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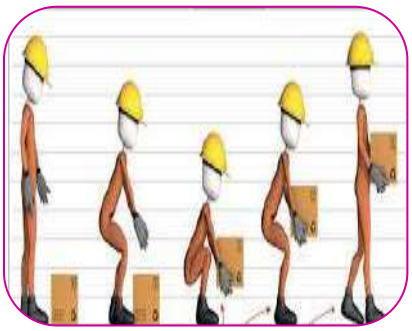
# APPLICATION OF ERGOLANDIA SOFTWARE TOOLS IN CIVIL WORKSTATIONS A PROPOSAL FOR IMPROVEMENTS IN WORK SAFETY IN THE REDUCTION OF EFFORTS,BRAZIL



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**ABSTRATCS**

*The workstation is fundamental for the performance of the worker in the course of human evolution. With the modernity, the ergonomy has been expanding in order to provide greater comfort to the activities developed by the men. The need for studies aimed at reducing damage to the health of the worker arises. This article has the objective of demonstrate the application of some Ergolandia Software tools as a tool for analyzing a job in the civil construction segment. Such research is characterized as a study of qualitative, quantitative and descriptive aspects, as it verifies the intensity of certain activities detailing the possible points to be corrected for a better well-being of the worker. The study shows the ergonomic risk analysis during tasks performed by a facade in a construction work at the Regional Labor Court of the 11th, metropolitan region of Manaus, in the state of Amazonas. The research instruments used were a verification directly at the construction site, photos and Ergolandia Software, OVAAS (Ovako Working Posture Analysin System), OCRA (The Occupational Repetitive Action), Rapula Upper Limb Assessment (RULA), REBA Entire Body Assessment), Suzane Rodgers, Moore and Garg for data processing and determination of the degree of ergonomic postural risk and muscular dysfunctions involved in each activity performed by the worker. It was concluded that the construction worker in the specific work is in a mercy of serious posture risks, which vary from anatomical region according to the type of task developed. But with corrections due, such risks can be mitigated.*

**KEYWORDS:** *Civil construction, Ergonomy, Ergolandia software.*

## 1. INTRODUCTION

Most of the time of human life in modern days is filled by work or the carrying out of some activity, so the search for a transformation of the accomplishment of a task as something pleasant and healthy is increasingly in progress, since an environment professional development results in greater efficiency in the development of an activity. In front of a new business scenario, with globalization, has been evident the paradigm changes in the business environment in search of better conditions and performance in terms of quality and productivity [10].In this way, the ideal working conditions are being gradually recognized as extremely important for companies to meet their goals and deadlines as well as demands in the work market. As for civil construction, this means requires the workers to perform arduous tasks. The Low school enrollment, small hours in training, damaged tools and low payments are some of the characteristics that

affect the worker in this area [14].It was, from this that was developed the need for a study based on a multidisciplinary science, whose main objective is the adequacy of the work to the man, thus promoting the physical and mental health and safety of the worker, a study called Ergonomy. Once the physical health of the worker is taken into account, his working day is of fundamental importance, as well as the peculiar characteristics of each function, since from this it's known that the execution of his tasks as for example a correct posture. The physical and emotional exhaustion, often caused by the factors that involve the postural problems of the individual in the work environment, decreases the worker's income and can provide several diseases [1]. In addition, it's seen that Ergonomy is extremely necessary to prevent and minimize the risks of work activities, providing maintenance of the physical and mental integrity of the worker. Therefore, this study, based on NR 17, tries to establish parameters that allow the analysis of the adaptation of the working conditions to the psychophysiological characteristics of the workers through Ergolandia Software. From the data processed and analyzed, to obtain the diagnosis of the activities of the workers in their jobs, and, therefore, to verify if there're possible ways of the workers to execute their activities faster and in a more secure way, aiming at the terms of the improvement of the working conditions and operating conditions.

## 2.BIBLIOGRAPHIC REVIEW

Civil construction is a high risk industry, as construction companies are seeking more and more for the worker safety. Despite the additional costs with security measures, adopting these procedures ultimately reduces the additional costs of missing labor or repair costs of damage to employees who doesn't work in accordance with safety standards, either for lack of training or training application [2].The safety measures at work go beyond of the use of protective equipment are also included measures that guarantee the comfort and health of the worker established by Ergonomy. This is defined by the Brazilian Association of Ergonomy (ABERBO) as a scientific discipline that relates the interactions between man and the system, applying theories and methods to build projects in order to improve the well-being of man and the performance of the system.The Ergonomy, as a science, still has its subdivisions. The Physical Ergonomy is linked to human anatomy, that is, it's the study of material handling, posture, repetitive movements, health and safety. The Cognitive Ergonomy relates to the mental process, as an example the memory and reasoning, linked to decision making, performance and stress. The Organizational Ergonomy consists of optimizing organizational, political and process systems and structures, including management, group work, organizational culture, and other factors related to management [4]. The Ergonomy aims the reduction of work-related illnesses, muscle damage due to fatigue, situations in which the worker may be exposed to the risk of accidents due to his posture, reduction of losses, damages and costs to companies, improvement in comfort and increase in productivity and worker performance [5]. The number of workers with occupational diseases, especially RSI (Repetitive Strain Injuries) and DORT (Work-Related Musculoskeletal Disorders), is increasing. The RSI can be defined as a set of diseases such as tendinitis (inflammation of the tendons), bursitis (inflammation of the bursa that functions as a buffer between the bones), Tenosynovitis (inflammation of the membrane surrounding the tendons), and others. Among the factors that cause the disease, the most common are: employees perform their activities incorrectly, not respecting their limits, not maintaining a posture adequate for the performance of their activities, absence of rest breaks and the stress that can lead to mainly irritability and emotional unrest. The DORT disorders are due mainly to the biomechanically incorrect use of the upper limbs with excessive force, maintenance of incorrect postures, high repeatability of a same pattern of movement and mechanical compression of the delicate structures of the upper limbs [11]. The Ergonomic risks in the civil construction include spinal problems, skin, hearing and injuries, as a consequence of work exposed to the sun, noise, vibrations, chemicals, electricity, among other factors, even occurring accidents [4]. The activity at the construction site constantly demands repetitive movements and handling of loads, characterizing it as heavy work, hindering correct posture patterns, causing excessive use of the musculature and triggering occupational diseases. The workstations in civil

construction are Furniture, poorly structured and most tasks are performed outdoors under heat and rainfall [11].According to the same author, the masons lean more than 1000 times a day to pick up brick, to take mortar with the spoon and to make the settlements. The level of activity exaggerated due to long journeys in search of an increasing productivity, associated to an activity with great ergonomic demands, places the construction workers in a position extremely vulnerable to the appearance of occupational diseases. It's worrying within the civil construction, the large number of workers suffering from musculoskeletal disorders arising from the activity in this sector. The regulatory norm NR-17 aims to establish parameters that allow the adaptation of the working conditions to the psychophysiological characteristics of the workers, so as to provide maximum comfort, safety and efficient performance, including aspects related to lifting, transport and unloading material, furniture, equipment and environmental conditions of the workplace and to the organization of work itself [3].The Ergonomic Analysis of Work (AET) aims to apply knowledge of ergonomics to analyze, diagnose and correct a certain work situation. This technique was developed by French researchers and can be considered as an example of corrective ergonomy, or ergonomy of correction [11]. The main objective of the EWT is to be a method for examining complexity without testing a chosen model. The Ergonomic analysis gives an understanding of everything that has happened, showing mainly the employee's performance. Thus, with the ergonomic analysis of the work one can verify the real conditions of the environment and work, the functions performed and the actual conditions of the task performed by the workers [11].Therefore, the ergonomy arises to determine the adequate space to perform the most diverse functions of workers with safety and quality. When analyzing a particular task, an assessment should always be made to verify that it's performed correctly. This analysis aims to avoid a health problem for workers. To facilitate the collection of these data, FBF Sistemas also develops software related to Ergonomics and Occupational Health, such as the Ergolandia Software, which brought together 22 ergonomic tools for job evaluation. The Ergolandia Software is designed for ergonomists, physiotherapists and companies who needs to evaluate the ergonomics of their employees. Developed by FBF Systems, the software is also intended for all professionals in the field of occupational health, teachers and students who wants to learn and apply ergonomic tools, increasing productivity and reducing occupational risks. The following are the conceptual definitions of six tools selected for the present study:

### 2.1 OWAS - OVAKO WORKING POSTURE ANALYSING SYSTEM

The OWAS method (Ovako Working Posture Analysis System) was developed by a Finnish occupational health steel group around the 1970s by the researchers Karu, Kansi and Kuorinka and named it. The same came from the need to identify and evaluate inadequate postures in the execution of an activity, which, together with other factors, lead to the appearance of musculoskeletal problems, leading the worker to incapacity for work, absenteeism and additional costs to the production process.The premise of this method in its development was to construct it as a simple but reliable method, thus guaranteeing ease in its use and also in learning, presenting the results of the percentages of time that the worker remains in an adequate posture or not, and also direct through the results for an improvement of the workstation [12]. The researchers who developed this method found 72 typical postures, which were the result of different combinations of the positions of the back (4 typical positions), arms (3 typical positions) and legs (7 typical positions)[11].

**Figure 1 - Positions evaluated in OWAS method**


Source: Iida, 2005

After the tests with workers, a reasonable consistency was found. Several postural experiments on discomfort were performed. A group of 32 experienced workers were evaluating the discomfort of each posture. In the sections two evaluations were performed using a four-point scale with the following descriptions: "normal posture without discomfort and no harmful effect on health" and "extremely poor posture, causes discomfort in a short time and can cause illness" [11]. Through the OWAS method, it was possible to identify and solve problems that had been pending for several years and in which previous attempts had failed [11]. Using the scores of each member comes the level of action that must be taken to ensure the integrity of the worker.

## 2.2 OCRA - THE OCCUPATIONAL REPETITIVE ACTION

The OCRA method was developed by Drs. Daniela Colombini, Enrico Occhipinti and Michele Fanti at the request of the IEA from 1996. These researchers developed this work in the Posture and Movement Ergonomics Unit (EPM) of Clinic Del Lavoro in Milan, Italy . This method evaluates and quantifies the risk factors present in the work activity and establishes, through a calculation model, an exposure index based on the comparison between the variables found in the work reality and what the recommended method recommends in that same environment of work [7].In this method the quantified risk factors are: the duration of the work, the frequency of technical actions performed, the strength employed by the operator, the inadequate postures of the upper limbs, the repetitiveness, the lack of periods of physiological recovery and the complementary factors such as extreme temperatures, vibration, wearing gloves, mechanical understandings, use of sudden movements, precision in the positioning of objects and the nature of the handle of the objects to be handled [7].

In order to obtain the exposure equation - IE of the OCRA method, the number of technical actions observed (ATO) was divided by the number of recommended technical actions (ATR). The result is compared with the risk classification reference to determine the level of action to be taken.

**Table 1 - Classification of OCRA tool levels.**

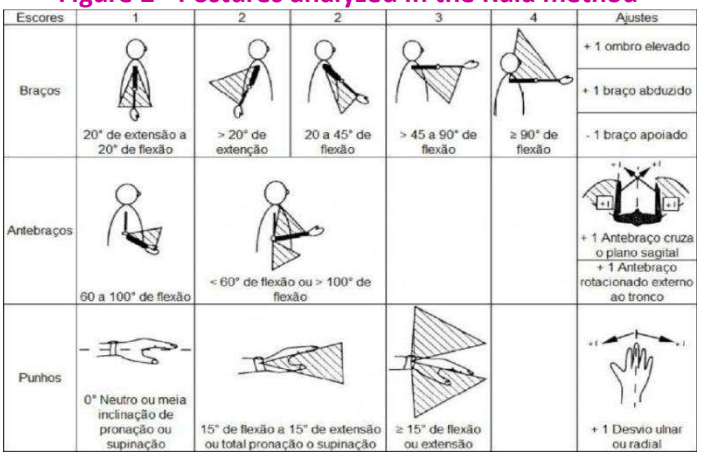
| Área | Valores OCRA | Nível de Risco | Ações |
|---|---|---|---|
| Verde | Até 2.2 | Aceitável | Nenhuma |
| Amarela | Entre 2.3 e 3.5 | Risco muito baixo | Verificar a situação e implementar melhorias |
| Vermelha | Maior 3.5 | Risco Presente | Redesenhar o posto e avaliar a saúde do pessoal |

Source: Colombini et al., 2005

## 2.3 RULA - RAPID UPPER LIMB ASSESSMENT

The RULA method was developed by McAtamney&Corlett in 1993 at the University of Nottingham Occupational Ergonomics Institute. This method seeks to assess the exposure of people to postures that contribute to RSI and DORT [13]. They developed this method for rapid assessment of potential damage to the upper limbs. Evaluating the posture of the trunk, upper limbs and neck; relating them to the muscular effort and the load in which the employee is exposed. Risk factors considered in the RULA method: a) number of movements; b) static muscle work; c) strength; d) posture during the task; e) working time; f) speed and precision of movements; g) frequency; h) duration of breaks [12].The RULA method was also developed for the following objectives: a) to provide a method of rapid population research to the risk factors of upper limb disorders; b) identify the muscular effort that is associated with the work posture; c) generate results that can be incorporated into a broader ergonomic evaluation [12].The application of the RULA method is divided in 3 steps: a) To observe and select the postures: in this stage the task cycle must be observed to verify which postures should be evaluated, searching for the one that is maintained for a longer time or that seems to compromise plus the collaborator; b) Score and record of the posture: one must check whether the left, right or both sides should be evaluated; c) Level of action: with the posture properly evaluated one can verify the level of action to be taken according to the final score.

**Figure 2 - Postures analyzed in the Rula method**




Source: Mcatamney and Corlett, 1993.

## 2.4 REBA - RAPID ENTIRE BODY ASSESSMENT

In the year 2000, Sue Hignett and Lynn McAtamney published in a journal specialized in applied ergonomics, a work presenting the REBA method. This method was developed together with ergonomists, physiotherapists, occupational therapists and nurses, where from a set of 600 postures, identified positions adopted for upper limbs [15].According to the creators, the REBA method allows the analysis of factors such as: a) type of handle; b) repetitive work; c) muscle activity; d) types of movements; e) applied forces; f) postures adopted. There're four main objectives in the REBA method: a) to develop a system of postural analysis sensitive to musculoskeletal risk in different activities; b) divide the body into segments to be analyzed individually; c) offer a scoring system for muscle activity caused by static, dynamic, rapid or unstable changes; d) offer a level of action as an indication of urgency [8] and, in addition, evaluates the amount of forced postures in manual tasks, giving greater importance to the upper limbs and repetitive movements [16].

They add that the REBA method evaluates both static and dynamic postures and unexpected or abrupt changes in posture [9]. Divide the body into segments and assess the upper limbs, neck, trunk, and lower limbs. The evaluation in the REBA method is done through in situ observation, where the work cycles are verified, identifying the postures of the trunk, legs, neck, arms, forearms, wrists and the amount of load; each in a specific table. With the postures identified, they are punctuated to obtain the final score, where it's compared with the intervention levels.

The REBA method demonstrates to the evaluator the need to plan corrective actions in the positions that most compromise the employee's health, taking into consideration which point of the body that is most affected by the task under analysis [9].

**Table 2 - Levels of intervention in the REBA method**

| Nível de ação | Pontuação | Nível de risco | Intervenção e posterio análise |
|---|---|---|---|
| 0 | 1 | Inapreciável | Não necessário |
| 1 | 2-3 | Baixo | Pode ser necessário |
| 2 | 4-7 | Médio | Necessário |
| 3 | 8-10 | Alto | Prontamente necessáric |
| 4 | 11-15 | Muito alto | Atuação imediata |

Source: Pavani and Quelhas, 2006.

## 2.5 SUZANE RODGERS

This method was developed by the American Dr Suzanne Rodgers and has the purpose of evaluating the risk of the activity performed from the analysis of three components: effort, duration of effort and frequency of effort. Evaluation through effort is divided by body segments. The duration of the effort is divided by seconds and the frequency of the effort by minutes. For each evaluated body segment, this is related to the task performed, attributing the duration and frequency of the effort. The final result of the method is given by the body segments evaluated.

The format analyzes the effect on a particular task in one of the six main parts of the body, which are: neck / shoulders; trunk - arms / forearms and wrists / hands / fingers. Legs / knee - ankles / feet / toes are chosen for urgency purposes. The following criteria of fatigue time: little urgency - equal to or less than 15 seconds of fatigue accumulation after 5 minutes of work. Moderate urgency - 15 to 60 seconds of fatigue accumulation after 5 minutes of work.High urgency - 60 to 120 seconds of fatigue accumulation after 5 minutes of work.Urgency Very high - equal to or greater than 120 seconds of accumulation of fatigue after 5 minutes of work.

The analytical technique may make easy the identification of the most effective modes of stress reduction. It's best applied as a means of determining the nature of the stress (intensity, duration or

frequency) as well as determining the degree to which it is necessary to change the function in order to reduce the risk of fatigue to a minimum. The report offers an approximation of frequency and effort level that are determinant in the severity of the combination which implies very short constant duration efforts, working continuously for 2 hours. According to Rodgers, the severity of the match corresponding to tasks performed with constant effort and frequency level combinations over two hours in which the muscle effort time is no more than 3 seconds per effort.

**Table 3 - Suzanne Rodgers Method**

**SUZANNE RODGERS (MUSCLE FATIGUE ANALYSIS)**

Referências: Rodgers, Suzanne H. (1992). A functional job evaluation technique. Occupational Medicine: State of the Art Reviews. 7(4):679-711.
Rodgers, Suzanne H.(1986). Job evaluation in worker fitness determination. Occupational Medicine: State of the Art Reviews. 3(2): 219-239.

| Região | Nível do esforço | | | Pontuação | | | Nível do risco |
|---|---|---|---|---|---|---|---|
| | Baixo [1] | Moderado [2] | Pesado [3] | Nível de esforço | Duração do esforço (Ver tabela A) | Frequência do esforço (Ver tabela A) | |
| Pescoço | Pescoço neutro. Em rotação parcial. Pescoço em flexão de 0 a 20°. | Cabeça gira para o lado. Cabeça está totalmente para trás. Pescoço em flexão cerca de 20°. | Idem ao moderado, porém com aplicação de força. Pescoço em flexão acima de 20° (pescoço toca no peito). | 1 | 1 | 2 | Baixo |
| Ombros | Ombros neutros. Ligeiramente em abdução. Ombros em flexão com algum suporte. | Ombros em abdução sem suporte. Braços trabalhando no nível dos ombros ou acima. | Aplicando força ou sustentando peso com os braços afastados do corpo. | Dir. 2 | 2 | 3 | Alto |
| | | | | Esq. 1 | 3 | 2 | Moderado |
| Tronco | Tronco ereto. Sentado com suporte lombar. Ligeiramente inclinado ou flexionado. | Em flexão frontal sem carga. Levanta carga com peso moderado próximo ao corpo. Trabalho próximo ao nível da cabeça. | Levantando ou aplicando força com rotação de tronco. Grande esforço enquanto flexiona o tronco. | 3 | 1 | 4 | Muito alto |
| Braços Ants braços | Neutro, braços afastados do corpo, sem carga. Levantamento de cargas leves (< 1kg) próximo ao corpo. Sem rotação forçada. | Rotação do braço enquanto exerce força moderada. | Aplicação de grande força com rotação. Levantamento de cargas com braços em extensão. | Dir. 1 | 2 | 1 | Baixo |
| | | | | Esq. 1 | 3 | 1 | Baixo |
| Punho Mãos Dedos | Força leve ou cargas mantidas próximas do corpo; punhos neutros. Esforços de preensão em manipulos confortáveis. | Preensão em manipulos largos ou estreitos; angulação moderada dos punhos, especialmente em flexão; uso de luvas inadequadas. | Esforços em pinça; desvios significativos dos punhos; objetos com superfícies escorregadias. | Dir. 2 | 2 | 2 | Moderado |
| | | | | Esq. 1 | 2 | 1 | Baixo |
| Pernas Joelhos | Parado. Caminhando sem flexionar-se. Peso do corpo distribuído nos dois pés. | Flexionado à frente. Inclinado sobre a mesa de trabalho. Peso do corpo sobre um pé. Gira o corpo sem exerce alguma força. | Exercendo grande força para levantar ou empurrar algum objeto. Se agacha enquanto exerce alguma força. | Dir. 1 | 2 | 2 | Baixo |
| | | | | Esq. 2 | 2 | 3 | Alto |
| Tornozelos Pés Dedos | Parado. Caminhando sem flexionar-se. Peso do corpo distribuído nos dois pés. | Flexionado à frente. Inclinado sobre a mesa de trabalho. Peso do corpo sobre um pé. Gira o corpo sem exerce alguma força. | Exercendo grande força para levantar ou empurrar algum objeto. Se agacha enquanto exerce alguma força. | Dir. 1 | 3 | 1 | Baixo |
| | | | | Esq. 3 | 1 | 3 | Alto |

Atenção: Prioridade N/A (não se aplica) significa que a combinação da duração e frequência selecionada não é possível.

| Tabela A | Pontuação = 1 | Pontuação = 2 | Pontuação = 3 | Pontuação = 4 |
|---|---|---|---|---|
| Duração do esforço | <6 s | 6 a 20 s | 20 a 30s | >30 s |
| Frequência do esforço | < 1/ min | 1a 5 / min | > 5 a 8 / min | > 8/ min |

Source: http://www.ergostore.com.br/kit-tools-ergonomicas/

## 2.6 MOORE AND GARG

It's a method of risk analysis of the development of muscle tendon dysfunctions in the upper limbs. The name "official" so to speak is Stain Index (or effort index) and was developed in 1995 by MOORE, J. S and GARG, A .; with the main objective of evaluating the risk of injuries to wrists and hands.

It presents great acceptance in the academic, business and judicial environments when it comes to demands related to repetitiveness, application of forces and forced postures to the distal extremities of the upper limb. To get an idea of what we are evaluating, we will go through some definitions that are necessary in this point of the article.

We'll talk a little bit about the repetitiveness and the application of forces. It's a method that analyzes whether workers, while performing their functions, are exposed to the risk of developing musculoskeletal diseases of the distal part of the upper limbs due to repetitive movements. Upper limbs are composed of hands, wrists, forearm and shoulder. Strain Index (SI) was based on biomechanical, physiological and epidemiological principles. It evaluates the physical exertion on the muscles and tendons of the extremities of the upper limbs during the task, as well as the psychic effort when performing the work. It's a semi-quantitative method of evaluation of musculoskeletal lesions that results in a givenqualitative numerical. The indicator is based on multiplicative interactions between the various functions, according to physiological principles. The intensity of the effort is an estimate of the effort required to perform the task. This is a subjective parameter of evaluation of the amount of effort performed by the worker in the performance of a task.

**Table 4 - Moore and Garg Method**

| FATOR | CLASSIFICAÇÃO | CARACTERIZAÇÃO | MULTIPLICADOR |
|---|---|---|---|
| FRT Fator Ritmo de Trabalho | Muito lento | ≤80% | 1,0 |
| | Lento | 81-90% | 1,0 |
| | Razoável | 91-100% | 1,0 |
| | Rápido | 101-115% - apertado, mas ainda conseguindo acompanhar | 1,5 |
| | Muito rápido | >115% - apertado e não consegue acompanhar | 2,0 |

Source: https://topergonomia.wordpress.com/2008/04/04/tools-ergonomics moore-e-garg /

## 3 MATERIALS AND METHODS

For the execution of the activities presented in this document some tools were used to help and agility to work among them some computer programs like: Microsoft Word, Microsoft Excel, Image Capture and Windows Media Player program to run the videos made in the cell in study. In order to carry out the scores of the activities, Ergolandia Software was installed in the demonstration version, provided by FBF Systems, which is intended for occupational health professionals, teachers and students (a commercialized program that can be tested free of charge for thirty days, available on the developer's website - http: // www.fbfsistemas.com/downloadergo.html). The software has twenty tools of ergonomic analysis where among these are the tools addressed in this study. In order to perform the ergonomic analysis tools it was necessary to go to the construction site and make video recordings of the operator performing the activity to be evaluated. There are many ways to classify surveys [19].

These ones can be classified: as to the nature, the approach to the problem, the objectives and the technical objectives. From the point of view of the character of the research, a research can be classified in applied research, when it aims to generate knowledge through the application practices related to specific problems, being this the type of research of this work [19]. With regard to the approach of the problem, we have that this work accumulates characteristics of quantitative and qualitative research. It is qualitative, since this study is based on data collection methods and some techniques are employed in these collections, such as open interviews [17]. And it is also characterized as a quantitative research, since it will use data collection method with numerical utilization. This research is classified as descriptive. This type of research seeks to be aware of the various situations and relationships that occur in social, political, economic and other aspects of human behavior, both of the individual taken alone and in more complex groups and communities [19].

The technical procedures of the present study use bibliographic research and case study. Bibliographical research is carried out using material that has already been published, such as books, periodical articles, monographs, dissertations, theses and also material taken from the internet, such as Brazilian norms [18].

## 4 RESULTS AND DISCUSSIONS

In this topic we'll present the individual analyzes of each activity listed, which from this one developed the correlation between the methods of ergonomic evaluation, where it evidenced the difference of sensitivity between the methods and evaluated the current present risks. The facade maker in a work is an activity composed of several types of tasks, where he submits the worker to several postural positions. And, for that reason, the analyzes were done at this specific jobsite at a construction site located in the city of Manaus, state of Amazonas, at the Regional Labor Court of the 11th, Aleixo neighborhood. The chosen employee was Elvis de Lima Santos, he is 50 years old and for five years he established himself in the profession of facade maker. He works eight hours daily and has two 15-minute breaks. One in the morning and one in the afternoon. With a basic questionnaire raised, such as age and safety equipment, it was noticed that although the employee had some appropriate PPE, the feeling of discomfort and pain was still

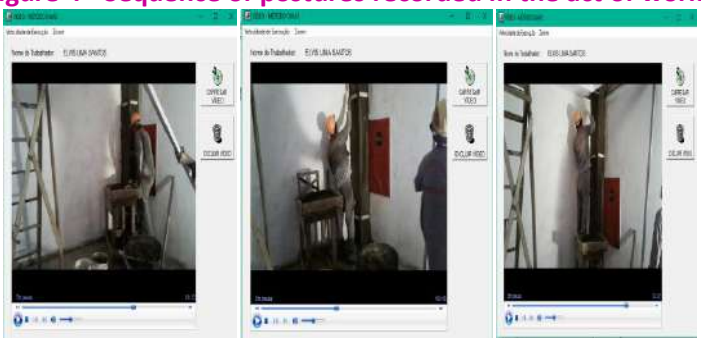
very regular. Based on this, the collected data has been added to Ergolandia Software tools to establish a result that is positive compared to safety standards. If not, evidence and propose improvements.

### 4.1 OWAS METHOD

**Figure 3 - OWAS evaluation screen for postural analysis.**

Source: prepared by the author

**Figure 4 - Sequence of postures recorded in the act of work.**



Source: author's collection.

According to the category of action of the method will be corrections in the very near future, because the method pointed a level 4 of severe postural correction, as seen in figure 3. Therefore, it was understood that the forces exerted do not pose risks but risks the posture at the time of the execution of the task that there is a huge repetition of movements from the act of manufacturing the mass to the constant replacement of the same made to finish the finish of the column, as shown in figure 4. In relation to the study, the objective was reached, showing that the method in question is an effective tool, making possible the creation of preventive and even corrective measures such as the use of a lumbar belt with suspender, for example, that fit the body of the worker, making him comfortable and contributing to stability in movements in the spine area.

### 4.2 OCRA METHOD

Figure 5 - OCRA assessment screen (time, frequency, strength, inappropriate postures of the upper limbs, repetitiveness, lack of physiological recovery periods, and complementary factors such as extreme temperatures).

Source: authored by the author.

**Figure 6 - Sequence of movements in the finish action**

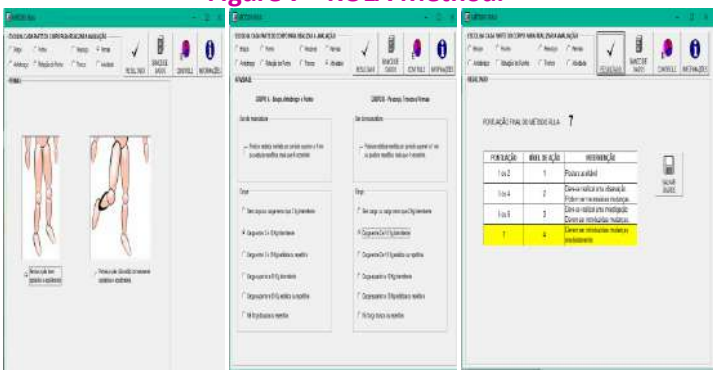
Source: author's collection.

In this method, it's observed that the score of 9.2 for the facade was between the numbers 7.6 to 11, yellow band - very low risk. It has been identified that this activity consists of several tasks, where it circulates freely, descends, climbs and rotates, but spends a lot of time performing the tasks, being the time very little rest. The proposal would be an extra time for rest, stretching through work gymnastics, because it does not have in the workplace, training by the occupational safety professional about ergonomics, as for posture. But you should always take safety measures to avoid future problems. This method was designed for the prevention of upper limb musculoskeletal disorders. The application of this tool is extremely important because it has a greater capacity to consider the different elements of risks existing in the work and the facility to identify the critical elements.

### 4.3 RULA METHOD

The RULA method offers us an evaluation of the overload of the upper limbs and neck, where posture is the determining factor within the work place. The results obtained through the postural analysis defined the level of action, taking into account several factors that may interfere in the work position, such as making a wrong move and this can cause serious health problems. These problems could be minimized with preventive measures and eliminated with regularization actions of the job. For the façade maker was identified result with score 7 and action level 4 as shown in figure 7, below, where changes should be introduced immediately. As already proposed in the OAWS analysis, a cervical belt with suspender would be of extreme necessity and importance to correct and prevent problems related to the posture at the shoulders and neck. Workroom classes with responsible professionals, before the work shifts, would improve the execution conditions of the task.

**Figure 7 - RULA Method.**



Source: authored by the author.

## 4.4 REBA METHOD

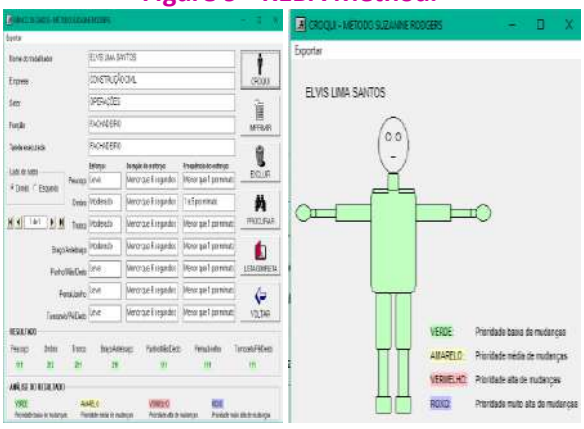
**Figure 8 - REBA Method.**

Source: authored by the author.

The REBA method analyzes the postures of whole body, repetitive work and muscular strength. In this study we observed that it is not all the postures that affect the health of the worker. Factors such as applied force, speed, intensity and time of effort must be taken into account, adding these factors can identify risk and avoid injury to the worker's health. In the analysis made with the façade maker, we had a worrying result whose score ranged from 8 to 10, as shown in figure 8, with a high risk degree. Immediate intervention is required in accordance with this method. Since this tool analyzes the different types of posture, such as static and dynamic, the best immediate solution would be the use of the cervical belt with suspender, since the facade maker performs in this function great body mobility and the strap exerts relief of pressure in the lumbar region overloaded, helps in correcting posture, protects the spine, increases trunk stiffness and reduces excessive muscle strength.

## 4.5 SUZANNE RODGERS METHOD

**Figure 9 - REBA Method.**




Source: authored by the author.

This method has the purpose of evaluating the risk of the activity performed from the analysis of three components: effort, duration of effort and frequency of effort. Evaluation through effort is divided by body segments. The duration of the effort is divided by seconds and the frequency of the effort by minutes. For each evaluated body segment, this is related to the task performed, attributing the duration and frequency of the effort. A number with three digital is formed, where the first represents the effort, the second represents the duration of the effort and the third represents the frequency of the effort. The analysis of the results shows us a color, which reflects the priority of the changes in the work. The green color reflects low shift priority; the yellow color has medium priority; purple reflects high priority and red

color, very high priority of changes. The color attested by this tool in field analysis with the façade maker has established a green color, in which it directly means a low priority for changes.

## 4.6 MOORE AND GARG METHOD

**Figure 10 - Moore And Garg Method.**


Source: authored by the author.

This tool presents great acceptance in the academic, business and judicial environments when it comes to demands related to repetitiveness, application of forces and forced postures to distal extremities of the upper limb. It evaluates the physical exertion on the muscles and tendons of the extremities during the task, as well as the psychic effort in accomplishing the work. The results obtained vary between 5 and 7, which indicates some risk present and that some preventive measures should be taken, such as training by the professional in safety of work, increase the rest time of the worker and work gymnastics.

## 5 CONCLUSION

The research in question presented relevance to the knowledge about the science that adjusts the workers to the working conditions, in an attempt to keep them safe and productive in their respective functions in the work environment in which they work. It is evident that many companies, most of them small, are not able to keep a specific professional to support the issues of work safety and ergonomics, to the point of carrying out the studies like these applied to this work, analyzing activities with greater potential health risks to operators. The methods chosen for this study are very easy to apply, requiring only that the information reported are correct according to those evidenced in the evaluated activity.The objective of this study wasn't to describe all the existing ergonomic tools and methods, but to gather only some that are easy to manipulate and adapt that could be used by the field analyst in construction. Recalling that it's impossible for a single tool to meet so many and varied objectives and specificities present in the ergonomic demands. Therefore, due to the different characteristics and needs of each situation, different protocols are being proposed and used. It was tried to gather some ergonomic tools to demonstrate its positive aspects and when from the negative aspects it was proposed improvements. It's therefore concluded that the Ergolandia Software's ergonomic tools assist in the identification of workloads, but that alone do not conclude the diagnosis of an analysis of working conditions. It's necessary to manage people who, together with the use of some of these software tools, can minimize problems and propose improvements in the environment, such as the cervical waist belt, that if used by the interviewee since the beginning of the research, most results that detected immediate changes, would be practically non-existent.

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Main picture: available in <http://sintramaerj.com.br /page. php? p=6>, access in jun.2018.