applicable result had a high percentage in relation to the others. In all the works analyzed in this phase, the presence of "Lifeline", "Safety Rope" and "Guardrail" is not applicable, as these are services that do not have a height greater than two meters from the ground, thus, those responsible for the works end up considering an unnecessary economic investment. The presence of "Protection barriers with sidings" was identified in 60% of the works, and 70% of them had "Excavation Protection" and "Floor Opening Protection". It was identified 100% of use of "Machinery and equipment protection" systems.

Regarding the category of practice of employees related to the execution of services, 100% of good practices were achieved in accordance with the regulatory standards (NR). The items analyzed were: presence of "Well-defined functions with necessary instructions", "Clearly informed work activities", existence of "Rotation of functions", identification of "Absence of repetitive efforts" in the execution of activities, use of "Appropriate techniques to lift materials or loads", existence of "Well-defined work schedules and informed to the worker", "Lunch and snack breaks being applied" and "Use of time clock or some time tracking tool".

Graph 3 refers to the practice of employees in relation to environmental conditions.



Graph 3 - Employee practice / Environmental conditions



Source: Survey data (2020).

When analyzing graph 3, 4 (four) items were identified with positive results in 100% of the works analyzed, namely, the presence of "Drinking fountain available and easily accessible", the presence of "Areas for defined intervals" and "Predetermined places for storage". The only thing that was not being applied was good practices in "Regulated stairs in good condition", which in 10% of the works were not identified. In addition, 60% of the works did not have "fire extinguishers available". Regarding the item "Free access to all work fronts", in this item taking into account that the carpenter does not access the space of the ironmonger or the service of the servant in the excavation of the foundation, it was not identified in 80% of the works analyzed.

With regard to the practice of employees in relation to tools and machines, 100% of good practices were achieved, according to the regulatory standards (NR), in the items "Use of tools in good condition", "Availability of new tools, when necessary, quickly", availability of "Clean tools", existence of "Place for storage of tools after use", presence of "Machines with protections on moving parts", presence of "Absence of exposed or worn electrical cables", presence of "Closed electrical panels" and "Hoses correctly stored".

## 4.2 MASONRY LIFTING

The masonry lifting stage is a long stage that includes the entire sealing of the work, both external and internal.

Graphs 4, 5 and 6 show the results of the application of the inspection *checklist* in the masonry survey stage.

Graph 4 shows the employees' practice regarding the use of PPE.





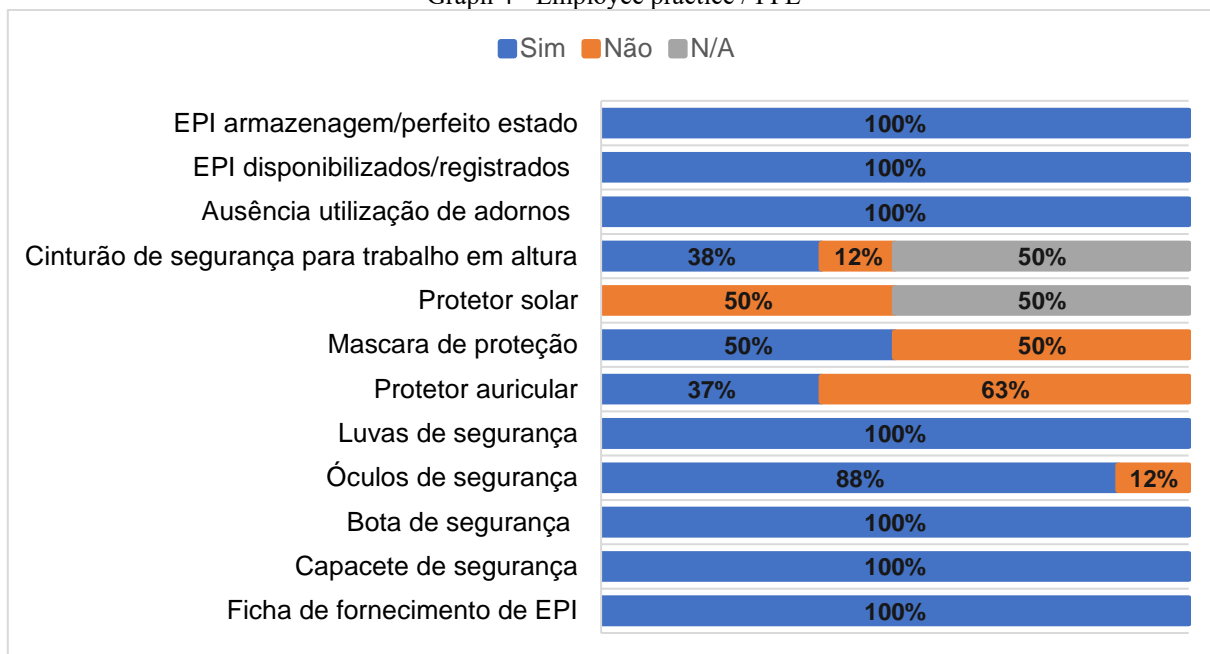
In the analysis, 7 (seven) items were evidenced, whose analysis demonstrates 100% compliance with occupational health and safety standards. The items were "PPE storage/perfect condition", "PPE made available/registered", "Absence of use of adornments", use of "Safety gloves", use of "Safety boot", use of "Safety helmet" and presence of "PPE supply sheet".

The use of "Safety harness for working at height" was identified in only 38% of the works, values that are much lower than those identified in the foundation phase. The absence of a belt can be evaluated as a great risk for the worker, as it is a risky activity, however, when applied to PPO works, 12% of the works were not identified as non-use, and 50% is not applicable because they are works of quick execution.

The use of "Protective Masks" occurred in 50% of the works and in 88% of the works the use of "Safety Glasses" was made. Only 38% of professionals use "Ear Protector".

The supply and use of "Sunscreen" was not identified in any of the works, with 50% of the works analyzed and 63% of the professionals not using "Hearing Protection".

Graph 4 - Employee practice / PPE

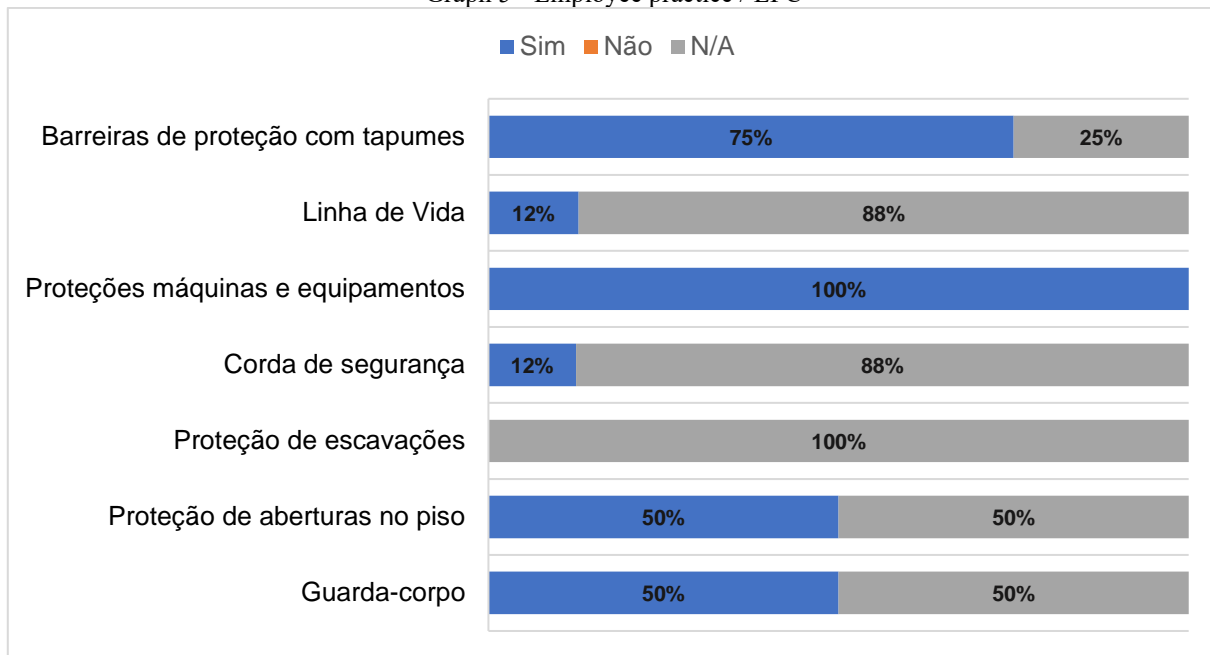


Source: Survey data (2020).

Analyzing from Graph 5, the non-applicable result had a high percentage in relation to the others. In the works analyzed in this phase, the presence of "Excavation Protection" is not applicable at this stage because there is no earth movement. The presence of "Protection barriers with sidings" was identified in 75% of the works, and 25% of them are not applicable, "Lifeline" and "Safety rope" it was found that 12% are used in this stage and 88% are not applied in this stage. It was identified 100% of use of "Machinery and equipment protection" systems.



Graph 5 - Employee practice / EPC



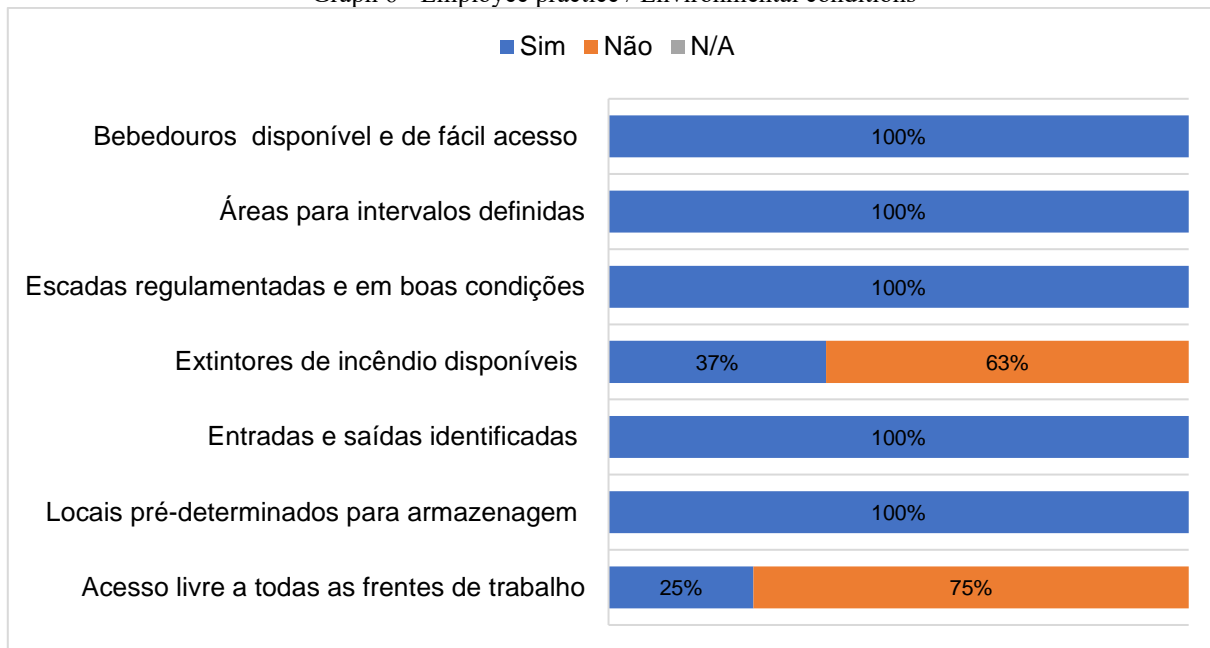
Source: Survey data (2020).

Regarding the category of practice of employees related to the execution of services, 100% of good practices were achieved in accordance with the regulatory standards (NR). The items analyzed were: presence of "Well-defined functions with necessary instructions", "Clearly informed work activities", existence of "Rotation of functions", identification of "Absence of repetitive efforts" in the execution of activities, use of "Appropriate techniques to lift materials or loads", existence of "Well-defined work schedules and informed to the worker", "Lunch and snack breaks being applied" and "Use of time clock or some time tracking tool". The environmental conditions were evaluated in graph 6.

When evaluating graph 6, 5 (five) items were identified with a positive result in 100% of the works analyzed, namely, the presence of "Drinking fountain available and easily accessible", the presence of "Areas for defined intervals", "Regulated stairs and good conditions", "Identified entrance and exits" and "Predetermined places for storage". The only thing that was not being applied were the good practices in "Free access to all work fronts", which in 25% of the works were not identified. In addition, 63% of the works did not have "fire extinguishers available".



Graph 6 - Employee practice / Environmental conditions



Source: Survey data (2020).

With regard to the practice of employees in relation to tools and machines, 100% of good practices were achieved, according to the regulatory standards (NR). in the items "Use of tools in good condition", "Availability of new tools, when necessary, quickly", availability of "Clean tools", existence of "Place for storage of tools after use", presence of "Machines with protections on moving parts", presence of "Absence of exposed or worn electrical cables", presence of "Closed electrical panels" and "Hoses correctly stored".

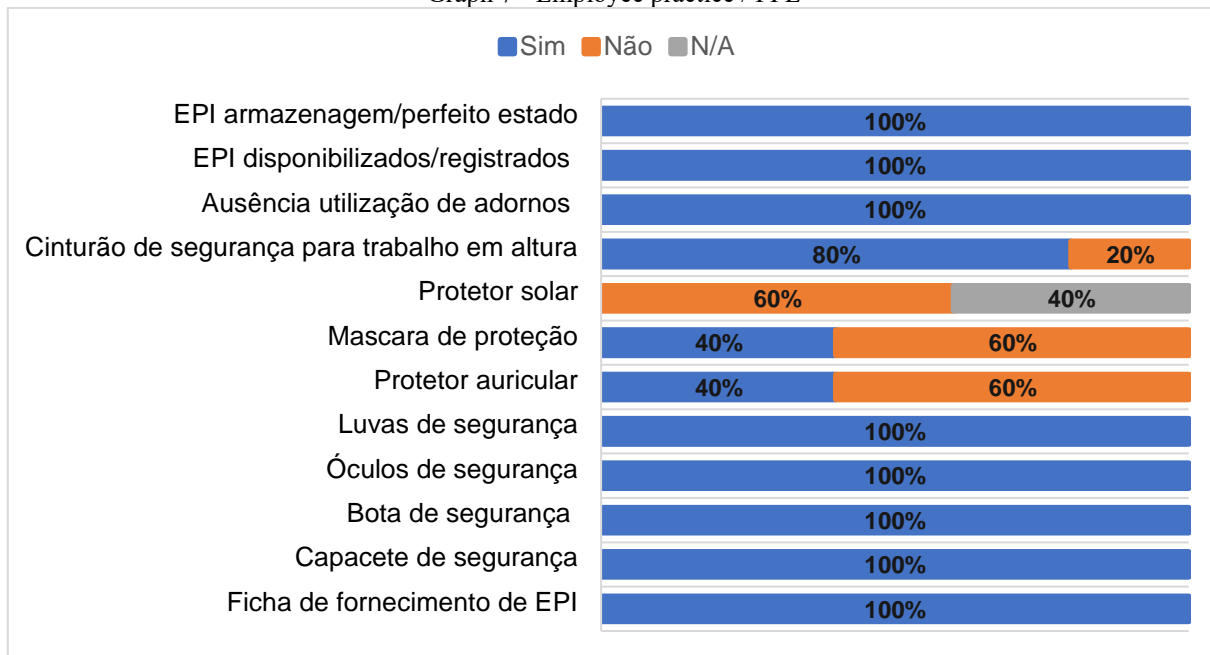
#### 4.3 COVERAGE

The roofing stage consists of the lifting and fixing of the scissors and then the assembly of the tiles, therefore, special care is required in the execution of the services, as it is a work carried out at height. Thus, graphs 7, 8 and 9 present the results of the application in the inspection *checklist* in works in the coverage phase.

Graph 7 shows the results regarding the employees' practice in the use of PPE.



Graph 7 - Employee practice / PPE



Source: Survey data (2020).

Graph 7 shows that eight (8) items were identified as follows: 100% compliance and use of good work safety practices, These are: "PPE storage/perfect condition", "PPE made available/registered", "Absence of use of adornments", use of "Safety gloves", use of "Safety glasses", use of "Safety boot", use of "Safety helmet" and presence of "PPE supply sheet".

The use of "Safety belt for working at height" was identified in 80% of the works. Thus, it is evident that 20% of professionals are subject to falls from heights, requiring greater attention to the standard that regulates the issue of work at height NR-35.

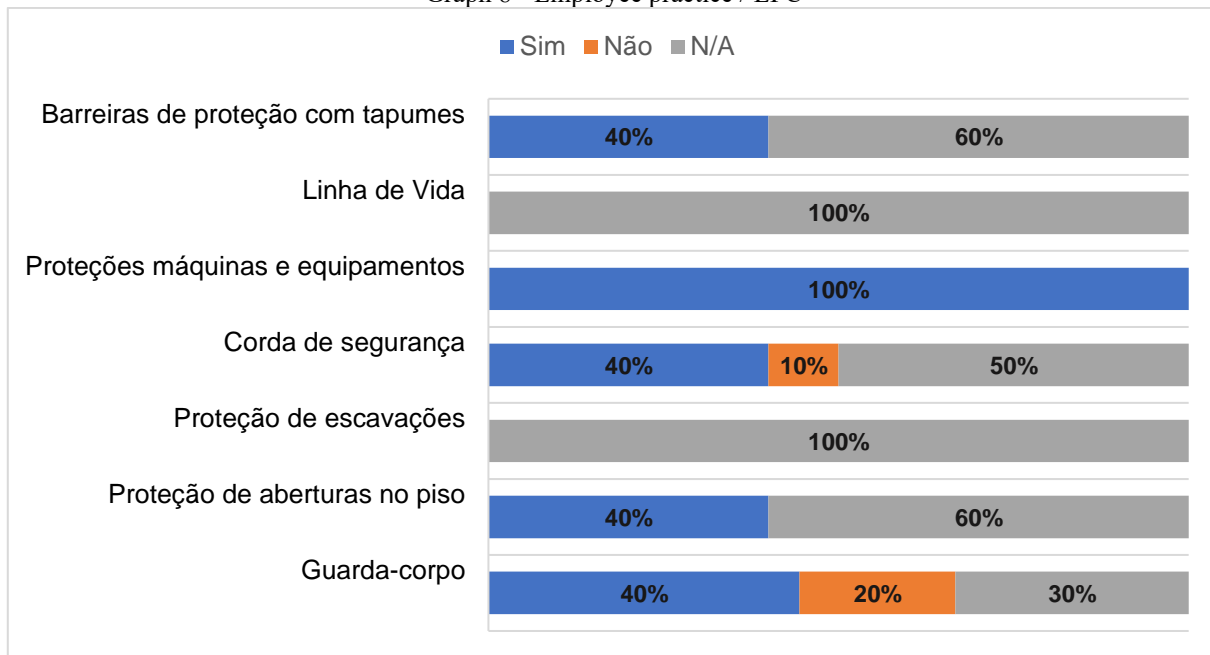
In the coverage stage, 60% of the analyzed works do not provide "sunscreen" to their employees and in 40% of the situations this item does not apply because it is not available for use by employees.

The provision of "Protective mask" and "Ear protector" was identified in only 40% of the works analyzed. These values are lower than those identified in the foundation phase of the work.

Graph 8 shows the practice of employees in relation to CPE, the non-applicable result had a high percentage in relation to the others, being "Lifeline", "Excavation protection" were the items that had the percentage of 100%. The presence of "Protection barriers with hoardings" was identified in 40% of the works, and 60% of them are not applicable, "Safety rope" it was found that 40% use in this stage and 10% do not use and 50% is not applied in this stage. It was identified that "Floor Opening Protection" was used by 40% and 60% was not applied at this stage.



Graph 8 - Employee practice / EPC

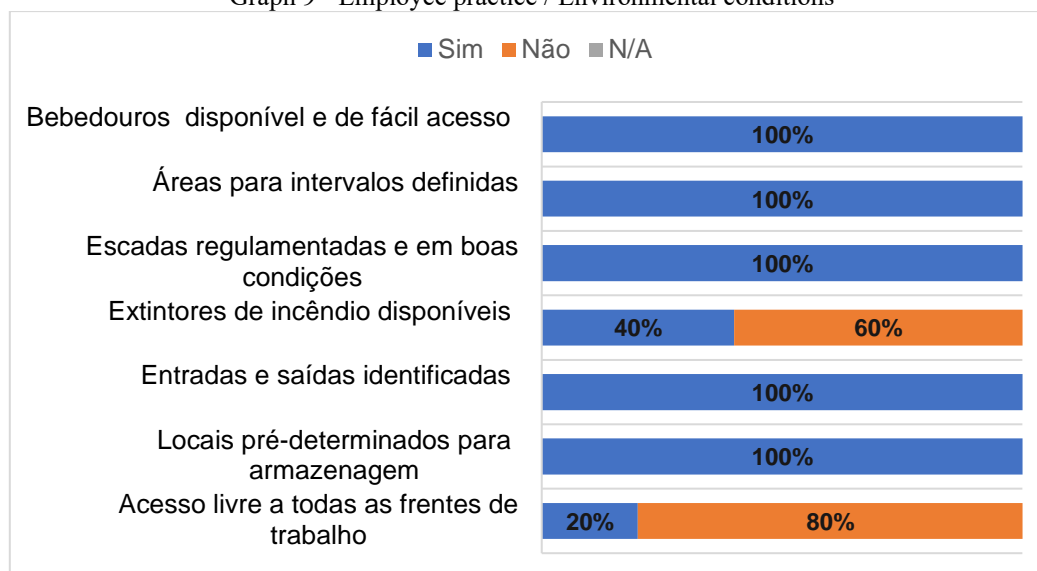


Source: Survey data (2020).

Regarding the category of practice of employees related to the execution of services, 100% of good practices were achieved in accordance with the regulatory standards (NR). The items analyzed were: presence of "Well-defined functions with necessary instructions", "Clearly informed work activities", existence of "Rotation of functions", identification of "Absence of repetitive efforts" in the execution of activities, use of "Appropriate techniques to lift materials or loads", existence of "Well-defined work schedules and informed to the worker", "Lunch and snack breaks being applied" and "Use of time clock or some time tracking tool".

The environmental conditions were evaluated in graph 9.

Graph 9 - Employee practice / Environmental conditions



Source: Survey data (2020).

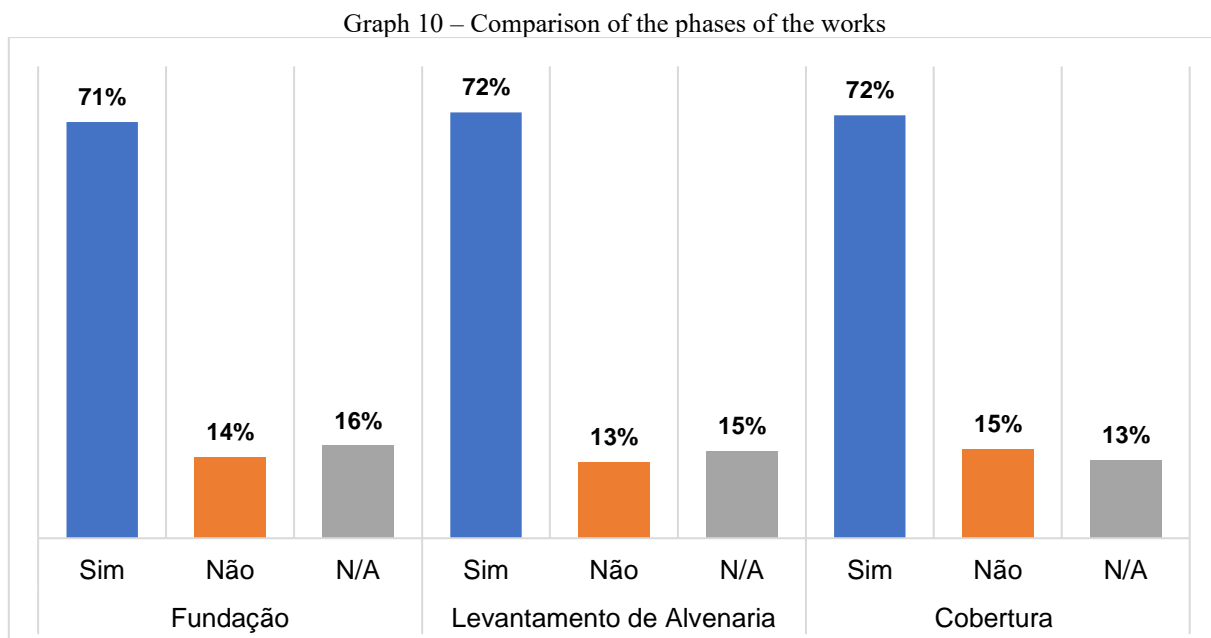


From the observation of the results obtained in graph 9, it can be stated that, in all the works analyzed, it was verified the existence of "Drinking fountain available and easy access", "Areas for defined intervals", presence of "Regulated stairs and in good conditions", "Identified entrance and exit locations" and existence of "Predetermined places for storage" of all equipment used during the execution of each stage of the works, One of the most used is the container for the safety and space for the equipment. In 60% of the works analyzed there were no "fire extinguishers available", and in 80% of the works there was no "Free access to all work fronts".

With regard to the practice of employees in relation to tools and machines, 100% of good practices were achieved, according to the regulatory standards (NR), in the items "Use of tools in good condition", "Availability of new tools, when necessary, quickly", availability of "Clean tools", existence of "Place for storage of tools after use", presence of "Machines with protections in moving parts", presence of "Absence of exposed or worn electrical cables", presence of "Closed electrical panels" and "Hoses correctly stored".

#### 4.4 COMPARATIVE ANALYSIS OF THE PHASES OF THE WORK

Graph 10 shows the comparison of the 3 phases of the works in which the inspection *checklist* was applied, making it possible to show which phase of the work did not record good occupational health and safety practices.



Source: Survey data (2020).

Graph 10 shows some important aspects from the analysis of each stage. Initially, regarding the execution of foundations, there is a rate of 71% of compliance with the regulatory standards (NR), however, in 14% of the works, the presence of adequate conditions for the work of the professionals



was not recorded. In 16% of the works, the items evaluated did not apply to the stage of the work under analysis.

In the masonry survey stage, the rate of 72% acceptance according to (NR) was analyzed, however, in 13% of the works, the conditions of the professionals who work in the work were not adequately evidenced. In 15% of the works carried out, the inspection was not applicable.

In the coverage phase, 72% of the approval was obtained according to regulatory standards (NR), 15% of the works did not have the application of adequate conditions to the professionals. And in 13% of the works carried out, the application of the *checklist* did not apply to this phase.

## 5 FINAL THOUGHTS

From the application of the *inspection* checklist, of the 28 works visited, it was verified through graphs that the small works (OPP) of the Minha Casa Minha Vida Program (PMCMV) in the municipality of Dois Vizinhos - PR make use of good safety practices according to regulatory standards, however, they do not perform analysis of the risks involved and do not apply control tools on them.

As it is a small work, it was possible to observe that the *checklist* can be quickly executed, by someone who already knows the work and is involved in the services daily, it would take 15 to 30 minutes for a total inspection. The daily inspection would be indicated at an early stage, to improve the concepts of good practices in the employees, create a mentality of recognition of risks and needs, after which a weekly inspection would be enough, just to maintain discipline in the activity already implicit in the services performed. The *checklist* could be executed initially by the person in charge of the work and then by any employee of the site.

It was possible to conclude during the execution of the work that most of the action plans generated are in relation to the person responsible for the work, activities that should be charged, monitored by him, such as the availability of PPE, and the care of the employees. This type of activity must always be implicit in any work, regardless of the size and number of employees. In terms of works and occupational safety, prevention through a properly applied risk analysis guarantees the person in charge and his employees greater effectiveness, in addition to safety and responsibility in the execution of services.



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## APPENDIX A

<b><u>CHECKLIST: SAFETY INSPECTION ON CONSTRUCTION SITES</u></b>				
Employee Practice / PPE	Yes	No	IN	
PPE Supply Sheet				
Safety helmet				
Safety boot or rubber boot				
Safety goggles				
Safety Gloves				
Ear protector				
Protective mask				
Sunscreen				
Safety harness for working at height				
Absence of adornments (watch, bracelets, chains, etc.)				
PPE made available is standardized and registered				
PPE with a place for storage, undamaged and in perfect condition				
Employee Practice / EPC	Yes	No	IN	
Railing				
Protection of openings in the floor				
Excavation protection				
Safety rope;				
Protections of moving parts of machinery and equipment				
Lifeline				
Protective barriers with sidings				
Employee Practice / Service Execution	Yes	No	IN	
Well-defined functions with necessary instructions				
Clearly informed work activities				
Job rotation				
Absence of repetitive strain				
Appropriate Techniques for Lifting Materials or Loads				
Well-defined working hours informed to the worker				
Lunch and snack breaks being enforced?				
Use of a time clock or some time tracking tool				
Employee practice / Environmental conditions	Yes	No	IN	
Free access to all work fronts				
Predetermined locations for storage of materials and machinery				
Clearly and unobstructed inputs and outputs				
Fire extinguishers available and in good condition				
Ladders available, regulated and in good condition				
Breaks, smoking and snack areas set				
Drinking fountain or water available and easily accessible on all work fronts				



<b>Employee Practice / Tools &amp; Machines</b>	<b>Yes</b>	<b>No</b>	<b>IN</b>
Use of tools in good condition			
Availability of new tools when needed quickly			
Clean tools			
Place to store tools after use			
Machines with guards on moving parts			
Absence of exposed or frayed electrical cables			
Enclosed electrical panels			
Properly stored hoses			